THE SUSTAINABILITY OF EUROPEAN MONETARY UNION

Evidence from business cycle synchronisation, monetary policy effectiveness and the Euro fiscal dividend

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Abstract

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EMU as the only functioning single currency area has been criticised as a non-optimal currency area since the Treaty on European Union was signed. Despite this, it has been seen as, probably, the most complete economic project that has ever been conducted by any group of governments. Through Dynamic Factor model and Panel VAR method, we are focusing on the issues of business cycle synchronisation, effectiveness of ECB monetary policy and the euro fiscal dividend, thus to advances the current studies on EMU through assessing whether it can be a sustainable system. For example, whether economic fluctuations can be effectively managed by implementing a single ECB monetary policy and financial market can be relied upon as a monitoring and enforcing device to discipline fiscal behaviour of Eurozone countries.

Overall, we concluded that EMU could be more sustainable if it was just formed by its core members, leaving the periphery outside the single currency area. However, since the EU has recently conducted many rescue measures to save the Eurozone, we are unlikely to see those troubled countries to quit EMU, at least, at the present time. The sustainability of the current EMU can be improved if more intra-trade can be promoted to enhance business cycle convergence; hence, it will be more likely to have a union-wide appropriate monetary policy. This will also reduce the requirement of depending upon using fiscal measures to compensate the loss of monetary sovereignty. Moreover, fiscal activities can also be better monitored/enforced since the financial market has begun to adequately adjust the long-term interest rates on Eurozone government bonds according to the development in those countries fiscal stance.

Keywords: EMU, Business Cycle Synchronisation, Panel VAR, Dynamic Factor Model
# Table of contents

CHAPTER 1 INTRODUCTION........................................................................................................1

CHAPTER 2 HISTORICAL DEVELOPMENTS OF MACROECONOMIC THEORIES AND THE CASE OF EMU ECONOMIC SYSTEM................................................................. 11

2.1 HISTORICAL DEVELOPMENTS IN MACROECONOMIC MODELS – FROM KEYNES BACK TO CLASSICAL ..................................................................................................................... 11
  2.1.1 The rise of Keynesians .................................................................................................. 12
  2.1.2 The return of the classical school – monetarists’ attacks on Keynes and new classical economics .............................................................................................................. 14
  2.1.3 New Keynesians’ defences.......................................................................................... 28
  2.2 CURRENT MAINSTREAM MACROECONOMIC MODEL AND THE EUROPEAN MONETARY UNION . 36
    2.2.1 Quick overview of NCM ......................................................................................... 37
    2.2.2 EMU economic policy and NCM ............................................................................ 40
  2.3 SUMMARY......................................................................................................................... 47

CHAPTER 3 BUSINESS CYCLE SYNCHRONISATION IN THE EUROZONE – A DYNAMIC FACTOR MODEL ANALYSIS .......................................................................................... 50

3.1 INTRODUCTION.................................................................................................................. 50

3.2 THEORIES OF COMMON CURRENCY AREA AND FACTORS IN BUSINESS CYCLE SYNCHRONISATION .............................................................................................................. 52
  3.2.1 Traditional theory of OCA ....................................................................................... 53
  3.2.2 Modern view of OCA theory – endogeneity hypothesis ........................................... 57

3.3 LITERATURE REVIEW – MEASURING OF SYNCHRONISATION AND PREVIOUS EMPIRICAL STUDIES 61
  3.3.1 Correlation method .................................................................................................. 62
  3.3.2 Alternative measurement – shock accounting ......................................................... 65

3.4 METHODOLOGY OF ANALYSIS – DYNAMIC FACTOR MODEL ........................................ 69
  3.4.1 Dynamic factor model ............................................................................................ 69
  3.4.2 Variables for measuring overall economic activities ............................................... 76

3.5 EMPirical RESULTS – SYNCHRONISATION OF EUROZONE BUSINESS CYCLES .................. 77
  3.5.1 Co-movement and common factor analysis for Euro12 members’ business cycles – a comparison between pre- and post-EMU periods .............................................. 78
  3.5.2 Explanatory analysis: what drives the synchronisation of Euro12 business cycles? ................................................................................................................................. 96
  3.5.3 Spill-over effects between some members of Euro12 ............................................. 113
  3.6 SUMMARY OF RESULTS AND CONCLUSION................................................................. 116

CHAPTER 4 EFFECTIVENESS OF THE ECB SINGLE MONETARY POLICY IN THE EUROZONE .......................................................................................................................... 121

4.1 INTRODUCTION.................................................................................................................. 121

4.2 REVIEW OF THEORIES OF MONETARY POLICY – NEW CONSENSUS VIEW AND POST-KEYNESIAN CRITIQUES .................................................................................................. 124
  4.2.1 Monetary policy and the new consensus model ....................................................... 125
  4.2.2 Critiques of new consensus model monetary policy ............................................... 131
CHAPTER 5 FISCAL STANCE AND LONG-TERM INTEREST RATES IN EMU – INVESTIGATING THE EXISTENCE OF A ‘EUROZONE FISCAL DIVIDEND’

5.1 INTRODUCTION ........................................................................................................... 210
5.2 EMU FISCAL RULES – THEIR NECESSITY AND PERFORMANCE ............................... 213
  5.2.1 Time inconsistency issue of monetary and fiscal policy ........................................... 213
  5.2.2 The implementation of EMU fiscal rules ................................................................. 220
5.3 DETERMINANCIES OF RELATIONSHIP BETWEEN FISCAL STANCE AND LONG-TERM INTEREST RATES IN EMU ................................................................. 224
  5.3.1 Fiscal dominance and monetary dominance – inflation ........................................... 226
  5.3.2 Fiscal regime ........................................................................................................ 228
  5.3.3 Financial integration and fiscal discipline ............................................................... 231
  5.3.4 Market mechanism and fiscal rules ....................................................................... 233
5.4 PREVIOUS LITERATURE – INVESTIGATING THE RELATIONSHIP BETWEEN FISCAL STANCE AND LONG-TERM INTEREST RATES ......................................................... 236
5.5 METHODOLOGY AND DATA ....................................................................................... 241
  5.5.1 Methodology – PVAR approach .......................................................................... 242
  5.5.2 Data ..................................................................................................................... 243
  5.5.3 Ordering of variables ......................................................................................... 245
5.6 EMPIRICAL RESULTS – DOES THE ‘EURO FISCAL DIVIDEND’ EXIST IN THE EUROZONE? .......................................................... 246
  5.6.1 Unit-root test ....................................................................................................... 246
  5.6.2 Lag length selection ............................................................................................ 247
  5.6.3 Estimation of the ‘Euro Fiscal Dividend’ – whole sample period vs. post-EMU period ................................................................. 249
5.6.4 Estimation of the ‘Euro Fiscal Dividend’ – the case of excluding Germany and France ................................................................. 256
5.6.5 Estimation of the ‘Euro Fiscal Dividend’ – has it changed since the recent financial crisis? ......................................................... 260
5.7 SUMMARY OF RESULTS AND CONCLUSIONS ......................................................................................................................... 271

CHAPTER 6 GENERAL SUMMARY AND CONCLUSION ................................................. 276

6.1 SUMMARY OF KEY RESULTS ............................................................................. 276
6.2 GENERAL CONCLUSION ..................................................................................... 283

REFERENCE ............................................................................................................. 289

APPENDICES ............................................................................................................ 318

Menu cost theory .................................................................................................... 318
The Efficiency wage model ...................................................................................... 320
List of figures

Figure 1-1 Eurozone real GDP 1999 to 2007 (2005=100) ......................................................... 5
Figure 1-2 Eurozone annual inflation 1999 to 2007 (2005=100) ........................................ 6
Figure 1-3 Eurozone long-term interest rates 1999 to 2013 ..................................................... 7
Figure 2-1 Friedman’sPhillips curve model .............................................................................. 16
Figure 2-2 Long-run ASAD model .......................................................................................... 25
Figure 2-3 Long-run ASAD Model – New Keynesian case ....................................................... 31
Figure 2-4 New Keynesian real rigidities ................................................................................. 33
Figure 3-1 Common factor for Euro12 real GDP growth (1985:Q1–1998:Q4) .................... 79
Figure 3-2 Common factors for Euro12 real GDP growth (1999:Q1–2012:Q2) ................. 81
Figure 3-3 Euro12 common factors vs individual members’ real GDP growth – pre- and post-EMU periods ........................................................................................................ 86
Figure 4-1 NCM three-equation model ..................................................................................... 129
Figure 4-2 Impulse-response for effects of monetary shocks (interest rate) on Eurozone (17 members) .................................................................................................................. 181
Figure 4-3 Effectiveness of ECB monetary policy ..................................................................... 183
Figure 4-4 Impulse response of GDP growth to the shocks of housing price and share price growth – Euro17 ........................................................................................................ 186
Figure 4-5 Impulse-response for effects of monetary shocks (interest rate) on Eurozone (12 members) .................................................................................................................. 188
Figure 4-6 Impulse response of GDP growth to the shocks of housing price and share price growth – Euro12 ........................................................................................................ 191
Figure 4-7 Impulse response for effects of monetary shocks (interest rate) on Euro12 members without IIGSP ........................................................................................................ 193
Figure 4-8 Impulse response of real GDP growth to monetary shocks (M1) ......................... 197
Figure 4-9 Impulse response of inflation to monetary shocks (M1) ......................................... 198
Figure 4-10 Impulse response of inflation to exchange rate shock (M1) .................................. 201
Figure 5-1 Time inconsistency and inflation bias ...................................................................... 215
Figure 5-2 Impact of sovereign debt shock on national growth rate of long-term interest rates and real GDP growth in the Euro12 area (1994:Q2–2012:Q1) .................... 250
Figure 5-3 Impact of debt shock on growth rate of long-term interest rates and real GDP growth in the Euro12 area (2000:Q1–2012:Q1) ................................................. 254
Figure 5-4 Impact of sovereign debt shock on growth rate of long-term interest rates and real GDP growth in the Euro10 area (2000:Q1–2012:Q1) ............................. 258
Figure 5-5 Impact of debt shock on growth rate of long-term interest rates in the Euro12 area (2000:Q1–2006:Q4 and 2007:Q1–2012:Q1) .............................................. 262
Figure 5-6 Impact of sovereign debt shock on growth rate of long-term interest rates in GIISP (2007:Q1–2012:Q1) ..................................................................................... 265
Figure 5-7 Impact of sovereign debt shock on growth rate of long-term interest rates in GIISP (2007:Q1–2012:Q1) ..................................................................................... 265
Figure 5-8 Impact of sovereign debt shock on growth rate of long-term interest rates in non-GIISP Euro12 area (2007:Q1–2012:Q1) ......................................................... 269
Figure A1 New Keynesian nominal rigidities ........................................................................... 320
Figure A2  Efficiency wage model.................................323
List of tables

Table 3-1 Parameter estimation for DFM – Euro12 members’ real GDP growth (1985:Q1–1998:Q4) ................................................................. 78
Table 3-2 Parameter estimation for DFM – Euro12 members’ real GDP growth ........................................ 80
Table 3-3 Cross-country correlation (1985:Q1–1998:Q4) ................................................................. 82
Table 3-4 Cross-country correlation (1999:Q1–2012:Q2) ................................................................. 83
Table 3-5 Average cross-country correlation for real GDP growth .............................................. 84
Table 3-6 Common factors for Euro12 real GDP growth ................................................................. 92
Table 3-7 Parameter estimation for DFM – Euro12 members’ consumption expenditure (2000:Q1–2011:Q1) ................................................................. 98
Table 3-8 Correlation between consumption expenditure and common factor of Euro12 consumption (2000:Q1–2011:Q1) ................................................................. 98
Table 3-9 Variance decomposition of consumption accounted ................................................................. 99
Table 3-10 Parameter estimation for DFM – Euro12 members’ investment expenditure (2000:Q1–2011:Q1) ................................................................. 102
Table 3-11 Correlation between investment expenditure and common investment factor of Euro12 (2001:Q1–2011:Q1) ................................................................. 103
Table 3-12 Variance decomposition of investment accounted for common consumption factors (2000:Q1–2011:Q1) ................................................................. 104
Table 3-13 Parameter estimation for DFM – Euro12 members’ exports expenditure (1999:Q1–2011:Q2) ................................................................. 107
Table 3-14 Correlation between investment expenditure and common investment factor of Euro12 (1999:Q1–2011:Q2) ................................................................. 108
Table 3-15 Variance decomposition of exports accounted for common exports factor (1999:Q1–2011:Q2) ................................................................. 109
Table 3-16 Average values of variance decompositions for Euro12 countries ................................................................. 112
Table 3-17 Variance decomposition for the Big 5 Euro12 members’ IP factor (1980:m1 to 2012:m2) ................................................................. 115
Table 4-1 IPS Panel unit-root test Eurozone data – 17 members ................................................................. 179
Table 4-2 Three Information Criteria test for Lag Length Selection – 17 Eurozone members (2000:Q2–2011:Q3) ................................................................. 180
Table 4-3 Statistically significant response of real GDP growth to monetary shock – Euro17 ................................................................. 182
Table 4-4 Statistically significant response of inflation to monetary shock – Euro17 ................................................................. 183
Table 4-5 Statistically significant response of real GDP growth to housing and share price shocks – Euro17 ................................................................. 186
Table 4-6 Statistically significant response of real GDP growth to monetary shock – Euro12 ................................................................. 189
Table 4-7 Statistically significant response of inflation to monetary shock (Euro12) ................................................................. 189
Table 4-8 Number of MCC achieved by EU member states (1992–2002) ................................................................. 192
Table 4-9 Statistically significant response of inflation to monetary shock – Euro12 without IIGSP ................................................................. 194
Table 4-10 Three information criteria test for lag length selection ................................................................. 196
Table 4-11 Statistically significant response of inflation to monetary shock (M1) ........... 198
Table 4-12 Three information criteria test for lag length selection................................. 201
Table 5-1 IPS panel unit-root test (1994:Q2 to 2012:Q1) ............................................ 247
Table 5-2 Lag selection – information criterion approach (1994:Q2–2012:Q1 and
2000:Q1–2012:Q1) .......................................................................................................... 248
Table 5-3 Statistically significant response of long-term interest rates (1994:Q2–2012:Q1)
...................................................................................................................................................... 252
Table 5-4 Statistically significant response of real GDP growth (1994:Q2–2012:Q1) .... 253
Table 5-5 Statistically significant response of long-term interest rate (2000:Q1–2012:Q1)
...................................................................................................................................................... 255
Table 5-6 Statistically significant response of real GDP growth (2000:Q1–2012:Q1) .... 256
Table 5-7 Lag selection – information criterion approach – sub-sample (2000:Q1 –
2012:Q1) ................................................................................................................................. 257
Table 5-8 Statistically significant response of long-term interest rate (2000:Q1–2012:Q1)
...................................................................................................................................................... 259
Table 5-9 Statistically significant response of real GDP growth in the Euro10 area
(2000:Q1–2012:Q1) .................................................................................................................. 259
Table 5-10 Lag selection – information criterion approach for Euro12 Area ............... 261
Table 5-11 Statistically significant response of long-term interest rate (pre-crisis and
post-crisis) ...................................................................................................................................... 263
Table 5-12 Lag selection – information criterion approach Euro10 area (2007:Q1–
2012:Q1) ................................................................................................................................. 264
Table 5-13 Statistically significant response of long-term interest rate: Euro10 vs. Euro12
Table 5-14 Statistically significant response of long-term interest rate GIISP (2007:Q1–
2012:Q1) ...................................................................................................................................... 268
Table 5-15 Statistically significant response of long-term interest rate non-GIISP Euro12
area (2007:Q1–2012:Q1) .......................................................................................................... 269
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List of abbreviations

DFM: Dynamic factor model
EU: European Union
Euro17: the area of Eurozone contains Austria, Belgium, Cyprus, Estonia, Finland, France, Germany, Greece, Ireland, Italy, Latvia, Luxembourg, Malta, the Netherlands, Portugal, Slovakia, Slovenia, and Spain
Euro12: the area of Eurozone contains Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Latvia, Luxembourg, the Netherlands, Portugal, and Spain
Euro10: the area of Eurozone contains Austria, Belgium, Finland Greece, Ireland, Italy, Latvia, Luxembourg, the Netherlands, Portugal, and Spain
EMU: European Monetary Union
EMUFR: EMU fiscal rule
IIGSP: Italy, Ireland, Greece, Spain and Portugal
MCC: Maastricht convergence criteria
NCM: New consensus macroeconomics model
OCA: Optimal currency area theory
PVAR: Panel vector autoregression model
REH: Rational expectation hypothesis
SGP: Stability and growth pact
TEU: Treaty on European Union
Chapter 1

Introduction

In 1992, fifteen European Economic Community members signed the Treaty on European Union (TEU), which formally implied the creation of the European Economic and Monetary Union (EMU) had finally started\(^1\). Twenty-two years later, among academics and policymakers, EMU, which has been seen as, probably, the most complete economic project that has ever been conducted by any group of governments, already has seventeen participating members across continental Europe (Austria, Belgium, Cyprus, Estonia, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Malta, the Netherlands, Portugal, Slovakia, Slovenia and Spain).

Its theoretical foundation was actually developed a few decades earlier. Optimal currency area theory (OCA), which was mainly developed by Mundell (1961), McKinnon (1963) and Kenen (1969), is the standard criterion for creating a single currency union\(^2\). This theory can be summarised into multiple criteria, which are mainly threefold\(^3\). First, similarity and convergence in the economic structure ensure that the currency union is less likely to face asymmetric shocks and that union-level policy will be optimal to all members. Second, sufficient factor and price flexibility form the absorber of the asymmetric shocks. Finally, policy integration would encourage macroeconomic policy coordination among members, which can be used to restore the disequilibrium at national levels.

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\(^1\) All the EU15 member states signed the TEU, but only 12 committed themselves to Stage Three of EMU. The UK, Denmark and Sweden effectively opted out of this.

\(^2\) More detailed discussion of OCA theory is available in Chapter 3.

\(^3\) See Baimbridge et al. 2005
Chapter 1 Introduction

Besides OCA theory, which sets out the selection criteria for forming a single currency area, the New consensus macroeconomics (NCM) model is the basis for the assumptions of how the economy should work and be operated for the Eurozone (Arestis 2011). Rational expectations and the efficiency market hypothesis play a key role in NCM (Fontana 2009). For example, an efficient and well-informed financial market and the rational expectations of economic agents can form a fiscal discipline mechanism, which works along with EMU fiscal rules (EMUFR) to ensure disciplined fiscal activities inside the Eurozone.

Moreover, since NCM is heavily based on the ideas of neoclassical thought (Goodfriend and King 1997, Fontana 2009), the typical Keynesian economic stabilisation is seen as ineffective in altering economic growth given that economic agents are assumed to be acting as ‘Ricardian’ consumers who are forward-looking and aware of government intertemporal budget constraints, and will react to government fiscal policy rationally. This in turn implies consumers take future tax liabilities fully into account in today’s consumption/saving decisions, hence government bonds will not be treated as net wealth and impacts of fiscal expansion may eventually be cancelled out by decline in private consumption (Buchanan 1976, Dimand 2002). The consequence of rapid use of fiscal policy may only lead to unnecessarily high prices. Therefore, fiscal policy is downgraded in NCM as government should only keep the budget balanced (Fontana 2009). In contrast to the downgrade of fiscal policy, since the fiscal/political independence of the European Central Bank (ECB), which can ensure the credibility of EMU’s monetary activities, monetary policy has been seen as a key policy instrument to stabilise/smooth the fluctuation of price in order for the economy to avoid or, probably, eliminate ‘inflation bias’ inside the Eurozone (Buti et al. 2001, Chair and Kehoe 2008).

Following the announcement of EMU project by the EU, many empirical studies, which are especially based upon the theoretical criteria of a single currency area, have been conducted by academics. Prior to the establishment of EMU, the suitability of creating a single currency union among those potential EMU
members was a key question among academics. Many studies have been carried out to evaluate whether EMU satisfied OCA criteria during the 1990s and early 2000s. To our knowledge, among them (Mundell 1997, Bayoumi and Eichengreen 1997, Caporal and Pittis 1998, Demetris et al. 2000, Kempa 2002) there is no evidence to prove EMU is an optimal currency area in terms of fully fulfilling OCA requirements.

Besides the above general studies of EMU, there are some papers attempting to evaluate the Eurozone referring to specific criteria of the OCA theory. In particular, they mainly focus on the issues, which would affect the operations of the Eurozone’s economic activities at an aggregated level. Minford and Rastogi (1990) and Bayoumi and Eichengreen (1992) suggest that the economic structures among union members have remained heterogeneous, which implies a higher probability of asymmetric shocks. This means the ECB’s single monetary policy for the entire EMU is less likely to be, union wide, optimal to each individual member. The central bank of the Eurozone – the ECB – may face the ‘one size fits all’ problem while they operate the single Eurozone level monetary policy.

Furthermore, in terms of asymmetric-shock-absorbing requirements of OCA, language and cultural barriers, and different legal systems across the Eurozone, leave EMU with insufficient factor mobility and flexibility. Thus, the automatic shock absorber inside the union may be relatively weak at offsetting asymmetric shocks (de Grauwe and Vanhaverbeke 1991, Heylen and van Poeck 1995, Arpaia et al. 2007, Janiak and Wasmer 2008). Finally, there is no centralised system of fiscal federalism available at the union level inside the Eurozone. Instead, the fiscal policy is operated on a decentralised basis at the national level. Therefore, the channel of fiscal transfer between union members does not exist inside EMU, which may potentially affect the sustainability of the union given that EMU has little power to conduct Eurozone fiscal policy to mitigate shocks (Wickens 2007, von Hagen and Wyplosz 2008).
Therefore, as has been raised by previous empirical works, we can see that the Eurozone was created under considerable doubts and some inherent weakness; in particular, the ECB’s monetary policy, which has been seen as the key policy instrument, may not be appropriate to each individual member of EMU. However, there is an influential economic theory that has been used to justify the movements of the Eurozone project: that is, the modern theory of OCA – the endogeneity of OCA hypothesis. This theory provides a pro-EMU argument that the improvement of intra-Eurozone trade, which can be delivered by the membership of EMU, will lead to a convergence among EMU national business cycles, which will eventually allow the ECB to implement an appropriate monetary policy union-wide (Frankel and Rose 1998).

In contrast to the endogeneity view of OCA theory, the counter-endogeneity view, which is represented by the specialisation hypothesis (Bayoumi and Eichengreen 1992 & 1996, Krugman 1993), argues that trade integration will enhance the specialisation of each country’s production since countries will tend to export more of those goods in relation to which they have comparative advantages. This, in turn, will reduce the income correlation and means that, even if the country did not fully satisfy OCA criteria before they joined the union, trade integration may not help them move towards satisfaction ex post. Furthermore, another counterargument to the endogeneity view of OCA theory points out that the monetary integration of EMU may not be able to enforce the correlation of business cycles (Baxter and Stockman 1989, Bordo and Helbling 2003, Bergman 2004). Their argument is focused on the costs of loss of exchange rate policy, which means that if, during asymmetric shocks, the exchange rate is no longer available as a shock-absorbing mechanism, the shock can force all the adjustments to take place in the real economy rather than via the exchange rate.

Since the establishment of EMU in 1999, the debate about whether the Eurozone is an optimal currency area has eased, and the focus of research on EMU has moved onto the question of whether the ECB can deliver a successful single monetary policy which meets the demands of each individual nation
within the Eurozone. The general conclusion is that the level of homogeneity of the monetary transmission mechanism (MTM) is insufficient for each member to have an identical reaction to ECB monetary policy, which implies the possible existence of a ‘one size fits all’ issue in EMU (Mojon 2001, Clausen and Hayo 2006). Moreover, attention has also been paid to business cycle synchronisation. If business cycles for currency union members remain or move towards divergence, the union-wide monetary policy is unlikely to be optimal for the large majority of EMU members, even when the MTM is homogenous (Artis et al. 2004, Grauwe 2009, Soares et al. 2009, Savva et al. 2010). Compared with two former research areas, during the period before the 2007–8 credit crunch and the Eurozone sovereign debt crisis, there was less focus on the relationship between national fiscal behaviour/stance and the level of long-term interest rates on government bonds. Fiscal discipline, it seemed to be optimistically assumed, can be enforced by EMU fiscal rules and an efficient market mechanism is probably the reason behind the lack of attention to fiscal stance–bond rates relations in EMU.

**Figure 1-1** Eurozone real GDP 1999 to 2007 (2005=100)

![Eurozone real GDP 1999 to 2007](image)

Source: Eurostat
During most of the first decade (i.e. before 2007) after the formal establishment of EMU, the benefits of being a member of the Eurozone seemed to overwhelm any criticism. For instance, by looking at the union level data for EMU during the period prior to the outbreak of 2007-8 credit crunch, economic growth remained positive and inflation was stable and low (see Figure 1-1 and Figure 1-2). At the national level, the immediate benefit of being a part of this ‘currency club’ was low interest rates (see Figure 1-3), and thus cheap money to compensate the loss of monetary sovereignty. However, the inherent issues of EMU (e.g. business cycle convergence, effectiveness of the ECB’s single union-wide monetary policy, high level of public debt etc.) remained (Minford and Rastogi 1990, Bayoumi and Eichengreen 1992, Arpaia et al. 2007, Janiak and Wasmer 2008). The outbreak of the 2007–8 global financial crisis, followed by the Eurozone sovereign debt crisis, has again raised the question of EMU sustainability.
Fiscal discipline, which is supposed to be enforced by EMU fiscal rules and market mechanisms, was poor among some of EMU members; moreover, following the 2007-8 financial crisis and major economic hardships afterwards, EMU slipped into its own sovereignty debt crisis and is suffering from a deep economic recession at the moment. Some countries have experienced significant increase in their government bonds rates since 2008. For example, interest rates on Greek, Irish and Portuguese government bonds raised from around just 5 percent, which were at a similar level as the other EMU member countries, to their peak level at 19.79 percent, 9.4 percent, and 10.09 percent respectively (see Figure 1-3), while the speed of economic recovery is slow. What is the cause of this? Why is EMU, which is supposed to be a sustainable economic system, currently experiencing the worst economic crisis compared to other major Western economies that have also been affected by the financial crisis (e.g. the USA and the UK)? By answering the question of whether EMU really is a sustainable economic system with the necessary conditions for having an effective and union-wide appropriate monetary policy, as pro-EMU economic
theories initially suggested (e.g. endogeneity of OCA hypothesis and NCM), it can help us to investigate the root of the current economic crisis inside the Eurozone.

The first question we can ask, which helps us to see if EMU is a sustainable system, is whether the ECB has the essential condition for operating a union-wide appropriate monetary policy. This essential condition is to have a highly synchronised business cycle among members inside the Eurozone (Guiso et al. 1999). If all members’ economies are moving in a highly similar way (i.e. economic growth is always moving in the same direction and at the same speed), then it indicates that all members will need similar levels of interest rates to facilitate their economic growth. Moreover, it also enables us to judge whether the endogeneity of OCA hypothesis really is a creditable justification for creating a monetary union with poor adherence to the Maastricht Convergence Criteria (MCC) among its members.

The second question will focus on the effectiveness of ECB monetary policy. We are not just concentrating on whether this supranational independent central bank does have effective influence on controlling inflation within the Eurozone. We will also evaluate if ECB monetary policy has different impacts on different countries, especially in terms of affecting real economic activities (e.g. real GDP growth). If ECB monetary policy does affect real economic activities differently among members of the Eurozone, then some countries have had to rely on national-level fiscal policy to compensate for the loss of monetary sovereignty in order to maintain/achieve their own economic targets. In such a situation, the overuse of fiscal policy is inevitable; this also helps us to explain the possible motivation for the poor fiscal discipline among some EMU members during the pre-crisis period (e.g. Greece, Italy, Spain, and Portugal).

The final question concerns NCM’s key assumption which has been used to assume the efficiency of the market. In particular, we will focus on the behaviour of the financial market, especially during the period prior to the 2007–8 financial crisis, to see whether the market does operate as has been described/assumed
by NCM theory. The particular issue we are concentrating on in this section of the thesis is the dynamic relation between long-term interest rates and the fiscal stance of EMU members: did the financial market fail to operate as an efficient device to discipline fiscal behaviour of EMU members (i.e. the monetary union provides excessive fiscal credibility, which allows members to overuse/misuse fiscal policy at national level – the ‘Euro Fiscal Dividend’ phenomenon)?

By answering these questions, this thesis advances the current studies on EMU through assessing whether it can be a sustainable system in the following ways: 1) this research will comprehensively look at the current status of EMU by focusing on some key issues which can crucially affect the macroeconomic performance/sustainability of the Eurozone. They are: business cycle synchronisation, effectiveness of ECB monetary policy and the Euro Fiscal Dividend; 2) analysis will focus on EMU as a whole rather than being interested in a few key economies, as has been the case among some previous studies; however, instead of using union-level aggregates, our research is based upon national-level data. The three papers format will be adopted here as follows, answering three key research questions:

- Has business cycle synchronisation among EMU members improved since the creation of the Eurozone?
- What’s the impact of the ECB’s monetary policy on macroeconomic performance?
- Does the ‘Euro Fiscal Dividend’ exist in the Eurozone?

For our analysis, we also augment the previous studies by analysing EMU as a whole, using national-level data rather than union-wide aggregates. This allows our research to be conducted without omitting information from any individual members of the euro area. This can be important given that EMU is a monetary union under the EU where each country is still sovereignly independent. To achieve this, two econometrics techniques are employed here: the panel vector autoregression (PVAR) method and the dynamic factor model (DFM). The main feature of these two methods is to allow the analysis of EMU to be done by
focusing on the post-EMU period without stumbling into the problem of low degrees of freedom, which is a common issue in conventional time series analysis on this area of research. The Eurozone is still examined as a whole through PVAR and DFM methods, together with being disaggregated into two groups: core members (i.e. Germany, France, the Netherlands, Austria, Belgium and Luxembourg), who are experiencing fewer issues during the crisis relative to the periphery members (i.e. Greece, Spain, Italy, Ireland and Portugal), whose economies are currently suffering from deep recessions and sovereign debt crises. The current poor performance of EMU’s economic activities and divergence among core and periphery members may suggest that there are inherent weaknesses that do not allow the economic stabilisation policy (e.g. ECB monetary policy) to be effective and probably had some role in causing the current economic struggles inside the Eurozone.

In this thesis, the research will be segmented into five major parts. Chapter 2 revises the historical development of macroeconomic theory in terms of EMU’s sustainability, which allows us to have overview of how the Eurozone’s economy is being operated. Chapters 3 to 5 respectively answer our three key research questions. Chapter 3 will use the DFM method to evaluate the degrees of business cycle synchronisation among EMU members since the creation of the euro. This enables us to evaluate the question of which whether EMU has a necessary condition for having a union wide appropriate monetary policy. Chapters 4 and 5 will use the PVAR model to discover the effectiveness of ECB monetary policy and the existence of the Euro Fiscal Dividend. Finally, this research will end in Chapter 6 by providing a general conclusion for key findings of the entire thesis, and pointing out possible scopes of future research.
Chapter 2

Historical developments of macroeconomic theories and the case of EMU economic system

The macroeconomic model is a key tool and a foundation, which is used for analysing/forecasting aspects of economic performance, such as output, inflation and unemployment. Therefore, it is crucial to policymakers in terms of designing/implementing an appropriate economic policy that can respond to the needs of the economy at the aggregate level. The purpose of this thesis is to evaluate the sustainability of EMU from the macroeconomic perspective. Hence, a quick overview of relevant macroeconomic models is a necessary initial step, which helps us gain a basic understanding of the theoretical foundation that determines EMU economic operations.

2.1 Historical developments in macroeconomic models – from Keynes back to classical

We will begin the review of development of modern macroeconomic models with the raise of Keynesians, in particular, the establishment of IS/LM model. This core theoretical tool of Keynesian macroeconomics, may be, no longer treated as the centre of current macroeconomics. However, it has been partially adopted in the current mainstream -- new consensus macroeconomic model. Therefore, it would be appropriate to start with the model of IS/LM and Keynesian’s view on macroeconomic issues.
2.1.1 The rise of Keynesians

The Great Depression in the 1930s had tremendous impacts on Western countries’ economies. In most countries in the USA and Europe, the unemployment rate was soaring, and the deflationary policy, which was proposed by the orthodox school at that time – neoclassical economics – had failed to solve this massive-scale economic crisis. Moreover, the Great Depression not only had deep impacts on day-to-day economic performance, but also shifted the focus and the way of thinking of modern economics. The focus of economics shifted from microeconomics to macroeconomics; the subject needed a good explanation of economic issues at the aggregate level, in order to provide a solution to the Great Depression.

However, due to the domination of classical economics before the Great Depression, there was very little room in the theories for understanding of unemployment. This shortcoming of the economic theories at that time provided an opportunity for John M. Keynes to step in, which eventually created a new sub-branch of economics, macroeconomics, and replaced the orthodox position of classical economics. Keynes’s The General Theory of Employment, Interest and Money (1936) shed light on the key economic problem at that time. The aim of this influential book was to elucidate the cause of the mass unemployment during the Great Depression and, therefore, to provide some solutions for the economic crisis of Western countries.

The explanation Keynes gave for the mass unemployment at that time concerns the relation between investment and aggregated demand. Rather than following the classical theory of investment, Keynes suggested that investment is not mainly driven by the level of interest rates; he said that the role of expectation among individual economic agents has a more important position in determining the level of investment expenditure at the aggregate level. If expectations of future economic stance are poor among most individual economic agents, then, despite a country having very low levels of interest rates, which should
encourage aggregate demand due to rising investment expenditure (classical view), poor expectations can outweigh the possible impacts of low interest rates, resulting in insufficient investment that will eventually cause a deficiency in aggregate demand. As a result of this, involuntary unemployment can soar in an economy if the market is left to solve the problem by itself.

Keynes’s book had received a great reception among economists who were also desperately searching for the answer and solution to the Great Depression. In 1936, an econometrics conference took place in Oxford. During this conference, John Hicks (1937) proposed a model, which was initially aimed at interpreting Keynes’s macroeconomic theories and making the comparison between them and classical theories, and which was the first version of the IS/LM model that eventually become the workhorse of the Keynesians’ macroeconomic model. Hicks’s work transformed Keynes’s ideas into a simple simultaneous equations model which can easily be used to show the joint outcomes of the real and money sides of the economy resulting from changes in economic circumstances and policies. Due to the further contributions made by Franco Modigliani (1944) and Alvin Hansen (1953), the IS/LM has become a baseline tool for analysing outcomes of economic policies among economists and policymakers. It is not a tool only for Keynesians: by changing the slopes of IS and LM curves, it can also be used by classical economists to illustrate their views of macroeconomics.

The key implication of the IS/LM model is the efficiency of Keynesian demand management policy. But the success of this model in analysing and demonstrating Keynes’s theory also relies on another essential concept of the Keynesian school of thought – the Phillips curve (PC) model. One of the shortcomings of the IS/LM model is the omitting of the variable of price, or, more precisely, the fixed price assumption (Snowdon and Vane 2005). Therefore, the original PC model, which was initially developed by Bill Phillips to study the relationship between inflation and unemployment (Phillips 1958), can fill the gap
here and hence complete the analysis for Keynesians. Given that the study is based on a solid empirical and statistical analysis over a long period of time, which was a remarkable achievement at that time, the work of Phillips was highly recognised by economists soon after the article was published (Gordon 2009). In particular, in the view of Keynesians, for example Paul Samuelson and Robert Solow (1960), the PC model has a useful theoretical implication for demand management policy. Since the Phillips curve model shows a negative relationship, it provides theoretical and empirical evidence about the possibility of governments using active/expansionary fiscal policy to ‘buy’ low levels of unemployment through ‘paying’ inflation as the price of the policy (Samuelson and Solow 1960).

### 2.1.2 The return of the classical school – monetarists’ attacks on Keynes and new classical economics

The Keynesian demand management policy, which incorporates the IS/LM model, did meet the demands of the policymakers in Western countries during the first couple of decades since the end of World War II. It provided governments with a solution for the high unemployment after the War and also a practicable way of boosting economic recovery. However, in the 1960s, before the Keynesian system formally collapsed in the 1970s, some economists, who are rooted from the classical school, started to question the demand management policy, especially in terms of its long-term consequences.

A representative, and one of the most influential, economist among those monetarists who started their attacks on Keynesian theory is Milton Friedman. In his presidential address to the American Economic Association in 1967, which turned into his famous paper *The Role of Monetary Policy* (Friedman 1968), he pointed out a crucial issue of Keynesian demand management policy, and was
proved right by the economic crisis in the 1970s. He questioned whether the trade-off between inflation and unemployment, which is the standpoint of Keynesian-type economic policy and frameworks, does exist in the long run. In particular, he focused on whether the government is really able to maintain low unemployment over the long run by altering the level of money supply.

Friedman argued that the inverse relationship only exists in the short run under certain circumstances (Friedman 1968). To allow an active economic policy (e.g. expansionary monetary policy) to work, some imbalance of information between firms and workers is essential. It is assumed that firms correctly anticipate inflation, which is caused by rising money supply, but workers are mistaken due to an information imbalance. Under such circumstances, the money is no longer nature to the real economic activities, given that a rise in money wage will be wrongly interpreted as an improvement in real wages by workers. Therefore, more workers will accept the market wage and unemployment will decrease (aggregate demand will rise). However, one key concept from Friedman’s PC model will ensure the inflation–unemployment trade-off will end in the short run. The backward-looking behaviour of workers leads them to learn from their previous mistakes, and therefore to adjust the expected price level upwards. This leads to a drop in employment and a fall in the level of output and national income.

Friedman agreed that wages would be negotiated between workers and firms for the subsequent periods, but workers and firms are interested in real wage not nominal wage; therefore, the wage agreed between both parties takes the expected level of future inflation into account. Therefore, the wage is set according to Equation (2-1):  

\[ w = f(U) + \pi^e \]  

(2-1)

---

4 The Friedman’s Phillips Curve still plays as a key part of the 3-equations model of New Consensus Macroeconomics, which we will discuss later in Chapter 4.
The growth rate of nominal wage \( w \) depends on a component determined by the level of unemployment and expected inflation for the period ahead. Moreover, this expected inflation is based on workers’ knowledge of inflation during the previous period. This implies that there will be many different PCs; each one will represent a unique level of expected inflation.

**Figure 2-1 Friedman’s Phillips curve model**

![Figure 2-1 Friedman’s Phillips curve model](image)

Source: figure drawn by the author

Suppose the economy is initially at full employment level: hence, only voluntary unemployment exists at the present time. Therefore, we are at point \( A \) where unemployment is \( U_n \) (see Figure 2-1). At this stage, the economy is on the short-term PC \( SRPC_1 \) with no changes in the level of money wage \( w \). This means workers did not experience any inflation; moreover, since we are at full
employment, the unemployment-determined component in Equation (2-1) has zero value; therefore, workers do not require any changes in the level of money wage for the next period \((w=\pi=\pi^e=0)\). Assuming the government decides to conduct a demand management policy through expansion in money stock, this monetary expansion will cause excess demand which eventually leads to a rise in the level of price and money wage, with price changing faster than wage rate. Because workers are backward-looking, the adaptive expectation of inflation still equals zero.

Workers mistakenly interpret higher money wages as an increase in real wages. Some of those workers who voluntarily decide to be unemployed while the economy is at point \(A\) now decide to accept job offers from firms. As a result of this, government successfully reduces unemployment below its full employment level (moves from point \(A\) to \(B\)). However, due to the backward-looking behaviour of workers, they eventually learn that inflation has risen, and the increase in real wage is just a short-term illusion. Moreover, as price is growing faster than money wage, real wages have actually fallen. Therefore, workers renegotiate wages with firms based on \((w_1+\pi^e)\), short-term PC shifts up to \(SRPC_2\), and unemployment will rise back up to \(U_n\) from \(U_1\). We are moving from point \(B\) to \(E\). If government wants to reduce unemployment again through monetary expansion, all the above processes will repeat again, leaving the economy with higher and higher levels of inflation with no change in the long-term equilibrium output/unemployment (assume no technological progress).

The implication of Friedman’s expectation-augmented Phillips curve model is to reject the trade-off relationship between inflation and unemployment but still accept the existence of it in the short run. Therefore, the long-run PC is a vertical line located at the natural rate of unemployment. As long as the economy is at its natural rate, any attempts to reduce the unemployment rate to below its natural rate will not be successful in the long run; the only consequence of this type of Keynesian economic policy will be a high level of price, but since the output is
dependent on the level of employment, which will eventually shift back to its natural level due to correct adjustments of workers’ expected inflation, the level of output will remain unchanged. Another implication of Friedman’s view on the PC model concerns the behaviour of the central bank. Monetary policy implemented by the central bank has to be based on rules rather than discretion, otherwise continued expansionary/discretionary monetary policy may lead to hyperinflation in the economy.

Although the attack of monetarists on Keynesian economics, which was led by Friedman, can be seen as the first wave of the attack on Keynes’s orthodox position from classical economists, the criticism made by Friedman mainly related to the policy issue of macroeconomics. He had demonstrated a ‘better’ model that can be used to analyse and predict the outcome of current economic policy. In fact, his argument about vertical Phillips curves and neutrality of money in the long run, which was proved right by the stagflation which took place across the Western countries in the 1970s, was later recognised by Robert Locus, the main figure of a new and more fundamental attack on the Keynesians’ theory of macroeconomics (Lucas 1972).

New classical economists, who were represented by Lucas at that time, had established a new theory to explain how the economy functions at the aggregate level from a microeconomics point of view, thus oppugning the justification of the Keynesian macroeconomic model. In Keynes’s view, the behaviour of individual economic agents is hard to predict at the collective level due to their ‘animal spirits’ and the assumption of the non-ergodic economy (Davidson 1982–3 & 2008). The motivations for holding money are not just about treating it as the medium of exchange; the speculative motive is also crucial to the demand of money function. The elasticity of the money demand function will be infinite in an extreme textbook case, therefore the monetary policy will be ineffective to alter the aggregate demand, but can be a useful tool for facilitating the expansionary fiscal policy (Wray 2006). Moreover, Friedman provided another
explanation of why monetary policy can be used to alter aggregate economic activities. Rather than use monetary policy as an assistant tool to fiscal policy, actually it has a direct impact on short-term unemployment and output through misperceptions of inflation, which are a direct result of expansionary monetary policy, by workers.

Another key element of the Keynesian revolution, the assumption of the non-ergodic world, challenged a fundamental concept of classical economics, which is the efficiency of the market under the influence of the ‘invisible hand’. The non-ergodic assumption of Keynes’s macroeconomics implies that the volatility of economic performance in both aggregate and individual markets is hard to predict given that the economy will face great uncertainty about the future (Allington et al. 2011). In other words, even if there is some evidence to show the market was and currently is efficient, the great uncertainty about the future can mean that behaviour of economic agents in this market may not be so efficient in the future. In contrast to Keynes, the ergodic axiom lies at the centre of the new classical economics, which indicates that if one conceives of the economy as stochastic, then the future outcome of any current decision is determined via a probability distribution process (Davidson 2008). That means the future outcomes of both economic agents’ behaviours and the economy as a whole can be foreseen by sufficient economic data and appropriate statistical analysis.

The shortcoming of the ergodic axiom assumption of tradition classical economics is the backward-looking nature of the behaviour of economic agents. For instance, the Friedman’s expectation-augmented Phillips curve model is entirely based on the backward-looking behaviour of workers allowing the short-run fluctuations of national output and employment level. Workers’ expected future price level, which will determine workers’ view of real wages, is assumed to be based on the experience of price level in the previous period. This allows an unanticipated monetary shock to take its effect on the employment level as workers will mistakenly see the rise in normal wage as a rise in real wage.
However, this backward-looking behaviour assumption does not answer Keynes's argument of the role of future uncertainty in the decision of economic agents who collectively influence the future economic outcome based on today's decisions.

In order to overcome the lack of consideration of future uncertainty, which has been seen as the main shortcoming of the traditional classical assumption of the ergodic axiom, Lucas's critique was developed to fill the gap. Lucas argued that the macroeconomic models (e.g. Keynesian dynamic IS/LM model, expectation-augmented Phillips curve model) cannot be relied on to predict the outcome of current policy or alternative economic policy given that these models do not correctly take into account the dependence of private agent behaviour on perceived or anticipated government policy rules for generating current and future values for government policy variables (Lucas 1976). In this sense, the economic model has to be structural by allowing the forward-looking behaviour of agents; hence, the estimation function is invariant to announced or perceived changes in government policy rules. In particular, when unknown functional forms are replaced by functions that are assumed to be known up to unknown parameter values, the estimated parameter values are said to be structural when they are invariant to announced or perceived changes in government policy rules.

This theory of Lucas's critique can be seen as 'completing' the classical economic assumption of the ergodic axiom, thus providing the theoretical justification for the traditional idea of classical economics – 'the invisible hand' of the market and the reason for the ineffectiveness of Keynesian economic intervention policy. Moreover, Lucas's critique also performs as a part of one essential new classical economic theory which provides the explanation of why the invisible hand does exist in the market. The rational expectation/behaviour hypothesis (REH), initially introduced by Muth (1961) and advanced by the work of Lucas (1965, published in 1981; 1966, published in 1981) and Lucas and Prescott (1971), had shifted economic assumptions on the behaviour of
economic agents from backward-looking to forward-looking and claimed that economic agents do behave rationally by learning from the past and using all available information to make the best prediction of the future values of a set of economic variables (e.g. inflation).

There are two versions of REH: weak and strong (Snowdon and Vane 2005). According to the weak version of REH, the expectation of the future value of a variable is said to be rationally formed, in line with the economic model, which assumes the agent has utility-maximising behaviour. In order to form this rational behaviour in estimating the future values of economic variables, economic agents will use all publically available information on factors which they believe have impacts on these variables. For example, if economic agents adopt the classical dichotomy and believe money is natural to real economic activities, the expansion of money stock only leads to proportional changes in the level of price; in this case, all the public information on money stock will be used to form the expectation of future inflation. This makes monetary policy ineffective in altering real economic variables unless the monetary authority makes an unannounced monetary expansion/contraction. Despite this, this method may adjust the level of economic activities in the short run; however, it can lead to a serious problem of ‘time inconsistency and inflation bias’.

Compared to the weak version, the strong version of REH, which is consistent with the original ideas of Muth (1961), takes a step further by assuming the correctness of agents’ expected future values of a variable in relation to the ‘true’ objective predictions from relevant economic models. The strong version does not insist on the absolute accuracy of agents’ expectations of future value; there can be some degree of random error (e.g. unexpected ‘surprises’ which also affect the future value of a variable), which prevents agents from having perfect foresight (Snowdon and Vane 2005). Hence, the REH can be represented using the following simple equation:
In Equation (2-2), $P^e_t$ is the expected future value of price at time $t$; it is rationally estimated using all the relevant information $\Omega$ available up to time $t-1$; and the accuracy of this expected future price is also affected by random error $\epsilon_t$. The error term is assumed to be random and not correlated to the information set $\Omega$ at the time when economic agents form their predictions. At the average level, the predictions made by those rationally behaved agents can be correct. Moreover, the random error is assumed to have a zero mean and to be uncorrelated to previous events; hence, any error occurring in the current period only affects the accuracy of ‘rational expectation’ for one period only. Furthermore, agents are also assumed to have great learning ability. Any mistakes made/experienced will be learned from by agents to prevent any systematic errors over time.

REH assumes there will be: (1) universal knowledge of the structural equations characterising the economy; (2) universal belief that all markets are cleared; and (3) universal understanding that all other agents also share assumptions (1) and (2), so they are common knowledge. Therefore, we will have a natural rate of unemployment given that a unique level of employment will clear the labour market. The output level of an economy is determined by this unique market-clearing employment level through the short-run production function, which is in accordance with the classical economic model for output determination. Furthermore, in order to prevent any unnecessary inflation – in other words, to keep the aggregate demand at the same level as the market-clearing output – real money supply has to be kept constant. Any discretionary monetary expansion will lead to an immediate rise in inflation as agents will adjust their price expectations in accordance with changes in the money stock. Fiscal policy will also be ineffective: any increase in the current level of government expenditure will be seen as future taxation, and economic agents will cut their current private expenditure by an equal amount. This crowding-out
phenomenon implies the downgrade of fiscal policy in view of new classical macroeconomics. All of these policy implications have been left within the current mainstream macroeconomic model, which is adopted by EMU to operate their economic policy.

REH has denied the effectiveness of demand management policy in altering real output and employment for an economy, together with the assumption of flexible wages in the labour market which allowing the economy to be continually at equilibrium in both the short run and the long run. Moreover, since there is an instant adjustment for an economy to move from one equilibrium to another, there should therefore not be a period when employment, price and output deviate from the natural equilibrium position, which is determined by the market-clearing employment level (Snowdon and Vane 2005). However, from historical data, we do observe fluctuations in real economic variables such as employment and output. The reason why sometimes the dynamics of economic activities can be different from the predictions of the new classical economic model has been explained through Lucas’s 'surprise' supply function, which was based on the Lucas imperfect information assumption (Lucas 1972, 1973 and 1975).

The perfect use of all publically available information and flexible price/wage allow the economy to adjust/maintain equilibrium in both the short and the long run. However, in Lucas’s view, once there is an information imbalance among firms and workers, then it is possible to see a temporary deviation of employment and output from their natural equilibrium levels (Lucas 1972, 1973). The simple form of Lucas’s analysis of ‘surprise’ supply function can be explained by Equation (2-3):

$$Y_{t} = Y_{n^{*}} + \alpha[P_t - E(P_t | \Omega_{t-1})] + \varepsilon_t$$

(2-3)

where $Y_{t}$ is the actual output at time $t$, $Y_{n^{*}}$ represents the natural rate of output which is determined by the natural rate of employment at present time period $t$;
$P$ is the actual price level; $E(P_t | \Omega_{t-1})$ expresses the rational expected price level for time $t$ workers anticipated at time $t-1$ by using all available information $\Omega_{t-1}$ up to the previous period of time $t$; and $\varepsilon_t$ is the random error term. Assuming we are in equilibrium and there is no systemic error of agents’ price expectation, then the price differential between actual and rational expected price $[P_t - E(P_t | \Omega_{t-1})]$ is zero, and the actual output $Y_t$ equals the natural rate of output $Y_n$. 

If we assume the distribution of information is imperfect, we have an information imbalance occurring in this economy, which is due to an unannounced monetary expansion. Then firms only know the price and costs of their own products, whilst the general price level for other markets can only be discovered in the next time period. Thus, firms are facing the problem of ‘signal extraction’, which is described by Lucas (1973). If information extracted by firms shows that the rise in the price level of their products in the market indicates shifts in the level of demand, the rational response of firms is to increase output by hiring more labours. Meanwhile, among workers, given the monetary expansion is unanticipated, the real wage they believe they are receiving at this period of time ($W/P^e$) has increased due to the rise in normal wage (expected price levels remain constant as workers do not have the information about a rise in money stock).

Therefore, economic agents have been ‘surprised’, which leads to a rightward shift of the aggregate demand curve from $AD_0$ to $AD_1$ (see Figure 2-2). Employment rises above its natural rate and we are temporarily producing more than the long-term equilibrium output $Y_n$. However, as we are assuming agents are rational, they learn from their experience of the past and will use all available public information to adjust their price expectations; therefore, soon workers will realise the higher level of money wage is just the consequence of higher price, which is due to the unannounced monetary expansion in the last period. As workers decide the allocation of time between work and leisure based upon
the real wage they anticipate receiving (Lucas and Rapping 1969), price and wage are fully flexible in the new classical model; therefore, those workers who mistakenly believed real wages had risen and decided to accept jobs, will now quit work and output will fall back to its natural level $Y_n$.

**Figure 2-2 Long-run ASAD model**

This model demonstrates that the economy should stay at its equilibrium level in both the long term and the short term given that the fully flexible price and rational expectation behaviours of agents allow continuous market-clearing to take place in an economy. Thus, the optimising behaviour of rational agents in the market implies that any unemployment observed is voluntary rather than involuntary. The demand management policy (through monetary expansion) can only alter the output and employment if it can ‘surprise’ agents by conducting
the policy secretly. However, this ‘surprise’ only has a short-term impact; in the
long term, after agents learn their mistake, employment/output will return to
the natural level, but price will remain high. Hence, there is no place for
policymakers to use any economic stabilisation policy to alter real economic
activities.

This proposition of policy ineffectiveness can be seen from a simple algebraic
analysis following Gordon (1976). It can be started from a linear Friedman’s
expectation-augmented Phillips curve model – Equation (2-4):

\[ \pi_t = \pi_t^e - \delta(U_t - U_n) + \delta\theta S_t \]  

(2-4)

Current inflation \( \pi_t \) depends on the expected inflation of current period \( \pi_t^e \), the
deviation of unemployment from its natural level \( (U_t - U_n) \) and random supply
shocks.

According to the classical dichotomy, inflation is the consequence of monetary
expansion; therefore, it can be represented as follows:

\[ \pi_t = m_t + \theta D_t \]  

(2-5)

\( \theta D_t \) is the random demand-side shock with zero mean. Due to the rational
expectation behaviours of agents, the expected inflation should equal the actual
growth rate of the money stock \( m_t \) if it is known to the public. Let’s assume
agents can process all available information at time \( t-1 \) to form a ‘true’
estimation of monetary expansion, \( m_t^e \); then we can write Equation (2-6):

\[ \pi_t^e = m_t^e \]  

(2-6)

Moreover, suppose the growth rate of money stock is controlled at the constant
rate \( \lambda_0 \) plus some proportion of the previous period’s deviation of unemployment
from its natural rate, and money supply can also be influenced by random shocks
in the current period. Since we have universal knowledge of economic model and
inflation is available to the public, then agents can form their expectation of the
growth rate of the money stock by using Equation (2-7):

\[ m_t^e = \lambda_0 + \lambda_1 (U_{t-1} + U_{n,t-1}) \]  \hspace{1cm} (2-7)

Then, any difference between actual money supply growth and expected
growth rate will indicate the occurrence of a random shock to money supply
(\(\theta M_t\)). Therefore, the accuracy of agents’ rational expectations of inflation will
depend on the whether any random shocks (\(\theta M_t\) and \(\theta D_t\)) occur at present time t. We can represent this by:

\[ \pi_t - \pi_t^e = \theta D_t + \theta M_t \]  \hspace{1cm} (2-8)

By substituting Equation (2-8) into Equation (2-4), we get:

\[ \theta D_t + \theta M_t = -\delta (U_t - U_n) + \delta \theta S_t \]

Then by rearranging Equation (2-8), we can show the determining factors of the
deviation of unemployment from its natural rate in Equation (2-9):

\[ U_t = U_n + \theta S_t - \frac{1}{\delta} (\theta M_t + \theta D_t) \]  \hspace{1cm} (2-9)

From Equation (2-9), we can see that the growth of the money stock, which is
managed by the monetary authority, does not appear in the equation. This
provides supports for the policy implications of the new classical economic
model, which claims that the fluctuations in the level of unemployment, and thus
changes in output from its natural level, are the outcomes of random shocks to
the economy. If there are no such unanticipated random shocks, the economy
will maintain its long-run equilibrium position. Hence, classical economists
recognise Friedman’s long-run vertical PC and the idea of the natural rate of
unemployment, but provide a different explanation of short-term fluctuations of
the economic aggregates. The purpose of monetary policy is controlling inflation rather than manipulating output; discretionary use of monetary policy will only cause a rise in inflation. This theory led to the proposition of the independence of the central bank that has been adopted in the current mainstream macroeconomic model, which was the theoretical foundation of the ECB.

2.1.3 New Keynesians’ defences

The emphasis of the new classical macroeconomic model is on policy ineffectiveness and random shocks (e.g. unanticipated monetary expansion) being the only sources of business cycles in the short run; otherwise there would be continual equilibrium. However, the later empirical studies did not support the idea of policy ineffectiveness, such as anticipated/announced systematic monetary policy having no real effects; instead, they found that announced/anticipated monetary policy does have impacts on output and employment (Mishkin 1982, Gordon 1982). The assumption of fully flexible wage price appears to be a shortcoming of the new classical school which leads to it conflicting with empirical evidence. This weakness of the new classical model has received attention from the new Keynesian economists. Theoretical studies such as Fischer (1977), Phelps and Taylor (1977) and Taylor (1980) have established models which consider some levels of wage rigidities (e.g. multi-period wage contracts) but also retain the rational expectation behaviours of agents, suggesting that monetary policy is not neutral to the real side of the economy.

Different theories have been developed to provide justifications for one essential Keynesian assumption – rigidities in price and wage. All of them can be divided into two strands: nominal rigidities and real rigidities. The former started with a more traditional Keynesian view, which claims that the rigidities exist in nominal price and wage. The failure of speedy adjustment in the level of money, wage and price gives room for the economy to perform in a non-Walrasian way. The possibility of instant and continuous adjustments towards equilibrium, which
is the core of Walrasian theory based on the new classical economic model, has now been ruled out. The latter recognises the possibility of the existence of nominal wage and price flexibility, but argues that, due to incomplete contracts and imperfect indexation, output and employment can still be very volatile once there is a shock to the economy or monetary policy is used to alter output and employment.

**Nominal rigidities**

The theory of nominal rigidities is a first response to the new classical model of macroeconomics, which argued that any anticipated monetary disturbance would be fully absorbed by the immediate changes in the level of price and wage, thus there would be an instantly and continuously cleared market. In contrast to this, new Keynesian economists such as Fischer, Phelps and Taylor have argued that, even under the rational expectation behaviours of agents, monetary disturbance can affect real economic activities such as output and employment if the continuous market-clearing assumption is dropped (Fischer 1977, Phelps and Taylor 1977). The foundation of their counterargument to the new classical model is based on their assumptions of labour market characteristics – in particular, the way of agreeing/setting wages among firms and employees.

Fischer’s analysis (Fischer 1977) emphasised that workers may realise there is a change in the level of price, but that pre-determined nominal wage is fixed by contract; hence, it is impossible to make an adjustment of nominal wage instantly, or even in the short run. This is also known as the Early Contract Theory. A feature of Fischer’s model of nominal rigidity and output is that it can be demonstrated through the new classical Lucas ‘surprise’ supply model. Therefore, we can show the model by starting with Equation (2-3):

\[
Y_t = Y_n + \alpha \left[ P_t - E(P_t | \Omega_{t-1}) \right]
\]

29
Workers will negotiate their long-term wages with employers based upon their expected price level for the next period; thus, the real wages workers aim to receive are fixed through a contract by setting the nominal wage increases as equal to the expected value of future inflation. This can be seen as:

\[ w_t = E(\pi_t \mid \Omega_{t-1}) \quad (2-10) \]

By substituting Equation (2-10) into Equation (2-3) and replacing price level \( P \) by inflation \( \pi \) in Equation (2-3) we get Equation (2-11):

\[ Y_t = Y_n + \alpha[\pi_t - w_t] \quad (2-11) \]

It shows that the aggregate supply is negatively related to the real wage, which is set through the multi-period contract between workers and employers (Fischer 1977). In Fischer’s view, the monetary authority has the ability to adjust the money supply more frequently; however, workers can only renegotiate their wage once their contract is about to finish. Therefore, inflation can fluctuate more in relation to nominal wage. Hence, if there is a shock, e.g. government announces a monetary expansion that was not anticipated by workers when they were negotiating their future nominal wage, since this event was not included in the information set \( \Omega \) at time \( t-1 \), the actual output \( Y_t \) can differ from its natural level \( Y_n \).

To understand the policy implication of this new Keynesian model, let us assume there is an unexpected demand shock, caused by economic recession in a major foreign trading partner. The aggregate demand curve will shift to the left due to this demand-side shock (see Figure 2-3). Assuming economic agents, including workers, are rational and information for the current period is perfectly available, if the wages are fully flexible as new classical economists assume, then, by instant adjustment in the level of nominal wage (\( W_0 \) to \( W_1 \)), the economy is able to move from point A to point C due to the downward shift of short-run AS curve SRAS. However, as the current nominal wage is fixed by the contract which
was agreed between workers and firms in the previous period, the equilibrium will move along the short-run AS curve SRAS(W₀), and we end up with a lower level of output Y₁ at point B.

Figure 2-3 Long-run ASAD Model – New Keynesian case

This nominal rigidity in money wage, which is caused by the persistence of long-term contracts, leaves room for the monetary authority to actively adjust the level of output by altering the quantity of money stock (Fischer 1977). The monetary authority can use discretionary monetary intervention by creating some inflation to reduce the actual real wage in the current period, thus increasing employment and shifting the short-run AS curve back to SRAS(W₀). Therefore, as long as the monetary authority can react to the exogenous shock more quickly than the time-consuming contract renegotiation lasts, even when
economic agents are rationally behaved as Lucas argued, there is always scope for the demand management policy (through monetary expansion) to have impacts on the level of output and employment in the short run.

Soon after Fischer’s model was developed to justify the validity of Keynesian demand management policy, it was criticised by new classical economists such as Robert Barro, who argued that Fischer’s model of macroeconomics – in particular, its view on the existence of contracts – had not yet cast off the typical shortcomings of traditional Keynesian economics – that is, a lack of solid microeconomic foundations (Barro 1977). Moreover, this model also lacks empirical support. In Fischer’s model, after an external shock the monetary variable can alter output by adjusting the level of employment through decreasing the real wage. In other words, the changes in the level of real wages are countercyclical. In fact, Mankiw suggested that, rather than taking a countercyclical path, the real wage has procyclical behaviours (Mankiw 1990). Instead of using nominal wage rigidities as the explanation of business cycles, new Keynesian economists turned their attention to the behaviours of suppliers in the goods market and the stickiness of nominal price in the market (Akerlof and Yellen 1985, Mankiw 1985, Parkin 1986). Through this model, which focuses on the behaviour of firms and its relation to overall economic activities, the Keynesian economic model provided more solid microeconomic principles for their macroeconomic models (Rotemberg 1987).5

Real rigidities

The nominal rigidities of price provide a microeconomic-oriented explanation for the observed fluctuations of real economic activities even if we assume economic agents are behaving rationally. They also imply that unemployment is not entirely voluntary; the involuntary type does exist due to the rigidities of nominal price. Therefore, Keynesian-type demand management policy is still vital to the stabilisation of an economy when there is an external shock in the short

5 Example of nominal price rigidities is available in Appendix.
run. The criticism of the menu costs approach to price rigidities argues that, although, the theory is capable of demonstrating a large impact of small menu costs on real economic activities, which depends on the slope of the marginal cost curve (Gordon 1990); however, the impulse of such effects is implausible (Ball et al. 1988). In fact, the disturbances to real economic variables are due to the combination of nominal and real rigidities (Ball and Romer 1990).

**Figure 2-4 New Keynesian real rigidities**

Suppose there is an external shock, which leads to a decline in aggregate demand. Hence, according the theory of menu costs, due to nominal rigidities, firms will choose to maintain their pre-shock profit-maximising level price. This can lead to severe disturbance to the effective demand of labour as each
imperfectly competitive firm reduces their labour force’s size and produces fewer products (Abel and Bernake 2001). Given the downward shift of the labour demand curve and the stickiness of price levels, the real wage will fall due to a fall in the level of the money wage. Moreover, this decline in real wage can be substantial if the labour supply is relatively inelastic (Ball et al. 1988, Gordon 1990, Romer 1993). Due to the decline of the real wage, the marginal costs of firms will also decline, which implies an upward-sloping marginal cost curve (see Figure 2-4). As the MC curve becomes upward-sloping in this case, the profit area when price is at \( P_1 \) tends to be bigger, and volume of profits for price level \( P_0 \) gets smaller. Therefore, if the labour supply is sufficiently inelastic, which implies a steeper MC curve, then firms will choose to reduce to the optimal level. Thus, the menu costs/nominal rigidities have no scope to explain the business cycles. Following the same principle, if the elasticity of demand falls like the downward shift of firms’ demand curve, then the marginal revenue curve will have an intense leftward shift. Thus, firms are more likely to maintain their pre-shock price levels.

Therefore, the nominal price rigidities can be a source of fluctuation of real economic activities; however, this source can’t be a unique force that can lead to much greater changes in macroeconomic performance. Real price rigidities have a much bigger role in explaining economic fluctuation that is due to the inflexibility of price level. Here, we can adopt the mark-up pricing equation for profit-maximising monopolistically competitive firms to illustrate the concept of real price rigidities. Let us start with marginal revenue equation, which takes the form of Equation (2-12):

\[
MR = P + P\left(\frac{1}{k}\right)
\]  \hspace{1cm} (2-12)

where \( P \) is the price of product of a firm, \( k \) is price elasticity of demand, and \( k < 0 \). According to the profit-maximising condition, the Equation (2-12) can be rewritten to demonstrate the function of profit maximisation for a firm:
By rearranging Equation (2-13), we can show the price is a mark-up on marginal cost, which is:

\[ P = MC \left( \frac{1}{1 + 1/\kappa} \right) \]  

(2-14)

Then we can replace the $MC$ (marginal cost) by $W/MPL$ given that the marginal cost to a firm is the real wage they have to pay to their workers, which can be calculated by nominal wage divided by the marginal product of labour. Hence, Equation (2-14) can be rewritten as:

\[ P = \frac{W}{MPL} \left( \frac{1}{1 + 1/\kappa} \right) \]  

(2-15)

From Equation (2-15), we can see that if the elasticity of demand remains constant, then, assuming a negative a shock, as the $MPL$ will not rise substantially due to decline in the level of labour inputs, which implies a flatter MC curve, we will have the presence of menu costs and low incentives for firms to reduce price. If the marginal cost falls as the price of input decreases, due to decline in the level of aggregate demand (falling AD leads to lower demand for labour and reduction of the price of labour inputs), as long as the mark-up can adjust sufficiently to offset the decline of marginal cost, the price $P$ will remain constant, or, at least, adjust downwards slowly. In fact, the nominal rigidities can be reinforced by real rigidities during the economic recession, given that implicit collusion may increase among imperfectly competitive firms; hence, there is no need of a very flat MC curve (bigger menu costs) to allow the existence of price rigidities (Romer 2001).
Real price rigidity has an important meaning to price inflexibility. It is the source of involuntary unemployment and also the justification for government economic intervention in the short run; nevertheless, the existence of real price rigidities does not necessarily indicate the occurrence of nominal rigidities (Ball and Romer 1990). In fact, the presence of real rigidities has an amplificatory function to the nominal imperfection, which can be seen as a distinguishing feature of the new Keynesian macroeconomic model (Mankiw and Romer 1991).

Besides real price rigidities\(^6\), the new Keynesian economic model also focuses on the labour market, which is emphasised by the new classical economists for its key features of flexible wages and continuous market-clearing\(^7\). Previously, wage inflexibility was explained through the early contract theory (Fischer 1977); however, it was criticised as lacking microfoundation and received insufficient empirical support (Barro 1977, Mankiw 1990). In response to the criticism and shortcomings of Fischer’s nominal wage rigidity theory, the real wage rigidities model was developed to explain the stickiness of price in the labour market. Hence, new Keynesians reinforced their view of non-market-clearing equilibrium and argued that the equilibrium may not be one where supply equals demand; in fact, it occurs at a time when no one in the market is willing to change their behaviour and the market is not necessarily clear (Stiglitz 1987).

2.2 Current mainstream macroeconomic model and the European Monetary Union

Modern macroeconomics has emerged since the rise of the Keynesian model, which tried to explain the cause of mass unemployment, thus providing a cure to economic problems at that time. From a historical view of macroeconomics, there have been continuous debates and alternation of orthodoxy positions in

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\(^{6}\) For other sources of real price rigidity please see details from: Thick market externalities (Diamond 1982); Input–Output table (Gordon 1981, 1990); Capital market imperfection (Bernanke and Gertler 1989, Romer 1993); Judging quality by price (Stiglitz 1987).

\(^{7}\) Example of real wage rigidities is available in Appendix.
this discipline, which has led to different implications for policy implementations. Over the last couple of decades, a new orthodoxy macroeconomics model – the new consensus macroeconomics (NCM) model has risen to become the current mainstream macroeconomic model, which has firmly established itself amongst both policymakers and academics (Allington et al. 2008).

2.2.1 Brief overview of NCM

The rise of NCM is a response to the need for a better macroeconomic model which can produce more satisfactory results than old-generation large-scale macroeconomic models (Fontana 2008). The old-generation large-scale macroeconomic models, such as the MPS model, which contains 60 equations, had become out of date given that the econometrics methods applied in MPS were obsolete by the early 1990s (Sims 1980 and 2002). Secondly, the large-scale model only considers adaptive expectation; however, the macroeconomic consensus at that time was influenced by Lucas’s work (Lucas 1976) on the role of rational forward-looking expectation and intertemporal decision-making in the context of monetary policy implementation (Fontana 2009). In comparison to MPS, NCM can include as few as three equations which contain the Philips curve, monetary policy curve and IS curve. Moreover, it takes the Lucas critique into consideration; hence, agents are behaving rationally and have a forward-looking manner.

The distinguishing feature of this new mainstream model has been its theoretical content. It is no longer classical versus Keynesian, but a blend of these two rival schools of thought, which gives it its name of ‘new consensus’. They were developed from the basic real business cycle (RBC) model into a Walrasian general equilibrium with endogenously determined rational

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8 The MPS model is a joint project between MIT, University of Pennsylvania, and the Social Science Research Council.
9 More detailed information about these three equation and NCM model are provided in Section 4.2.1.
expectations, but under some alternative assumptions. Instead of starting from a model with perfect competition, no asymmetric information and other market imperfections, NCM adopts monopolistic competition, nominal price and wage stickiness and considerations of the possibility of other market imperfections. So NCM rejects the idea of continuous market-clearing, through the incorporation of some market frictions, showing that the new classical conclusion about macroeconomic policies’ ineffectiveness comes from the adoption of this hypothesis, not from the incorporation of rational expectations. It also recognises the vertical long-term aggregate supply curve and vertical Phillips curve; hence, government economic intervention is ineffective in the long run. The monetary policy should be rule based, rather than implemented discretionarily. Therefore, we can say that NCM is heavily based upon the new Keynesian model, but has also adopted some key features of new classical economics (Meyer 2001, Arestis and Sawyer 2008).

Since NCM adopts the idea of the vertical aggregate supply curve and Phillips curve (Carling and Soskice 2005), in the long term the economy will be at its potential level of output and economic agents will be able to use all available information to form rational expectations on anticipated/announced monetary policy; hence, there is no room for discretionary monetary policy to be effective in altering the real output and employment level. Monetary aggregates will be natural to economic activities, and so will the interest rate policy. The monetary policy has to be designed to be a tool responsive to any deviation of output from its natural level, and also try to adjust any differentials between actual inflation and target inflation, therefore maintaining price stability without creating any inflation bias (Taylor 1985 and 1999).

In order to achieve price stability and avoid inflation bias, a ‘conservative’ independent central bank needs to be created which has adequate credibility of its price stability policy (Cukierman 1992, Goodhart 1994, Svensson 1997). A

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10 More detailed explanations of NCM, such as the three-equation model, and implications of implementation of monetary and fiscal policy will be given in Chapters 4 and 5.
nominal anchor has to be created by the monetary authority, thus causing economic agents’ expectations of inflation to converge on a determined point. Since under an inflation-targeting regime, a central bank is assumed to be independent of fiscal authority and focusing on price stability, eventually the inflation expectation of the agents will move towards the target, as long as the central bank has a history of credible policies and is not causing time inconsistency problems.

This ‘price stability’ objective is a core mission of a successful economic policy since the ‘stagflation crises of Western economies in the 1970s. The concern of policymakers on overall economic performance shifted from ‘maintain low unemployment’ to ‘keep price stable and low’. The independent central bank provides a possible channel to achieve this major economic goal. However, the fiscal policy could make contradictory impacts on price stability if discretionary fiscal policy was implemented (Woodford 2001, Brück and Zwiener 2006 and Chair and Kehoe 2008). Therefore, in order to achieve a successful price stability macroeconomic policy, fiscal dominance has to be avoided given that high government debt could well constrain the ability and willingness of the central bank to maintain the target inflation by controlling the central bank base rates (Turner 2011).

Secondly, Ricardian equivalence, which suggests the ineffectiveness of fiscal policy given that households rationally see today’s rise in government spending as tomorrow’s higher taxation, also indicates the downgrade of the fiscal policy and upgrade of the monetary policy in the new consensus macroeconomics model (Fontana 2009). Moreover, the economic aggregates are assumed to be fluctuating around the long-term equilibrium where unemployment is at its non-acceleration inflation rate level (NAIRU), and this equilibrium is determined by the supply side of the economy, such as equilibrium in the labour market. Effective demand no longer has a determining role in the long-term equilibrium
of the economy; hence the fiscal policy is treated as an ineffective tool in long-term economic activities (Arestis and Sawyer 2008).

Overall, the characteristics of NCM in respect of policy implications are: 1) price stability is the major goal of economic policy. Given inflation is a monetary phenomenon, monetary policy has to be rule based and an independent central bank provides credible monetary policy that is crucial to avoid inflation bias and maintain a stable price. The rule of monetary policy is based on the inflation-targeting strategy: the interest rate is used as an instrument to manipulate inflation around the target level (through adjusting the differentials between natural rate of output and actual output level); 2) since the long-term equilibrium is supply-side-determined, and economic agents are assumed to have, at least, some levels of Ricardian behaviour towards expansionary fiscal policy, therefore fiscal policy can be seen as an ineffective policy instrument. However, there is a possibility that government may discretionarily use the fiscal policy to facilitate their political needs (Alesian and Perotti 1995, Balassone Francese 2004), and such discretionary use of fiscal policy can weaken the effectiveness of ‘price-stability’-type monetary policy; hence, fiscal discipline has to be monitored and enforced.

2.2.2 EMU economic policy and NCM

In the process of establishing EMU, member states have lost their monetary sovereignty and monetary policy has been centralised at the union level. The European Central Bank, the only, and supranational, monetary authority, was created for implementing the monetary policy for the entire Eurozone. The treaty on the European Union ensured its independent status to any fiscal authorities and their governments within EMU. The primary objective of the ECB is to maintain price stability within the Eurozone, which is officially written down
in Article 127(1) of the Treaty on the Functioning of the European Union and also written down in a statement of the ECB as\textsuperscript{11}:

\begin{quote}
To maintain price stability is the primary objective of the Eurosystem and of the single monetary policy for which it is responsible. This is laid down in the Treaty on the Functioning of the European Union, Article 127 (1).

"Without prejudice to the objective of price stability", the Eurosystem shall also "support the general economic policies in the Union with a view to contributing to the achievement of the objectives of the Union". These include inter alia "full employment" and "balanced economic growth".
\end{quote}

The implementation of monetary policy has been treated by the ECB as mainly sustaining price stability in the long run, but it still recognises its impacts on the level of real economic activities such as output and employment; however, such impacts will vanish in the long term\textsuperscript{12}:

\begin{quote}
In the short run, a change in money market interest rates induced by the central bank sets in motion a number of mechanisms and actions by economic agents. Ultimately the change will influence developments in economic variables such as output or prices. ... Real income or the level of employment are, in the long term, essentially determined by real factors, such as technology, population growth or the preferences of economic agents.
\end{quote}

The principle behind the ECB’s monetary policy implies the policy implications of NCM, which has adopted the idea of supply-side-determined long-term equilibrium and short-term economic fluctuations due to the slow adjustments of wages in the labour market. The vertical long-term Phillips curve (PC) adopted by NCM economists shows that in the long term the natural level of unemployment, and hence the output, is neutral to the level of the price that can be affected by monetary shocks. Therefore, the inflation–unemployment trade-off relationship does not hold for the economy in the long term. While unemployment is still elastic to a change in the level of price, there is room for


monetary policy to have an effect on real economic activities. However, the implementation of monetary policy should only react to the deviation of actual output or inflation from their natural rates and target levels respectively (Taylor 1999). Any discretionary use of monetary policy can cause the occurrence of the time inconsistency issue and damage the credibility of the monetary authority, which leads to a suboptimal equilibrium between inflation and unemployment and price stability of the economy is damaged (Kydland and Prescott 1977, Barro and Gordon 1983a&b). Hence, we can say that the principle of the ECB’s monetary strategy, which is given in their statement, is consistent with the policy implications of the NCM model.

Although the ECB adopts the NCM model and sees monetary policy as an essential instrument to controlling fluctuation of price level, in terms of policy practice, it adopts a slightly different strategy from the NCM model. Such policy objectives among NCM and the ECB are based on the hypothesis that of inflation in the long term is a monetary phenomenon. Based on this, a target inflation strategy is suggested by the NCM model, such as using the Taylor rule (Taylor 1999) to adjust inflation around the target level; hence, the interest rate should be set at equal to the inflation rate, and should react positively to deviations of current inflation above target and positively to deviations of current output above the natural rate. This inflation-targeting strategy is fully adopted by many central banks such as the Bank of England (Horvath and Mateju 2011). In practice of monetary policy, the ECB also set out a target of ‘closely around 2 per cent inflation’, which has been seen by the ECB as adequate to avoid deflation and too little inflation (ECB 2008), but with a different practice from the Taylor rule to assess the necessity of changing interest rates.

The method adopted by the ECB is called A Two-Pillar Approach (Gerlach 2003, Issing 2006). Rather than using estimations of output gap and the deviation of inflation from its target level as indicators of changing interest rates, the ECB adopts a range of variables to decide if interest rate has to be changed to
maintain the long-term monetary goal of price stability. All of those variables, which are used in the two-pillar approach of the ECB, can be categorised twofold: economic condition variables and monetary development variables. The logic behind this two-pillar approach is related to the various time perspectives of inflation, and its causes, which require a different focus of monetary policy. For the former, it focuses on a basket of variables that is related to domestic and international economic conditions, which include overall economic activities – output, level of aggregate demand, conditions of labour and capital markets, fluctuations of exchange rates and balance payments, fiscal policy, financial markets, balance sheet position of the euro area sector, and global economic conditions (ECB 2004). This is in order to assess future price development in the short and medium term based upon the broad economic conditions. The latter considers the impacts of development of monetary aggregates – money supply – on the level of price over the medium and long term (ECB 2004). This clearly reflects the NCM view on the cause of inflation over the long term and neutrality of money.

The fundamental idea of this two-pillar approach is principally consistent with the NCM model. Monetary policy’s goal is primarily focused on price stability rather than being used discretionarily to boost real economic activities. However, there are still some differences between the ECB’s and NCM’s approaches to monetary policy. According to the NCM model, in particular, as the Taylor rule suggested, an explicit inflation target has to be set as a benchmark to monetary policy, output gaps are considered an indicator of potential source of inflation from the real side of the economy, and monetary aggregates are not included in the model. In contrast to NCM, the ECB’s two-pillar approach does consider the growth of the money supply as a major source of inflation in the medium and long term and an implicit inflation target level is adopted. Nevertheless, given the consistency of ECB monetary policy with the NCM model at principle level, but also the differences in their implementation strategies, it is still sensible to expect the ECB to be able to deliver an effective monetary policy for the whole
Eurozone. However, by considering the possible existence of heterogeneity of monetary transmission mechanisms among member states of EMU, and different requirements of the interest rate due to insufficient business cycle synchronisation, ECB monetary policy can be appropriate for the entire euro area, but may not be optimal for every individual member.

Compared to the centralised monetary policy, the fiscal policies of EMU are still designed and implemented at the national level. This decentralised fiscal regime allows members’ government to keep their fiscal sovereignty. However, rules have been set by the EU to monitor and enforce fiscal discipline within the euro area. The EMU fiscal rules require that the national budget deficit does not exceed the 3 per cent of GDP ceiling, and the national debt has to be maintained below 60 per cent of GDP. These fiscal rules are enforced through the Stability and Growth Pact (SGP), which mainly contains three elements: 1) to pursue the medium-term objective of a balanced budget; 2) the submission of annual stability and convergence programme by members of EMU; 3) to monitor and enforce the fiscal ceiling.

Member countries have to submit their budgetary data with stability programme each year to the European Commission. The stability programme will be examined by the Economic and Financial Affairs Council (ECOFIN) and recommendations will be made available to each member’s government. If the examination of a country’s stability programme report shows the member’s fiscal stance has diverged from its medium-term objective, a warning/recommendation has to be issued to strengthen their stability programme. If there are no improvements in a member’s budgetary condition, and no exceptional circumstances have been found, then this member can be judged as breaching EMU fiscal rules and fines can be imposed\(^\text{13}\).

As per the statement from the European Commission, the need for the union-level fiscal rules and relevant enforcement mechanism is mainly to enhance price stability within the Eurozone\textsuperscript{14}:

*By imposing a common framework within which Member States would set budgetary policy, the possibility of negative impacts on other euro area countries – whether stemming from the inflationary impact of large deficits or the destabilising effect of unsustainability or insolvency – could be reduced and monetary policy could operate in a stable environment.*

The motivation of EMU’s fiscal rules reflects the view of NCM on fiscal policy. The fiscal policy is only able to alter real economic variables in the short-term and is neutral to long-term output that is supply-side determined. Moreover, the Ricardian equivalence (RE) hypothesis suggests that ‘Ricardian’ consumers, who are forward-looking and aware of government intertemporal budget constraints, will react to the government fiscal policy rationally, which implies consumers take future tax liabilities fully into account in today’s consumption/saving decisions, hence government bonds will not be treated as net wealth and impacts of fiscal expansion may eventually be cancelled out by decline in private consumption (Buchanan 1976, Dimand 2002). Hence, fiscal policy is not effective in achieving full employment. Instead, it can be harmful to ‘price stability’ given that the credibility and outcome of price stability monetary policy is hardly to be achieved without controlling fiscal behaviour of individual members in the monetary union (Woodford 2001, Brück and Zwiener 2006, Chair and Kehoe 2008).

Despite the ‘price stability’ goal being set as the essential objective of EMU’s economic policy, and fiscal policy having to be closely monitored and enforced by EMU, the adherence to EMU fiscal rules among members and the reform of the SGP in 2005 shows that most EMU members have no intention of complying with the original SGP and require more flexibility (Bonatti and Cristini, 2008). During 2001–4 six countries – France, Germany, Greece, Italy, the Netherlands and

\textsuperscript{14} http://ec.europa.eu/economy_finance/economic_governance/sgp/q_and_a_en.htm.
Portugal – became formally subject to the excessive deficit procedures for breaking the 3 per cent GDP limit. Instead of enforcing the rules and applying sanctions to those members, a dramatic event took place inside EMU. In November 2003, tensions with respect to the rules reached a climax when the ECOFIN refused to take a decision on the basis of a recommendation by the European Commission to move to the next step in the sanction procedure for Germany and France. After the European Commission had brought the case to the Court of Justice, the Court ruled that the Council had not been allowed to take its own decisions outside the scope of the EU Treaty (European Court of Justice, 2004). At the same time, it also confirmed the discretion of the Council on whether or not to move forward in the sanction procedures\(^\text{15}\).

Although the adherence to EMU fiscal rules was poor among members of the Eurozone, the instruments of economic governance were too weak to force governments of EMU members to commit to the SGP after the memberships were granted to them (Eichengreen 2005; Larch et al. 2010); however, the NCM model also implies another mechanism which can also perform as a device to monitor and enforce fiscal behaviours of EMU. The rational behaviour of economic agents in financial markets should be able to penalise any ‘bad’ behaviour of fiscal authorities in the Eurozone. As monetary policy has been centralised at the union level, member governments are no longer able to finance their budget by issuing new money or devaluing their currency; therefore, national debts and budget deficits have to be financed through issuing government bonds in financial markets. This implies that the market may have a crucial role in public borrowing. There will be fewer risks of free-rider issues, if the financial market is able to identify the risk premiums of public debt borrowers in different debt situations (Warin and Wolff 2005).

The role of the financial market in disciplining fiscal behaviour is based upon the *efficiency market hypothesis* which is one of the main implications of the

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\(^\text{15}\) More details about the implementation of the SGP are available in Chapter 5.
rational behaviour model. By using all available information about countries’ fiscal and general economic conditions, rational agents in the financial market, who are supposed to have good knowledge, should be able to discriminate between governments and make borrowing more difficult by adjusting upwards the interest rate on bonds. Therefore, this rational behaviour of agents on government bonds can discipline borrowers’ fiscal activities. However, the 2007–8 credit crunch and the current Eurozone sovereign debt crisis seem to suggest the market, which is assumed by NCM to be efficient and have rational behaviour, had failed to correctly price assets and charge appropriate risk premiums on EMU members’ government bonds.

2.3 Summary

In this chapter, we have reviewed the state of modern macroeconomics by highlighting key theories and their developments. The Keynesians who explained the economic fluctuations are the consequence of demand deficiency established the modern macroeconomic. Therefore, fiscal policy needs to be conducted to stimulate the economic recovery through direct spending and improvements on confidence and expectations among private economic agents as the results of expansionary fiscal policy. However, due to outbreak of economic crisis in late 60s and 70s, Keynesians theory no longer able to be used to explain and providing cure to stagflation. Hence, Monetarists and New Classical economics rose, thus to provide more appropriate answers to the present economic issues at that time. In responds to lose of its dominate position, newly developed mainstream Keynesian thoughts – New Keynesian economics defined Keynes’ theory through explanation of nominal and real rigidities.

Given the evolving of macroeconomic theories, different school of thoughts has merged that creates the New Consensus Macroeconomics. The current mainstream macro-model, which is a mixture of new classical and new Keynesian
theories, adopts the rational behaviour hypothesis and supply-side-determined long-term equilibrium of output; it also recognises that price/wage rigidities in the short term are the cause of business cycle and deviation of unemployment/output from its natural rate; therefore, it rejects the assumption of continuous market-clearing. As the results of rational behaviour and supply-side-determined long-term equilibrium, vertical Phillips curves are continually used to indicate the limitations of discretionary economic stabilising policy, and to indicate that monetary policy has to be rule based and mainly used to achieve price stability.

Fiscal policy has been downgraded to be considered an ineffective policy tool for real economic activities, and harmful to ‘price stability’ monetary policy. The independent position of the ECB and its policy goal and implementation of monetary policy are, by and large, consistent with the NCM model. The fiscal policy framework designed by the EU, which aims to discipline the fiscal behaviours of EMU members, also reflects the adoption of the NCM model as the theoretical foundation of EMU’s economic operations.

For the financial market, where government interact with lenders for accessing funds to finance their budget deficits and debts, the underlying assumption putting forward by the NCM is the market should be perform rationally and efficiently. The implication of this is that the behaviour of fiscal activities of EMU members could be monitored enforced through a dual mechanism, which contains EMU fiscal rules and financial market. Hence, if both fiscal discipline mechanisms operated normal as they should be, the fiscal behaviours within the Eurozone can be well managed and maintained.

In the next three chapters (Chapters 3, 4 and 5), we will start to assess whether EMU is a sustainable economic system in terms of the NCM model, e.g. effectiveness of monetary policy on controlling inflation and its impacts on other macro-variables (Chapter 4), and the existence of the Euro Fiscal Dividend, which
show whether the financial market did perform rationally and efficiently in monitoring/enforcing fiscal behaviours within EMU (Chapter 5). Before we answer these two questions, in Chapter 3 we will first evaluate business cycle synchronisation among EMU members to see if the general economic conditions among members have converged to a similar level, which allows the ECB to implement a union-wide appropriate monetary policy. If this is the case, members should be less likely to rely on using their fiscal policy to compensate the loss of monetary sovereignty.
Chapter 3 Business cycle synchronisation in the Eurozone – a dynamic factor model analysis

3.1 Introduction

The EMU is criticised as a non-optimal currency area. This is partially due to the heterogeneity of economic structures among member countries. This implies different reactions in each domestic market to a common union policy, and different impacts on the domestic macroeconomic performance due to a common external shock. Therefore, the business cycles of EMU members might also remain heterogeneous across EMU. For instance, countries in an upward phase of the cycle may prefer a relatively tight monetary measure; in contrast, countries in a downward phase of the cycle may need more expansionary monetary policy. Hence, if business cycles for currency union members remain divergent or move toward divergence, the union-wide monetary policy is unlikely to be optimal to the large majority of EMU members, even when the MTM is homogenous (Artis et al. 2004, Grauwe 2009, Soares et al. 2009, Savva et al. 2010).

However, the current developments in the theory of OCA (mainly influenced by Frankel and Rose 1998) have suggested that economic structures can be changed by participation in a currency union – this is known as the endogeneity of OCA hypothesis. The argument is that cycles will tend to be more synchronised due to the increase in trade, if the intra-industry trade dominates the inter-industry trade. This argument favours the original OCA theory that was developed based on classical and monetarist ideas, which was mainly contributed by Mundell and Friedman in the 1950s and 1960s (Cesarano 2006). The modern view of OCA
theory suggests that due to economic integration members will tend to share the same, or, at least very similar, business cycles. Therefore, different countries will more likely be subject to common patterns of economic shocks. Moreover, due to the synchronisation of business cycles across the currency union, the fluctuations of price also tend to be similar among members. This indicates that the cross-country relative prices are constant; therefore, the exchange rate policy is not needed. Indeed, trade intensity is found to lead to more synchronisation within the euro area.

Hence, if evidence of business cycle convergence existed in the euro area, we might say that the centralised monetary policy would be likely to be optimal, and dependence on domestic fiscal instruments might become lower among EMU members. Many previous studies have suggested that the business cycles in the euro area have become more similar (Fatás 1997, Artis and Zhang 1997 & 1999, Agresti and Mojon 2001, Belo 2001, Monfort et al. 2003, Altavilla 2004, Darvas and Szapary 2004, Enders et al. 2010, Siedschlag and Tondl 2011 etc.). However, other previous works argued that the business cycles of many euro countries are still substantially out of sync, and there is no strong evidence to support the argument of a European business cycle (Kose et al. 2003, Kaufman 2003, Artis 2004, Darvas and Szapary 2004, Massmann and Mitchell 2004, Camacho et al. 2008, Giannone et al. 2010, Lee 2012, Lehwald 2012). Because of the relatively short history of EMU, the above results are mainly drawn from the literature that is focused on the pre-EMU period. Therefore, the above conclusions, which are mainly based on members’ experience before the adoption of a single currency, can be considered as a misleading representation of what actually happened during the first decade of the currency union. Thus, the actual picture of cyclical convergence over the first decade needs to be studied.

In this chapter, we will make comparison of the business cycle synchronisation among all initial twelve members of the Eurozone between the pre-EMU and post-EMU periods. The contribution of this is that we consider all twelve countries’ growth dynamics in a single model, rather than using a correlation
approach, which only considers a pair of countries (e.g. Artis and Zhang 1999, Inklaar de Haan 2001, Massmann and Mitchell 2004, Camacho et al. 2008, Enders et al. 2010). To achieve this, the Dynamic Factor model (DFM) was adopted as the platform of our analysis, which enables us to uncover the unobservable common factor which captures the co-movements of macroeconomic aggregates across these members of EMU. Moreover, given that most macro-variables are collected on a quarterly/annually basis, implementation of DFM also allows us to avoid the usual problem of low degrees of freedom when the regression-based research is trying to focus on the post-EMU period only. Furthermore, we contribute to the existing literature (Beine et al. 2000, Kaufman 2003, Kose et al. 2003, Monfort et al. 2003, Lumsdaine and Prasad 2003, Giannone et al. 2010, Siedschlag and Tondl 2011, Lee 2012, Lehwald 2012) by investigating which key components of the growth dynamics for each member can be seen as the driving element for business cycle synchronisation. Finally, we attempt to advance the study through a further analysis to check if the convergence of cycles is due to the spill-over effects among members.

In the following section, we will firstly review the OCA theories in Subsection 2, followed by the literature review of previous empirical studies. In Subsection 3, the econometrics method for this chapter will be discussed. The empirical findings and conclusions will be presented in Subsections 4 and 5 respectively.

3.2 Theories of common currency area and factors in business cycle synchronisation

The EMU was created based on the theoretical model of an optimal currency area; however, the Eurozone itself and its members do not fully satisfy the criteria that are set out by OCA theory for creating the optimal currency union.
Moreover, the adherence to the Maastricht Convergence Criteria, which were designed as a simplified EMU version of the OCA criteria, was generally poor among the initial 12 members of EMU (including Greece). All of these imply the possibility of divergence among the overall economic activities between member states of the Eurozone; thus, countries may require different levels of interest rates to facilitate their domestic economic goals.

This will not only cause the implementation of union-wide appropriate ECB monetary policy to become more challenging; also given EMU has no centralised fiscal transfer system, national-level fiscal policy can be more frequently used by governments of Eurozone members to compensate the loss of monetary sovereignty. Consequently, the ‘price stability’ goal of the ECB can be dampened and sovereign debt will rise. Therefore, the degrees of business cycle synchronisation among members of EMU are crucial to both successful union-wide monetary policy and fiscal discipline. In this section, by reviewing the theories of optimal currency areas, we will gain an overview of the inherent weaknesses of EMU that could harm the success of the Eurozone, and also see how the modern version of this theory prompts the idea of EMU through arguing that the initial divergence of cycles’ co-movements can be solved by improvements in the level of synchronisation due to granting of membership.

3.2.1 Traditional theory of OCA

The fundamental theoretical foundation of optimal currency area (OCA) theory began with the seminal work of Mundell (1961), which suggests that a currency area should be a region where borders should not be considered as the borders of countries. The debate in OCA theory had remained an academic interest until the European Union started the process of creating the Eurozone. First, Mundell emphasises the significance of convergence between the economic structures of the regions or countries within a currency area. Given that a currency area involves relinquishing the exchange rate as an instrument that can be used for
correcting external imbalances, an OCA requires structural convergence so that the risk of asymmetric shocks is minimised.

Second, Mundell (1961) stated that factor mobility, especially labour mobility, is also crucial to creating and maintaining an optimal currency union. If an asymmetric shock occurs in a currency union, unemployment may worsen in parts of the region, but not in others. If this forces other low-unemployment members to accept inflation as a cure for the asymmetric shock, then this currency area cannot be considered as an optimal currency area. Moreover, if demand for goods shifts from region A to region B, this may cause an economic downturn that may cause rising unemployment in region A; however, region B will be exposed to inflationary pressure. Given the loss of regional/national monetary policy and exchange rate mechanisms, both regions of the currency union need another mechanism to restore the equilibrium. Mundell argued that if factor mobility is sufficient in a currency union, labour from high-unemployment regions can move to other parts of the currency union, therefore the balance of payments will restore equilibrium and there will be no need for the members’ own exchange rate mechanisms, and the union-level monetary policy can be appropriate for all. Furthermore, Mundell also emphasised the importance of price and wage flexibility as mechanisms to cope with idiosyncratic demand shocks. Hence, if labour mobility or price and wage flexibility is present in an economy (region), there is no need for national-level monetary policies e.g. exchange rate policy.

Factor mobility may influence the degree of efficiency of common monetary policy; however, in the monetarist view of OCA theory, the loss of national monetary policy may not be crucial to the currency area (Matthes 2009). The traditional OCA theory, which is developed based on Keynesian macroeconomic theory, considers a negatively sloped Phillips curve. Under this assumption, conducting monetary policy that induces unexpected inflation can lead to lower unemployment rates and adjust the real wage downwards. Thus, losing the ability to create policy shocks is very serious to the policymakers. That is the
purpose of having factor mobility built into OCA theory: to be treated as an automatic shock absorber. However, in the view of monetarists with a rational expectation model, workers tend to focus on the real wage rather than the nominal one. Therefore, the Phillips curve tends to slope vertically. Thus, national monetary policy appears to be less effective, which means the danger of losing national monetary sovereignty may not be as crucial as the counterargument to OCA theory described.

Factor mobility provides one of the theoretical bases for explaining the reason for moving monetary policy from the national level to union level. However, if factor mobility is insufficient to compensate the loss of monetary sovereignty, then the currency union can be exposed to asymmetric shocks with insufficient policy instruments to correct imbalance. For instance, language and cultural barriers, and different legal systems across the Eurozone leave EMU with a weak automatic shock absorber to offset possible asymmetric shocks (Heylen and van Poeck 1995, de Grauwe and Vanhaverbeke 1991, Arpaia et al. 2007, Janiak and Wasmer 2008).

Following the work of Mundell (1961), McKinnon (1963) does not question the relevance of the convergence requirement, but made another major contribution to early OCA theory. McKinnon emphasised the degree of openness as a key criterion for forming an OCA. Given a high degree of openness in the economy, foreign price shocks can be more easily transmitted to the domestic price level through bilateral trade. As with the rise in the cost of living in the domestic economy, wage contracts and price can be significantly influenced by the exchange rate due to the reduction of money illusion (Shafir et al. 1997). This implies that the adjustments of the exchange rate may become less effective as a mechanism for correcting the trade balance. Therefore, the argument here is that, the more open the economy is, the more advantage this country may have from a fixed exchange rate regime. This is especially relevant to small economies, as a small economy is less likely to efficiently produce all the products it needs.
Therefore, it is more advantageous to engage in international trade and only produce those goods concerning which it has comparative advantages.

Furthermore, Kenen (1969) also contributes to OCA theory as the third key founder of the theory. Product diversification, also known as specialisation, is an important criterion of selecting a potential member of an OCA. He argues that sufficient factor mobility, especially labour mobility, rarely exists between countries. Therefore, the OCA needs another criterion to ensure the join a currency is feasible (or to have a fixed exchange rate regime). Kenen (1969) highlights the importance of a well-diversified (or less specialised) economy as it determines the effects and outcomes of changes in the demand patterns. Assuming a demand shift on a product is caused by a random shock rather than induced by the fluctuations of business cycles, if the economy is specialised in this type of product and the economy is less diversified, consumers will demand more of other goods that are produced by foreign countries, and consumption of this product from both domestic and foreign markets will fall. This may lead to an economic downturn and rise in unemployment.

However, under the flexible exchange rate regime, a fall in the revenue of exports will reduce the demand for the domestic currency, and, therefore, cause depreciation of the exchange rate. This can actually help to restore international competitiveness, which in turn may lead to recovery of the economy. If this country is in a currency union, the exchange rate adjustment cannot be exploited; hence, the recovery will rely on the reduction of wages and national fiscal policies. In comparison with a specialised economy, a country with well-diversified domestic industries can be more resistant in the above situation. Unemployment will be less likely to be affected by the export demand shift in a particular industry.

During the 1990s and early 2000s, many empirical studies were carried out to evaluate whether EMU is satisfied with OCA criteria. To our knowledge, among them (e.g. Mundell 1997, Bayoumi and Eichengreen 1997, Caporal and Pittis
Chapter 3 Business cycle synchronisation in the Eurozone

1998, Demeztris et al. 2000, Kempa 2002) there is no evidence to prove EMU is an optimal currency area. Some studies (Demeztris et al. 2000, Baimbridge et al. 2005) even argue that EMU is more motivated by political determination than economic factors. Besides these general studies of EMU, some studies have attempted to evaluate the Eurozone referring to a specific criterion of OCA. Minford and Rastogi (1990) and Bayoumi and Eichengreen (1992) suggest that the economic structures among union members remain heterogeneous, which implies a higher probability of asymmetric shocks. This means EMU monetary policy is less likely to be union-wide optimal.

Furthermore, language and cultural barriers and different legal systems across the Eurozone leave EMU with insufficient factor mobility and flexibility, thus the automatic shock absorber inside the union may be relatively weak at offsetting asymmetric shocks (Heylen and van Poeck 1995, de Grauwe and Vanhaverbeke 1991, Arpaia et al. 2007, Janiak and Wasmer 2008). Finally, there is no system of fiscal federalism available inside the Eurozone. Instead, the fiscal policy is operated centrally at the national level. Therefore, the channel of fiscal transfer between union members does not exist inside EMU, which may potentially affect the sustainability of the union (Wickens 2007, von Hagen and Wyplosz 2008). Despite the counterargument of EMU in respect to traditional OCA theory, the modern view of the theory has provided some new argument to support pro-EMU academics and policymakers.

3.2.2 Modern view of OCA theory – endogeneity hypothesis

The modern view of OCA theory emphasises the positive relation between monetary integration and economic convergence in EMU. This ‘optimistic view’ is raised by Frankel and Rose (1997) who argue that further economic and monetary integration can lead to less divergence among members of a currency union. In other words, the business cycle synchronisation will improve among member states after the creation of the union; therefore, the cost of not having
their own national-level monetary policy, which could be used to adjust internal imbalance, is minimised. For pro-EMU supporters, this theory can be interpreted as asserting that, once a country enters a common currency area, even if it did not satisfy the criteria ex ante, eventually through economic integration (e.g. improved trading relationships with other members of the currency union) this country could satisfy the criteria ex post. This argument implies that even if EMU is established with non-optimal members, it will still shift towards an optimal currency area through continued economic interaction, and the single monetary policy is more likely to be union wide appropriate over time.

This theory is known as endogeneity hypothesis of OCA. Frankel and Rose (1997) point out that, with the creation of the currency union and removal of trading barriers (such as removing custom and border controls, removing exchange rate uncertainty and transaction costs etc.), the correlation between movements of key business cycle variables (e.g. GDP, consumption, exports and imports etc.) will increase if intra-trades make up the majority of trading patterns or common demand shocks prevail. Their theory implies that the international trade pattern and international business cycle correlation are endogenous and based on the forward-looking model. The principal foundation of the endogeneity hypothesis is built upon on the Lucas critique (Lucas 1976) which states that a prediction based on historical data, especially highly aggregated data, would be invalid if the relationship between relevant variables could be altered by conducting economic policies. If the policy change alters the relationship between the variables, then the future relationship between the variables may not be fully represented by the historical relationship.

In summary, according to the pro-EMU theory (Frankel and Rose 1997, Frankel 1999, de Grauwe and Mongelli 2005), countries which have a close relationship of trading will have a high interdependence on one another’s national income. Thus, they may be able to consider forming a currency union according to the endogeneity hypothesis, and the correlation of business cycles should improve since it is closely related to trade integration between members. This implies
that the high level of intra-trade in Europe would enforce the synchronisation of business cycles, which eventually could lead Europe to become a common currency area.

Empirical works which focus on Europe tend to suggest the endogeneity hypothesis is pronounced for Europe. Artis and Zhang (1995) show that the increasing trade integration among European monetary system countries had shifted those member states towards a universal business cycle. Baxter and Koupartitas (2005) find that bilateral trade plays an important role here, since countries that have more trade with each other have more correlated business cycles. Fidrmuc (2004) confirms Frankel and Rose’s endogeneity hypothesis, though argue that, rather than increasing trade directly affecting the convergence, it depends more on increasing structural similarities of foreign trade.

Furthermore, some other studies have shown that the monetary integration of the single currency can lead to a significant improvement in the volume of trade among members, which provides the fundamental basis for the argument of the endogeneity hypothesis. Frankel and Rose (2000) and Glick and Rose (2002) report some extremely large positive effects of monetary integration on the trading relations among members of the common currency. The former claimed that, between two countries sharing the same currency, trade is three times bigger than if they traded with different currencies. Glick and Rose’s results are based on a much larger volume of data and reach similar conclusions, which is that a common currency can double the volume of trade between members.

In contrast to those studies that are pro endogeneity view of OCA theory, the counter-endogeneity view, which is represented by the specialisation hypothesis (Bayoumi and Eichengreen 1992 & 1996, Krugman 1993), argues that trade integration will enhance the specialisation of each country’s production since countries will tend to export more of those goods concerning which they have comparative advantages. This, in turn, will reduce income correlation and means
that if the country did not fully satisfy the OCA criteria before they joined the union, the trade integration may not help them move towards satisfaction of them ex post. Krugman (1993) applies data from North America to show that the increase in trade integration actually causes further increases in divergence rather than raising income correlation and economic convergence, as promised by Frankel’s theory. This result would suggest the creation of a currency union in North America could be costly.

Furthermore, another counterargument (Baxter and Stockman 1989, Bordo and Helbling 2003, Bergman 2004), which works in a similar fashion to Krugman’s specialisation hypothesis, points out that the monetary integration of EMU may not be able to enforce the correlation of business cycles. Their argument focuses on the costs of loss of exchange rate policy. For instance, under a fixed exchange rate regime, the central bank is required to maintain its peg on the objective currency. Or, if the economy joins the currency union, it will lose its monetary sovereignty. That, in turn, means that, during the asymmetric shocks, if the exchange rate is no longer available as a shock-absorbing mechanism, it can force all the adjustments to take place in the real economy rather than via the exchange rate.

The empirical studies of how the exchange rate may have impacts on the co-movements of growth dynamics among countries are mixed. Baxter and Stockman (1989) show no evidence of the positive relation between stability of exchange rate and business cycle synchronisation. Bordo and Helbling (2003) confirm that the correlation of GDP growth is not significantly dependent on the relative length of the year in which the exchange rate was pegged. Bergman (2004) provides direct empirical evidence to support the idea that the exchange rate may function as a shock-absorbing tool. He reports that the synchronisation of business cycles is positively related to the volatility of the exchange rate. However, other empirical studies finished with a different conclusion – the higher the volatility of the exchange rate, the lower the co-movement of cycles (Otto et al. 2001, Inklaar et al. 2008).
In the above section, we have reviewed both traditional and modern views of OCA theory. Although EMU does not fully meet the criteria set out by the traditional OCA theory, the modern view of the OCA theory – the endogeneity hypothesis – has provided a theoretical argument for creating EMU among non-optimal members/regions. This theory suggests that even in a currency union that is not satisfying the OCA criteria ex ante, trade integration among member states can improve the situation ex post. This implies that the improvements of synchronisation of business cycles, which are caused by intra-trade in the Eurozone, can eventually solve the ‘one size fits all’ issue. The trading pattern in the Eurozone does suggest that the key trading partner of each member is actually other fellow members of EMU. Therefore, this may reflect some possibilities of improvement in the convergence of members’ economies. However, as we also mentioned above, the anti-EMU argument also suggests the theoretical possibility of EMU remaining as a currency union with low levels of co-movement of overall economic activities across members. Hence, it is important to the policymaker to review the issue of synchronisation of business cycles in the Eurozone, in particular to understand whether there are a grounds for implementing a successful single monetary policy.

3.3 Literature review – measuring of synchronisation and previous empirical studies

The approach to measuring the business cycle synchronisation, at a broad level, can be categorised into two types. One is the correlation method, and the other is known as the shock accounting approach. In this subsection, we will review these two approaches and their empirical studies as well.
3.3.1 Correlation method

The correlation method is one of the most widely used approaches for investigating the convergence of business cycles. It evaluates the degrees of business cycle convergence by testing if the key output variables (e.g. GDP or industrial production (IP)) for the pair of objective countries are moving together in the same direction. The most commonly adopted approaches of the correlation method are: the dynamic correlation measure (Croux et al. 2001), the concordance index (Harding and Pagan 2002) and the phase-adjusted correlations method (Koopman and Azevedo 2003).

Croux et al. (2001) suggest the dynamic correlation measure of business cycle synchronisation, which is defined as the co-spectrum between two series over the product of the spectra of each series. The advantage of using this method is that researchers can estimate the extent of co-movement within a group of countries without selecting a base country as a reference. However, this method does perform differently between finite and infinite time series. The authors define their approach as tending to measure the fluctuations in the series over a certain time period, which they call a frequency band. In the case of infinite time series, within a certain time period the dynamic correlation between two objective series is equal to the regular correlation between two band-passed series. In contrast, if we have a time series, which is approaching finite, then the equality between correlation of two series and correlation of two band-passed series no longer holds. This means that when the dynamic correlation measure of Croux et al. (2001) deals with large time series, it tends to produce less accurate estimations. Based on the work of Croux et al. (2001), the business cycle coherence approach was developed by Hallett and Richter (2004). The characteristic of this approach is that the method will be less sensitive to the variation of time. That, in turn, allows the research to test the degree of correlation between two series for both the cases of single frequency and how this changes over time. However, statistically it is difficult to make the judgement about the importance of those changes (Hallett and Richter 2004).
Chapter 3 Business cycle synchronisation in the Eurozone

The second approach – the concordance index method, which is proposed by Harding and Pagan (2002) – uses a binary indicator variable of recessions and expansions to measure the co-movement between two series. They define the index as the percentage of the time when the two series are in the same phase of the business cycles. This actually means that although we are still estimating the co-movements of two series, this is a nonparametric method since we have to measure the business cycles by using the classical method first. Given this feature, the index may work more flexibly than parametric-type correlation analysis, because it is possible to artificially select the method of defining expansion and recession. However, since the index is based on the length of the cycles, a drawback of this nonparametric method is that it does not consider any other information except length of time.

The phase-adjusted correlation method proposed by Koopman and Azevedo (2003) is a model that estimates unobserved components that account for time varying between cycles and time varying phase difference. The first feature of this method is that the contemporaneous correlation can be separated into parts due to differences in the position of phase shift (the cycle of two countries) and a ‘phase-shift’-adjusted correlation. Second, they allow for time variation in both the phase shift and the phase-shift-adjusted correlation. Although this last innovation seems valuable, they can only implement their method by imposing a monotone time function. In other words, the correlation can either go up or down over the sample period. While this provides useful information, visual inspection of their cyclical component series suggests that periods of stronger and weaker correlation alternate.

The study by Fatás (1997), which uses employment growth as the measure of business cycles, concludes that during the period 1966–2002 the correlation of cycles of 12 EU countries was higher during the post-EMS period than the pre-EMS time. By using a large volume of OECD data on industrial production (IP), which runs from 1960 to 1995, Artis and Zhang (1999) conclude that the European business cycles became more similar after the creation of European
ERM. However, their result was not confirmed by a later study. Inklaar and de Haan (2001) use the same data source with a similar time period (1960 to 1997) as the paper by Artis and Zhang (1999), but, using only an HP filter to measure the cycles, they find that the European cycles are better correlated with Germany rather than both Germany and the USA as in the previous study. They also conclude that the correlation is higher from 1971 to 1979 than 1979 to 1987. Therefore, there is no evidence to prove that the business cycles became more synchronised after the establishment of the ERM in 1979.

A similar conclusion is drawn by Agresti and Mojon (2001) and Belo (2001). They use GDP as the measure of the cycles, and report that the countries of the euro area have a high and increasing correlation of cycles over time. Massmann and Mitchell (2004), who use monthly OECD IP data from 1960 to 2000, find that EMU business cycle convergence has been really mixed over the last four decades. According to the authors’ results, despite the mean correlation of EMU members being positive on average, they have switched between periods of convergence and divergence. Before the mid-1970s, the correlation was moving upwards with a peak level of almost 0.8 for most of the 12 EMU business cycles. Then the degrees of correlation of cycles gradually fell to zero until the mid-1980s, but the results are statistically insignificant. During the late 1980s and early 1990s, the correlation became more volatile. It began with a quick recovery that pushed the value of correlation almost back to its previous peak. However, a rapid fall followed afterwards in the early 1990s.

The studies that cover a short sample size (from the 1980s to the early 2000s), such as Altavilla (2004) and Darvas and Szapary (2004), have found the evidence to show that business cycle synchronisation was improved during the run-up period to EMU in the 1990s. But the latter do not only rely on the quarterly GDP; the authors also focus on the variables of components of GDP. Besides the estimation of correlation, Darvas and Szpary (2004) also analyse the volatility and persistence of the cycle. Their results suggest that the core EMU members France, Germany, Italy, the Netherlands, Austria and Belgium have a higher
degree of business cycle convergence than other members of the euro area. The countries that have the lowest level of correlation, especially in terms of expenditure of consumption and service, are Ireland, Finland and Portugal.

Among more recent literature, Camacho et al. (2008) evaluate the synchronisation of European countries with data covering the period from 1960 to 2004. These authors find evidence that is against the argument of a common business cycle, in terms of length, depth and shape, in either the EU or the euro area. This result reinforced the argument of de Haan et al. (2007), who present findings emphasising the difficulty of choosing an appropriate monetary policy stance given the actual differences in the business cycle features. In contrast, Enders et al. (2010) conclude that an increase in the correlation of output and some of its components has been found during a pre-Euro (1985–96) to Euro (1999–2007) period. They, however, do not focus on the divergence between core and peripheral Euro area countries.

3.3.2 Alternative measurement – shock accounting

The correlation methods for both parametric and nonparametric approaches that we have mentioned above do not consider the drive element of business cycles. Therefore, correlation methods are able to answer the question of whether the cycles become similar, but incapable of investigating the factors which may contribute to the convergence of business cycles. In comparison to the correlation method, the alternative approaches – shock accounting method, which are made up by Vector Autoregressive model and factor models, are used to answer the above two questions.

The simple review of the shock accounting approach can be seen from the general model which is described in Clark and Shin (2000) as:

$$e_{r,i,t} = a_t + b_{r,i} + c_{i,t} + u_{r,i,t}$$  \hspace{1cm} (3-1)
The model demonstrated that the shock $e$ in industry $i$ in region $r$ (or representing a country) depends on the common shock $a$, region/country-specific shock $b$, industry-$i$-specific shock $c$ and idiosyncratic shock $u$. The underlying assumption of this is that there is no correlation among various shocks, and an industry-specific shock at time $t$ is a shock to all countries but not in other industries. This identification assumption seems to be overly restricted; however, the authors argue that it in fact can provide a low-bound benchmark estimation, which can tell us the importance of industry- or country-specific shocks. Although this model is simplified to the general level where dynamics cannot be assessed, it is easy for us to see the key point of this type of approach (Clark and Shin 2000). Equation (3-1) only represents a simple version of the shock accounting approach. The relatively modern approaches, which are based in the same spirit, are used to overcome the limitations of correlation analysis of business cycle synchronisation. This more sophisticated approach, which can be employed in this chapter, is the dynamic factor model (DFM). The basic idea of this approach is that the common movement in a cross section of $n$ stationary time series can be captured by common factors, and unobservable variables can influence the evolution of all series (Breitung et al. 2005).

DFM has more advantages than the other type of shock accounting approach – the VAR method (Forni et al. 2000, Sybille 2012). First, factor models can cope with many variables without running into scarce degrees of freedom problems often faced in regression-based analyses. Exploiting a lot of information can lead to more precise forecasts and macroeconomic analyses. A second advantage of factor models is that idiosyncratic movements, which possibly include measurement error and local shocks, can be eliminated. This yields a more reliable signal for policymakers and prevents them from reacting to idiosyncratic movements. The final advantage is that factor models can remain agnostic about the structure of the economy. This means the analysis does not need to rely on tight assumptions, which is sometimes the case in structural models. For instance, the structural VAR model, which is also a common approach in this field, requires the researcher to take a stance on the variables to decide which one determines
the outcome, and where the number of variables determines the number of shocks. (More detailed discussion of DFM will be available in the methodology chapter.)

Beine et al. (2000), who apply a time series VAR model with 23 years’ monthly IP data of a group of EMU countries (Austria, Belgium, France, Germany and the Netherlands), find that common cyclical movements do not exist among these countries. That, in turn, implies these key members of EMU do not constitute an OCA area. The later work of Artis (2004) also reaches a conclusion that is not in favour of supports to EMU. In addition to this, by using GDP as the indicator of synchronisation, the results of this paper contradict his previous work (Artis and Zhang 1997 & 1999). The author discovered that actually, among European countries, many do not move along a similar phase of cycles; therefore, the European business cycle is rather an elusive phenomenon. However, Kaufman (2003) has a contradictory result to Beine et al. (2000). He also used the IP and points out that the European countries are a coherent group according to the cyclical movements.

Monfort et al. (2003) adopt the DFM with a selection of quarterly GDP for G7 countries over the 22-year period between 1970 and 2002. They point out that France, Germany and Italy form a coherent area distinct from the others. This result is in line with the paper of Lumsdaine and Prasad (2003), which uses a large volume of monthly IP data from 1963 to 1994, and states that for EMU countries the correlation with the European component is much stronger than the world component. Mansour (2003) estimates the annual GDP growth for 113 countries by using DFM, and shows that the European factor is generally weaker than the world factor. However, he also draws positive conclusions about EMU – that is, that the EU is the most integrated region compared to others. In contrast, Kose et al. (2003), who use variable of output and its key components (consumption and investment) over a similar time period as Lumsdaine and Prasad (2003), draw a different conclusion. The authors show that the common
European factors only have a minor impact on the fluctuations of European aggregates. This implies that there is no evidence of a European cycle.

Siedschlag and Tondl (2011) analyse the impact of trade integration and specialisation on the business cycle synchronisation in EMU. The result of this paper supports the optimistic view of the euro area. These authors show that the deeper trade integration with the euro area had a pronounced direct positive effect on the synchronisation of regional output growth within the euro area. Industrial specialisation, which is the result of monetary integration, was a source of cyclical divergence. However, it also had an indirect positive effect on regional output growth synchronisation via its positive effect on trade integration. Giannone et al. (2010) and Lehwald (2012) reach similar conclusions that emphasise that the business cycle has actually diverged between the core and periphery groups. The synchronisation of the main macroeconomic variables has increased in the core area of EMU since the creation of the union. In contrast, inside the periphery group the co-movements of key variables have declined during the post-EMU period. Lee (2012) also has unfavourable results on the euro area. His finding is that output and inflation among EMU members was moving towards synchronisation during the run-up period to the euro area. However, there is little evidence to show that EMU factor still prevailed after the operation of a single currency.

Overall, the evidence on business cycle synchronisation in the euro area is mixed and it partly depends on the periods defined and the benchmark that is used. However, most of the current evidence suggests that periods of greater and lesser synchronisation tend to alternate. Still, there is quite some evidence that, during the 1990s, business cycle synchronisation in the euro area increased.
3.4 Methodology of analysis – dynamic factor model

In the earlier section, we reviewed the prior literature on business cycle synchronisation in the Eurozone. The approaches to evaluating the co-movements of cycles can be distinguished as the correlation method and the shock accounting method. For this particular research, we are aiming to answer the question of how the business cycles of the original twelve EMU members have converged since the creation of the single currency union. Therefore, we need to measure the degrees of synchronisation by considering all twelve members’ data; thus, the co-movements of 12 time series of overall economic activities are studied. In this subsection, we will explain our chosen econometric approach before the presentation of our empirical results.

3.4.1 Dynamic factor model

For this particular research, we aim to investigate the synchronisation of the Eurozone business cycles. Moreover, understanding the potential cause of the synchronisation is another objective of this study. Since the Eurozone only has a relatively short history and data availability is rather unbalanced across different member countries, the problem of a low level of observations of business cycle variables may not be avoidable. The macroeconomic-related studies usually face the problem of data availability, especially in terms of numbers of observations. Since the post-war period, many series of variables have become available across the different fields of macroeconomics. However, regardless of the sizes of series, the numbers of observations of this macroeconomic series are relatively low. They are either in annual form, e.g. 20 to 40 years, or in a quarterly format that provides a relatively large data set. This fundamental issue of macroeconomic research may only be eliminated through the passage of time. In the short term, it still remains crucial to our work, especially when we need to study the dynamics of macroeconomic phenomena and policies.
In terms of methods of research, despite the correlation approach being one of the most widely used methods in this field (Artis and Zhang 1995, Belo 2001, Fidrmue and Korhonen 2003, Darvas and Szapáry 2005, Gayer 2007, Levasseur 2008, Kappler et al. 2008, Gouveia and Correia 2008, Gogas and Kothroulas 2009), it also suffers several drawbacks. First, the correlation coefficient must be estimated at a sub-period of the sample. This means different sub-periods could lead to very different estimates of the euro effect on business cycle synchronisation (Artis and Zhang 1997 & 1999, Inklaar and de Haan 2001). Second, it does not allow for a separation of idiosyncratic components and common co-movements. Third, it is basically a static analysis that fails to capture any dynamics in the co-movement. Furthermore, in addition to these important drawbacks of correlation approach, for this study we are trying to discover the business cycle synchronisation for the Eurozone as whole, rather than looking at a bivariate correlation of a pair of countries. In order to overcome the problem of relatively short data sets of the Eurozone countries, and conduct an analysis for the entire EMU, we can adopt the dynamic factor model (DFM) approach to conducting this analysis.

Furthermore, since the late 1980s, in comparison to the early definitions of business cycles e.g. the classical cycle of NBER and the growth cycle of OECD, the views on this topic have been further developed into a much wider international context which considers economic interactions among different countries. Attention has been focused on the feature of business cycles that was originally proposed by Burns and Wesley (1946). The authors state this feature to be the co-movement of individual economic series and different behaviour of economies during their expansion and contractions. This theoretical concept of business cycles can be captured by using DFM, which enables us to obtain the common factor from a set of many macroeconomic series. That can eventually be used to assess the dynamics of economic activities among different countries, which are the indictors of synchronisation of business cycles.
Generally, DFM has some advantages over other methods in various respects (Forni et al. 2000, Lehwald 2012). First, factor models can cope with many variables without running into the scarce degrees of freedom problems often faced in regression-based analyses. Exploiting a lot of information can lead to more precise forecasts and macroeconomic analyses. For example, in comparison to the VAR method, VAR approach attempts to capture the co-movements among different series requires adequate degrees of freedom, which sometimes can be difficult to have as the available length of the macroeconomic data. This is particularly relevant to the case of EMU given that it only has a relatively short data set of one decade. A second advantage of factor models is that idiosyncratic movements, which possibly include measurement error and local shocks, can be eliminated. This yields a more reliable signal for policymakers and prevents them from reacting to idiosyncratic movements. The final advantage is that the factor model can remain agnostic about the structure of the economy. This means the analysis does not need to rely on tight assumptions, which is sometimes the case in structural models.

The basic idea of this approach is that the high dimensional vector of time series $Y_t$ is driven by the latent dynamic unobserved factors $f_t$ and vector of mean zero idiosyncratic disturbances $e_t$, which is assumed to be uncorrelated with the factor innovations (Breitung et al. 2005, Stock 2010). The simple DFM model can be written as:

$$
Y_t = \lambda(L) f_t + e_t \\
\lambda(L) = \Psi(L) f_{t-1} + \eta_t
$$

where, $Y_t$ and $e_t$ represent an N series which is N×1 vector; there are M dynamic factors $f_t$ and error terms $\eta_t$. $L$ represents the lag operator, and the lag polynomial $\lambda(L)$ and $\Psi(L)$ are vectors of N×M and M×M respectively. The term $\lambda(L) f_t$ represents the common component of $Y_t$, where each individual $\lambda(L)$ is the dynamic factor loading $\lambda_i(L)$ for the $i^{th}$ series $Y_{i,t}$.
There are two main approaches of DFM: the linear space model and the generalised dynamic factor model. These are usually also known as parametric (first generation) and nonparametric (second generation) models of DFM (Stock 2010). The former, through the linear state space model, uses the Kalman filter to compute the Gaussian likelihood, and the parameters are estimated by maximum likelihood, then the Kalman filter is used to obtain efficient estimates of the factors (Stock and Watson 1989, Sargent 1989, Quah and Sargent 1993). This approach provides optimal estimates of the latent factors. However, the main drawback is that this model is usually only capable of handling relatively small numbers of parameters and series. The second generation (Forni and Reichlin 1998) of estimators entailed nonparametric estimation with large $N$ using cross-sectional averaging methods, primarily through principal components methods. The key result in this approach is that the principal components estimator of the space spanned by the factors is consistent. Moreover, if $N$ is sufficiently large, the factors are estimated precisely enough to be treated as data in subsequent regressions. The main disadvantage of this approach is that this model necessitates a very large number of cross sections of idiosyncratic components in order to be valid.

For empirical studies, there is no evidence of which approach is superior to another. The principle for selecting the appropriate approach should follow the features of these two methods and the available data sets; in other word, the size of cross sections that is going to be considered by research. The nonparametric method of DFM is the common choice among the recent studies on the synchronisation of Eurozone business cycles (Giannone et al. 2010, Siedschlag and Tondl 2011, Lehwald 2012, Lee 2012). However, these authors have not given any justifications for not selecting the first generation of DFM. Similar studies which focus on the G7 and East Asia area (Monfort et al. 2003, Moneta and Rüffer 2009) adopt the parametric method, and have shown evidence of the capability of parametric methods in research which focuses on dozens of countries. The consideration of which type of DFM should be employed for a particular study needs to take the numbers of variables of the
analysis into account. Obviously, if the research contains large numbers of series, then the second generation of DFM has to be adopted, as the first generation cannot cope with such problems due to computational issues. However, if only limited numbers of variables will be used, then the first generation of DFM should not be automatically rejected by researchers.

Moreover, parametric-based DFM also contains the following advantages. First, the method can handle data sets which include mixed frequencies or missing data. Second, when the analysis has a flexible range of specification e.g. non-stationary DFM and idiosyncratic noise with strong cross-correlation, the parametric DFM approach can be more efficient than the principal-components-method-based second-generation DFM method. In contrast, second-generation DFM is more appropriate when the model contains large numbers of series. However, the performance of principal-components-based DFM will deteriorate if there is heteroscedasticity or the idiosyncratic noises have strong serial correlation (Stock and Waston 2002). Moreover, it can be inefficient when the explanatory power of the factors does not strongly dominate the explanatory power of the idiosyncratic noise (Onatski 2012).

Another advantage of the parametric model is that the parametric state space formulation can handle data irregularities (Harvey 1989). For example, if some series are observed weekly and some are observed monthly, the latent process for the factors in DFM can be formulated as evolving on a weekly time scale. But the dimension of the measurement equation depends on which series are actually observed. That is, the row dimension of matrix for common factors’ coefficients (matrix B in Equation (3-5)) would change depending on the variables actually observed at the given date. Moreover, since this is a fairly flexible model, the second advantage is that the model can be used to distinguish between common factor for the entire area of research and cross-country spill-over effects, which may also contribute to synchronisation of cycles (Monfort et al. 2003, Moneta and Rüffer 2009).
Thus, in this chapter, we will follow the methods of Monfort et al. (2003) and Moneta and Rüffer (2009) and employ the first-generation approach of DFM for our analysis. Let’s start with the simple static factor model, which can be written as:

\[ Y_t = BF_t + \xi_t \]  

(3-3)

where the common movement in a cross section of \( n \) stationary series \( Y_t \) can be captured by \( k \) common unobservable factors; \( B \) is an \( n \times k \) matrix of loading coefficients; \( F_t \) is a \( k \times 1 \) vector of factors; and \( \xi_t \) is an \( n \)-dimensional stationary process. This is also called strict factor model, where \( \xi_t \) is assumed to be uncorrelated. The main drawback of this model is that it does not allow the existence of dynamic relations between factors and other variables. Therefore, we may introduce the element of dynamics into Equation (3-3) to transfer the static model to DFM:

\[ Y_t = B(L)F_t + \xi_t \]  

(3-4)

\[ B(L)F_t = \sum_{i=1}^{\infty} B_i F_{t-i} \]

Since we are following Monfort et al. (2003) and Moneta and Rüffer (2009) by adopting the linear state space model for DFM approach, the model can therefore be written as:

\[ Y_t = AY_{t-1} + BF_t + \varepsilon_t \]  

(3-5)

\[ F_t = CF_{t-1} + \eta_t \]

and the variance–covariance matrix of the error term \( \varepsilon \) is assumed to be diagonal:

\[
V[\varepsilon] = \begin{bmatrix}
\sigma_1^2 & 0 \\
0 & \ddots \\
0 & \ddots & \sigma_n^2
\end{bmatrix}
\]
This model assumes that the cross section of n stationary series \( Y_t \), depends on the country-specific autoregressive component of order one; there are \( k \) unobservable factors \( F_t \), which are common to all series; and the \( \varepsilon_t \) and \( \eta_t \) are independent Gaussian white noise terms. The matrix \( B \) is factor loadings, which measures the impact of common factors on each series of \( Y_t \). Matrix \( A \) is assumed to be diagonal, therefore capturing the core notion of the DFM that the co-movements of the multiple time series arise from \( F \). For the second equation of the state space model, the \( C \) matrix is also set to be diagonal, which ensures the dynamics of the unobservable factors \( f \) are univariate.

In the linear state space model, each matrix and error term is a function of a finite dimensional unknown vector of parameters and the past value of vector of parameters and the past value of \( Y_t \); thus the model is parametric and can be estimated by the Kalman filter (Harvey 2008). The Kalman filter provides at each step \( k \) the likelihood function for \( k+1 \) conditional on information given at \( k \). Therefore, the log-likelihood function for the entire sample can be constructed as a by-product of the Kalman filtering (Monfort et al. 2003). Furthermore, as the numbers of time series and observations are relatively small compared with microeconomic and large-scale macroeconomic studies, the maximum likelihood approach used in the parametric type of DFM does not run into computational problems.

Moreover, given the flexibility of this model, which contains a restricted vector autoregressive equation, spill-over effects among Eurozone members is possibility to be identified by modifying the restrictions on the VAR part of the DFM model. This can be done by relaxing the restrictions that we have posed on matrix \( A \) in Equation (3-5). Initially, matrix \( A \) is assumed to be diagonal; if we let \( A \) become non-diagonal, the model would become a mixture of a first-order VAR and a dynamic factor model. The part of any idiosyncratic shock which causes spill-over effects will no longer be categorised as a common shock but will, rather, be captured by the off-diagonal elements of the \( A \) matrix.
3.4.2 Variables for measuring overall economic activities

In this research, we are trying to identify the convergence of the business cycle among EMU members; in other words, the co-movements of overall macroeconomic aggregates will be studied. For measuring overall economic activities, the most widely and commonly used variables for measuring synchronisation of business cycles are GDP and industrial production (Monfort et al. 2003, Moneta and Rüffer 2009, Giannone et al. 2010, Siedschlag and Tondl 2011, Lehwald 2012, Lee 2012). The GDP is usually collected on a quarterly basis and it is common to include the components of GDP in data, such as consumption, investment, or exports. For measuring the synchronisation of cycles, there is no consensus view on which particular variable is absolutely superior to others. Therefore, it is necessary to focus on the broadest possible variables of output. Given that the aim of this chapter is to establish the understanding of overall co-movements of aggregate economic activities among member countries of EMU, we will follow previous works and use real GDP and industrial production for this analysis. Furthermore, since the output variables are commonly available on an annual or quarterly basis, the monthly industrial production data can also be included as an alternative high frequency/observation measurement of cycles.

For this research, we aim to investigate the synchronisation of business cycles for the Eurozone members after the establishment of EMU. Since the newer members of the Eurozone all joined EMU recently, we will only concentrate on the original 12 members of the Eurozone (Euro12), which are Austria, Belgium, France, Finland, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal and Spain. Overall economic activity for the Euro12 countries is measured in quarterly real GDP growth rate, which is provided by the Main Economic Indicators from OECD. The data period for real GDP growth is from 1985:Q1–2012:Q2. Quarterly data on consumption, investment and exports is collected from Eurostat, covering the periods 2000:Q1–2011:Q1, 2000:Q1–2011:Q1 and 1999:Q1–2012:Q2 respectively. Consumption is measured in
millions of euros at constant price; gross fixed capital formation is used to represent investment, which is also measured in millions of euros with constant price. Both consumption and investment data are log-differenced to render the data stationary. Data on exports is measured in the real rate of growth. Monthly real industrial production (IP) growth rates for the period 1980:m1 to 2012:m2 are collected from OECD Key Short Term Economic Indicators.

3.5 Empirical results – synchronisation of Eurozone business cycles

In this section, we will present the results from dynamic factor model (DFM) analysis to evaluate to what extent the individual aggregate economic activities of each member can be explained by the common factors of the whole union, and hence to investigate the degree of synchronisation of the Eurozone original 12 members’ (Euro12) business cycles. The initial step of the analysis in this chapter is to estimate the common factor for Euro12’s real GDP growth by using the DFM that is specified in Equation (3-5). The specification for this model is that the matrix $A$ in Equation (3-5) is set to be diagonal, and there is one common factor, which can be used to capture the co-movements of Euro12 members’ business cycles. This setting of the model restricts each country’s real GDP growth at time $t$ only depending on its own previous lag. The co-movement of real GDP growth fluctuations among Euro12 members, which may be the result of common shocks or spill-over effects between members, are captured by the common factor $F$. Hence, although the model does not directly measure the interlinkage among members’ economic activities, we do assume that spill-over effects exist in the union.
3.5.1 Co-movement and common factor analysis for Euro12 members’ business cycles – a comparison between pre- and post-EMU periods

3.5.1.1 Preliminary estimation

By using the DFM method, we have obtained initial estimates of the parameters for Equation (3-5) by using real GDP growth for all Euro12 members in the period 1985:Q1–1998:Q4. The estimation of this time period helps us establish a comparison benchmark, which can later be used for comparison with the results for EMU Stage Three period, to see whether there is any evidence of improvements of business synchronisation inside the Eurozone. In Table 3-1 we present results for the parameters estimation of DFM. The coefficients for idiosyncratic autoregressive $\alpha_i$ are significant for most of the series except France, Portugal and Spain. Furthermore, the factor loading $\beta_i$ for the Euro12 common factor is statistically significant for most members besides Luxembourg. This indicates that the dynamics of economic growth among most Euro12 members depend on both of their own autoregressive elements and the Euro12 common factors.

<table>
<thead>
<tr>
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<tr>
<td>$\alpha$</td>
</tr>
<tr>
<td>Austria 0.814</td>
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<tr>
<td>(0.000)</td>
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<tr>
<td>Belgium 0.648</td>
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<tr>
<td>(0.000)</td>
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<tr>
<td>Finland 0.895</td>
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<tr>
<td>(0.000)</td>
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<tr>
<td>France 0.820</td>
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<tr>
<td>(0.695)</td>
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<tr>
<td>Germany 0.804</td>
</tr>
<tr>
<td>(0.000)</td>
</tr>
<tr>
<td>Greece 0.290</td>
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<tr>
<td>(0.025)</td>
</tr>
<tr>
<td>$c$</td>
</tr>
<tr>
<td>(0.000)</td>
</tr>
</tbody>
</table>

$Y_{1,t} = \alpha_i Y_{1,t-1} + \beta_i F_t + \varepsilon_t$

$$F_t = c F_{t-1} + \eta_t$$

Note: numbers in brackets are the $p$-values
Figure 3-1  Common factor for Euro12 real GDP growth (1985:Q1–1998:Q4)

The common factor for Euro12, which can capture the co-movements of all series in this data set, can be used to identify the dynamic of economic growth for Euro12 as a whole by plotting them against the time variable. In Figure 3-1 we can identify a clear economic downturn during the early 1990s. This common recession was triggered by the rise in oil prices caused by the first Gulf War, and rising real interest rates in Europe due to the reunification of Germany as the Bundesbank responded to the expansionary fiscal policy in Germany by increasing its interest rate. Furthermore, during autumn 1992 and summer 1993 the recession culminated in Europe as the result of the ERM crisis (Jonung and Hagberg 2005).

In order to carry out the comparison of results both pre- and post-EMU, we keep the same settings of DFM and run the estimation again for the period 1999:Q1–2012:Q2. In Table 3-2 we present the estimation of parameters for the model by looking into the post-EMU period. Except for France, the dynamic of growth for all members of Euro12 can be explained by their own autoregressive
element at the 10% significance level. The coefficients for each country’s factor loading are significant, except for Greece. The interesting part of Table 3-2 is that besides Portugal and Spain the values of factor loading $\beta_i$ are generally much higher than the values in Table 3-1. Although the factor loading dropped for Portugal and Spain, the fall in value is small. Moreover, the coefficient of factor loading for Greece is statistically insignificant. This result may provide initial evidence to suggest that for Euro12 the synchronisation of cycles may be improved during Stage Three of EMU. However, before making any conclusion, we need to do a few more tests by using the results which are obtained through DFM analysis. Again, by plotting the common factors for the post-EMU period (see Figure 3-2), we can clearly identify a significant drop in the dynamic of growth since the 2007, which reflects the recent late-2000s global financial crisis. And there is another minor decline in the level of economic growth for Euro12 during the beginning of Stage Three of EMU, which may reflect the bursting of the IT bubble in the early 2000s.

<table>
<thead>
<tr>
<th>Country</th>
<th>$\alpha$</th>
<th>$\beta$</th>
<th>Country</th>
<th>$\alpha$</th>
<th>$\beta$</th>
</tr>
</thead>
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</tr>
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</table>

$Y_{it} = \alpha_iY_{i,t-1} + \beta_iF_t + \varepsilon_t$

$F_t = cF_{t-1} + \eta_t$

Note: numbers in brackets are the $p$-values.
Figure 3-2 Common factors for Euro12 real GDP growth (1999:Q1–2012:Q2)

Source: produced by the author
### Table 3-3 Cross-country correlation (1985:Q1–1998:Q4)

<table>
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<th>Belgium</th>
<th>Finland</th>
<th>France</th>
<th>Germany</th>
<th>Greece</th>
<th>Ireland</th>
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Source: produced by the author
Table 3-4 Cross-country correlation (1999:Q1–2012:Q2)

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Source: produced by the author
First, we run a simple cross-country correlation test to generate a brief overview of the co-movement among real GDP growth for each member of Euro12, and the correlation between common factor of Euro12 and individual countries’ economic activities. From Table 3-3 and Table 3-4, we can see that the cross-country correlations regarding real GDP growth and common factor have generally increased across Euro12 members since the establishment of EMU. In Table 3-5, we can see the average value of cross-country correlation of real GDP growth has improved significantly for each individual member. The lowest degree of improvement is Portugal, but it has increased by 34 per cent compared with the post-EMU period. The average correlations for most Euro12 countries are between sixties and seventies. Nevertheless, for Greece, despite the average cross-country correlations being improved by 41 per cent, the average correlation for the post-EMU period is only 0.400. This is even lower than some countries’ figures for the pre-EMU period e.g. Austria, Belgium, France, Italy etc.

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<th>improves</th>
</tr>
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Note: average values are calculated from Tables 3-3 and 3-4

Moreover, since the co-movement of economic activities among Euro12 members has improved over the last 12 years, this may indicate that the correlation between individual countries’ growth dynamics and common factor,
which capture the co-movement of fluctuations of all Euro12 countries’ real GDP growth, should also be expected to increase. This can also be seen from Table 3-3 and Table 3-4. The average value for correlation between Euro12 countries and common factors has increased from 0.589 to 0.777. And, not surprisingly, as the cross-country correlations for real GDP growth are low in both the pre- and post-EMU periods for Greece, the correlation for Greek economic activities and Euro12 common factors only improved by 0.054 points.

The results of the correlation analysis show that the co-movements of the Euro12 countries’ economic activities have improved over the last 12 years. Moreover, the correlation between the common factor and individual members’ growth dynamics has also increased between the pre- and post-EMU periods. However, this only suggests that, for most Euro12 members, their trends of economic growth are generally converging to the trend of Euro12. It could be the case that the volatilities of common trend and individual trends are still insufficiently matching with each other. Therefore, even when an EMU member is on a similar trend as the Eurozone, because of the degree of fluctuations between individual and common trends, we still cannot conclude that the synchronisation of business cycles has sufficiently improved for the Eurozone to conduct a union-wide economic policy. This may be especially important to the policymakers. Policy designed for the union as a whole, e.g. monetary policy, can be too radical for some countries, and may lead to increases in the local price level. However, simultaneously it could insufficient for others, as the decline in their national output is far greater than the union trend. Therefore, the correlation analysis may only provide some preliminary results for testing the degree of business cycle synchronisation in the Eurozone.

Since it is necessary to go beyond correlation analysis, therefore, in order to investigate the question of to what extent EMU members’ national cycles converge with the common trend for Eurozone, first we can plot the common factor and national real GDP growth in a diagram. This graphic analysis will be repeated twice for both the pre- and post-EMU periods. Then, we can visually
check the trends of each pair, to see whether, besides sharing the same direction of movements, the degree of their volatilities is also similar between Euro12 common trend and national growth dynamics. This would allow us to quickly obtain some basic insights into synchronisation of business cycles.

Figure 3-3 Euro12 common factors vs individual members’ real GDP growth – pre- and post-EMU periods

Austria

Belgium

Finland
Chapter 3 Business cycle synchronisation in the Eurozone

France

Pre-EMU

Post-EMU

Germany

Pre-EMU

Post-EMU

Greece

Pre-EMU

Post-EMU
Chapter 3 Business cycle synchronisation in the Eurozone

Ireland

Pre-EMU

Post-EMU

Italy

Pre-EMU

Post-EMU

Luxembourg

Pre-EMU

Post-EMU
From Figure 3-3, the results provide mixed pictures of business cycle synchronisation in EMU at the overall level. Generally, we could arrange Euro12 members into three groups. In the first group, since the creation of the Eurozone, the trend of movement of individual countries’ real GDP growth and trend of common factor have become similar and fluctuations of these two lines are also
in a narrow range. These countries are Austria, Belgium, France, Germany, Italy, the Netherlands and Spain. The common feature of these countries is that the national trends and common trends were already sharing similar paths. However, for each country, the volatilities of these two trends were quite different. The second group is made up of Ireland and Luxembourg. The similarity and volatility of trends for the second group were poor during the pre-EMU period. Since the establishment of the Eurozone, the similarity of trends has improved, but volatility of national trends still remains high relative to the trend of Euro12 common factor. In the third group, formed by Finland and Portugal, the national trends are such that they seem to be more synchronised during the pre-EMU period than the post-EMU period. Finally, Greece forms the final group for Euro12 members: no improvements in business cycle convergence are revealed by comparing its national growth dynamics with the Euro12 common factors that capture the co-movements of Euro12 members’ overall economic activities.

During both the pre- and post-EMU periods, graphically there is no evidence to suggest co-movement between national growth dynamics and Euro12 common trends. This is also reflected by the results in Table 3-3 and Table 3-4, which show that there is only a minor improvement in the level of correlations for Greece for both cross-country real GDP growth and correlation with common trend. Another interesting finding from the above figure is Portugal. Both correlation and graphic analysis show that it is unlike most other Euro12 countries, which had improved in the similarity and volatility between trends. However, the co-movements between Portugal’s business cycle and the Euro12 common trend actually declined after its entry to the Eurozone. For the case of Greece and Portugal, the results may indicate that for a subsection of the Eurozone, the membership of a common currency area has not improved the synchronisation of members’ business cycles. Instead, it may lead to decline of the degree of co-movements between national growth dynamics and union common trend.
3.5.1.2 Shock analysis – variance decomposition

Two tests were conducted to evaluate the extent of cycle synchronisation across the Euro12 area. First, we estimated the common factors of the Euro12 members for both the pre- and post-EMU periods, which successfully identified economic downturns that occurred over the last three decades. Then a correlation test was conducted to see the similarity between national trends and common trend of Euro12. This analysis suggests that, for most series, the national growth trends have become similar to common trends since the creation of the Eurozone. However, it does not provide evidence for the degree of synchronisation in respect of the volatilities of individual and common trends. In other words, besides knowing trends are moving at a similar direction to Euro12 trend, we also need to understand the degree of dynamics between them. Therefore, we take a step further to check the volatilities of trends by using graphic analysis. This quick investigation shows that the degrees of business cycle synchronisation among members are at different levels. Moreover, as Greece and Portugal did not show evidence of cycle convergence, the results are mixed for Euro12 as a whole.

Since, we have visually identified the level of business cycle synchronisation, we can therefore take a further step, that of using variance decomposition to interpret the results of the above graphic test numerically. Furthermore, from a theoretical point of view, this method is better than correlation test. We can use variance decomposition to identify the dynamic response of national growth trends to the shocks of the common factor. Thus to understand to what extent the common factor, which captures the co-movement of all Euro12 members’ growth dynamics and reflect the common trend of economic activities for the entire area, can contribute to the fluctuations of individual members’ economic aggregates.
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<th>Steps</th>
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Chapter 3 Business cycle synchronisation in the Eurozone

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| **Italy**              | Steps   |          |         |          |
| 2                      | 0.0003  | 0.0191   |         |          |
| 3                      | 0.0009  | 0.0422   |         |          |
| 4                      | 0.0016  | 0.0625   |         |          |
| 5                      | 0.0024  | 0.0784   |         |          |
| 6                      | 0.0030  | 0.0898   |         |          |
| 7                      | 0.0036  | 0.0970   |         |          |
| 8                      | 0.0041  | 0.1009   |         |          |
| **Average**            | 0.0023  | 0.0700   |         |          |

| **Luxembourg**         | Steps   |          |         |          |
| 2                      | 0.0051  | 0.00002  |         |          |
| 3                      | 0.0154  | 0.00004  |         |          |
| 4                      | 0.029   | 0.00006  |         |          |
| 5                      | 0.0439  | 0.00007  |         |          |
| 6                      | 0.0589  | 0.00008  |         |          |
| 7                      | 0.073   | 0.00009  |         |          |
| 8                      | 0.0857  | 0.00009  |         |          |
| **Average**            | 0.0444  | 0.00006  |         |          |

| **Netherlands**        | Steps   |          |         |          |
| 2                      | 0.0031  | 0.0196   |         |          |
| 3                      | 0.0080  | 0.0140   |         |          |
| 4                      | 0.0132  | 0.0682   |         |          |
| 5                      | 0.0178  | 0.0873   |         |          |
| 6                      | 0.0216  | 0.1020   |         |          |
| 7                      | 0.0247  | 0.1128   |         |          |
| 8                      | 0.0270  | 0.1202   |         |          |
| **Average**            | 0.0164  | 0.0749   |         |          |

| **Portugal**           | Steps   |          |         |          |
| 2                      | 0.0041  | 0.0011   |         |          |
| 3                      | 0.0075  | 0.0028   |         |          |
| 4                      | 0.0098  | 0.0046   |         |          |
| 5                      | 0.0113  | 0.0063   |         |          |
| 6                      | 0.0123  | 0.0078   |         |          |
| 7                      | 0.0130  | 0.0089   |         |          |
| 8                      | 0.0135  | 0.0098   |         |          |
| **Average**            | 0.0102  | 0.0059   |         |          |

| **Spain**              | Steps   |          |         |          |
| 2                      | 0.0028  | 0.0285   |         |          |
| 3                      | 0.0056  | 0.0744   |         |          |
| 4                      | 0.0077  | 0.1237   |         |          |
| 5                      | 0.0092  | 0.1699   |         |          |
| 6                      | 0.0102  | 0.2104   |         |          |
| 7                      | 0.0111  | 0.2450   |         |          |
| 8                      | 0.0115  | 0.2740   |         |          |
| **Average**            | 0.0082  | 0.1608   |         |          |

Note: the results with underlines indicate that the coefficients in matrix B for the impact of common factors on real GDP growth ($Y_{i,t} = \alpha_i Y_{t-1} + \beta_i F_t + \epsilon_{it}$) are statistically insignificant at the 5% level.

The results of variance decomposition are presented in Table 3-6 for each country; we estimate the variance decomposition of real GDP growth accounted for by the shock of Euro12 common factors. The method of estimation is using the time series vector autoregression method to obtain the variance decomposition of the impact of common factor on each country’s real GDP growth rate. This enables us to see, with one unit change in national growth
dynamics, how the common factor will contribute to such changes at each step/quarter. The initial step (first quarter) is not reported given that the lag length equals one, which indicates that at the first quarter the only variable having an impact on real GDP growth is itself. Hence, we have reported the variance decomposition for seven steps (from the second period to the eighth period after the initial shock) in Table 3-6. The variance decomposition will be calculated for both the pre- and post-EMU periods, in order to draw comparisons between the two periods and remain consistent with previous graphic analysis.

From the previous graphic analysis in Figure 3-3, we have seen that, even for those countries that have trends relatively similar to the co-movements of Euro12 as a whole, the volatility of national trends was much different from the common trend according to the graphic comparison. We can represent this by looking at the values of decomposition of each country at the pre-EMU period. The average variance decomposition for each country is generally very low for countries like Belgium, Finland, Greece, Ireland, Luxembourg, the Netherlands and Spain. For most of them, the average impact of common factor shock on national real GDP growth is only around 0.05. Austria and Finland have the highest response level: above 0.05 for each of them.

However, for Austria, as with some of the other countries, e.g. Germany, Greece, Ireland and Luxembourg, the coefficient that represents the responsiveness of national real GDP growth to a common factor shock is statistically insignificant. Remaining members have statistically significant results for the coefficients in matrix B (i.e. for the impact of common factor on real GDP growth \((Y_{i,t} = \alpha_i Y_{t-1} + \beta_i F_t + \epsilon_{it})\) are statistically significant at 5% level, which implies there is an established relation between national real GDP growth and Euro12 common trends during the pre-EMU period. However, given the very low variance decomposition value, for each unit change of real GDP growth only a very small proportion of these changes can be explained by common Euro12 factor. These reflect the graphic analysis in Figure 3-3 which implies low
convergence between national growth dynamics and overall co-movements among the initial 12 EMU members during the pre-EMU period.

Although the business cycle synchronisation among members in Euro12 countries was low during the pre-EMU period, according to the endogeneity hypothesis of OCA developed by Frankel and Rose (1997), the monetary and economic integration in a common currency area should improve the co-movements of members’ business cycles. This pro-EMU argument, at least for some members, is proven by the results for the post-EMU period in Figure 3-3 and Table 3-6. In Figure 3-3, we have seen that, besides Finland, Greece, Ireland, Luxembourg, and Portugal, the remaining members of Euro12 had some significant improvements in the degree of business synchronisation. Trends of national economic growth, and, more importantly, the volatilities among national trends and common factor, are all improved.

In Table 3-6, the estimation of variance decomposition for Austria, Belgium, France, Germany, Italy, the Netherlands and Spain shows that the trends of their national GDP growths are more closely related to the common factor than in the pre-EMU period. The size of the impacts is much bigger than the value for the pre-EMU period, and more importantly the coefficients for representing the responsiveness of national economic growth to a common factor shock are all statistically significant for these seven countries at the 5% level. Spain has the highest value of variance decomposition, which is 0.1608. This indicates that one unit change in the rate of real GDP growth in Spain, 16.08% of the change in real GDP growth, can be explained by the Euro12 common factor. This is much higher than its value for the pre-EMU period, which is only 0.0082.

Among Ireland, Luxembourg, Greece and Portugal, which are the countries identified as having poor business cycle convergence among Euro12 members, Ireland and Luxembourg had only very minor improvements since they joined the Eurozone. The values of variance decomposition are improved by comparing them with their own previous performance; however, they are still very low in
relation to those countries which have high degrees of synchronisation. For instance, the average variance decomposition for Ireland only improved from 0.001 to 0.0095; the value of Luxembourg’s increased from 0.0444 (statistically insignificant) to only 0.00006. These values are much lower than the other ‘good performance’ countries, and while it can be seen from the graphic analysis in Figure 3-3 that these two countries’ business cycles appear to be relatively converged with Euro12 co-movements, still the degrees of improvements are very minor and poorer than the others.

For Greece, there has been no improvement that can be discovered by either graphic or variance decomposition analysis. The results of variance decomposition for both periods are statistically insignificant, which reflects the outcomes from Figure 3-3’s graphic analysis as the volatility of Greek real GDP growth is high in relation to Euro12 co-movements. Finally, for Finland and Portugal, the values of variance decomposition confirm that the level of cycle convergence for these two countries has declined rather than improved since the creation of EMU. Membership of EMU is assumed by the endogeneity hypothesis of OCA to be able to promote business cycle synchronisation among member states through intra-Eurozone trade, but this appears not to be the universal case within the euro area.

3.5.2 Explanatory analysis: what drives the synchronisation of Euro12 business cycles?

In the previous subsection, we use the dynamic factor model to estimate the common factors of Euro12 members’ co-movements of national business cycles. The results show that national trends are moving closer to the common trends of Euro12 for most countries. However, the degree of synchronisation, which is in respect of volatilities of national and common trends, remains different inside EMU. Some countries had significant improvements in the convergence of cycles; however, this is not a case for the other members. Synchronisation of business cycles can provide an ideal basis for conducting a successful union-
level monetary policy. Thus, the enhancement of convergence of members’ growth dynamics is crucial to the task of solving the ‘one size fits all’ issue in the Eurozone. For policymakers, it is important to have a better understanding of the aggregate economic factors that drive the synchronisation of cycles.

In order to answer this question, in this subsection we will analyse the main components of national output by using DFM in Equation (3-5). By estimating the common factors of the main components of GDP, we are aiming to evaluate the co-movements of these components, to see which common factor or factors are closely related to each member of Euro12, and therefore to identify the main driving factor in the synchronisation of EMU’s growth dynamic, and in the case of each country. The main components of aggregate economic activities are: final consumption expenditure, investment expenditure and exports.

3.5.2.1 Consumption expenditure

With the economic integration and removal of trade barriers among European Union member countries, the free movement of goods and services may indicate that the members’ own consumption expenditure is not necessarily constrained by their own domestically produced goods and services. In Table 3-7 we present the estimation of parameters of DFM for consumption expenditures. The coefficient $\beta$ is statistically significant for all countries; however, the values of $\beta$s are very low for all countries in Euro12. This may suggest that the common factor of Euro12 consumption expenditure has no pronounced effects on the consumption dynamics at national level. The correlation between consumption dynamics at national level and the common factor of Euro12 consumption is provided in Table 3-8. The results of correlation are extremely low, which suggests that the fluctuations of national consumption expenditure are not on a similar path to that of the common trends of Euro12.
Table 3-7 Parameter estimation for DFM – Euro12 members’ consumption expenditure (2000:Q1–2011:Q1)

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\[ Y_{it} = \alpha_i Y_{i,t-1} + \beta_i F_t + \epsilon_{it} \]
\[ F_t = cF_{t-1} + \eta_t \]

Note: numbers in brackets are the p-values

Table 3-8 Correlation between consumption expenditure and common factor of Euro12 consumption (2000:Q1–2011:Q1)

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<td>Netherlands</td>
</tr>
<tr>
<td>Portugal</td>
</tr>
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<td>Spain</td>
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</table>

Source: results are produced by the author
### Table 3-9 Variance decomposition of consumption accounted for common consumption factors (2000:Q1–2011:Q1)

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<th>Steps</th>
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Figures of variance decomposition for each country’s consumption expenditure, which is accounted for the impact of common factor of Euro12, are presented in Table 3-9. As expected, Spain, Ireland and Finland, and all other members of Euro12, have low levels of variance decomposition, commonly below 0.1, or have statistically insignificant coefficients in matrix $\beta$. This

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Note: the results with underlines indicate that the coefficients in matrix $B$ for the impact of common factors on real GDP growth ($Y_{i,t} = \alpha_iY_{i,t-1} + \beta_iF_{i,t} + \varepsilon_{it}$) are statistically insignificant at the 5% level. Results for Germany, Greece, the Netherlands and Portugal are statistically significant at the 10% level.

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<td>8</td>
<td>0.0462</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average</td>
<td></td>
<td>0.0359</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
indicates that among those countries that have low variance decomposition, the one unit change in the level of national consumption, less than 10 per cent of its change can be explained by the impact of common factor (implying that the fluctuations in consumption are more volatile than the co-movements of Euro12 consumptions). Furthermore, the coefficients for representing the impact of common factors on national consumption are statistically insignificant for some countries that have low values of variance decomposition (e.g. Portugal, the Netherlands, Germany and Greece).

Therefore, from the low value of variance decomposition and insignificance of the coefficients for reflecting impacts of common factor, we can conclude that, for most members of Euro12, consumption expenditure does not make a pronounced contribution to the convergence of the co-movements of Euro12 growth dynamics. In contrast to these countries, the dynamics of consumption of Spain, Ireland and Finland can be explained by common consumption factor shock. But the value for Spain is only 0.0359, which is just about one third of the values for Spain and Ireland. This result indicates that consumption is only a driving element for overall business cycle synchronisation for a small part of the Eurozone.

3.5.2.2 Investment expenditure

With the free movement of goods and capital within the Eurozone, resource investment may not be constrained at the national level. Furthermore, the decision to invest may also not be dependent only on the members’ own growth dynamics. This may suggest some possibilities of co-movements of Euro12’s national-level investment fluctuations. As investment is a key component of national output dynamics, if there is some evidence of synchronisation of investment dynamics, then investments should have a key role in the convergence of Euro12 business cycles. Estimated results of those parameters in DFM for Euro12 investment expenditures are presented in Table
3-10. We have recovered the unobservable common investment factor for Euro12 members. Similar to the results for common consumption factors, the values of coefficient $\beta$ are very small, which may suggest that there is just a very low level of co-movements among Euro12 members. Moreover, the coefficient $\beta$ for Greece is statistically insignificant.

<table>
<thead>
<tr>
<th></th>
<th>$\alpha$</th>
<th>$\beta$</th>
<th></th>
<th>$\alpha$</th>
<th>$\beta$</th>
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<tbody>
<tr>
<td>Austria</td>
<td>0.591</td>
<td>0.002</td>
<td>Ireland</td>
<td>-0.230</td>
<td>0.007</td>
</tr>
<tr>
<td></td>
<td>(0.000)</td>
<td>(0.000)</td>
<td></td>
<td>(0.117)</td>
<td>(0.002)</td>
</tr>
<tr>
<td>Belgium</td>
<td>-0.141</td>
<td>0.003</td>
<td>Italy</td>
<td>0.062</td>
<td>0.002</td>
</tr>
<tr>
<td></td>
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<td>(0.000)</td>
<td></td>
<td>(0.684)</td>
<td>(0.000)</td>
</tr>
<tr>
<td>Finland</td>
<td>-0.374</td>
<td>0.004</td>
<td>Luxembourg</td>
<td>-0.334</td>
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</tr>
<tr>
<td></td>
<td>(0.007)</td>
<td>(0.000)</td>
<td></td>
<td>(0.018)</td>
<td>(0.018)</td>
</tr>
<tr>
<td>France</td>
<td>-0.443</td>
<td>0.003</td>
<td>Netherlands</td>
<td>0.129</td>
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<tr>
<td></td>
<td>(0.058)</td>
<td>(0.000)</td>
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<td>(0.462)</td>
<td>(0.000)</td>
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<tr>
<td>Germany</td>
<td>0.001</td>
<td>0.004</td>
<td>Portugal</td>
<td>-0.128</td>
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<tr>
<td></td>
<td>(0.993)</td>
<td>(0.000)</td>
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<td>(0.424)</td>
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<td>Greece</td>
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<td>0.478</td>
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<tr>
<td></td>
<td>(0.011)</td>
<td>(0.933)</td>
<td></td>
<td>(0.001)</td>
<td>(0.000)</td>
</tr>
<tr>
<td>$C$</td>
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<td></td>
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<tr>
<td>Common factor $F$</td>
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<td>(0.000)</td>
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</table>

$Y_{it} = \alpha_i Y_{i,t-1} + \beta_i F_t + \epsilon_{it}$

$F_t = cF_{t-1} + \eta_t$

Note: numbers in brackets are the $p$-values
Table 3-11 Correlation between investment expenditure and common investment factor of Euro12 (2001:Q1–2011:Q1)

<table>
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<th>common factor of Euro12 investments</th>
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<td>0.516</td>
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<td>Greece</td>
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<td>Ireland</td>
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</tr>
<tr>
<td>Italy</td>
<td>0.456</td>
</tr>
<tr>
<td>Luxembourg</td>
<td>0.183</td>
</tr>
<tr>
<td>Netherlands</td>
<td>0.553</td>
</tr>
<tr>
<td>Portugal</td>
<td>0.247</td>
</tr>
<tr>
<td>Spain</td>
<td>0.653</td>
</tr>
</tbody>
</table>

Source: results are produced by the author

Since the values of coefficient $\beta$ are low for every member of Euro12, it is not surprising to see a low correlation between national investment dynamics and trend of common investment factors of Euro12. From Table 3-11, we can see that the average value of correlation is only 0.454. France has the highest correlation between fluctuation in national investments and common investment factor, which is only 0.741. This is 17% lower than the correlation of French growth dynamics and common real GDP growth factor. The low value of the investment correlation indicates that the national trend of investment does not move on a similar path to the common investment factor.

The second question we will investigate is to what extent the dynamics of investments for each member of Euro12 can be explained by the common investment factor. This can be used to reflect the convergence between national and Euro12 investment dynamics in respect of the volatility of their trends. The Euro12 countries can be arranged into two groups according to the results of variance decomposition for national investment dynamics accounted for common investment factors. The results can be seen in Table 3-12.
<table>
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<th>post-EMU</th>
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<td></td>
<td>Average</td>
</tr>
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<td><strong>France</strong></td>
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<td>Steps</td>
<td></td>
<td></td>
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<tr>
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</tr>
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<td>0.0379</td>
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<td>0.0391</td>
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<tr>
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<tr>
<td>Average</td>
<td>0.0284</td>
<td>Average</td>
</tr>
</tbody>
</table>

Note: the results with underlines indicate that the coefficients in matrix B for the impact of common factors on real GDP growth \( Y_{it} = \alpha_i Y_{t-1} + \beta_i F_t + \epsilon_{it} \) are statistically insignificant at the 5% level. Results for Finland, Luxembourg, and the Netherlands are statistically significant at the 10% level.

The first group contains countries like Austria, France, Germany, Ireland, Italy and Spain. The Euro12 common factor for investment do have a statistically significant impact on these countries’ national investment dynamics. However, the levels of the effects are divergent among countries in the first group. Austria and Ireland have the highest values of variance decomposition – 0.0612 and
0.0276 respectively. For the other four countries, despite the common investment factor being able to explain their investment dynamics as proven by the variance decomposition, the values are very low among them. Hence, the fluctuations of investments between these two countries are poorly converged with the overall co-movements of Euro12 investments.

The second group is made up by the rest of the countries in the Euro12 area whose variance decompositions are statistically insignificant. The variance decompositions of those countries are also generally low in value. Greece, as usual, has the worst results – 0.0057 for the average value, and the coefficients in matrix B are statistically insignificant. The statistically insignificant variance decomposition estimations for these countries reflect the fact that the volatility of these countries’ investment dynamics and common investment factors diverged from each other during the post-EMU period. Hence, this suggests that investment expenditures do not contribute to the overall convergence of the Euro12 aggregates activities for these members of the Eurozone. Since Table 3-12 provides us with mixed results, which split the Euro12 area generally into two groups, we see that the investment expenditure only plays some role in the synchronisation of business cycles in Austria, France, Germany, Ireland, Italy and Spain, and it is only pronounced for Austria and Ireland. Meanwhile, for countries like Belgium, Finland, Greece, Luxembourg, the Netherlands and Portugal, the co-movements of their national investment dynamics and common trends of Euro12 also remain divergent.

3.5.2.3 Exports expenditure

Trade has been recognised as a key driving force of business cycle synchronisation for a common currency by the endogeneity hypothesis of OCA (Frankel and Rose 1997). Therefore, in this subsection we will focus on the exports of each member state of Euro12. The ideal data for this analysis concerns intra-trade between the members of the Eurozone. However, intra-trade data is only available at the annual level. The data set is too small for
estimating the co-movements of export dynamics in EMU for the post-EMU period. Thus, total exports are selected as the alternative to the data on intra-
exports.

The parameter estimations are presented in Table 3-13. The coefficient $\beta$ is statistically significant for all members of Euro12. Moreover, the values of $\beta$ are much higher than the results in the previous two estimations, which are for consumption and investments. The common export factor is successfully captured by our DFM with high values of coefficient $\beta$. Hence, we may expect to see better results in correlation analysis than the previous estimations for the other two main components of national output.

<table>
<thead>
<tr>
<th>Table 3-13 Parameter estimation for DFM – Euro12 members’ exports expenditure (1999:Q1–2011:Q2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\alpha$</td>
</tr>
<tr>
<td>Austria</td>
</tr>
<tr>
<td>(0.000)</td>
</tr>
<tr>
<td>Belgium</td>
</tr>
<tr>
<td>(0.001)</td>
</tr>
<tr>
<td>Finland</td>
</tr>
<tr>
<td>(0.240)</td>
</tr>
<tr>
<td>France</td>
</tr>
<tr>
<td>(0.000)</td>
</tr>
<tr>
<td>Germany</td>
</tr>
<tr>
<td>(0.000)</td>
</tr>
<tr>
<td>Greece</td>
</tr>
<tr>
<td>(0.001)</td>
</tr>
<tr>
<td>Common factor $F$</td>
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<tr>
<td>(0.000)</td>
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</tbody>
</table>

$Y_{it} = \alpha_i Y_{t-1} + \beta_i F_t + \varepsilon_{it}$

$F_t = cF_{t-1} + \eta_t$

Note: numbers in brackets are p-values
Table 3-14  Correlation between investment expenditure and common investment factor of Euro12 (1999:Q1–2011:Q2)

<table>
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<tr>
<th></th>
<th>common factor of Euro12 investments</th>
</tr>
</thead>
<tbody>
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<td>Austria</td>
<td>0.872</td>
</tr>
<tr>
<td>Belgium</td>
<td>0.794</td>
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<tr>
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<td>0.779</td>
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<tr>
<td>France</td>
<td>0.820</td>
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<td>0.810</td>
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<tr>
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<tr>
<td>Ireland</td>
<td>0.597</td>
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<tr>
<td>Italy</td>
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<tr>
<td>Luxembourg</td>
<td>0.686</td>
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<td>Netherlands</td>
<td>0.769</td>
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<tr>
<td>Portugal</td>
<td>0.657</td>
</tr>
<tr>
<td>Spain</td>
<td>0.721</td>
</tr>
</tbody>
</table>

Source: results are produced by the author

The correlation of national export dynamics and the trend of common factor is greater than in the results we obtained for consumption and investment. The average correlation among the Euro12 members is 0.747, which is 65% higher than the average value of the correlation for consumptions and common consumption factor. The highest value of correlation is for Austria, which is 0.872. Belgium, Finland, France, Germany and Italy also have relatively high levels of correlation, which are either above 0.8 or very close to it. Although we have a much higher average correlation for exports than consumption and investments, we still cannot conclude that the trends of exports at national level for Euro12 countries are generally on a similar path to that of the co-movements of the entire region. Countries like Greece, Ireland, Luxembourg and Portugal have a low level of correlation – 0.630, 0.597, 0.686 and 0.657 respectively. The Netherlands and Spain have higher correlation coefficients; however, the value is just around 0.75. Therefore, although we have a higher average correlation for Euro12 countries, for each country, the results are mixed.
Following the method of the previous two subsections, we will estimate the variance decomposition for the national-level export dynamics accounted for common export factor. It would enable us to see how common factor can explain the dynamics of exports for each member of Euro12, which can help us form views on the volatility of national export dynamics and common co-movements among Euro12 members, thus understanding if trading has contributed to the overall cycle convergence inside EMU.

<table>
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<th>post-EMU</th>
<th></th>
</tr>
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<td><strong>Belgium</strong></td>
<td></td>
</tr>
<tr>
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<td></td>
<td>Steps</td>
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</tr>
<tr>
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<td>0.0251</td>
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<td>0.0934</td>
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<td>Average</td>
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<td></td>
<td>Average</td>
<td>0.0676</td>
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| **Finland**    |          |         | **France** |         |
| Steps          |          |         | Steps     |         |
| 2              | 0.0022   |         | 2         | 0.0246  |
| 3              | 0.0046   |         | 3         | 0.0513  |
| 4              | 0.0063   |         | 4         | 0.0725  |
| 5              | 0.0072   |         | 5         | 0.0855  |
| 6              | 0.0077   |         | 6         | 0.0904  |
| 7              | 0.0079   |         | 7         | 0.0903  |
| 8              | 0.0079   |         | 8         | 0.0889  |
| Average        | 0.0055   |         | Average   | 0.0629  |

| **Germany**    |          |         | **Greece** |         |
| Steps          |          |         | Steps     |         |
| 2              | 0.0096   |         | 2         | 0.0015  |
| 3              | 0.0195   |         | 3         | 0.0033  |
| 4              | 0.0266   |         | 4         | 0.0049  |
| 5              | 0.0302   |         | 5         | 0.0061  |
| 6              | 0.0314   |         | 6         | 0.0068  |
| 7              | 0.0314   |         | 7         | 0.0073  |
| 8              | 0.0312   |         | 8         | 0.0076  |
| Average        | 0.0225   |         | Average   | 0.0047  |
In Table 3-15, the variance decompositions are statistically significant for all members of Euro12. The Netherlands has the highest value of variance decomposition among Euro12 countries. Finland and Greece have variance decompositions that are the lowest among Euro12 members – 0.0055 and 0.0047 respectively. For the other countries whose variance decomposition is

<table>
<thead>
<tr>
<th></th>
<th>Ireland</th>
<th>Italy</th>
<th>Luxembourg</th>
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<tr>
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<tr>
<td>2</td>
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<td></td>
<td>0.0214</td>
<td></td>
<td>0.0084</td>
<td>0.0108</td>
</tr>
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<td>0.0512</td>
<td></td>
<td>0.0197</td>
<td>0.0205</td>
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<tr>
<td>4</td>
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<td>0.0780</td>
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<td>5</td>
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<td>7</td>
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<td>0.1264</td>
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<td>0.0421</td>
<td>0.0436</td>
</tr>
<tr>
<td>8</td>
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<td></td>
<td>0.1287</td>
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<td>0.0422</td>
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</tr>
<tr>
<td>Average</td>
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<td></td>
<td>0.0784</td>
<td></td>
<td>0.0275</td>
<td>0.0294</td>
</tr>
</tbody>
</table>

|     |         |       |            |             |          |       |
| Steps |         |       |            |             |          |       |
| 2    | 0.0241  |       | 0.0287     |             | 0.0102   | 0.0102 |
| 3    | 0.0490  |       | 0.0637     |             | 0.0205   | 0.0205 |
| 4    | 0.0677  |       | 0.0938     |             | 0.0338   | 0.0338 |
| 5    | 0.0791  |       | 0.1147     |             | 0.0405   | 0.0405 |
| 6    | 0.0840  |       | 0.1249     |             | 0.0432   | 0.0432 |
| 7    | 0.0850  |       | 0.1268     |             | 0.0436   | 0.0436 |
| 8    | 0.0847  |       | 0.1252     |             | 0.0432   | 0.0432 |
| Average | 0.0592 |       | 0.0847     |             | 0.0294   | 0.0294 |
also statistically significant, the range of the value of their results is between 0.0225 and 0.0784. These results suggest that the common exports factor for Euro12 do have some importance to the individual national export dynamics for most countries, and can be treated as a main driving element of cycle synchronisation in EMU. However, the levels of importance vary across these members of Euro12 area. Therefore, again, we have mixed results for the driving elements of business cycle synchronisation. Nevertheless, since the common export factors can explain the export growth for every member of Euro12, thus the co-movements of export dynamics are relatively important for understanding the synchronisation of overall economic activities in the Eurozone compared to consumption and investment expenditures.

3.5.2.4 Drivers of co-movements for each country

Here, we will provide a summary of the driving element for each country. In Table 3-16 we present the average variance decomposition for all the key components of national output, in order to identify the driver of co-movements of Euro12 business cycles for each member. Among these three key components of national output, consumption expenditure is only important to explain the synchronisation of cycles for Finland, Ireland and Spain. For investment expenditure, the co-movements of Euro12 investment dynamics statistically cannot explain the fluctuations of national-level investments for Belgium, Finland, Greece Luxembourg, the Netherlands and Portugal. Moreover, the variance decompositions are low for those countries whose variance decompositions of investments are statistically significant, e.g. France, Germany, Italy and Spain. Export growth is a relatively important economic aggregate, which can be used to explain the co-movement of export growth dynamics for all of the Euro12 members. In particular, it is statistically significant for the four major economies in the Eurozone, who hold a large proportion of the overall output of EMU.
At the individual level, for the case of Austria, France, Ireland, Italy and Spain, all three key components are statistically significant, which indicates that the convergence of the dynamics of these three output components is important to understand the synchronisation of their business cycles with common Euro12 trend. For Belgium, Finland and Luxembourg, only investment dynamics has no statistically significant contribution to their synchronisation of cycles; consumption has no significant role for Germany’s cycle convergence with the other members of the Eurozone; and for the Netherlands, Portugal and Greece, only exports make a contribution to overall business cycle synchronisation.

Although, for these countries, the convergence of the co-movements of some or all output components were contributing to the overall synchronisation of economic activities, the values of variance decompositions are unbalanced among them. For the case of Belgium, France, Germany, Italy, Luxembourg, the Netherlands and Portugal, only co-movements of exports have a relatively important role for explaining the overall economic activity synchronisation in Euro12 for these three countries. Consumption is the main driving element of
convergence of cycles in Finland, Ireland and Spain. Greece has the lowest synchronisation of business cycles within the Euro12 area.

Despite the exports showing some positive impacts on business cycle convergence, the low value of the variance decomposition implies the low degree of synchronisation among Greek exports and common co-movements of Euro12 exports. For Finland and Portugal, overall business cycle synchronisation had declined since they joined EMU; this can probably be explained as each of these two countries only has one component of GDP that has pronounced contributions, while the other two either have insignificant or minor impacts on the convergence of their domestic economic activities and Euro12 common co-movements.

3.5.3 Spill-over effects between some members of Euro12

In the DFM model Equation (3-5), the matrix A is set to be diagonal. This restriction of the model implies that there are no links between the current economic activities of each country. Common growth factor, which capture the co-movements of Euro12 countries’ growth dynamics, might imply a common shock that causes the fluctuation of real GDP growth for the entire union. Or it can also reflect an asymmetric shock to a country that eventually spills over to other members of the Eurozone, thus affecting the overall co-movement of economic activities in the Eurozone. In addition to the above results of business cycle synchronisation in Euro12, we may also be able to investigate to what extent the synchronisation is caused by the common shocks and spill-over effects.

Since the restriction of our DFM allows the common factors to capture the co-movement of cycles which can be caused by either common shocks or spill-over effects, we can relax our restriction by allowing the matrix A to become a non-diagonal general matrix. Therefore, the first equation in Equation (3-5) has been
transformed to a standard first-order vector autoregression equation. This allows coefficient $\alpha$ in matrix $A$ not only to capture the effect of each member’s own lagged growth, but also enables the matrix $A$ to capture any spill-over effects between countries. The common factor $f$ will no longer capture the idiosyncratic shock, which causes the spill-over across countries, as a common shock to the entire region.

Although theoretically we can use the non-diagonal matrix $A$ to capture the asymmetric shocks which cause the spill-over effects, this analysis may be difficult to apply to the entire Euro12 membership, given that we are aiming to identify the degree of synchronisation which is caused by the spill-over effects in the Euro12 area. However, the relatively short data set means that the length of quarterly real GDP growth is not sufficient for our analysis for the entire Euro12 area. Therefore, we will concentrate on the five biggest economies of the Eurozone, which are France, Germany, Italy, Spain and the Netherlands, and use the monthly real industrial production growth as the approximation for overall economic activities for the post-EMU period.

In Table 3-17, we have presented the variance decomposition for both diagonal $A$ matrix and non-diagonal $A$ matrix DFMs. If the non-diagonal $A$ matrix could successfully capture the spill-over effects between these five major economies, then we would expect to see that the variance decomposition for diagonal $A$ matrix DFM is greater than that for non-diagonal $A$ matrix DFM. For Spain, the variance decomposition is 14% higher than the values from non-diagonal $A$ matrix DFM analysis. This indicates that in Spain nearly 14 per cent of the synchronisation of aggregate economic activities, which is originally identified by the original common IP factor, is due to the lagged spill-over effects from the other four major economies in the Euro12 area. In the case of Germany, France, Italy and the Netherlands, the variance decompositions that accounted for the original common IP factor are lower than that for the non-Diagonal $A$ matrix model. This suggests that the DFM with non-diagonal $A$ matrix failed to capture the spill-over effects for Spain and Italy.
<table>
<thead>
<tr>
<th></th>
<th>France</th>
<th>Germany</th>
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<th>Spain</th>
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<tbody>
<tr>
<td></td>
<td>Diagonal A matrix</td>
<td>non-Diagonal A matrix</td>
<td></td>
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<tr>
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<td>0.0079</td>
<td>0.0075</td>
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<td></td>
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<td>0.0211</td>
<td>0.0200</td>
<td>0.0076</td>
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<tr>
<td></td>
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<tr>
<td></td>
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<td>0.0440</td>
<td>0.0178</td>
</tr>
<tr>
<td></td>
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<td>0.0641</td>
<td>0.0538</td>
<td>0.0223</td>
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<tr>
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<td>0.0759</td>
<td>0.0620</td>
<td>0.0262</td>
</tr>
<tr>
<td></td>
<td>Step 8</td>
<td>0.0064</td>
<td>0.0862</td>
<td>0.0690</td>
<td>0.0295</td>
</tr>
</tbody>
</table>

Source: produced by the author
The failure to capture the spill-over effects in the other four countries could be due to the inherent weakness of this analysis. Since the first equation in the DFM, which contains the non-diagonal $A$ matrix, only allowed lagged spill-over effects to be captured by the model, it is incapable of capturing the within period or high-frequency spill-over effects. Moreover, industrial production only reflects some parts of overall economic activities; therefore, the finite coverage of IP may imply the analysis omitted other important economic aggregates that are probably under the influence of the spill-over effects from other fellow members. This approach of identifying the impacts of spill-over effects on co-movements of business cycle only succeeds in the case of Spain. However, the results do imply that the spill-over effects may have a role for the development of business cycle synchronisation in EMU, or, at least, for some members.

### 3.6 Summary of results and conclusion

In this chapter, we have examined the business synchronisation of Euro12 members by using the dynamic factor model (DFM). In contrast to previous empirical studies for EMU (Breitung and Eickmerir 2005, Lehwald 2012, Lee 2011) that employed the second-generation DFM approach, we have employed the first generation approach. We have shown that for the case of the Eurozone, this finite variable approach is capable of producing statistically significant results for a study which focuses on the regional level rather than the global level.

First, we estimated the unobserved common factor which can capture the co-movements of Euro12 growth dynamics. Then, a conventional correlation test was used to investigate to what extent the movement of national growth trends is on a similar path to Euro12 common trends. The results show that the correlation between national real GDP growth and Euro12 common factors generally improved after the creation of the Eurozone, except in the case of
Portugal. Hence, since the creation of the euro, for the majority of members of Euro12, national growth dynamics are generally moving in the same direction as the co-movements of the entire Euro12. This result may be important to policymakers since it suggests that, for most major economies in EMU, they all need the same type of union-level monetary policy.

Nevertheless, the requirements of the same type of monetary policy may not necessarily suggest that the ‘one size fits all’ issue does not exist inside EMU, although most major members, who hold a majority share of Eurozone GDP, will need the same type of policy; however, the individual needs of policy may still remain divergent if the degree of fluctuation of growth dynamics differs across members. Therefore, graphic and variance decomposition analysis was carried out after we obtained the correlation coefficients for Euro12. The results suggested a mixed result. For Austria, Belgium, France, Germany, Italy, the Netherlands and Spain, the synchronisation of cycles in respect of the volatility of national and common trends is improved significantly. However, for the rest of the countries in the Euro12 area, there have been no pronounced improvements. In particular, for the case of Portugal and Finland, the synchronisation of cycles declined rather than improved.

Our findings have drawn different conclusion from a recent empirical study (Lee 2011), which suggests that the synchronisation of cycles only increased during the run-up period of EMU, but that there is no evidence to show that the improvements continued after the creation of EMU. The results here are in line with other recent empirical studies (Kaufman 2003, Montoya and Haan 2007, Giannone et al. 2010, Lehwald 2012). They have confirmed the argument that has been put forward by Sinn et al. (2011), who suggest that the introduction of EMU may encourage imbalance between member states rather than delivering the universal enforcement of economic convergence, and that, after the establishment of EMU, the single currency area has caused a divergence between core and periphery groups of Euro12.
The synchronisation of growth dynamics has improved in countries like Germany, France, Italy, and the Netherlands, as well as several other relatively small economies such as Austria and Belgium. In contrast to the core group countries, the improvement of synchronisation of business cycles in periphery group of EMU is poor, and there is generally only some improvement of the correlation between national growth dynamics and trends of Euro12 common growth factors; however, the volatilities between fluctuations of national GDP growth and co-movements of Euro12 cycles remain relatively high. These undesirable results of business cycle synchronisation are especially severe in Greece and Portugal. For Greece, there is only an insignificant improvement in the value of correlation coefficients, and no improvement in variance decomposition has been statistically detected. The synchronisation of business cycles for Portugal has declined in terms of both correlation and volatility of its own growth dynamics and common Euro12 growth factors. Therefore, the endogeneity hypothesis of OCA theory may only be the case for the core group of EMU. The integration of economic activities does not guarantee a better co-movement of cycles for the entire Eurozone. Our results also raise a question about membership of EMU: should those countries in the periphery group be included in EMU in the first place?

Following the basic estimation of the synchronisation of Euro12 business cycles, we have also evaluated the co-movements of three key components of national output: consumption, investments and exports. By estimating the synchronisation of these key economic aggregates, we are able to identify which aggregates may play an important role for understanding the synchronisation of overall economic activities. In the previous literature, which also employed DFM, this area was ignored, or partially ignored, by the authors. In Lee (2012), the author only concentrates on the overall level of output, but did not explore the driver of the co-movements of overall economic activities. Lehwald (2012) considers two components of national output, which are consumption and investment. We draw a similar conclusion as that author, who discovers that the members of Euro12 generally have different drivers of
synchronisation of cycles. However, Lehwald (2012) does not include export in his analysis, which has a crucial role in Frankel and Rose’s (1997) endogeneity hypothesis of OCA.

It is only the synchronisation for Germany, Greece, the Netherlands and Portugal that consumption cannot be statistically used to explain, and it has minor contributions to overall convergence in France, Italy and Luxembourg. Investments are more important than consumption to explain the drivers of convergence in co-movements of economic activities for Austria and Ireland, but has no pronounced impacts for Belgium, Finland, France, Germany, Greece, Italy, Luxembourg, the Netherlands, Portugal or Spain. Overall, the integration of trade is key to improving the convergence of cycles inside the Eurozone, and should be treated as the main policy objective for EMU members, in order to improve the probability of implementing an appropriate union wide appropriate monetary policy.

At the union level, exports are more important than the other two components of output. They can be used to explain the co-movements of economic activities for all members of Euro12. However, for Greece and Finland, the low variance decompositions imply low degrees of convergence in terms of export activities among these two countries and overall Euro12 co-movements. This also reflects our results from basic estimation, which suggest the endogeneity hypothesis is only true for some parts of the Eurozone.

Finally, we have also attempted to use the DFM approach to identify to what extent the synchronisation of business cycles is caused by the spill-over effects that may be caused by an idiosyncratic shock to certain countries. To my best knowledge, this analysis has not been implemented by previous empirical studies, at least for those that employed the DFM approach. However, due to the limitation of the data set, we only conducted this analysis on France, Germany, Italy, Spain and the Netherlands by using industrial production rather than real GDP. We detected that the spill-over effect does have a substantial
share in the synchronisation of cycles for Spain. However, we failed to uncover the impact of spill-over on the co-movements of cycles for Germany, France, Italy and the Netherlands. This can be due to the feature of the model that only allows the matrix $A$ in Equation (3-5) to capture the lagged spill-over effects. Hence, this might suggest that there would be a possibility of the existence of high-frequency or within-period spill-over effects in Spain and France. We were not able to identify the share of spill-over effects in causing synchronisation for every country we selected; however, given the positive results for Spain, this does shed light for possible further research into this area where we need a better model to capture the high-frequency or within-period spill-over effects.

Overall, we recovered some evidence which suggests that the synchronisation of business cycles is improved for most countries in the Euro12 area except Portugal and Greece. However, only correlation of trends is generally improved for most countries. The degree of volatility between national growth dynamics and trends of common growth factor is only improved within these countries from the core group of Euro12. Rather than having union-wide improvements in the convergence of economic activities, which was argued by the endogeneity of OCA theory, instead, the imbalance between core and peripheral countries occurred after the creation of the Eurozone. Therefore, after 12 years of operation of EMU, in terms of business synchronisation, there is still a substantial challenge for the ECB to deliver a union wide appropriate monetary policy, which points to the reason behind constant increases in the level of national debt and overuse of fiscal policy among some EMU members.
Chapter 4

Effectiveness of the ECB single monetary policy in the Eurozone

4.1 Introduction

The Treaty on the European Union (TEU) stipulates that the institutional framework of EMU monetary policy is to be a centralised system managed by the European Central Bank (ECB). However, this framework of EMU has been subject to ongoing debate among academics. The centre of the debate focuses on a practical problem of common monetary policy in the Eurozone – the ‘one size fits all’ issue (Feldstein 1997, Obstfeld 1997, Sinn and Reutter 2001, Wickens 2007), which can arise due to the existence of heterogeneity of the monetary transmission mechanism (MTM)\(^\text{16}\) and lack of business cycle synchronisation\(^\text{17}\) among members of EMU.

\(^\text{16}\) The findings of literature which evaluates the monetary transmission mechanism (MTM) across the Eurozone or European countries remains controversial. During the pre-EMU period, Dornbush (1998) argues that the effect of a monetary shock is similar in Germany, the UK and France but smaller in Sweden and Italy. Ramaswamy and Sloek (1998) conclude that in Germany, Austria, Belgium, Finland and the Netherlands the effect of monetary policy on output takes longer to occur, but is almost twice as great as in France, Italy, Spain, Sweden, Portugal and Denmark. Similar findings are also confirmed by Whitely (1997) and Eharmann (1998). In contrast, other research carried out during the pre-EMU period argues that the heterogeneity of the MTM is not significant in Europe. For example, Gerlach and Smets (1995) find that the effects of monetary policy are relatively homogenous across European countries; however, it is more effective in Germany than others. The empirical works conducted during the post-EMU period also remain controversial. The ECB (2002) and Angeloni et al. (2003) have stated that it is difficult to detect the systematic difference in the MTM across EMU members. Peersman (2004) also drew a conclusion which shows the MTM is relatively homogenous within EMU where the effects of monetary policy in the Eurozone are relatively uniform. However, other literature still casts doubt on the homogenous nature of the MTM in EMU (Mojon 2001, Clausen and Hayo 2006).

\(^\text{17}\) This, in the end, can cause the rise of the problem of inappropriate ECB monetary policy at the national level even when the MTM tends to be homogeneous among members (Artis et al. 2004, Grauwe 2009). For detailed empirical results of business cycle synchronisation among EMU members, please see Chapter 3.
If the ‘one size fits all’ issue exists in EMU, the monetary policy may be appropriate in terms of reacting to the needs at the Eurozone level, but can be inappropriate to some members of EMU, which, in turn, makes the monetary policy less effective if we consider national-level information. The member governments, who do not see ECB monetary policy as the appropriate measure for their domestic needs, may have to rely on fiscal policy to offset the impact of shocks whilst poor economic performance raises the risk premium of national debts. This would have a further negative impact on EMU economic recovery, as the cost of serving national debt will generally increase across members, which can cause a sovereign debt crisis in some countries. Therefore, the understanding of effectiveness of ECB monetary policy is crucial to assess whether EMU is an economic system which can be stabilised through manipulation of monetary instruments.

Among previous studies, which were produced to uncover the dynamic relations among monetary shocks and macroeconomic variable movements (e.g, Butzen et al. 2001, Peersman 2001, Valderrama 2001, Chatelain et al. 2002, Vermuelen 2002, Rabanal 2003, van Arel 2003, Peersman 2004, Rafiq and Mallick 2008, Favero and Giavazzi 2008, Martínz-Carrascal and Frenando 2008, Weber et al. 2009, Peersman 2011), there are several issues that have attracted our attention. First, the focus of previous literature is either on the union-wide aggregates or on the national-level data for some selected key Eurozone members. However, such an angle for research can be problematic given that both union-level and key economy approaches only use limited information, which omits data of other EMU members. Therefore, an understanding of the effect of ECB monetary policy cannot be adequately obtained.

channel of the MTM or a single driving force, the result could omit other channels which may also have substantial effects on real economic activities. Second, empirically it is difficult to separate a specific channel from the others; in fact, different channels are actually co-intervening with each other. Therefore, these results are capable of assessing the effects of a monetary policy through a particular channel of the MTM, but generate an inconclusive explanation of the overall effects of monetary shocks.

Third, despite the VAR method being one of the most frequently used approaches to assess the effects of monetary policy on macroeconomic variables (Peersman 2001, van Arel et al. 2003, Rabanal 2003, Peersman 2004, Favero and Giavazzi 2008, Weber et al. 2009, Peersman 2011), the time series VAR approach may not be appropriate for use in studying the post-EMU period in terms of the impacts of monetary policy on EMU economies. This problem is due to the short operational history of EMU, which only generates limited time series observations that can lead to low degrees of freedom when the analysis seeks to contain multiple endogenous variables.

Therefore, this empirical study chapter mainly contributes to the existing literature through the following points. First, adoption of the panel vector autoregression (PVAR) approach: the use of panel data techniques tackles the problem of data limitation and the asymptotic results are easier to derive from panel data. The dynamic response of macroeconomic variables to monetary shocks during the post-EMU period can be recovered from the consideration of national-level information of every member of EMU. Thus, this study enables us to evaluate the effectiveness of the ECB’s monetary policy within the euro area without falling into the problem of narrow focus, on either only union aggregates or a few members.

Moreover, the implementation of the PVAR method, particularly in respect of delivering benefits of rich observations and allowing endogenous interactions between variables within the system, allows us to build a model that allows
multidirectional causality to exist between the monetary instrument and various macro-variables. Hence, we can recover the dynamics among monetary policy and other variables, which indicate the overall economic performance of EMU economies without having the issue of low degrees of freedom. Third, through consideration of various aggregate variables simultaneously in a single PAVR model, this analysis will be carried out independently of any specific channel of the MTM.

In the following sections of this chapter, we will begin with a review of the fundamental economic theory that is used by the ECB for implementing the single monetary policy for the entire EMU. This will be followed by a section reviewing relevant previous literature. The fourth subsection focuses on the PVAR model that is used as the econometric approach for our empirical analysis. Finally, through the last two subsections, this chapter will present our empirical results to assess the effectiveness of the ECB’s monetary policy and our conclusion for this chapter.

4.2 Review of theories of monetary policy – new consensus view and post-Keynesian critiques

Before starting the empirical section of this chapter to investigate the effectiveness of ECB monetary policy, it is essential to review some economic theories which help us to understand the underlying general principles that have been used by the monetary authority to design and implement their policy. For EMU, current economic operations (e.g. monetary policy) are largely based on the latest mainstream macroeconomic model, which is known as the new consensus macroeconomics (NCM) model. In this subsection of Chapter 4, we will review relevant background theories of monetary policy, in particular, to understand how monetary policy can be used to influence the key
Chapter 4 Effectiveness of the ECB single monetary policy in the Eurozone

macroeconomic variables (i.e. price and output) within the framework of NCM. Moreover, in order to critically understand the mechanism lying behind the implementation of monetary policy, it is necessary to compare NCM with other heterodox schools. Therefore, the main critiques from the school of post-Keynesians on NCM monetary policy will also be reviewed here.

4.2.1 Monetary policy and the new consensus model

Over a long period of time, the theories of macroeconomics were distinguished by different schools of thought, which possessed different views on how the economy works at the aggregate level, hence providing different arguments as to the role of short-run economic stabilisation policies. However, those models (i.e. classical, new classical, Keynesian, new Keynesian etc.) have one after another failed to successfully explain and provide solutions to the fluctuations of macroeconomy. Since the 1990s, a new model has been established which aims to combine the strength of different schools of thought, and therefore to create a better model which can be used as a more appropriate tool to study macroeconomics (Fontana 2009). This new model is known as the new consensus macroeconomics (NCM) model which combines the elements of new classical economics, monetarism and new Keynesians. For example, NCM shares the idea of a vertical Phillips curve in the long term, but downward-sloping curve in the short term; prices are sticky in the short run and economic agents have rational expectations etc. In other words, it is a model which is based on the neoclassical system and shares the insights of monetarists and new Keynesians; thus, it is also referred to as a new neoclassical synthesis (Goodfriend and King 1997, Fontana 2009).

NCM can be explained based on three equations model, which contains the IS curve equation, the Phillips curve equation and the monetary policy (MP) equation (Carling and Soskice 2005). First, NCM focuses on the relationship
between output gap, real interest rates and exogenous private and public
demand. The simple IS equation can be seen as:

\[ Y_t - Y_e = D_t^{EX} - Y_e - \alpha r_{t-i} \quad (4-1) \]

where \((Y_t - Y_e)\) measures the difference between the actual output at time \(t\) and
equilibrium output \(Y_e\): output gap at time \(t\); \(D_t^{EX}\) is the exogenous demand shock
from both private and public sectors at a given period of time; \(r_{t-i}\) is the lagged
real interest rates and \(\alpha\) represents the sensitiveness of interest-rate-related
spending (e.g. investments). By moving both \(Y_e\) to the left-hand side of Equation
\((4-1)\), we can obtain the simple form of IS curve that emphasises the level of
output:

\[ Y_t = D_t^{EX} - \alpha r_{t-i} \quad (4-2) \]

Both equations show very similar characteristics to traditional IS curve equation,
which implies the output (or output gap) depends on current level of fiscal policy
and autonomous investment (shifts of IS curve) and is negatively related to the
level of real interest rates (slope of IS curve). However, the NCM-IS curve
equation also has its own feature, which is different from the traditional version.
The NCM-IS curve contains a forward-looking element \(r_{t,i}\). Monetary authority
has a forward-looking mentality, and sets a level of real interest rate in the
previous period to control present output (output gap).

In the case of the Phillips curve equation, NCM shares the same view as
Monetarists by adopting a downward-sloping short-run Phillips curve which
allows the existence of the unemployment–inflation trade-off, and a long-run
vertical Phillips curve (Carling and Soskice 2005). Therefore, inflation will increase
if unemployment is below the non-accelerating inflation rate of unemployment
(NAIRU) (positive output gap), and vice versa for the situation of negative output gap. The equation of the Phillips curve can be seen as follows:

\[ \pi_t = E(\pi_{t+1}) + \beta(Y_t - Y_e) + \varepsilon_t \quad (4-3) \]

From Equation (4-3), we can see that the current level of inflation \( \pi_t \) is determined by the expected future inflation at time \( t+1 \) (the expectation is based on previous inflation and other price-relevant information) and the level of contemporaneous output gap. Moreover, \( \varepsilon_t \) represents unexpected price shocks. The term \( E(\pi_{t+1}) \) is important as it indirectly implies the creditability of monetary authority, hence affecting the position of the short-run Phillips curve\(^{18}\).

Finally, the third MP equation looks at how the monetary authority sets the level of interest rate in relation to its policy goal (i.e. price stability/inflation-targeting). In NCM, the interest rate is the policy instrument, which the central bank can use explicitly to control inflation and output; moreover, it also indicates the replacement of LM by the MP curve since the money supply is endogenously determined (Romer 2000). The most famous and widely accepted monetary rule (interest policy rule) is the Taylor rule, which proposed the monetary authority should respond to changes in both price and aggregate demand in order to maintain price stability or achieve the target inflation (Taylor 1999). In other words, the central bank needs to change the interest rate if inflation deviates from its target or positive output gap appears in the economy.

According to the Taylor rule (Taylor 1999), the equation of MP can be written as follows:

\[ i_t = \pi_t + r^n + \delta_1(\pi_t - \pi^*) + \delta_2(Y_t - Y_e) \quad (4-4) \]

\(^{18}\) For discussion of the credibility and the time inconsistency issue of monetary policy, please see Chapter 5.
where \( i \) is the nominal interest rate which central bank directly controls; \( \pi \) is the level of inflation and \((\pi_t - \pi^T)\) measures the deviation of inflation from its target; and \( \delta_1, \delta_2 \) are the parameters that represent the weights of deviation of inflation and output gap on the decision of interest-rate-setting. Since it is the real interest rate that has impact on economic activities rather than the nominal rate, we can rearrange Equation (4-4) as follows:

\[
r_t - r^n = \delta_1 (\pi_t - \pi^T) + \delta_2 (Y_t - Y_e)
\]  

(4-5)

The element \( r^n \) is the natural rate of real interest rate, which is the rate when actual output is equal to the potential level (Williams 2003); moreover, if the left-hand side of Equation (4-5) equals zero, then it implies that the monetary policy is consistent with the inflation and output targets (Carlstrom and Fuerst 2003).

The central bank reacts to the observed inflation and output gaps to set nominal interest rates to force the economy into moving, or keep it around its target inflation level; however, it is commonly agreed that the monetary policy may not have immediate effects on inflation but with some lags (Friedman 1961, Batini and Nelson 2001, Carling and Soskice 2005). Carling and Soskice (2006) refer to the previous empirical study which was conducted by the Bank of England (1999), thus adopting the two lags model of NCM monetary policy to explain the process of inflation adjustments. Here, for the purposes of demonstrating how monetary policy affects an economy at the aggregate level, we will follow Carling and Soskice (2006) to illustrate the process of how interest rate policy can be used to affect output and inflation.

The two lags model argues that monetary policy may only affect inflation two time periods later. For example, if the central bank observes that inflation has deviated away from its target level in the current period, it has to think ahead about the objective level of output (output gap) in the next period, which will
eventually lead to the inflation level in the second period after the initial monetary policy shock in period zero.

Figure 4-1 NCM three-equation model

In Figure 4-1, the initial disequilibrium that was observed by the monetary authority is at the point A when the economy is at period zero. At point A, the
actual output $Y_0$ is greater than the potential output $Y_e$ that is associated with the long-run Phillips curve (LRPC). This positive output gap leads to a higher level of inflation $\pi_0$ that is way above the inflation target $\pi^T$. Assuming the private economic agents also observe the inflation level $\pi_0$, the short-run Phillips curve (PC) will be $PC(\pi_0)$, which will cause inflation to increase further to $\pi_1$. Since the $PC(\pi_0)$ and $Y_0$ give inflation $\pi_1$, the central bank knows the constraint of their monetary policy is a new short-run PC $PC(\pi_1)$ at period one. Moreover, assuming that the MP curve the central bank adopts is $MP_1$, the desirable position in the short run is where $MP_1$ interacts with $PC(\pi_1)$. For these reasons, the central bank will set the interest rate to $r_0$ at period 0, the higher costs of borrowings will discourage interest-rate-related private spending, and thus the output will drop to $Y_1$ at period one given the upward movements on the IS curve. This decline in output (negative output gap: $Y_1 < Y_e$) will give a lower level of inflation at $\pi_2$ when the economy is at period two.

Because the central bank always thinks ahead, it understands the monetary policy at period zero is insufficient to bring inflation bank to its target; however, the output can be seriously dampened. In period one, policy makers in central bank would know that if they introduced another round of monetary policy, the short-run PC they would face after the initial monetary shock would be $PC(\pi_2)$. Thus, the interest rate will be set at $r_1$ which will give output $Y_2$ at period two and inflation $\pi_3$ at period three. With this forward-looking mentality, the central bank can continually adjust the interest rates at each period of time, which will allow the economy to move along the MP curve towards target inflation and output ($\pi^T$ and $Y_e$). Assuming there are no other external or policy shocks, the economy will eventually move back to an equilibrium point (on LRPC) where the natural rate of interest $r_n$ equals actual interest rate; moreover, since inflation and output are at their target and potential levels respectively, Equation(4-5) has a value of zero.
Now, let’s consider another situation in which the central bank demonstrates relatively less inflation-averse but more unemployment-averse in its monetary policy; then the MP curve becomes steeper (MP2 in Figure 4-1). The economy still begins with point A, and the output Y0 and PC(π0) at period zero will lead to π1 at period one. This time, because the central bank is less inflation-averse, the desirable position for this economy to be (back on MP curve) is where PC(π1) cuts cross the MP2. Therefore, according to this constraint, the central bank will set the interest rate to r0* at period zero, which will give a smaller negative output gap compared with the previous example (|Y1* - Ye| > |Y1 - Ye|). Due to this smaller upward movement on the IS curve, the deflationary pressure is also weaker in this case. At period two, inflation is π2* rather than π2; moreover, the downward shift of the short-run PC is also smaller (from PC(π1) to PC(π2*)). For this unemployment-averse central bank, it will take a much longer time to adjust inflation back to its target level.

4.2.2 Critiques of new consensus model monetary policy

Since NCM has arisen among neoclassical and new Keynesian economists (e.g. Goodfriend 1997, Woodford 2002, Romer 2000, Taylor 2000, Walsh 2002), it is not surprising to see that the critiques of NCM are from post-Keynesian economists (Lavoie 2004 & 2006, Rochon 2004, Setterfield 2004, Smithin 2004, Palley 2006, Monvoisin and Rochon 2006) who argued that NCM is actually nothing new but only the newest incarnation of mainstream macroeconomic theories.

The first critique of NCM focuses on the rule of monetary policy; in particular, the argument emphasises the reason for absence of the monetary aggregates (disappearing of LM curve). In our previous demonstration of NCM monetary policy, we have seen that the interest rate has been used by the central bank as the policy instrument to alter the output and inflation according to the deviation

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19 For detailed discussion see Carling and Soskice (2005 & 2006).
of inflation and output from their target and equilibrium levels (Taylor rule) (Romer 2000). This implies that the meaning of monetary policy is actually referring to the interest rate policy rather than the traditional ‘monetary aggregate policy’, which was emphasised by Friedman in his expectation-augmented Phillips curve model. Therefore, despite NCM adopting Friedman’s idea of long-run vertical PC and short-run downward-sloping PC, the monetary policy instrument NCM argued should be used is interest rate rather than money supply (Taylor 1999).

The reason for this is that, first, according to the Taylor rule, changes in the level of interest rate are a reaction to the changes in the output gaps and inflation, rather than a response to the changes in the level of money supply (see Equation (4-5)). Second, in contrast to the traditional exogenous money supply in Friedman’s expectation-augmented Phillips curve model, the central bank actually has little control over the border money; therefore, in fact, the money supply is endogenously determined, which means that the dynamics of monetary aggregates are the response to the needs of the economic system (Allsopp and Vines 2000). Hence, the monetary authority uses the central bank base rate as the monetary policy instrument rather than altering market interest rate through control of the money supply, and the monetary aggregates have a minor role in the making of monetary policy (McCallum 2001, Romer 2000).

Post-Keynesians agreed that money is endogenously determined; in fact, the theory of endogenous money plays a central role in post-Keynesian theory (Rochon 1999, Fontana 2003). However, the endogeneity of the money supply in post-Keynesians’ perspective is different from that of NCM. It seems more like an implicit rather than explicit theoretical concept in NCM. Cecchetti (2000) states that based on many countries’ evidence border money is difficult to control, but the monetary base or narrow definition of money still can be effectively managed by the central bank; hence, targeting monetary aggregates as the policy instrument is no longer feasible and effective. Setterfield (2004) assessed the NCM view of endogenous money supply and argued that the interest rate
policy is preferred to the money targeting policy by the monetary authority given that the demand for money is unstable in view of NCM. Hence, the choice of interest rate policy is mainly motivated by practical issues of contemporary monetary environment.

For post-Keynesians, the endogenous money supply is well defined by the economic theory\textsuperscript{20} (Fontana 2003). More importantly, the endogenous money supply is not only referring to the border money; it also includes the monetary base which is controlled by the central bank (Rochon and Rossi 2007). There are two main theories which have been established to explain the endogeneity characteristic of the money supply, known as the accommodationist and structuralist approaches (Pollin 1991). The accommodationist approach is also known as a horizontalist approach (Moore 1988), given that the model contains a horizontal credit–money supply function at the given rate of interest. This horizontal money supply function implies that the central bank is forced to accommodate any rise in demand for reserves at the given rate of interest due to increase in bank lending; hence the money supply is exclusively credit driven in this approach (Moore 1988, Lavoie 1992, Rochon 1999).

In contrast to the accommodationist view, structuralists also agree the endogenous money supply is fundamentally caused by the demand for credit of private economic agents (Arestis 1997); however, the infinitely elastic credit-money supply function was rejected in the structuralist approach (Dow 1996, Sawyer 1996). In this post-Keynesian view of endogenous money supply, the money supply is argued as being dually dependent on monetary-authority-controlled reserves and the asset and liability management practices of commercial banks; therefore, if the central bank refuses to accommodate increasing demand for credit by raising the level of reserves, through their own initiatives commercial banks may still be able to obtain funds from other financial institutions (Palley 1988, 1994).

\textsuperscript{20} For detailed discussion, see Fontana (2003).
Even though accommodationists and structuralists are distinguished by different views on the elasticity of the credit–money supply function, both approaches see money arising as the product of increase in demand for bank credit and the central bank as having little or no control of it. This consensus on endogenous money supply leads to both NCM and post-Keynesian theory agreeing on the disappearance of the LM curve which is based on the exogenous money supply theory. However, post-Keynesians criticised the rejection of LM curve as an illusion given that the positive relationship between output and interest rate that is contained in the LM curve has not been broken (Monvoisin and Rochon 2006). The reaction of interest rates to the output fluctuation in NCM is an administrative response since the fluctuation of output will affect the central bank’s decision on interest rate through the monetary policy rule (i.e. Taylor rule), rather than a market determinate phenomenon in the standard Keynesian macroeconomic model.

The second post-Keynesian critique of NCM monetary policy emphasises the policy objective of inflation-targeting. From the monetary policy curve (see Equation (4-5)), we can see that the setting of interest rates is a response to deviation of inflation from its target; moreover, the interest rate will affect the price level through the adjustments of output gaps by altering the interest-rate-related spending and the short-run Phillips curve (see Equation (4-3) and Equation (4-4)). Therefore, this model implies that the adjustments of inflation contained in this model are particularly focused on demand pull rather than cost push inflation. If the main determinant factor of observed high inflation is due to the rise in the costs of production (i.e. oil price shock), the interest rate policy may not effectively affect the price level but lead to dampening of output and rising unemployment (Arestis and Sawyer 2004).

The third critique focuses on the Taylor rule and, in particular, one of its key elements – natural rate of interest. In Equation (4-5), we can see that the \( r_n \) is an exogenous variable that has an impact on the setting of the central bank policy.
rate; however, the policy rate has no influence on the natural rate. Moreover, the other two equations in the NCM model have no role to determine $r_n$. Therefore, if the central bank has a different policy rate relative to the natural rate whilst the output and inflation are at their equilibrium and target levels, then this inappropriate central bank policy rate can jeopardise the stability of the economy (Woodford 2001). 

Since the natural rate of interest is so important to the NCM model, in particular, for setting an appropriate policy rate to achieve economic stability, it is crucial to accurately estimate the value of $r_n$. However, post-Keynesian economists criticise the estimation of the natural rate of interest as a difficult task and usually arbitrary (Smithin 2004, Arestis 2009). Rochon and Setterfield (2007), who refer to Smithin (1994 & 2007), argue that there is actually no natural rate of interest given that the rate is based on the existence of a continuous aggregate production function which had long been rejected by heterodox economists. Moreover, post-Keynesians also argue that even the natural rate of interest can be successfully identified; however, it is not the sole condition for achieving equilibrium – through appropriate use of fiscal policy, the macroeconomic objectives can also be achieved (Smithin 2007, Wray 2007).

Finally, post-Keynesians follow the traditional Keynesian view on determinacy of investment and reject the simple interest/investment relation implied by the IS function in the NCM model, and argue that there is a more complex relationship between interest rate and investment (Kriesler and Lavoie 2007). In fact, the quantity of credit available in the economy has a more influential role on investment than the interest rates, which is the price of credit (Kriesler 1997). Empirically, the new Keynesian economist Taylor (1999) has also found that the interest elasticity of investment is non-linear and asymmetric. The negative effect of interest rate policy on output, and in particular, on investment spending is more pronounced during the period of economic boom; however, it is more likely to be ineffective for stimulation of investment and output in times of
recession. Hence, using the interest rate as the instrument of monetary policy, especially during times of recession, is considered to be a ‘pushing on a string’ type policy (Nevile and Kriesler 2001).

Give these criticisms of NCM monetary policy, in particular using central bank interest rates as the policy instrument, the Post-Keynesians generally view monetary policy is an ineffective policy tool relative to the view of NCM. However, among post-Keynesian economists, there are two types of view on the effectiveness of monetary policy. The first can be seen as an ‘extreme’ view of monetary policy. Those post-Keynesians who support this view (Lavoie and Seccareccia 1999, Smithin 2007, Wray 2007, Godley and Lavoie 2007) argued that monetary policy is not reliable and usually ineffective for altering aggregate output, and that fiscal policy is more capable of achieving macroeconomic objectives such as full employment, and monetary policy could become more flexible in terms of setting real interest rates to achieve better distribution of income\(^\text{21}\). In contrast to the ‘extreme’ view, the second group is relatively moderate as to monetary policy. They (Moore 1988, Fontana and Palacio-Vera 2006, Palley 2006 & 2007, Fontana 2007) believe that the monetary policy (interest rate policy) can be used as a counter-cyclical tool to adjust economic activities at the level of fine-tuning; however, fiscal policy is still relatively important than monetary policy.

To summarise this subsection, by adopting the mainstream new consensus macroeconomics (NCM) model we have demonstrated how monetary policy can be used to achieve price stability through adjustments of interest-rate-related spending. We have also discussed the post-Keynesian critiques of the NCM view of monetary policy, whose arguments are mainly focused on the IS and MP curves. Although, post-Keynesian economists prefer fiscal to monetary policy as the tool for stabilising short-term business cycles, there is barely a consensus

\(^{21}\) For details of distribution of income and fiscal policy, see Godley and Lavoie (2007).
among NCM and some of the post-Keynesians on the effectiveness of monetary policy.

4.3 Channels of the MTM and relevant literature

The MTM is a process which describes the impact on real economic activities from changes in monetary instruments. The effectiveness of the monetary policy is determined by two fundamental factors. First, the price has some degree of rigidity; and second, the financial structure of the credit market. To policymakers, it is useful to understand the overall effectiveness of monetary policy, which could enhance the probability of better monetary policy in terms of timing and effectiveness. There are three major channels of the MTM: the interest rate channel (also known as traditional cost channel), the asset price channel and the credit channel, where adjustment of monetary instruments can pass through its influence to the real macroeconomic variables such as output, and inflation. Each channel has its own emphasis which provides various explanations of linkages between monetary policy and economic performance at the aggregate level. Through the discussion of each channel of the MTM here, we will summarise the fundamental theories and empirical studies of monetary policy through different channels, in order to provide a broad and essential picture of effectiveness of monetary policy, and therefore to provide a starting point for this research.

4.3.1 Interest rate channel

The interest rate channel is a traditional model of MTM which is widely used as the typical textbook case (e.g. Keynesian ISLM models). The Keynesian ISLM model indicates that the central bank or policymaker could use, for example, an expansionary monetary policy to maintain or improve the output level as denoted by the following: $M \uparrow \Rightarrow i_r \downarrow \& I \uparrow \Rightarrow Y \uparrow$. It works in the following
sequences: at a given level of interest rate, increase in real money balance ($M \uparrow$) from the central bank could be perceived as the excessive of cash to households. Thereby, households will reduce the real money balance by exchanging cash for bonds, which will lead to a fall in interest rate ($i_r \downarrow$), thus encouraging investment as the cost of borrowing becomes cheaper.

This traditional channel of the MTM is also known as the neoclassical money view of the MTM. The standard model (Jorgenson 1963 and Poterba 1984) views the user cost of capital as a determinate factor of the level of investment, which the interest rate has a direct effect on. The model can be written as follows:

$$UC = P_c[(1-t)i - E(\pi_c) + d]$$ (4-6)

where $UC$ is the user cost of the capital, $P_c$ is the relative price of the capital, $t$ is the marginal tax rate, $i$ is the nominal interest rate, $E(\pi_c)$ represents the expected appreciation of value of capital, and $d$ denotes the depreciation of capital. To transfer the nominal terms of Equation (4-6) to real terms, we can introduce inflation into the model by adding the expected inflation rate $\pi^e$. Thus, Equation (4-6) can be rewritten as follows:

$$UC = P_c[(1-t)i - \pi^e] - \{E(\pi_c) - \pi^e\} + d$$ (4-7)

where $(1-t)i - \pi^e$ is the real after-tax interest rate, and $\{E(\pi_c) - \pi^e\}$ is the expected real appreciation of value of capital.

The argument of this model is that, if the expected inflation rate $\pi_e$ is sticky, the value of $\{E(\pi_c) - \pi^e\}$ tends to be constant at least in the short run. Therefore, the adjustment of short-run nominal interest rates can alter upwards the user cost of the capital, hence influencing the decision of spending on investment. Taylor (1995) empirically tests this channel for both sides of the Atlantic Ocean. He suggests that this channel is more significant in the USA compared with European countries (the UK, Germany and Italy). In order to contradict the
doubts about the assumption of sticky price, Taylor (1998) shows that the price stickiness exists in both the macro- and micro-level data analysis; in particular, here it referees to stickiness in wage-setting.

Among empirical studies, the discussion of the significance of the interest rate channel remains controversial. Bernanke and Gertler (1995) doubt the significance of the interest rate channel, suggesting that it is difficult to measure the impact on the real side of the economy from monetary policy through the interest rate channel. Rabanal (2003 & 2007) also argue that the interest rate channel is not significant in the USA or euro area. In contrast, Taylor (1995) suggests that monetary shocks through the interest rate channel have a significant influence on decisions about spending. Barth and Ramey (2001), Revenna and Walsh (2006), and Chowdhury, Hoffmann, and Schabert (2006) also reach a similar conclusion: that the interest rate channel plays an important role in monetary transmission.

There are couple of factors that are crucial to affecting the effectiveness of the traditional interest rate channel. First is the assumption of price stickiness. Taylor (1998) provides an overview of empirical evidence to prove the existence of price and wage stickiness at both macroeconomic and microeconomic levels. Monetary shocks can alter the upward/downward pressures on the cost of capital only if the price is sticky, at least in the short run. By adopting the Fisher equation:

\[ 1 + \hat{i}_{t,t+k} = (1 + r_{t,t+k}) \times (1 + \pi_{t,t+k}^e) \]  

\[ (4-8) \]

where \( \hat{i}_{t,t+k} \) denotes the nominal rate of interest for the time period from \( t \) to \( t+k \), \( r_{t,t+k} \) is the real interest rate from time \( t \) to \( t+k \), and \( \pi_{t,t+k}^e \) is the expected inflation at time \( t \) for the time period of \( t+k \).
The equation implies that an increase in the nominal interest rate by the central bank leads to a rise in real interest rate, if the expectation of inflation remains constant or at least there are some degrees of stickiness in the adjustment of inflation expectation. Therefore, if the $\pi^e$ is highly volatile, or at least moving away from a value of zero, the changes in the short-run interest rates may only generate a relatively small impact on real interest rates which firms need to pay for the financing of the investment. In the context of EMU, due to the different levels of domestic inflation and economic performance, the inflation expectation may differ across members at the national level. However, the Eurozone base rate is set based on EMU aggregates; this would imply the probability of the ‘one size fits all’ issue for the union. The member who has a relatively high expectation of inflation may find the user cost of capital is actually decreasing relative to the increase in the ECB interest rates, and vice versa in the low-inflation-expectation countries.

The second factor relates to the time horizon of which interest rates influence the decision of spending. Because capital assets are usually long-lived (e.g. lands, premises or machinery), firms and households may value the cost of acquiring new capital against the adjustments of the capital’s value over a long period of time. In other words, real interest rates and the expectation of the appreciation of capital value that affect decisions on spending may be related to the expected life of the capital assets (Boivin et al. 2010). This implies that the real long-term interest rate has a key role in influencing the level of spending.

However, real long-term interest rates cannot be directly adjusted by the central bank; instead, the short-term nominal rates are actually used to form the policy tool, which aims to alter the macroeconomic performance. The mechanism of how the controlled adjustment of short-term nominal interest rate transforms the long-run real interest rate fundamentally depends on the price stickiness and expectations (Mishkin 1996). In principle, the long-term real interest rate is an average of expected future real short-term interest rates. The lower level of short-term nominal interest rate would lead to the lower long-
term real rate. Previous empirical studies have confirmed the existence of the above relationship between short-term and long-term real rates (Roley and Sellon 1995, Mehra 1996, Buttigilione et al. 1997, Andersson et al. 2006). However, due to the difficulties of measuring the price stickiness and expectation, it is hard to estimate the impact on the long-term real interest rate from fluctuation of the short-term nominal rates.

Only a few (e.g. Mojon 2000, Angeloni et al. 2002, Chatelain et al. 2002) empirical studies have been done on the traditional interest rate channel, which mainly focused on the pre-EMU period beside Chatelain et al. (2002). Mojon (2000) states that due to the difference in the structures of financial markets and balance sheets of firms and households, the interest rate channel is heterogeneous among EMU members. Nevertheless, the author also argues that the heterogeneity of the MTM can be relieved by a single money market and ECB monetary policy. Ageloni et al. (2002) provide a comprehensive summary of a batch of research projects which were conducted by the Monetary Transmission Network of the ECB. They conclude that both the interest rate and the credit channel exist in EMU area. However, the homogeneity of the interest rate channel remains relatively low across the Eurozone members. Chatelain et al. (2002) also test both the interest rate and credit channels for the euro area by a method that Chatelain describes as a ‘narrow and wider’ approach. With panel data at the micro level, he selects four major EMU members (Germany, France, Italy and Spain), and assumes the firm’s investment to be the only interest-rate-sensitive spending variable. This work concludes that the cost of capital is sensitive to the fluctuations of interest rates where the cost also plays a crucial role in determining the level of investment. The interest rate channel was found in all four key European countries during the first two years of the post-EMU period, but the effectiveness remains heterogeneity.

Alongside the above empirical works, which focus on the traditional interest rate channel, many empirical works on the interest rate channel have switched to a different direction (Rabanal 2003, Chowdhury et al. 2006, Ravenna and
Walsh 2006, Tillmann 2008 & 2009, Hulsewig et al. 2009). The distinguishing feature between the traditional interest rate channel and the new approach is their focus on the supply-side perspective. Instead of explaining the cost channel of the MTM through the ‘interest rate changes – user cost of capital – investment’ relationship, this new approach looks at the linkage of ‘interest rate change – cost of capital – inflation changes’. The supply-side version of the interest rate channel tries to explain the issue of ‘price puzzle’ (i.e. the phenomenon of the inflation rise following the contraction in monetary policy). Ravenna and Walsh (2006) suggest that the daily business of firms relies on borrowing working capital from financial intermediaries, and the price puzzle is a consequence of the supply-side version of the interest rate channel. For example, before firms can sell their final products in the goods market, they have to borrow to finance the cost of production such as labour, raw materials, etc. This also applies to the ongoing investment of firms, which also rely on funds from the financial markets.

Moreover, the change of short-term interest rates is not only affecting the demand of investment as the theory of user cost of capital suggested; however, it also has some relatively immediate effects on the real side of the economy. The price of final goods in the market will rise eventually, because firms have to pay more on their loans of working capital which are used to finance production factors. The significance of this channel depends on the structure of the economy. Henzel et al. (2007) suggest that monetary policy does act as a cause of supply-side shocks to the economy, as the increase in the interest rate can lead to a rise in the marginal cost of firms. But they also claimed that this would be more likely to happen to those industries which are relying on short-term finance for production.

In the context of the euro area, the empirical results of this channel remain controversial. Rabanal (2003 & 2007), by adopting a Bayesian framework, estimates a small-scale macroeconomic model and finds that the cost channel is not quantitatively significant in both the euro area and the USA. In contrast,
Tillmann (2008) argues that the supply-side version of the interest rate channel actually matters in both the USA and EMU. The author also states that, despite the USA financial market being more recognised as a market-oriented system while the euro area is closer to a bank-based financial system, the structure of financial markets is a minor influence on the existence of the channel. In contrast, Henzel et al. (2009) confirms the findings of Rabanal (2003 & 2007) and suggests that the cost channel in the euro area is insignificant. Moreover, the cost channel is only sufficient to generate the price puzzle if the degree of nominal wage stickiness is high or there is a low degree of price stickiness. In addition to the former, other studies recognise the existence of the supply-side version of the interest rate channel, but they also argue this channel is not pronounced in EMU compared with the USA (Chowahury et al. 2006, Hulsewig et al. 2006 & 2009).

The attention to the interest rate channel seems to have been switched from the demand side to the supply side of the economy. But to the best of our knowledge we did not find any literature either at the theoretical or empirical level which leads us to ignore the traditional interest rate channel. Of course, the purpose of monetary policy is to stabilise the fluctuations of price and the policy should not be used as a demand management tool, as this will only generate higher inflation in the long term. However, in practice, monetary policy does form a tool which can facilitate the growth of the economy, especially in the short run. The 2008 financial crisis gives us an example of monetary interventions. All major monetary authorities in Western countries, e.g. the ECB, the Bank of England and the Federal Reserve in the USA, were conducting expansionary monetary policies to rescue the economy from the danger of a long-term slump. Therefore, the relationship between the monetary instruments and the macroeconomic variables is still worth investigating, especially to policymakers when an appropriate policy needs to be established to offset economic shocks.

As we have already mentioned, price stickiness is a key element to the traditional interest rate channel. If the price/wage is highly volatile in response
Chapter 4 Effectiveness of the ECB single monetary policy in the Eurozone

to the present economic stance, then it is likely to have a weak traditional interest rate channel as the interest rate and the price changes will occur with a small time gap. In the case of the Eurozone, increased price flexibility is assumed to be one of the advantages to the Eurozone members following the granting of EMU membership, as monetary union will encourage improvements in factor mobility and flexibility across the union (Sibert 1999, Sibert and Sutherland 2000). Because membership implies the loss of monetary independence and restricted fiscal policy, it will encourage members to enhance policy reforms in the labour market to improve price and factor flexibility.

However, the improvements in price and factor mobility are likely to be constrained by the inevitable social and political costs of labour market reforms. Hallett et al. (2006) argue that the market is more flexible in the US than the Eurozone due to reform fatigue in EMU; in particular, wage flexibility is very low in the core compared with periphery member states. Dhyne et al. (2009) have produced a comprehensive report on the price rigidities in the euro area, which covers the post-EMU period. They argue the economic integration of EMU brings a negative impact to labour market flexibility rather than improvements to it. It shows that, inside the Eurozone, no fewer than 75% of firms can only adjust their wages once a year or even less frequently; price adjustments of goods and services are general relatively easier, but still no more than 50% of firms are able to adjust the price annually. Verhelst and Van den Poel (2010) also suggest that price rigidity is more severe in Europe than the USA, which is blamed on the aggressive short-term price strategy in the USA. The empirical results of wage/price rigidity in the euro area have shown indications of some failure in the reform of members’ labour markets. However, in the context of the interest rate channel, the low degree of price and wage flexibility in the Eurozone may suggest the probability of a place for the traditional interest rate channel to operate in EMU.
4.3.2 Asset price channel

The traditional interest rate channel emphasises the interest rate as the only cost of the acquisition of capital assets that determine the level of spending in the economy. However, altering interest rates also affects the price/value of assets, which is the determining influence on the level of spending. This is the reason why the Keynesian model has received objections from monetarists, who argue other prices also have a crucial role in determining macroeconomic outcomes, such as currency and equities, which forms another major channel of the MTM – the asset price channel.

Exchange rate channel

In an open economy, in the case of uncovered interest rate parity\(^{22}\), in terms of returns it is indifference to hold bonds in the form of either domestic or foreign currency. Because the expected arbitrages are identical to both domestic and foreign bonds, change in the domestic interest rate would lead to a differential between the domestic and foreign interest rates. This implies the possibility of arbitrage by switching the existing holdings of bonds from a low interest rate currency to a high interest rate currency. Therefore, the changes in monetary policy may lead to alterations in the exchange rates.

Dynamics of exchange rates have direct impacts on macroeconomic performance in the form of output. The mechanism of the exchange rate channel can be shown by the following: $\text{MS} \downarrow / i \uparrow \Rightarrow \text{E} \uparrow \Rightarrow \text{NX} \downarrow \Rightarrow Y \downarrow$, where NX denotes the net exports, and E represents the exchange rate. Once the monetary authorities adjust interest rates upwards, foreign investors may start to adjust their wealth portfolio by switching some of their assets into the currency with a higher interest rate (Wickens 1985, Obstfeld and Rogoff 1995). The increase in

\(^{22}\) Interest rate parity is uncovered when the no-arbitrage condition is satisfied without the use of a forward contract to hedge against potential exchange rate fluctuations. Investors are indifferent among the available interest rates in two countries; because adjustments of the exchange rate between those countries are expected to eliminate the potential arbitrage (e.g. the euro return on euro deposits is equal to the euro return on foreign deposits).
demand for domestic currency will create an upward pressure on the exchange rate, thereby leading to the appreciation of this currency. This can cause the decline of international competitiveness of exports and the imports become more favourable due to the relatively low prices. If other variables are assumed constant, the fall in net exports can lead to shrinkage in the level of national output. However, domestic inflation may be under downward pressure as the price of imports drops.

Globalisation and, in particular, the rise in cross-border production and trade indicate the importance of the exchange rate channel in the open economy perspective. For instance, with the share of international trade in the economy for a given change in import price expanding, the effect on domestic inflation should be more significant (Mishkin 2009). Hence, in the sense of globalisation and economic integration the economy may become more sensitive to economic shocks from overseas trading partners.

However, this is particular to the Eurozone because it has been commonly considered as a closed economy; thus the empirical analysis of the MTM usually excludes the exchange rate channel (Mojon and Peersman 2001, Peersman 2004, Cecioni et al. 2010). One reason behind this assumption is the relatively low proportion of trade in the overall weight of GDP. The trade to GDP ratio in EMU in 2008 was 40 per cent that is just 10 percentage points higher than the USA which is commonly treated as a closed economy (Cecioni et al. 2010). However, the relatively low trade to GDP ratio does not necessarily mean that the impact of the exchange rate on macroeconomic variables (e.g. inflation) is not pronounced in the Eurozone. In fact, it was suggested that this has an important and direct impact on domestic price fluctuations (ECB 2000).

Nevertheless, there are only a few empirical studies on the exchange rate channel in the case of EMU, with mixed results. Among them, Angeloni et al. (2003) find the impact on the exchange rate from monetary policy is difficult to measure inside the Eurosystem since the movements in both exchange rates and
interest rates closely linked at high frequencies. Thus, it is difficult to identify which is the actual cause of the change in another. Boivin and Giannoni (2008) find no evidence to show there is a systematic influence of global factors (e.g. exchange rates) on major macro-variables. Galati et al. (2007) have shown that, instead of following the assumption of interest parity conditions, interest rate differentials between domestic and foreign markets are always offset by the movements of exchange rates. Changes in the short-term interest rate would lead to one-to-one movements in the exchange rate, which magnify the effects of changes in interest rates on the real side of the economy. Favero and Giavazzi (2008) argue that it is inconsistent with the empirical evidence to treat the euro area as a closed economy since the long-term interest rates in the Eurozone respond to both US and European variables (e.g. inflation, output gap and short-term rates), and the US variables are more important to the long-term rates than these local variables, at both the pre- and post-EMU periods.

Despite the mixed results of the empirical studies, it is unadvisable to accept the assumption of the euro area being a closed economy as granted, since the trade GDP ratio is marginally higher than the USA (Cecioni et al. 2010); nor does the closed economy assumption simplify the empirical analysis. In fact, ignoring the foreign sector could cause the omission of important explanatory variables and be harmful to the understanding of overall effectiveness of EMU monetary policy. Thus, foreign variables such as foreign short-term rates and exchange rates with major trading partners need to be included, at least, as exogenous variables to the model.

**Equity effects**

Besides affecting the price of currency, monetary policy also has impacts on real economic activities through its effect on the valuation of firms’ assets. This forms the second approach to the asset price channel, which emphasises the relation between variation of the equity price and the level of spending.
**Tobin’s q theory** (Tobin 1969) suggests that monetary shocks impact on the level of spending, because they can lead to a fluctuation of equity price. In theory, firms are motivated to conduct investments through issuing new equities at a high price level, if the market value of the firm is higher than the cost of replacement capital and the acquisition of new machineries and premises. Tobin (1969) defined this relationship by using a parameter $q$, which is calculated by market value of the firm divided by the cost of capital replacements (or cost of investments). If the value of $q$ is high across the firms, it indicates that the investments will tend to be high at the aggregate level, and vice versa for the case of the low $q$ value. Moreover, the theory also assumes that the share price represents all available information about a firm because the equity market is sufficiently efficient, which means the fundamental value of the firm can be measured by the stock market valuation. The price of equity, therefore, should reflect the current and future expectation value of the firm. This means the $q$ value is the only necessary factor to use for evaluating investment demand of firms. The asset price channel through Tobin’s $q$ can be denoted as: $MS \uparrow / i \downarrow \Rightarrow P_{eq} \uparrow \Rightarrow Tobin’s \ q \uparrow \Rightarrow I \uparrow \Rightarrow Y$.

If we assume monetary authorities increase the money supply, which means there could be excessive supply relative to demand, households may replace the excessive money balance by other financial assets. Equity may become more popular than bonds given the decline in the interest rates (Mishkin 1996). As the consequence of a rise in demand of equities, values of firms are improved through higher share prices in the equity market. Eventually, investments will increase as the cost of capital acquisitions becomes lower relative to the value of firms – a higher Tobin’s $q$ value. The mechanics of Tobin’s $q$ theory seem straightforward; however, the main drawback of the theory is that the key variable – marginal $q$ – is unobservable. In practice, this theory usually fails to predicate investment behaviour of firms (Blanchard et al. 1993, Chirinko 1993, Bond et al. 2000, Bond and Cummins 2001, among others).

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23 The marginal $q$ is defined as $\frac{\Delta \text{ market value}}{\Delta \text{ capital stock (investment)}} = \text{marginal } q$. 

148
Thus, in practice, the average $q$ can be used, alternatively, if the production and cost functions adhere to the constant return of scale, and a firm is a price taker in all markets (Hayashi 1982). The simple form of an investment equation can be written as follows (see Bond and Cummins 2001):

$$\frac{I_t}{K_t} = a + b \cdot \left[ \frac{V_t}{(1-\delta)p^K_tK_{t-1}} - 1 \right]$$

(4-9)

where $I_t/K_t$ is the investment ratio at the time $t$, $V_t$ is the equity price of the firm, $p^K_t$ represents the price of capital at time $t$, $\delta$ is the rate of capital depreciation. $\frac{V_t}{(1-\delta)p^K_tK_{t-1}}$ is defined as the average $q$ of a firm at time $t$ with the capital asset of $(1-\delta)K_{t-1}$ that is carried from the past. If the value of marginal $q > 1$, the market price of the firm is greater relative to the cost of replacement capital, and then the new investment can be financed by issuing a number of shares against the existing capital assets of firms.

However, this alternative approach was criticised by empirical studies as the average $q$ model has failed to explain movements in investment. One of the main criticisms suggested that rather than following the key assumption of the average $q$ model, the fluctuation of share prices in the market is not purely caused by the fundamentals (Bond et al. 2000, Bond and Cummins 2001). The theory assumes that the movements in fundamentals should be reflected by changes in price of equities which represent the true value and all available information of firms. Even though theory assumes that the information can be fully accessed by market participators, the speculative nature of financial markets is too important to be ignored. Bond and Cummins (2001) argue that investments cannot be purely explained by share price, because the valuation in the equity market significantly deviates from the fundamental value$^{24}$ of listed

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$^{24}$The fundamental value is given by the market value less the speculation component; and the fundamental components are proxied by the value of sales, dividends, cash flow, and earning forecasts.
firms, which can be explained by the omission of the speculative bubbles in financial markets.

Two methods can be used to remodify the standard average $q$ model. First, the components of speculative bubbles are introduced into the analysis. Second, some other financial variables (e.g. cash flow, stock of liquid asset and working capitals etc.) are added into the investment equation. For the former method, Anderson and Subbaraman (1996) find that for Australia the fundamental component has a stronger impact than market equity price on the investment, which cannot be explained by the speculative component. Chirinko and Schaller (2001) showed the evidence for Japan during the late 1980s whereby investment was affected by the market bubbles during that period of time. In the case of the latter approach, Alonso and Bentolila (1994) detect the elasticity of investment to equity market movements in Spain, which are relatively low due to the poor financial market developments at that time. Ashworth and Davis (2001) investigate the G7 countries and find that the average $q$ is only significant for France and Japan. Assarsson et al. (2004) used a multivariate error-correction model to suggest that, besides the average $q$ model, other variables such as real output and capital gearing also determine the level of investment in Sweden.

Although these remodified Tobin’s $q$ methods, which were widely applied at the micro level in the previous literature, provide some useful extensions to overcome the weakness of the original theory in empirical applications, this may not be the case at the macro level of analysis. Because only public listed companies are capable of accessing funds from equity markets, while other small or medium enterprises can only obtain credit externally (e.g. bank loans or credit from non-banking financial firms), this might be one reason why empirical research is more concentrated on the credit channel to demonstrate the MTM. In this chapter we aim to evaluate EMU monetary policy at the aggregate level to consider the impact on the overall level of output and inflation, rather than solely focusing on a specific industry (e.g. firms are listed in the equity markets). Thus, the Tobin’s $q$ theory seems too unilateral to be used solely to explain the
MTM of EMU at the macro level. However, because of the above weakness of Tobin’s \( q \) theory, it is not necessary to ignore the asset price channel in our analysis. The equity price can be at least partially used to explain business investments (Alonso and Bentolila 1994, Assarsson et al. 2004). Furthermore, it is an important factor which affects the firms’ ability to access external funds.

4.3.3 The credit channel

The money view of the MTM (e.g. interest rate channel and asset price channel) emphasises the impact of prices or costs of the capital stock on aggregate demand. In contrast, the credit view of the MTM – the credit channel – argues that the fluctuations of aggregate spending are the result of the imperfect and asymmetric information in the financial market, which affects the real side of the economy through bank lending and balance sheet channels. In this view, the difference between the costs of funds raised internally – retaining earnings – and the costs of external financing – issuing equity or loans – reflects the external financial premium. The size of it represents the degree of imperfection in the credit market.

The credit channel is usually twofold: the bank-based channel (e.g. the bank lending channel and board credit channel, which includes banks and other non-bank credit providers) and the balance sheet channel. The former suggests that the dynamics of monetary contractions lead to changes in the adverse selection problems between creditors and borrowers, which affect the volume of loans supplied to borrowers. The latter emphasises that changes in monetary policy affect the financial stance of the borrowers.

In the view of the bank lending channel, the changes in real economic activities directly depend on the volume of credit supply from the banks. Banks have a special role to provide a channel to small and medium firms that can only access the credit market through bank loans (Bernanke and Blinder 1988, Stein 1998).
For example: $\text{MS} \uparrow / i \downarrow \Rightarrow \text{Bank deposits} \uparrow \Rightarrow \text{Bank loans} \uparrow \Rightarrow I \text{ and } C \uparrow \Rightarrow Y \uparrow$. Expansionary monetary policy through reducing the liquidity ratio leads to a rise in money supply, which will increase the available funds of the bank loans and lower the interest rates. Thus, borrowers can obtain loans more easily for investments and probably also raise consumptions of households if the spending partially depends on the bank loan (e.g. credit cards and short-term loans).

There are two conditions that have to be met, in order to make the bank lending channel work (Kashyap and Stein 1995). First, firms (at least some of them) must rely on loans from banks, as they are not able to raise funds from stock markets; second, the central bank must be able to adjust the level of the loan supply in the private banking sector. However, the key implication of this channel is that monetary policy is important to the small and medium firms, but is less crucial to the large firms that have a wider choice of ways to access credit. Therefore, the bank lending channel is more popular at the micro level but incapable of explaining the overall assessment of macroeconomic variables (Kashyap et al. 1993, Bernanke 1993, Valderrama 2001 and Butzen 2001, among others).

The broad credit channel, which includes all financial intermediaries in the market, is designed in response to the weakness of the bank lending channel. The value of financial intermediaries’ assets or, in other words, the balance sheet stance of those financial intermediaries will determine the supply of credit. The balance sheet of banks can be affected by monetary policy in two ways. First, expansionary policy can raise the asset price of banks which will immediately improve the balance sheets of banks. Second, the lower short-term interest rates would mean the higher net interest rate margins that banks profits are made from will improve the balance sheets of banks over time.

However, the changes in the institutional structure of financial markets have made the bank-based channel generally less important than before. First, the development in financial products makes the monetary policy less pronounced
through these channels. Altunbas et al. (2009) suggests that the recent developments, such as asset securitisation, augment the bank’s liquidity, reducing the impact of contractionary monetary policy on funds of banks. Hence, it reduced the importance of the bank lending channel of the MTM. In the case of moral hazard, Altunbas et al. (2009) also argues, asset securitisation can transfer at least part of the credit risks to other financial market participators, allowing banks to reduce the risk of loan repayment default. Thus, banks are better sheltered by intensive asset securitisation against the monetary shocks.

Purnanandam (2007) also shows that derivatives cause contractionary monetary policy to become less effective in controlling bank lending behaviour. Furthermore, globalisation and European economic integration also lead to the weakening of the bank-based channel. The cross-border merger and acquisition created internationally based large banks that are capable of responding to domestic liquidity shocks by transferring assets between different regions/countries and headquarters, which is necessarily making the domestic bank-based channel less effective (Cetorelli and Goldberg 2009).

The alternative approach to the bank-based channel of the MTM is the balance sheet channel, which was developed during the 1980s and 1990s (Bernanke and Gertler 1989, Gertlerand and Gilchrist 1994, Oliner and Rudebush 1996). This channel arises from the issues of asymmetric information which present between banks and borrowers, and emphasises the linkage between the financial stance of borrowers and volume of credit supplied by financial intermediates. The balance sheets of borrowers, which perform as financial health indicators, can be used to assess risks of potential defaults (e.g. how much collateral firms can use to guarantee their liabilities). An increase in net worth of borrowers implies more available collateral for loan credits, thus adverse selection becomes low, which means a rise in lending for investments. In contrast, lower net worth of borrowers would indicate a rise in the moral hazard problem, because it implies that the owners are more likely to engage in risky investment as they have less of an equity stake in their firms. Since high-risk
investment may imply the high probability of default, less credit will be offered to borrowers for their investment.

Monetary policy can affect the balance sheets of firms in several ways. First, it can improve balance sheets by increasing firms’ cash flow, since a fall in the short-term interest rates can reduce the interest expenses of firms’ existing loans. With higher cash flow, firms have a better finance stance, which allows them to conduct investment projects either through internal funds or by applying for loans from financial markets. Second, monetary policy can influence the equity price of firms as we mentioned earlier. Thus, improvements in the net worth of firms through higher share prices indicates more collateral available for liabilities (e.g. adverse selection), and owners of firms have less intention to conduct risky projects (e.g. moral hazard). Thus, funds from loans become more easily accessed by the firms, which will ultimately increase the level of investments. Mishkin (2007) argues that monetary policy could influence the net worth of borrowers, which is reflected by the stance of their balance sheets. Given the asymmetric information in the market, the assets of borrowers are collateral for their loans, and their value is a straightforward indicator of potential loss if the borrower defaults on the loan repayment. Empirical studies (Bondt 2004, Ashcraft and Campello 2007, Angelopoulou and Gibson 2007) suggest that the balance sheet channel is important to transmit the impact of monetary policy on spending and output in the euro area, the USA and the UK respectively.

The balance sheet channel is equally applied to household consumption. In principle, changes in the value of household assets (e.g. housing price) have direct effects on net worth of households. Since the problem of asymmetric information also exists between lenders and households, thus, changes in net worth of households could affect their ability to access credit, similar to the case of firms (Hatzious 2005, Benito et al. 2006). Aoki et al. (2004) suggest that the balance sheet channel for households has an important role, which is represented by the increase in responsiveness of consumption to changes in housing price. Muellbauer (2008) argued that the asset price may only be a
causal direct influence on consumption; however, it at least manifested the better ability of households to access credit by applying loans against housing wealth.

Moreover, in countries with well-developed financial markets, consumer spending may react to changes in monetary policy more sensitively through this channel. Calza et al. (2007) demonstrate that the correlation between the household consumption and housing price is related to the mortgage market characteristics in OECD countries; the elasticity of household consumption and output tends to be bigger in countries with more developed financial markets. Goodhart and Horfmann (2008) and Assenmacher and Gerlach (2008) also confirm that the responses of output to changes in housing price and monetary policy is stronger in Western industrialised countries like the UK, France, Germany and the US during the recent period than it was before.

In practice, it is difficult to distinguish the credit channel and the interest rate channel (Ciccareli et al. 2010). The credit channel emphasises the relationship between monetary instruments and level of loan supply. In contrast, the money view of the MTM focuses on demand for credit. However, both demand and supply of credit are unobservable variables. It is possible these two channels may operate simultaneously when monetary shocks occur. For example, a tightening in monetary policy can lead to shrinkage in volume of loan at the aggregate level, which can be explained through both money and credit views of the MTM. In the money view, decline in loan volume is through the interest rate channel as a higher market lending rate causes the drop in the demand for loans. In the credit view, decline in the supply of loans is responsible for the lowering of aggregate loan level.

In the presence of the credit channel, the interest rates on credit may respond faster to monetary shocks than the default risk-free interest rates. This implies that the interest rate spreads can be used as the method of identifying the credit channel in practice (Zurlinden 2005). However, this approach relies on the
availability of the data, which may not be available in all EMU countries. In addition, it is also difficult to apply a uniform method to all members, as the system of banking and financial markets remains heterogeneous across the Eurozone (Lensink 2002). Furthermore, there are another two factors which may also affect the identification of the credit channel. First, if credit rationing exists in the system, the interest rate spreads may not be discovered with the existence of the credit channel. This is because lenders may ration credit as a response to the monetary shocks, hence the spreads between interest rates of risky and default risk-free credit could remain unchanged. Second, there is a possibility of identifying the existence of the credit channel with the absence of its crux. For instance, following a contractionary monetary policy, the economy can be suppressed as the decrease in growth rates. This would imply a worse general economic environment and the higher probability of bankruptcies of some firms. A possible consequence is that the interest rate spreads of default risk-free and risky credit may widen even without the assumption of asymmetric information.

In order to solve the identification problem of the credit channel, the empirical studies have focused on the cross-sectional implications of the data at the micro level (e.g. data at the firm and bank level). Most of them only focus on the national level or on a small group of EMU countries. For example, Vermuelen (2002) investigates the importance of the balance sheet channel in Germany, France, Italy, and Spain; Martinz-Carrascal and Frenando (2008) also focus on the balance sheet channel of six euro area countries with help from the micro data; Valderrama (2001) and Butzen et al. (2001) estimate the bank lending channels in Austria and Belgium respectively. Valderrama (2001) uses the VAR method to suggest that monetary policy has a distributional effect in Belgium, as small firms are more sensitive to monetary shocks than large firms. Because the micro identification method only concentrates on the specified sector of the economy, it only provides some limited analysis. This implies the micro data approach is

Credit rationing is the case where borrowers are denied loans even when they are willing to pay a higher interest rate. This is because individuals and firms with risky investment projects are the ones who are willing to pay the highest interest rates. Thus, higher interest rates increase the adverse selection problem and lower interest rates reduce it (see Stiglitz and Weiss 1981).
unable to evaluate the overall effects on macroeconomic variables from the monetary shocks (Kashyap and Stein 2000). In addition, because loan demand and supply cannot be directly observed in the market, the micro data method restricts the assumptions of loan demand changes by using actual granted credit, which implies the difficulties of quantifying the relative impact on real activities of changes in loan demand and supply.

Overall, among these existing empirical studies, the results are rather mixed. Many studies have focused on a specific channel, which may come with several issues. First, these results are incapable of assessing the overall effectiveness of monetary policy. By only concentrating on a specific channel of the MTM or a single driving force, they could omit others which may also have a substantial effect on real economic activities. Moreover, these channels and forces may work in the same direction as the specified channel/driving force to enhance the effectiveness of monetary policy, or they may operate in a different direction which actually brings a negative impact on policy goals. Second, it requires some empirical methods to isolate these specific channels from other potential factors, but it is difficult to separate a specific channel from others. In fact, different channels are actually co-intervening with each other (Worms 2004, Black and Rosen 2007) (e.g. the asset price and balance sheet channels). Hence, it would generate a limited and inconclusive explanation of the overall effects of monetary shocks if the analysis simply focused on a specific channel of the MTM. In contrast with previous empirical works, through being independent from any specific channel of the MTM, we will analyse the aggregate level date to check the overall impact of monetary policy on real economic activities as a whole at both union and national level.

Peersman 2011). Among them, the focus is either on the union aggregates, or on the national level for some selected Eurozone members. However, the understanding of the effects of EMU monetary policy cannot be studied based solely on the union-level aggregates. Furthermore, the concentration of research is also inappropriate if it relies on the national-level data of a few major economies. Moreover, both approaches analyse the effects of monetary policy by using only limited information and omitting the data of other members of the Eurozone.

Finally, among existing literature, the vector autoregression (VAR) method is one of the most frequently used approaches to assess the effects of monetary policy on macroeconomic variables (Peersman 2001, van Aarel et al. 2003, Rabanal 2003, Peersman 2004, Favero and Giavazzi 2008, Weber et al. 2009, Peersman 2011). The benefit of using VAR to estimate the effects of the central banks’ actions is its ability to deliver empirically credible responses of macroeconomic variables without imposing burdensome restrictions on the dynamic structure of the model. Like other time series methods, the VAR system is also heavily dependent on the scale of the time series data. Therefore, the common issue of the previous literature is that the adequacy of the VAR method is questionable due to the relatively small time span of available data on EMU. The data for some major members of EMU, e.g. Germany and France, may be sufficiently large to run a time series VAR, and these countries contribute a large proportion of union-level GDP and other macro aggregates. However, the results from studying these key EMU members are too narrow to be used as the proxy of the whole union.
4.4 Methodology – panel vector autoregression model

In the previous section, we reviewed the recent empirical literature studying the impact of monetary policy on macroeconomic variables for both Eurozone members and other major developed economies. Given the complexity of channels that monetary policy takes to influence overall economic activities, there is no single monetary transmission mechanism that can be solely used to study the question of the overall effects of monetary policy instruments on key economic aggregates. Moreover, it also requires complex methods to isolate a chosen MTM from other MTM channels, which usually means a partial focus in the research. Since we aim to check the overall effectiveness of the ECB’s monetary policy on the Eurozone’s macroeconomic performance, rather than studying any individual MTM channel, we need an appropriate econometrics technique which allows us to establish an approachable and comprehensive method to implement this empirical analysis. Thus, in this subsection of Chapter 4, we will review a chosen method that will be adopted for the purpose of evaluating the overall impacts of ECB monetary policy.

4.4.1 Vector autoregression (VAR) estimation

Sims (1980) suggests that using a traditional large-scale econometrics model restricted by its ‘incredible’ assumptions on identification, where variables are segmented into the categories of endogenous and exogenous to the model, ignores the possibility of interdependence between variables, as well as being incapable of testing such interdependence relationships. In response to the weakness of traditional methods, Sims (1980) suggests that if simultaneity is truly the case among variables, then the interdependence of variables needs to be considered, therefore all variables should be treated as endogenous to the testing model.
Chapter 4 Effectiveness of the ECB single monetary policy in the Eurozone

The main criticism of applying VAR methods to study monetary policy states that the behaviour of private agents is forward-looking rather than backward-looking, but VAR cannot measure the forward-looking component of monetary policy, thereby VAR is incapable of properly measuring the monetary shocks. In particular, the dynamic stochastic general equilibrium (DSGE) model is suggested as a popular alternative to the VAR method (Rabanal 2003 & 2007, Huelsewig et al. 2006, Lee 2009). Nevertheless, a different strand of literature (Ball 1999 & 2000, Estrella and Fuhrer, 2002) argues that the backward-looking models are appreciable in at least two important aspects. They tend to offer a good fit with the data, and their dynamics closely resemble those filtered with VARs. Despite the increase in popularity of the DSGE approach, the VAR method still retains its position as one of the most commonly used approaches to study the impacts of monetary policy.

In addition, as we have mentioned earlier, there is no comprehensive model which covers all channels of the MTM. Each MTM theory only focuses on a particular channel with concentration on a relatively small number of variables. Under this weakness of theories of the MTM, the VAR method offers a flexible analytical system where dynamic relationships can be quantified based on a minimal theoretical structure (Arias 2007).

The simple two-variable, first-order case of the VAR system can be written as:

\[
\begin{align*}
  x_t &= \alpha_{10} + \alpha_{12} y_t + \beta_{11} x_{t-1} + \beta_{12} y_{t-1} + u_{xt} \\
  y_t &= \alpha_{20} + \alpha_{21} x_t + \beta_{21} x_{t-1} + \beta_{22} y_{t-1} + u_{yt}
\end{align*}
\]  

(4-10)

The values of \( x_t \) and \( y_t \) depend on each other’s current and past values and their own current values. The error terms \( u_{xt} \) and \( u_{yt} \) are uncorrelated white noise disturbances with constant variance. Equation (4-10) can be written into a more compact format as:

\[
AZ_t = A_0 + A_1 Z_{t-1} + u_t
\]

(4-11)
which represents the following:

\[
\begin{bmatrix}
1 & \alpha_{12} \\
\alpha_{21} & 1
\end{bmatrix}
\begin{bmatrix}
x_t \\
y_t
\end{bmatrix}
= \begin{bmatrix}
\alpha_{10} \\
\alpha_{20}
\end{bmatrix}
+ \begin{bmatrix}
\beta_{11} & \beta_{12} \\
\beta_{21} & \beta_{22}
\end{bmatrix}
\begin{bmatrix}
x_{t-1} \\
y_{t-1}
\end{bmatrix}
+ \begin{bmatrix}
u_{xt} \\
u_{yt}
\end{bmatrix}
\]

\[\begin{bmatrix}
A \\
Z_t \\
A_0 \\
A_I \\
Z_{t-1} \\
u_t
\end{bmatrix}\]

The simple VAR system represented by equations Equation (4-10) cannot be directly estimated, because of the correlation among \(x_t\) with \(u_{xt}\) and \(y_t\) with \(u_{yt}\). Therefore, we can multiply Equation (4-11) by \(A^{-I}\), which helps us to generate a standard reduced form of the VAR system:

\[
Z_t = \Gamma_0 + \Gamma_1 Z_{t-1} + U_t \quad (4-12)
\]

where \(\Gamma_0 = A^{-I}A_0\); \(\Gamma_1 = A^{-I}A_I\) and \(U_t = A^{-I}u_t\). The standard form of the VAR model does not present the estimation problems of the structural form, which we mentioned in an earlier paragraph. In this reduced form of the two-variable VAR system, the errors \(U_t\) are composites of the white noise processes \(u_t\) and therefore have zero means and constant variances and are individually serially uncorrelated.

More generally the VAR system can be written as:

\[
Y' = B'^1 + \sum_{l=1}^{p} B'^2 Y'_{t-l} + \eta' \quad (4-13)
\]

Where \(Y'\) is a \(k \times 1\) column vector of endogenous variables; \(B'^1\) is \(k \times 1\) column vector of specific intercepts; \(B'^2\) is \(k \times k\) parameter matrices; \(\eta'\) is the \(k \times 1\) white noise error term, which allows the tolerance of serial correlation to appears in the model \(E (u_t, u_{t+s}) \neq 0 (s \neq 0), \eta_t = \rho \eta_{t-1} + \text{stochastic disturbance.}\)
4.4.2 Format of data set – using panel data instead of time series

Time series is a common selection and a popular format of data sets available for macroeconomic studies. It is favoured by economists because of its rich properties in variety estimation methods and massive quantities of empirical application of them. However, the unbiased estimates of parameters not only rely on the correct specification of models and application of appropriate tests; it also and more importantly requires the data set to contain sufficient large numbers of observations of well-defined data items obtained through repeated measurements over time – the large T. However, if the size of T is small, the estimated coefficients may not represent the true value, even when the t-value and F tests are significant.

An insufficient number of observations over a small time period may shatter the estimation of parameters. This could be the real issue in the research on monetary policy in the euro area. The short operational history of the Eurozone had already become a concern for empirical research: ‘Unfortunately, studying the monetary policy transmission process in the euro area is difficult at this stage, due to the extreme scarcity of data’ (Angeloni and Ehrmamm 2003). There are several ways to count the length of the euro area; if we treat the formal starting point of the Eurozone as Stage Three of EMU, which is from January 1999, the euro area only has 12 years’ history up to the year 2011.

However, if we adjust the period of changeover – replacing individual members’ old national currencies by euro notes and coins between 1999 and January 2002 – the history of the euro area shrinks down to nine years. Of course, we could include Stages One and Two of EMU, to expand the size of T from 12 years to 19 years. However, it does not provide significant improvements on the size of the data: there only would be 19 observations on each variable for each member state if annual data is assumed to be used. Of course, we can use quarterly data instead (monthly data are not commonly available to aggregate macro data), and therefore have bigger expansion on the number of observations for each
member state, $X_1 = 76$, based on which the size of the data should be sufficient for time series analysis. Nevertheless, the issue attracting attention here is the availability of quarterly data for each EMU member.

Sousa (2010) applies VAR method with quarterly data from 1980:1 to 2007:4, which estimated the euro area and its eight major economies separately. The author find that a substantial fall in wealth follows monetary contraction, the fall in housing wealth lasting much longer than financial wealth in the euro area. Gelain (2008) applies the dynamic stochastic general equilibrium model (DSGE) to union-level quarterly time series data, to test the credit channel of the MTM in the euro area. Furthermore, Rafiq and Mallick (2008) apply VAR methods to time series quarterly data on France, Germany and Italy to estimate the impacts on output by monetary shocks, their data covering 1980:1 to 2005:4. All these works estimate a specific channel of the MTM at union level or/and with comparison to a few major euro members to broaden the picture. Their data covers up to the last 30 years with a minimum of at least 80 observations, which seems to be sufficient to run a time series analysis.

However, if the research aims to include all member states to produce a comprehensive study of Eurozone, sufficient and consistent length of time series data may not be feasible for all 17 member countries. If quarterly data is available for each variable of each single country, but the data covering the 1980s for the former communist countries (e.g. Slovakia, Estonia etc.) is unreasonable to use, because their economy was managed under the planned economy regime at that time, the figures may be invalid to be tested under the economic theory based on the market economy regime. The time period the data therefore should cover is from no earlier than the 1990s up to now, if all current EMU member states are included in this study. Thereby, we can eliminate the potential problematic data from the former communist period.

Furthermore, a small data set will typically suffer a lower degree of freedom if dummy variables are included in the model which aims to take the effects of
certain events on the error terms. The solution to overcome the above fundamental problem of this research is using panel data to increase the numbers of observations. For each variable we choose, assuming only annual data is applied, we can obtain at least \( N \times T = 17 \times 20 = 340 \) observations, where \( N = 16 \) entities, \( T = 20 \) years. Macroeconomic panel data is usually rarely available for researchers, but we can collect the time series data for each EMU member, and pool them into a single data set to create our ‘artificially’ made panel data. This method is also known as the pooled cross-sectional time series data.

4.4.3 VAR combined with panel data – panel vector autoregression (PVAR)

Like other time series methods, the VAR system is also heavily dependent on the scale of the time series data. Due to the relatively small time dimension of available data, the adequacy of the VAR method is questionable. For instance, the issue of using time series VAR method is the decision of how many lags researchers should put into the model. During estimation of the multivariable VAR system, their lags can seriously consume the degrees of freedom, in particular with small time period data sets. To overcome this drawback, we could pool the time series across the different union members to generate a panel data set, which can substantially increase the efficiency and the power of the analysis.

Holtz-Eakin et al. (1988) provide a benchmark study on applying the VAR method to the panel data. The original motivation is to suggest that the advantage of the VAR model – the capability to analyse the dynamic relationship between variables and the causal relationship among them, which can be equally applied to the panel data. In particular, they mean applying the VAR method to microeconomics, as the data on micro units is usually short in time series, but rich in panel data. Despite the original motivation of PVAR being to apply VAR to micro databases, the advantage of this method is that it can also be applied to macroeconomic research. Gavin and Theodorou (2005) argue that by adopting a panel approach in a macroeconomic framework, it helps to uncover common
dynamic relationships which might otherwise be obscured by individual country-level analysis. The PVAR method is now becoming popular for cross-country analysis of the monetary policy (Assenmacher-Wesche and Gerlach 2008, Goodhart and Hofmann 2008, Boivin et al. 2009).

Moreover, PVAR is the application of the VAR method to panel data, but the principle of the model is the same as its time series counterpart, which means the model can be easily applied to test the dynamic relations among variables and only requires minimum restrictions on the model, especially compared with another alternative macroeconometric model – the dynamic stochastic general equilibrium model (DSGE) (Canova and Ciccarelli 2013). In the case of the DSGE model, it builds up a ‘large and complex’ framework that contains multiple sectors, agents, markets; each market’s constraints are specified and agents in each sector of the economy are assumed to maximise their goal (or minimise the loss) subject to those constraints. Since the DSGE model attempts to cover the entire economy, it is usually seen as, probably, one of the most comprehensive/advanced techniques we can use to study macroeconomics. In particular, it helps to evaluate and provide good analysis on the impact of the government’s economic policies.

However, unlike a straightforward ‘pure’ econometric method, the DSGE model can be seen as a combination of a mathematic modelling of a ‘designed’ economic scenario with an econometric estimation of it. As the first step in building up this model, relevant economic theories have to be selected to create the ‘designed’ economic scenario. The new consensus macroeconomics (NCM) model is commonly used as the theoretical building blocks of DSGE, which contains some of the key neoclassical concepts such as rational behaviour and expectations of agents, and the market tending to clear itself after the short-run. Given such restrictions on how the economy should behave at a micro level, which collectively explains the macroeconomic activities at the aggregate level, the outcome of this kind of model is possibly misleading.
Chapter 4 Effectiveness of the ECB single monetary policy in the Eurozone

First, the assumption of the rational expectation of economic agents can be problematic. The Lucas theory argues that, by using all available current information, average expectation of all economic agents tends to be equal to the ‘true’ future events, which also matches the predictions of relevant economic theory (Lucas 1972). One of its implications is the rational behaviour of agents. As agents are able to ‘perfectly’ predict the future outcome from current events, future uncertainty tends to be unimportant; therefore, economic agents are less likely to behave irrationally given that others’ behaviours will average the irrational behaviour out. Since rational expectation theory emphasises that today’s value of a variable (e.g. price) depends on expectation of the future price; in other words, future price also depends on expectations of the future’s future price. This relation can extend to the infinite.

However, as rational expectation operates under the assumption of unique future market equilibrium, the model can be undetermined when we extend the equation to infinity, which may contain multiple future equilibriums. Hence, this implies the existence of possible future uncertainty, which prevents economic agents behaving rationally at all times. According to the prospect theory (Kahneman and Tversky 1979), with the presence of uncertainty, the behaviours of agents are not in line with neoclassical assumptions of maximising profit and utility, and economic agents’ behaviours are more likely to be risk-averse. Therefore, the behaviour of economic agents is unlikely to be constant over time; economic decisions are largely affected by the changes in uncertainty and expectation. In fact, human behaviour may not be fully explained by the probability theory, but can be understood using the ‘animal spirits’ argument which was suggested by Keynes in 1936 as an approach to explain investment behaviour and consequently macroeconomic performance.

Moreover, another issue with the theoretical foundation of the DSGE model is its assumption of a clear market. The market is assumed to be always moving towards equilibrium. This relies on well-behaved economic agents with good quality and good availability of information (their rational
expectation/behaviour). However, since the assumption of rational expectation and behaviour of economic agents can be overly optimistic, it is not surprising to see the assumption of a clear market receiving a lack of empirical support. For example, Akerlof (1970) proves that under many circumstances markets do not tend to be optimised and not even clear. Spence (1974) and Stiglitz (2003) both argue that due to the asymmetric information in the market, there are no automatic adjustments that allow the economy to reach full employment automatically. Moreover, Williamson (2002) has developed a ‘transaction theory’ which argues that, due to the difficulties and costs of collecting information, it is impossible or too expensive to gather all required information for each economic transaction; hence, frictions during the market adjustment process are inevitable and prevent the full adjustments from taking place.

Therefore, since the basic theoretical foundation of the DSGE model has its shortcomings in relation to the realistic economic environment and behaviour of agents, the DSGE model should not assume that the designed economic scenario could always permanently and automatically move towards a unique equilibrium if the model was built with more realistic assumptions. However, if we allow the model to contain more realistic assumptions of the real world, then the outcome of the model may show a path of an economy moving towards an unbalanced and disequilibrium economy, which requires government intervention through active fiscal or monetary policy. This is in conflict with the fundamental policy implication of NCM or neoclassical macroeconomics theories.

In addition to the issues of DSGE’s economic theoretical assumptions, in terms of its practice – model estimation – it also has some shortcomings. The key issue of the DSGE model relates to identification of parameters. Canova and Sala (2009) have summarised these identification problems of which the DSGE model usually experience\(^{26}\). First of all, the mapping between structure parameters and

\(^{26}\) Only relatively small numbers of studies have been done to address the problem of identification for the DSGE model. This is mainly due to its computational issues. For more details, see Iskrev (2008).
reduced form statistics is not unique given that the population objective function does not have a unique maximum or minimum. This indicates that different models with potentially different interpretations may not be distinguishable. This problem is known as *observational equivalence*. The second problem is *under-identification*, which happens when the objective function is constant for all values of that parameter in a selected range. For example, parameters can disappear from the solution of rational expectations. *Weak identification* is another identification issue DSGE model may have, even when all parameters can enter the population objective function separately, and the population function does have a unique maximum/minimum. But the curvature may be small, which means different values of the parameters around the neighbourhood may lead to the same value of the objective function.

Moreover, another source of identification problems is small sample size. Under such conditions, the significant bias on parameter estimates can arise, which induces economic dynamics that differ from those of the true data-generating process. This problem can be especially relevant to this research. As we are trying to estimate the impact of the ECB’s monetary policy during the post-EMU period which started from 1999, the sample size of those key macroeconomic variables only consists of several dozen observations.

Overall, the advantage of the DSGE model implies its potential problems. Due to its complexity and full coverage of the whole economy, this model usually requires many restrictions to allow each element of data and each sector of the economy to coordinate with the others, and hence, to allow the model to work. That means the model may contains overly strict assumptions which means the study tends to be a benchmark analysis (Canova and Ciccarelli 2013). The realistic assessment which policymakers need for understanding the impacts of their policy under real world conditions may not be always fully addressed.

In comparison to this, PVAR as an alternative model for study policy impacts for macroeconomic analysis, which assumes every variable is endogenous, tends
to discover the information underlined by data without imposing many restrictions on the analysis. Since all variables are endogenous and assumed to be correlated with each other, this assumption allows the PVAR to have similar features to the DSGE model, which enables us to study an economic problem more closely to the real world situation, but it is easier to implement. Moreover, the panel data approach enables us to solve the problem of limited small sample size, which is the current issue in EMU-related empirical research. Furthermore, the DSGE model is a time-series-based analytical approach, whilst we are trying to analysis EMU as whole, but do not wish to lose the information from the national level; hence, the panel data method was chosen to be used, which allows us to take the members’ data into account and also improves the sample size, which is crucial to the estimation bias.

The particular technique to be used here is that of pooling the time series data across different entities to form a panel data set. The fundamental idea behind this method is that all entities are characterised by the same regression equation at all points in time. The standard form of the estimation equation is:

$$Y_{it} = \alpha + \sum_{k=1}^{K} \beta_k X_{kit} + e_{it} \quad (4-14)$$

where the $i = 1...n$, $N$ entities; $K = 1...k$, $K$ regressors; $t = 1...T$, $T$ time dimension; $\alpha$ is the common intercept for all entities; $\beta_k$ represents the coefficients of each regressors; and $e_{it}$ is the error term for each entity. However, this standard form of panel data equation has one major drawback, which is that the intercept and coefficients of each regressor are assumed to be identical for each entity.

As we are applying the panel approach to the VAR method, it is necessary to consider the issue of panel data analysis. The fundamental assumption of the panel data method is that it assumes the underlying structures of cross-sectional units are the same. Here, this refers to the economic structures of EMU member countries being the same. However, this restriction is usually violated in practice, which may especially be true for our research.
The ECB runs the union-level monetary policy across the whole region; in
principle the policy is independently made, and no individual or group of
members is capable of pulling the weight of policy toward to their own interests.
Therefore, the euro area monetary policy is designed to stabilise the union-level
economy based on union-level data. In the case of this chapter, we are not only
aiming to estimate how monetary policy affect the real economy based on union
level aggregates, or simply adding a small number of major members into the
estimation (e.g. Dornbush 1998, Ramaswamy and Sloek 1998, Peersman 2004,
2010). We aim to analyse the effects of monetary policy in EMU through using of
national level data, which includes all existing member states of the Eurozone. In
respect to the differences of economic structure among the members, the
intercept and the coefficients of regressors are likely to be different across the
entities. If we establish the model without building individuality into the model,
the error term will be forced to absorb the effects of individuality of members,
\( \text{Var} (e_{it}) \neq \sigma^2 \) a constant \((i = 1,2...n)\).

One way to overcome this drawback of the panel method is to introduce fixed
effects; therefore, individual heterogeneity can be built into our model. Verbeek
(2004) states that introducing fixed effects intuitively makes sense if each
individual in the sample is ‘one of a kind’, and cannot be viewed as a random
draw from some underlying population. This interpretation may be more
appropriate when \( K \) denotes countries. Thus, the standard form of our PVAR
model can be written as:

\[
Y'_{i,t} = B^1 + F_i + \sum_{p=1}^{P} B^2(p)Y'_{i,t} + \delta^t_{i,t} \quad (4-15)
\]

where \( Y'_{i,t} \) is k × 1 column vector of endogenous variables of each N entities, \( i = 1,2,...N \). \( B^1 \) is i × 1 vector of common intercept. \( B^2(p) \) is the kp × i matrix of slope
coefficients of K endogenous variables of the N entities; \( p \) is the lag order. \( F_i \) is
country-specific fixed effects. \( \delta'_{i,t} \) is the \( i \times 1 \) column vector of the white noise error term.

The standard way to estimate a VAR system like Equation (4-15) is applying OLS methods, which severely depends on the numbers of observations. This is known as a Hurwicz-type bias that is inherently live with dynamic modelling. As the Hurwicz-type bias approaches zero if numbers of observation go to infinity, it may not always receive much attention in time series analysis because VAR studies usually contain sufficiently large numbers of observations. However, it could be an issue common to the panel data approach as the Hurwicz-type bias does not depend on the size of cross sections (Nickell 1981). Even when cross sections go to infinity, the size of the bias still negatively depends on the numbers of time series dimensions in panel dynamic models with fixed effects.

In order to overcome this weakness of panel dynamic estimation, an alternative estimator – GMM – has been proposed to replace the standard OLS estimator (Arellano and Bond 1991, Arellano and Bover 1995). Since the fixed effects may cause bias due to the correlation between our country-specific effects \( F_i \) and lags of dependent variables, we can apply the Helmert procedure (Arellano and Bover 1995) to eliminate this bias, which is also referred to as forward mean differencing, i.e. the contemporaneous correlation can be removed by applying forward mean differencing after time-demeaning our variables instead of normal mean differencing (Bos and Stam 2011). Since the Helmert transformation preserves the transformed variables and lagged regressors are orthogonal, coefficients can be estimated under the GMM system by using lagged regressors as instruments.

**4.4.4 Benchmark PVAR**

From the above section, we have established the baseline econometrics technique for this chapter: 1) by pooling the time series data across the different
entities (EMU and euro members), panel data will be created to overcome the possible issue of a short data set, which is mainly caused by the relatively short history of EMU; 2) a PVAR method\(^{27}\) will be applied to estimates of the responses of different variables to monetary shocks at both union and national levels. In this subsection, we will present more details about the methodologies for this chapter.

In some previous literature it is not unusual to see that the Eurozone has been described as a closed economy with the exclusion of the exchange rate channel of the MTM (Mojon and Peersman 2001, Peersman 2004 and Cecioni et al. 2010). At the first stage, we will analyse the MTM in the closed economy model; it implies that the variables we choose will exclude those that may contain the international features, e.g. effective exchange rates, balance of payments, variables of foreign trading partners etc.

The general form of the model is a restricted version of the multi-country VAR approach that is raised by Canova and Ciccarelli (2009), which takes the general form of Equation(4-15):

\[
Y'_{i,t} = B^1 + F_i + \sum_{p=1}^{P} B^2(p)Y'_{i,t} + \delta'_{i,t}
\]

where \(Y'_{i,t}\) is \(k \times 1\) column vector of endogenous variables of each N entity, \(i = 1, 2, ..., N\). \(B^1\) is \(i \times 1\) vector of common intercept. \(B^2(p)\) is the \(kp \times i\) matrix of slope coefficients of \(K\) endogenous variables of the N entities; \(p\) is the lag order. \(F_i\) is country-specific fixed effects. \(\delta'_{i,t}\) is the \(i \times 1\) column vector of white noise error term.

\(^{27}\) The panel VAR estimation will be performed by using the updated version of Love’s (Love 2006) PVAR STATA automatic dofile (unofficial third-party STATA upgrade package), which was written by Dr Yujun Lian at Lingna College, Sun Yat-Sen University.
4.4.5 Data set

Source of data

Our macro-level panel data covers the period from 2000:Q1, when the first wave of EMU creation was completed (Greece joined EMU), to 2011:Q3, which forms N*T=810 observations for all EMU members. Given the overall goal of this chapter (e.g. trying to estimate the impact of ECB monetary policy on the overall economic performance and also see its impacts on the other subsections of the economy that are relevant to the transmission of the monetary policy; moreover, to study the interactions between those key areas of the MTM and overall economic activities), we include various variables which form different channels of the MTM into our PVAR model. The endogenous variables in basic estimation are: real GDP (RGDP), real short-term ECB interest rates (IR), quarterly share markets indices (SI), housing price index (HPI), inflation (HICP); monetary base (M1); and real effective exchange rate (EER); these will be considered as well after the completion of basic estimation.

RGDP data, narrow money supply (M1) and real effective exchange rates are all collected from the Eurostat database. Short-term interest rates are measured by the quarterly central bank interest rates. Due to data unavailability for Estonia for the period 2000 to 2010, quarterly money market interest rates are used as the alternative measurement. Cyprus joined the Eurozone after 2007, hence the national central bank interest rates are chosen to be used for this period. The inflation rate is measured by the percentage changes in the consumer price index, which are published by the IMF.

Housing price index (HPI) data for countries like Germany, Ireland, Italy Luxembourg, the Netherlands, Portugal and Slovakia is collected from the Bank of International Settlements (BIS). However, the BIS only provide half-year data for HPI, and expected Portuguese data is monthly; therefore, linear interpretation was conducted to convert half-year data to quarterly data for these countries. Data for Estonia is unavailable for the period 2000:Q1–2003:Q2.
HPI for Cyprus is only available from the ECB database, which covers the period 2006:Q1–2011:Q3. For Slovenia data is available from 2003, which is collected from the ECB (2003:Q1–2011:Q1) and BIS (2011:Q2&Q3). HPI data is from Eurostat, which covers the period 2006 to 2011. Share market index data is all collected from Eurostat, but with some missing data. Data for Cyprus can only be found from 2004. Data for the period 2010:Q4–2011:Q3 is unavailable for Slovenia.

**Ordering of data**

The focus of this chapter is to produce impulse response functions that help us to estimate the response of one variable in the system to the shocks of another in the PVAR system while others are holding constant. A particular order has to be set up, since the assumption of identification, which is the variable that comes earlier in the order, affects the following ones contemporaneously as well as with a lag. The variable coming later only affects the previous one with a lag. This is a usual convention of the VAR system; since the variance–covariance matrix of errors is unlikely to be diagonal, to isolate shocks to one of the VAR errors it is necessary to decompose the residuals in such a way that they become orthogonal (Durlauf and Blume et al. 2010).

Therefore, in our basic estimation the orthogonalised shocks will be recovered by adopting Cholesky decomposition with the following ordering of variables:

\[
Y = [RGDP \ HICP \ IR \ HPI \ SI]
\]

According to standard monetary theory (Christiano et al. 2000) and common practice of empirical studies of it (Peersman 2001, van Aarle et al. 2003, Rabanal 2003, Peersman 2004, Favero and Giavazzi 2008, Weber et al. 2009, Peersman 2011), output and price are placed before the interest rate in the ordering of endogenous variables. The other two endogenous variables are stock market index and housing price index. At this stage we will order housing price before the stock market. We are assuming that, in response to monetary and
Chapter 4 Effectiveness of the ECB single monetary policy in the Eurozone

Macroeconomic shocks, housing price is relatively stickier than share market price.

4.4.6 Lag length selection

Before we start conducting the analysis through the PVAR model, it is essential to select an appropriate lag length, which is just the same as running a conventional regression of time series VAR. In general, there are two ways to select lag length. First, maybe, is the relatively unpopular one is that by methods of running the analysis many times to generate the residual sum of squares (RSS) for each lag length, e.g. lag length = 1,2,3,4,... By comparing the values of these RSS, we would be able to select a lag length which could produce better results. However, the problem of this approach is that we may have a few lag lengths that produce very similar, or even almost identical, values of RSS. If this is the case, we may have to select one subjectively.

In order to overcome the above weakness, the information criterion can be used as the alternative approach, which may be more popular than the former, to decide the appropriate lag length for analysis. Three main information criterion (IC) methods are widely adopted in empirical studies: Akaike’s IC (AIC), Baysian IC (BIC) and Hannan and Quinn’s IC (HQIC). The equations of these three IC methods are listed as below:

\[
AIC = [M \times \ln(2\pi) + M + \ln|\hat{V}|] + \frac{2k}{N^*}
\]

\[
BIC = [M \times \ln(2\pi) + M + \ln|\hat{V}|] + \frac{\ln(N^* \times k)}{N^*}
\]

\[
HQIC = [M \times \ln(2\pi) + M + \ln|\hat{V}|] + \frac{2 \ln[\ln(N^*) \times k]}{N^*}
\]

where \(M\) represents the numbers of endogenous variables; \(\ln|\hat{V}|\) defines the value of RSS; \(k\) is the number of parameters that can also be written as \(M^2 \times p\); and \(N^*\) is the total numbers of observations that can be calculated as \(N^* = N \times \)
(T,p). The fundamental ideas of these three IC methods are actually the same: using the sum of RSS and the numbers of parameters as the judgemental criteria for lag length selection.

The term $M \times \ln(2\pi) + M$, which appears in all three equations, is a constant term that is not related to goodness of fit or numbers of parameters. That means this constant term will not change if the lag length changes. Therefore, following the suggestion of Lütkepohl (2004), we can eliminate $M \times \ln(2\pi) + M$ from all three equations to get:

\[
AIC = \ln|\hat{\sigma}| + \frac{2M^2 \times P}{N^*}
\]

\[
BIC = \ln|\hat{\sigma}| + \frac{\ln(N^*) \times k}{N^*}
\]

\[
HQIC = \ln|\hat{\sigma}| + \frac{2\ln[\ln(N^*)] \times (M^2 \times P)}{N^*}
\]

It is not unusual to find that the results of the above three IC methods are different. Hence, the subjective selection of lag length may not be fully avoided. In this case, we may follow Lütkepohl (2004) who suggested that BIC and HQIC may be more preferable to the AIC given that the AIC is usually a more conservative method that usually gives a relatively large lag length when the sample towards infinite. In contrast, BIC and HQIC will tend to produce a smaller lag length. The bigger lag length can consume degrees of freedom significantly, hence, this difference between these three IC methods is more relevant to a relatively small sample.
4.5 Empirical results – the effectiveness of ECB single monetary policy

In this section, we will present the empirical analysis of the effectiveness of the ECB’s union-wide monetary policy by adopting the PVAR method as our econometrics technique, which enables us to estimate the impact of the policy on the Eurozone through the consideration of national-level data collectively rather than simply using union-wide aggregates. The analysis begins with evaluating the overall effects of ECB interest rate policy on the entire Eurozone (17 current members), followed by a study of the original 12 members who joined EMU during the wave. Since some members had poor adherence to the Maastricht Convergence Criteria during the pre-EMU period (and were also badly affected by the 2007–8 financial crisis), we also tried to investigate whether ECB monetary policy had been more effective for those core members of the Eurozone who generally achieved better performance in terms of business cycle synchronisation than for those troubled periphery members, most of whom have low degrees of cycle convergence.

Finally, we added monetary aggregates and exchange rates into our analysis. For the former, we aimed to see if the Eurozone’s economic activities were sensitive to money supply shocks, in order to see if it is possible to use the monetary base to alter economic aggregates, especially during a time of recession when either interest rate policy has reached its limited (liquidity trap) or a low rate is simply not enough to stimulate economic recovery through altering investment expenditure. Regarding the latter, having exchange rates added into our analysis, which allows us to take an open economy view in our model, helps us to see if the degree of exchange rate pass-through to domestic price can be a problem to EMU’s economic recovery when currency depreciates during times of economic hardship.
4.5.1 Panel unit-root test

As with time series regression analysis, panel regression estimation is also likely to be affected by the presence of unit roots. Hence, in order to perform a PVAR analysis of the chosen variables above, it is necessary to carry out a unit-root test as a standard procedure. In this chapter, we have chosen Im, Pesaran and Shin (IPS), which is based on the well-known Dickey-Fuller procedure. IPS suggests a more flexible and computationally simple unit-root test for panel data, which allows error variance and heterogeneity of the dynamics across entities (Barbreri 2006). It also requires fewer time observations, but still maintains the power of the test. Moreover, unbalanced panel data is allowed in the IPS test, and its t-bar test performs better when N and T are small (Im et al. 1997 & 2003).

IPS begins by specifying a separate augmented Dickey-Fuller (ADF) regression for each cross section with individual effects and no time trend:

\[
\Delta y_{it} = \alpha_i + \rho_i y_{i,t-1} + \sum_{j=1}^{p_i} \beta_{ij} \Delta y_{ij,t} + \epsilon_{it}
\]

where \(i = 1, \ldots, N\) and \(t = 1, \ldots, T\). The null hypothesis to test for unit roots is \(H_0: \rho_i = 0\), for all \(i\); \(H_1: \rho_i < 0\), for some \(i\). IPS use separate unit root tests for the \(N\) cross section units. Their test is based on the ADF statistics averaged across groups. After estimating the separate ADF regressions, the average of the \(t\)-statistics for \(p_i\) from the individual ADF regressions, \(t_{iT}(p_i)\):

\[
\bar{t}_{NT} = \frac{1}{N} \sum_{i=1}^{N} t_{iT}(p_i \beta_i)
\]

The \(t\)-bar is then standardised and it is shown that the standardised \(t\)-bar statistic converges to the standard normal distribution as \(N\) and \(T \rightarrow \infty\).

We conducted an IPS test on all variables and, from Table 4-1, we can see that variables’ inflation (CPI) and short-term real interest rates (IR) are stationary at the 1% significance level for Eurozone data. A null hypothesis of non-stationary cannot be rejected for the other four variables RGDP, HPI, SI, M1 and EER at both
1% and 5% significance levels. In order to render our data stationary, we take the logarithm transformation through the first difference of log which transforms the data to the form of its own percentage change. Therefore, we will estimate our variables as $\Delta RGDP$, CPI, IR, $\Delta LHPI$, $\Delta SI$, $\Delta M1$ and $\Delta EER$.

Table 4-1 IPS Panel unit-root test Eurozone data – 17 members

<table>
<thead>
<tr>
<th>Variable</th>
<th>Test Statistic</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>RGDP</td>
<td>0.4872</td>
<td>0.6869</td>
</tr>
<tr>
<td>HICP</td>
<td>-2.9526***</td>
<td>0.0016</td>
</tr>
<tr>
<td>IR</td>
<td>-4.1930***</td>
<td>0.0000</td>
</tr>
<tr>
<td>HPI</td>
<td>-1.5102</td>
<td>0.0655</td>
</tr>
<tr>
<td>SI</td>
<td>0.3833</td>
<td>0.6493</td>
</tr>
<tr>
<td>M1</td>
<td>7.5122</td>
<td>1.0000</td>
</tr>
<tr>
<td>EER</td>
<td>-0.2113</td>
<td>0.4163</td>
</tr>
</tbody>
</table>

Note: *** represents rejection of $H_0$: all panels contain unit roots at the 1% significance level. Values in brackets are p-values.

4.5.2 Results of basic estimation – interest rate shock

4.5.2.1 Analysis of existing members of the Eurozone (17 members)

Before the PVAR analysis can be conducted to study the effectiveness of monetary policy, it is crucial to decide the length of the lag in our estimation. The information criteria approach is employed here to help us to select an appropriate lag length for our PVAR model. The results are displayed in Table 4-2. It is not surprising to see AIC picks up a bigger lag length than the other two since AIC is a conservative method that usually gives a relatively big lag length. However, BIC and HQIC, which tend to give small lag length and allow better degrees of freedom to the model, have not reached the same conclusion here. HQIC and BIC suggest lag length 5 and lag length 3 respectively. Since the
difference between HQIC and BIC are not significant, therefore, lag length 5 will be selected here given that the value lies between the results of AIC and BIC.

<table>
<thead>
<tr>
<th>AIC</th>
<th>BIC</th>
<th>HQIC</th>
</tr>
</thead>
<tbody>
<tr>
<td>-14.6299</td>
<td>-13.1370</td>
<td>-14.0498*</td>
</tr>
<tr>
<td>-14.6295</td>
<td>-12.9227</td>
<td>-13.9654</td>
</tr>
<tr>
<td>-14.5986</td>
<td>-12.6684</td>
<td>-13.8467</td>
</tr>
<tr>
<td>-14.6700</td>
<td>-12.5059</td>
<td>-13.8258</td>
</tr>
<tr>
<td>-14.7371</td>
<td>-12.3281</td>
<td>-13.7962</td>
</tr>
<tr>
<td>-14.9308*</td>
<td>-12.2646</td>
<td>-13.8879</td>
</tr>
</tbody>
</table>

The results of the basic PVAR model for the existing 17 Eurozone members are displayed in Figure 4-2. It shows that the impulse responses of real GDP growth (approximated by log-differenced real GDP), domestic inflation rate, growth rates of housing price and stock price (approximated by $L\Delta LHPI$ and $L\Delta SI$) to one standard deviation of monetary policy shock implied by the panel regression, together with two standard error bands (i.e., 5% and 95%), obtained by Monte-Carlo simulation with 1000 repetitions. The impulse responses are typically significantly different from zero at the 95% level, because of the large amount of information that comes from using the panel approach.
Figure 4-2 Impulse-response for effects of monetary shocks (interest rate) on Eurozone (17 members)

<table>
<thead>
<tr>
<th>Real GDP Growth</th>
<th>Inflation</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1" alt="Graph" /></td>
<td><img src="image2" alt="Graph" /></td>
</tr>
<tr>
<td>Housing Price</td>
<td>Stock Market Price</td>
</tr>
<tr>
<td><img src="image3" alt="Graph" /></td>
<td><img src="image4" alt="Graph" /></td>
</tr>
</tbody>
</table>

Note: errors are 5% on each side generated by Monte-Carlo with 1000 repetitions

The response of real GDP to monetary policy shocks, which is reported in the impulse response pattern in Figure 4-2, shows that real output growth will decline soon after the initial monetary shock takes effect, and this negative dynamic response will last until quarter 8. However, since during the period of the first to third quarters and the period beyond quarter 6, the zero line has been located within the area between two error bonds, therefore the impulse responses of real GDP growth to a monetary shock are only statistically significant at the 95% confidence interval during the period quarter 4 to quarter 5. One unit shock of monetary policy, which is identified by a 100-base-point increase in central bank interest rate, will lead to an accumulated fall in GDP growth by almost 27 base points (see Table 4-3) within a period of 4th and 5th quarters.
Table 4-3 Statistically significant response of real GDP growth to monetary shock – Euro17

<table>
<thead>
<tr>
<th>Period</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Response</td>
<td>-0.1384</td>
<td>-0.1269</td>
</tr>
<tr>
<td>Total response:</td>
<td>-0.2653</td>
<td></td>
</tr>
</tbody>
</table>

Source: produced by the author

This result is partially in line with the early study of Peersman and Smets (2001) who report the output of the euro area will fall from its peak value of 12 base points around period 3 in response to a standard interest rate shock, but most of their results are statistically significant at the 90% confidence interval. Although in the early study the authors show that monetary shock has statistically significant impacts on Eurozone output for most periods within their estimation period, Peersman and Smets (2001) use area-wide data, thus the analysis lacks the consideration of the national-level information. By adopting the panel data, which enables us to conduct an analysis based on national-level data, our results only show that monetary policy has some effect on EMU members at certain times. This difference confirms the previous study of Rafiq and Mallick (2008) who conduct a time series VAR analysis on the effectiveness of EMU monetary policy in Germany, France and Italy respectively and conclude that the response of output (magnitude and timing) to monetary policy shock remains different between these three major EMU members contribute nearly 70% of the Eurozone’s GDP. Moreover, our results also imply the conclusion in Chapter 3, which found that the business cycle convergence among EMU members is relatively low, thus the ECB’s monetary policy will not be appropriate to every EMU member all the time.

In the case of inflation, from Figure 4-2 we can see that inflation among countries in the Euro17 area will decline immediately after the initial monetary policy shock, and the negative response of inflation lasts until the end of the fourth quarter, but changes with a diminishing rate. The overall drop in the level of inflation, if no other shocks occur, is nearly 2.19 percentage points (see Table
4-4) and the magnitude of monetary shock reach its peak in quarter 1. The result, displayed here, suggests ECB monetary policy is an effective policy tool for controlling the level of inflation among EMU members with strong impacts in terms of both magnitudes and timing.

<table>
<thead>
<tr>
<th>Period</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Response</td>
<td>-0.4977</td>
<td>-0.5626</td>
<td>-0.5256</td>
<td>-0.4571</td>
<td>-0.1147</td>
<td>0.2518</td>
</tr>
</tbody>
</table>

Total response between the period quarter 0 to quarter 4: -2.1877

Source: produced by the author

Figure 4-3 Effectiveness of ECB monetary policy

Source: figure drawn by the author
Chapter 4 Effectiveness of the ECB single monetary policy in the Eurozone

By comparing the impulse responses of both inflation and real GDP growth to a standard deviation of monetary shock, some interesting information is implied by the above results. Inflation will react to the monetary shock more rapidly than output of the Eurozone members. This phenomenon might indicate that, for EMU, it has a relatively steep short-run Phillips curve (PC) and inflation-averse monetary rule curve in the context of the NCM three-equation model, or at least one of these situations may exist (Carling and Soscike 2005). If an economy has an independent central bank (e.g. the ECB) that usually conducts a more inflation-averse monetary policy than those politically dependent central banks, the monetary policy curve is less steep for the independent central bank (MP₁ in Figure 4-3).

Moreover, if this economy had a steep PC, this would allow the monetary authority to adjust inflation towards target level with relatively small changes in the level of output. Assume the economy is at point A in Figure 4-3, where the actual inflation $\pi_0$ is higher than the target level $\pi_T$. The inflation-averse central bank can use interest rate policy to alter inflation down to $\pi_1$ by cutting output to $Y_1$, thus the economy will move to short-run optimal point B where PC₁ intersects with MP₁. However, if the central bank is not politically independent, it is not unusual to assume this monetary authority has a flatter MP curve in NCM. If this is the case and the Phillips curve is relatively flat as well, then the optimal point in view of this central bank is point C which indicates that the relatively big fall in output (output fall to $Y_2$) only gives a smaller drop in inflation to $\pi_2$.

Further to the above result of inflation response, from Figure 4-2, we see that inflation rises between the 5th and 9th quarters and the statistically significant impacts of monetary policy on inflation during this period appear at the seventh quarter with a value of 0.2518 (see Table 4-4). This result might imply the existence of a ‘price puzzle’ within the Eurozone, or at least in some of its members. The price puzzle reflects the view of the supply-side version of interest rate channels (Ravenna and Walsh 2006, Henzel et al. 2007), which suggests the daily business of firms relies on borrowing working capital from financial markets.
where firms can borrow funds to facilitate their production activities before receiving revenue from sales. Moreover, this also applies to the ongoing investment of firms, which also rely on funds from financial intermediaries. The above result shows price will rise after monetary tightening, but the degree to which it rises is not significant and the statistically significant impulse response can only be found at quarter 7. This finding is generally in line with the previous studies, which indicate the existence of a moderate price puzzle in European countries (Peersman 2001, Henzel et al. 2007, Assenmacher-Wesche 2008).

Following a monetary policy shock, the dynamic response of housing price will begin a fluctuation around the zero line for 5 quarters, then be followed by falls in its growth rate for another 7 quarters before the recovery of positive growth in housing price (see Figure 4-2). Despite the results in Figure 4-2 showing some pronounced impacts of an interest rate policy shock on housing price, none of the impulse responses of the growth rate of housing price index of EMU members are statistically significant at the 95% confidence level. This result provides evidence for confirming the conclusion of Becker et al. (2007) who argue that interest rate policy is not effective in dealing with asset price bubbles. Hence, even though the ECB tried to use interest rate policy to cripple the housing boom inside the Eurozone before the 2007–8 financial crisis, it may not be an effective policy tool to fulfil the role but can discourage output growth instead.

From Figure 4-2, we can see that, for the case of share price index, its response to a monetary policy shock starts with a small-scale falling in the growth rate during the period quarter 2 to quarter 4. However, these negative impulse responses are statistically insignificant. The growth rate of share price will become positive again from quarter 5 until the end of our estimation period (15 quarters), but the statistically significant response begins from the 7th quarter. This result implies that the stock market will recover from a negative monetary policy shock at a similar time as the end of the negative response of GDP growth. Similar findings were provided by Assenmacher-Wesche (2008),
which predicted real GDP and stock price will recover almost simultaneously – that is, 7 quarters after a monetary shock.

**Figure 4-4 Impulse response of GDP growth to the shocks of housing price and share price growth – Euro17**

![Graph showing impulse response]

Note: errors are 5% on each side generated by Monte-Carlo with 1000 repetitions

<table>
<thead>
<tr>
<th>Table 4-5 Statistically significant response of real GDP growth to housing and share price shocks – Euro17</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Housing price shock</strong></td>
</tr>
<tr>
<td>Period</td>
</tr>
<tr>
<td>Response</td>
</tr>
<tr>
<td>Total response: 0.0021</td>
</tr>
<tr>
<td><strong>Share price shock</strong></td>
</tr>
<tr>
<td>Period</td>
</tr>
<tr>
<td>Response</td>
</tr>
<tr>
<td>Total response: 0.0152</td>
</tr>
</tbody>
</table>

Source: produced by the author

Since we are adopting the VAR approach on the panel data set of EMU members, we are not only able to study the dynamics of GDP growth to a monetary policy shock, but the responses of GDP growth to the shocks of other endogenous variables in our model can also be recovered. In Figure 4-4, we are presenting the impulse responses of GDP growth to one unit standard deviation of growth rates of housing price and share price respectively. By comparing two
impulse responses from the above figure, we can see that the share price shock has a bigger impact than the shock of housing price on the rate of GDP growth, but with the same length of statistically significant impacts. For the case of housing price shock, real GDP growth will increase immediately with a statistically significant response of 0.08 basis point and 0.13 basis point at period 0 and period 3 (see Table 4-5).

In contrast to the housing price shock, the share price shock has a relatively pronounced effect on real GDP growth, except the statistically significant responses are also only found in the early periods of our estimation time horizon. Following a unit shock in share price (1 percent point increase in the growth rate of share price index), the growth rate of GDP will have statistically significant responses in period 0 and period 1 with the real GDP growth rate increasing by 0.87 and 0.67 basis points respectively. From these results (see Table 4-5 and Figure 4-4), we can see that the equity channel and balance sheet channel (household balance sheet) both exist inside the Eurozone. However, both channels only have short-term effects on the output growth but with different levels of accumulation impacts over their effective period.

4.5.2.2 Analysis of original members of the Eurozone (12 members)

Following the analysis of the existing 17 members of the Eurozone, here we would like to perform the same PVAR estimation on the original 12 members of EMU to see whether ECB monetary policy can be more effective for them; moreover, by checking the possible differences between the results of the Euro17 and Euro12 data sets, we may also able to see if the heterogeneity of the MTM existed among old and new members. In Figure 4-5, we present the impulse response of real GDP growth, inflation, growth rates of housing price and share price index to a monetary policy shock that is still measured by one standard deviation of real central bank interest rate. Following a monetary shock, which is triggered by the ECB’s union-wide monetary policy, in terms of timing of
the impacts, the impulse response for GDP and inflation among Euro12 members is similar to the results of the Euro17 data set (see Figure 4-2). Real GDP growth will drop after quarter 1 until quarter 8, but the statistically significant results can only be found at quarter 4 and quarter 5. Although the timing of the effects of monetary policy on real GDP is similar between Euro12 and Euro17 areas, the magnitude is different. The peak of the impact for the Euro12 area appears at quarter 4 with a value of -0.1115 (see Table 4-6), which means the growth rate of GDP will drop by about 11.2 basis points when the monetary policy is having its maximum impact on the real economy. This impact is smaller than the peak value we discovered for the Euro17 area by about 2.7 basis points. Moreover, the accumulation of effects in the Euro12 area is also smaller than in the Euro17 area.

Figure 4-5 Impulse-response for effects of monetary shocks (interest rate) on Eurozone (12 members)

Note: errors are 5% on each side generated by Monte-Carlo with 1000 repetitions
In the case of inflation’s response to the ECB’s monetary policy, with a 1 per cent point increase in the real central bank interest rate, the same as the result for the Euro17 area, inflation will drop immediately after the effects of shock take place until quarter 4. The difference from the result of Euro17 is that, in terms of timing, the ECB’s monetary policy seems to have a longer impact on inflation in the Euro12 area; statistically significant responses can be also found in the period between quarter 11 and quarter 14. Moreover, despite the result showing that inflation will respond positively to a negative monetary policy shock in quarter 7, this result, which may indicate the existence of ‘price puzzle’, is not statistically significant at the level of 95% confidence interval.

Similar to the response of GDP to monetary shock, in terms of the magnitude, the impulse response of inflation to a monetary shock is also different between the Euro12 area the Euro17 area. From Figure 4-5 and Table 4-7, we can see that during the first period (from quarter 1 to quarter 4), the accumulation impacts of a monetary shock on inflation is -1.9268, which is just 0.2609 percent points
lower than the contemporaneous response of inflation for the Euro17 area, which is -2.1877. Furthermore, since the ECB’s monetary policy can impact on inflation over a longer time horizon, the overall response of inflation is -2.2853, which is much higher than the overall response of inflation for the Euro17 area given that the total impact is just -1.675 if we count the ‘price puzzle’.

By combining the results for inflation and real GDP, we can see that over the 15-quarter estimation period, for the Euro12 area, following a monetary shock the overall drop in the growth rate of real GDP is -0.1981 percent points which will be accompanied by a -2.2853 percent points decline in inflation. This result may suggest that the ECB’s monetary policy is more effective for the Euro12 area in terms of controlling inflation, with a relatively low weakening effect on aggregate economic activities.

Regarding the impulse response of housing price to a monetary policy shock in the Euro12 area, the result in Figure 4-5 leads to the same conclusion as the outcome of Euro17 analysis. Although the growth rate of housing price will respond to a monetary shock negatively among Euro12 members, all the impulse responses, which we obtained over 15 estimation periods, are statistically insignificant. Therefore, as in the Euro17 area, we conclude that there is no strong evidence to show a pronounced relationship between housing price and central bank interest rate. In the case of share price index, its growth rate does not decline after the occurrence of a monetary shock. This implies the weak influence of interest rate policy on overall economic activities (i.e. GDP growth). Since the share market usually has a forward-looking mentality, within the Euro12 area, a monetary shock can be seen as an effective tool for achieving stable inflation and leaves GDP with a smaller/minor downturn effect; therefore, the share market may not see rising in interest rate will penalise overall economic activities, but should be effectively ease inflationary pressure.
Finally, we have also obtained the impulse responses of real GDP to a unit shock of housing and share price respectively. By comparing the results between Figure 4-4 and Figure 4-6, we can see that the reaction of real GDP to share price shock is almost the same as the result of the Euro17 area in terms of both timing and magnitude. This implies that the equity channel of the MTM may operate in a similar way among original members and new members of the Eurozone. Share price has a short-term positive role on the overall economic activities in Euro17 and Euro12 areas; however, there is no strong evidence to show the shock of share price will have a longer-term impact on real GDP growth given that the impulse responses are only obtained for the early period over the 15-quarter estimation time horizon. In case of housing price shock, although the impulse response for Euro12 shows similar patterns to the result for the Euro17 area; however, none of the responses at each associated period is statistically significant. The household balance sheet channel has no important role if we consider the Euro12 as a whole, but the possibility of its existence at the national level cannot be denied based on the panel approach.
4.5.3 Basic estimation without Italy, Ireland, Greece, Portugal and Spain (IIGSP)

Some studies (Demeztris et al. 2000, Baimbridge et al. 2005) argue that EMU is more motivated by political determination, rather than economic factors. The EU designed its own version of currency union criteria – the Maastricht Convergence Criteria (MCC); the advocates of the Eurozone believe that the attainment of the MCC would indicate the compatibility of EMU members with union-wide monetary policy in both favourable and unfavourable economic circumstances (Baimbridge et al. 2005). Despite the theoretical criticism of the MCC, when the euro was formally established in 1999, only three EMU members had achieved adherence to all five MCC criteria. This may weaken the effectiveness of EMU single monetary policy, as different countries may require different levels of monetary policy, even under union-wide economic shocks.

<table>
<thead>
<tr>
<th>Table 4-8 Number of MCC achieved by EU member states (1992–2002)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Luxembourg</td>
</tr>
<tr>
<td>France</td>
</tr>
<tr>
<td>Germany</td>
</tr>
<tr>
<td>Ireland</td>
</tr>
<tr>
<td>Belgium</td>
</tr>
<tr>
<td>Netherlands</td>
</tr>
<tr>
<td>Austria</td>
</tr>
<tr>
<td>Finland</td>
</tr>
<tr>
<td>Spain</td>
</tr>
<tr>
<td>Portugal</td>
</tr>
<tr>
<td>Italy</td>
</tr>
<tr>
<td>Greece</td>
</tr>
<tr>
<td>Number of member states meeting all MCC</td>
</tr>
</tbody>
</table>

Source: figures are adopted from Baimbridge et al. (2005)
From Table 4-8, we can see that the average achievement of the MCC across the initial 12 members from 1992 to 2002 is only 2. Spain, Portugal, Italy and Greece had the worst performance, especially before 1998, which is the year prior to the fixing of a national exchange rate. They had accelerated their achievements concerning the MCC, which made them just about qualified according to EMU criteria, before the official establishment of the euro. Now, fourteen years since the first day of EMU, these four countries have attracted much attention from the international community again, due to their threats to the stability of the Eurozone. Thus, it would be interesting here to estimate the overall effectiveness of monetary policy in EMU when Italy, Spain, Greece and Portugal are excluded in the panel analysis.

Figure 4-7 Impulse response for effects of monetary shocks (interest rate) on Euro12 members without IIGSP

Note: errors are 5% on each side generated by Monte-Carlo with 1000 repetitions
In Figure 4-7, we are presenting the impulse responses of real GDP growth and inflation to a one-unit shock in central bank interest rate in both the areas of Euro12 and Euro12 without IIGSP. In terms of the dynamic response of real GDP in these two areas, the results show that ECB monetary policy has a statistically significant impact on the real GDP growth at quarter 4 after the initial monetary shock. Despite the impulse response graph also indicating a negative short-term relationship between real GDP growth and ECB monetary policy, the results are all statistically insignificant. Therefore, we believe that there is no strong evidence to prove the existence of a pronounced impact of ECB monetary policy on real GDP growth in the area of Euro12 without IIGSP. This difference between these two areas may suggest that the slopes of the short-term Phillips curve may differ across these two parts of the Eurozone. Hence, it also provides evidence for the existence of heterogeneity of the MTM among regions inside EMU.

| Table 4-9 Statistically significant response of inflation to monetary shock – Euro12 without IIGSP |
|---|---|---|---|---|---|---|
| Period | 0 | 1 | 2 | 3 | 4 | 11 |
| Response | -0.2867 | -0.3827 | -0.3570 | -0.4319 | -0.3770 | -0.1800 |
| Period | 12 | 13 |
| Response | -0.1857 | -0.1556 |
| Total response between period quarter 0 to quarter 4: | -2.3566 |

Source: produced by the author

In the case of effectiveness of ECB monetary policy in controlling inflation, the results show minor differences between these two regions only in the respect of magnitudes of response. The timings of statistically significant responses of inflation to monetary policy shock are the same across Euro12 and Euro12 without the IIGSP area (see Figure 4-7). Inflation will drop immediately until quarter 4, then statistically significant impacts will appear again during the period between quarter 11 to quarter 13. The overall impacts of ECB monetary policy on inflation are slightly different across these two areas. From Table 4-9, we can see that overall response of inflation in the area of Euro12 without IIGSP is -2.3566, which is only 0.0713 smaller than the result of the Euro12 area. This
slightly smaller impact of monetary shock on inflation is not surprising to see given that IIGSP’s real GDP growth is more sensitive to ECB monetary policy than other parts of the Euro12 area.

By comparing the results of Euro12 and Euro12 without the IIGSP area, we may see that the IIGSP countries’ economic aggregates are vulnerable to the inflation-averse type of monetary policy, since the impulse response of real GDP growth for the area of Euro12 without IIGSP is statistically insignificant, but for the same test on the Euro12 area, the statistically significant relationship between growth and monetary policy was recovered. Therefore, in order to maintain a low level of inflation inside the euro area, a rise in ECB interest rate will have similar effects on the Euro12 and IIGSP areas, but IIGSP’s economic growth will be more likely to be dampened than that of the other members. This may explain why the fiscal policy had been used more rapidly among those countries and public debt levels were much higher than those of other members in EMU since they joined the Eurozone.

4.5.4 Estimation of Eurozone with money variable

Despite the interest rate variables having received more attention than money variables during conducting research on monetary policy, empirically money variables played an important role in monetary strategies of some major economies during the latest 2000s financial crisis. Both the US and the UK had conducted quantitative easing (QE), in order to prevent their economies slipping into deep recession with deflation, which the Japanese had experienced during the last decade of the 20th century. The Eurozone, as the second biggest economy in the world, had also lapsed into the recent economic crisis, which was the first time the 17 member states had faced a common economic shock since the establishment of EMU. Different from the US and the UK, the only monetary measure which the ECB had conducted during the recession is the interest rate
policy. It is interesting to ask how effective the money variable could be in the Eurozone if QE was conducted by the ECB.

Therefore, in this subsection we will extend our basic estimation for EMU by including the narrow monetary aggregate (M1) in the PVAR model. Given the results of the three IC approaches which are displayed in Table 4-10, we will conduct the PVAR model with lag length 2 for the period of Stage Three EMU (2000:Q2–2011:Q3) for both Euro12 and Euro12 without the IIGSP area. The identification strategy is the same as the previous section. Referring to standard monetary theory, we are placing M1 before the short-term interest rate IR. This allows a contemporaneous impact on interest rate, growth of housing price and share price. Thus, the vector of endogenous variables will be estimated as \{RGDPG, CPI, M1, IR, HPPC, SI\}.

<table>
<thead>
<tr>
<th>Lag</th>
<th>Euro12 AIC</th>
<th>Euro12 BIC</th>
<th>Euro12 HQIC</th>
<th>Euro12 Without IIGSP AIC</th>
<th>Euro12 Without IIGSP BIC</th>
<th>Euro12 Without IIGSP HQIC</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>-25.309*</td>
<td>-22.316</td>
<td>-24.126</td>
<td>-4.5494</td>
<td>-0.4765</td>
<td>-2.9092</td>
</tr>
</tbody>
</table>

Source: produced by the author

In Figure 4-8, we have displayed the PVAR results for two sample sets. The first is the impulse response of real GDP growth to M1 shocks and interest rate shock.
in Euro12. The second section of Figure 4-8 shows the results for the Euro12 area without IIGSP. Compared with the previous studies, which also consider money as the instrument of monetary policy, our result is similar (Peersman and Smets 2001), which shows monetary aggregates have impacts on real GDP and reach their peak value at around quarter 4. However, our results suggest the monetary aggregates will have their maximum impact on real GDP growth at about the seventh quarter after the initial monetary shock, which may suggest that the adjustments to the monetary base will take a longer time to affect the real side of the economy than was estimated by previous studies during in the early 2000s.

Figure 4-8 Impulse response of real GDP growth to monetary shocks (M1)

![Graph showing impulse response of real GDP growth to monetary shocks (M1)](image)

Note: errors are 5% on each side generated by Monte-Carlo with 1000 repetitions

By comparing the results of Euro12 and Euro12 without the IIGSP area, we can see the possible heterogeneity of the MTM among these two areas again, which has been already suggested by our early estimations. Figure 4-8 shows these two areas will respond to a monetary aggregate shock differently in terms of timing of its effects on real GDP growth. The area of Euro12 without IIGSP responds to a monetary aggregate shock one quarter earlier than the Euro12 area, but the effects die out more quickly as well. In terms of magnitudes of effects, despite the fact that ECB monetary aggregate shock can impact on real GDP growth longer in the Euro12 area, the area of Euro12 without IIGSP may respond to the monetary aggregate shock more strongly. In Table 4-11, we can see that the accumulation of statistically significant responses of real GDP growth to a 1% M1
shock is more than twice as big in the non-IIGSP area of Euro12 than the whole Euro12 area. This difference between these two areas, again, suggests the existence of MTM heterogeneity between different groups of EMU members. The ECB’s monetary policy (M1) can be used more effectively in boosting the economic aggregates in those countries that have good levels of business synchronisation.

<table>
<thead>
<tr>
<th>Table 4-11 Statistically significant response of inflation to monetary shock (M1)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Euro12</strong></td>
</tr>
<tr>
<td>Period</td>
</tr>
<tr>
<td>Response</td>
</tr>
<tr>
<td>Period</td>
</tr>
<tr>
<td>Response</td>
</tr>
<tr>
<td><strong>Total response:</strong> 0.0023</td>
</tr>
</tbody>
</table>

| **Euro12 without IIGSP**                      |
| Period | 4  | 5  | 6  | 7  | 8  | 9  |
| Response | 0.0007 | 0.0009 | 0.0010 | 0.0010 | 0.0009 | 0.0007 |
| **Total response:** 0.0052                    |

Source: produced by the author

**Figure 4-9 Impulse response of inflation to monetary shocks (M1)**

Note: errors are 5% on each side generated by Monte-Carlo with 1000 repetitions
The monetary aggregates do have effects on the growth of real GDP across the Euro12 area, which suggests that extensive QE may be able to help EMU members with the current economic recession, as long as extra funds inside the banking system can be used for boosting lending activities among businesses/firms and financial markets. However, the ECB’s primary objective is to maintain its inflation-averse objective rather than stimulate the growth of the economy. But if the ECB’s unconcerned attitude about QE is due to their concerns of possible inflationary pressure from monetary expansion, our results may suggest that such worry about inflationary pressure on EMU’s economy is a bit too cautious (see Figure 4-9). The maximum responses of inflation to a 1% increase in M1 are only 0.0009 and 0.0013 for Euro12 and the Euro12 area without IIGSP respectively. This shows some room for the ECB to operate an extensive QE in the early stages of the 2007–8 global financial crisis to ease and prevent such deep falls in economic activities across the Eurozone, which are the key issues concerning all EMU members.

4.5.5 Estimation of Eurozone with exchange rate

In previous sections, we have focused on the overall effect of monetary policy in respect of closed models. This setting is based on the special feature of the Eurozone trading pattern, which is that the major trading partners of EMU members are their fellow EU members. The underlying issue of closed models is the ignorance of the exchange rate channel of the MTM. Although intra-EMU trade holds a significant share of total Eurozone trading, as exchange rate channel may play an important role in economic recovery, it is worth extending this analysis into an open economy perspective.

According to the standard textbook example, currency depreciation is usually a by-product of a recession. However, a troubled economy can recover from its slump through the restoration of international competitiveness, which is due to falling export prices. On the other hand, depreciation of domestic currency not
only brings down the price of exports, it can also push up domestic inflation due to rising import prices. As imports become more expensive, the adjustment of trade balance can be promoted. Domestic expenditure will switch from imports to domestically produced goods and services. Hence, economic recovery can be further boosted by surges in domestic consumption.

It seems that high exchange rate pass-through to import price should stimulate the economy through recovery of both domestic and international markets. However, exchange rate depreciation may actually slow down the speed of recovery rather than boosting it, if we move our attention away from the price of imports to domestic inflation. Suppose the exchange rate pass-through is not only on import price, but domestic inflation also responds to it sensitively; that is, domestic inflation has a one-to-one reaction to exchange rate changes. The combination of currency depreciation and rising inflation can cancel out, or at least weaken the improvements in, export competitiveness. Therefore the degree of exchange rate pass-through to domestic price has an important role in the economic recovery.

Hence, we are extending our analysis by introducing exchange rate variables into our PVAR model. Here, we are using an effective exchange rate rather than a bilateral exchange rate vis-à-vis the US dollar, which was used by many previous studies (Campa et al. 2005, Marazzi et al. 2005, Coricelli et al. 2006). Each Eurozone member has a high trade dependence on their fellow EMU countries. By using the single currency across the whole union, there are no exchange rate relations among euro members. Therefore, if the euro depreciates, EMU member states cannot gain export competitiveness within the Eurozone or experience much inflationary pressures from other members. However, the restoration of trading competitiveness and possible high inflationary pressure may happen if we consider non-EU trading partners. Hence, we think an effective exchange rate is the right concept to use here, as the analysis is trying to consider the total effects of exchange rate changes on Eurozone domestic price.
Chapter 4 Effectiveness of the ECB single monetary policy in the Eurozone

The real quarterly effective exchange rates (EER) for Eurozone members are collected from the Eurostat database, besides Belgium’s and Luxembourg’s which are obtained from the IMF and IBS databases respectively. In this subsection, we will place EER before the variable of domestic price. The ordering of variables implies the EER will only react to output and monetary shocks contemporaneously, and the exchange rate has a contemporaneous effect with domestic price. This arrangement is set to capture the information which indicates the degree of pass-through between exchange rate and inflation. Thus, the model will be estimated as {RGDPG IR EER CPI}.

<p>| Table 4-12 Three information criteria test for lag length selection |
|-------------------------|----------------|----------------|----------------|</p>
<table>
<thead>
<tr>
<th>Lag</th>
<th>AIC</th>
<th>BIC</th>
<th>HQIC</th>
</tr>
</thead>
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</tr>
<tr>
<td>2</td>
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<td>-11.9376</td>
</tr>
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<td>3</td>
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<td>-11.6195</td>
<td>-12.1488</td>
</tr>
<tr>
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<td>-11.7816*</td>
<td>-12.3862</td>
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<tr>
<td>6</td>
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<td>-12.4152</td>
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</tr>
<tr>
<td>10</td>
<td>-13.0844*</td>
<td>-11.3983</td>
<td>-12.4277*</td>
</tr>
</tbody>
</table>

Source: produced by the author

Figure 4-10 Impulse response of inflation to exchange rate shock (M1)

Note: errors are 5% on each side generated by Monte-Carlo with 1000 repetitions
We will estimate our model for the current Eurozone area – Euro17 at lag length 5 (see Table 4-12). The impulse response diagram for inflation is displayed in Figure 4-10. In the short term, a unit exchange rate shock (1% increase in real effective exchange rate) leads to a minor decrease in domestic inflation by less than 0.001 base points. This is far less than the crucial one-to-one relationship, which can be used to show an unfavourable correlation between exchange rate and economic recovery that is caused by the ‘exchange rate pass-through’ phenomenon. The result here implies that domestic inflation in the Euro17 area is not sensitive to exchange rate shock, and it is more appropriate to treat the Eurozone as a closed economy rather than an open economy given that the majority of trade is taking place between EMU members.

The result we obtained in this subsection can be seen as the outcome of the introduction of the single currency to the Eurozone, which had eliminated the exchange rate uncertainty among EMU members; therefore, the high level of EMU intra-trade, which was encouraged by the membership of the euro area, may provide some explanation of the above result that is in line with previous studies (Campa et al. 2005). Campa et al. (2005) look at the early stage of EMU, have funded the transmission from exchange rate to imports price in the euro area, is relatively high in the short run, but incomplete. In the long run, the pass-through is complete and high, although the value is still lower than unity. Furthermore, the author also argued that the exchange rate pass-through to domestic inflation should become continuously weaker as the result of enlargement and convergence of Eurozone economies.

4.6 Summary of results and conclusion

In this chapter, we have examined the effectiveness of ECB monetary policy by using the panel vector autoregression method (PVAR). In contrast with previous studies, through the PVAR approach we are able to estimate the impact of ECB
monetary policy on EMU’s economy in terms of the dynamic responses of choosing key macro-variables by considering national-level information, rather than focusing purely on Eurozone level aggregates or by using a few key economies of EMU to represent the whole single currency area. Moreover, in contrast with previous empirical works, through being independent from any specific channel of the MTM, we analysed the aggregate-level data to check the overall impact of monetary policy on real economic activities in the euro area.

First, we identified the monetary shock as a 1 percent points increase in the ECB’s base rate, and thus estimated the impacts of ECB monetary policy on the Euro17 area. We found that the ECB monetary policy is effective in altering the level of inflation across the current euro area. Inflation will respond to the interest rate shock immediately after the occurrence of the shock. However, the ECB’s single monetary policy affects real GDP growth to a minor degree relative to the response of price level in the Euro17 area. This may confirm that the creation of this supranational monetary authority – the ECB – has brought significant credibility to the Eurozone’s single monetary policy (Cukierman 1992, Goodhart 1994, Svensson 1997). With a clear inflation-averse monetary policy, and possible a relatively steep short-run Phillips curve, the ECB’s single monetary policy seems to be able to fulfil its role of controlling inflation inside the Eurozone as has been assumed by NCM theory.

However, the weak response of economic aggregates to the monetary shock may indicate a potential issue, which actually may have already happened inside the Eurozone; that is, ECB monetary policy (interest rate policy) may not be adequate, at least not when used alone, to stimulate the growth or recovery of EMU’s economies during the time of recession. This may be due to the existence of MTM heterogeneity among EMU members. Moreover, it may also reflect the different levels of business cycle convergence among different groups of euro participants. In contrast to the interest rate policy, EMU’s GDP growth is more sensitive to changes in the monetary base. Nevertheless, the shock of monetary
aggregates (M1) has a smaller influence on domestic inflation across the Eurozone than the inflationary impact of ECB interest rate policy.

This reflects the fact that monetary aggregates do have pronounced influence on overall economic activities in the short run, which has been particularly recognised by Post-Keynesian theory as they believed that ‘money matters’ to macroeconomic performance (Dow and Eral 1982). The monetary policy which is implemented through adjusting high-powered money can be useful during the economic downturn, especially when interest rate policy is no longer effective in stimulating private expenditure. The ECB missed the opportunity to conduct an expansionary monetary policy, which includes both conventional and unconventional monetary policies, thus trying to prevent the Eurozone’s economy sliding into the slump that is still badly affecting some of its members at present.

Benefit from the panel approach, we are able to estimate the impacts of ECB monetary policy on different regions of the Eurozone rather than previous literatures, which were looking at it as whole or on country level (Butzen et al. 2001, Peersman 2001, Valderrama 2001, Chatelain et al. 2002, Vermuelen 2002, Rabanal 2003, van Arel 2003, Peersman 2004, Rafiq and Mallick 2008, Favero and Giavazzi 2008, Martinz-Carrascal and Frenando 2008, Weber et al. 2009, Peersman 2011). We have also conducted the same analysis on the areas of Euro12 and Euro12 with IIGSP (Ireland, Italy, Greece, Spain and Portugal). In terms of controlling the level of inflation, all three areas had slightly different, but not significant, responses to the ECB’s interest rate policy. However, IIGSP’s levels of economic growth are more sensitive to the fluctuation of ECB base rate than those of other members of EMU. This may explain why the debt remained high even during the period of the pre-2007–8 global financial crisis among these countries, which currently have the worse economic performance and suffer from both low/negative growth and sovereign debt problems.
These differences reflect the results that we obtained in Chapter 3, which show that those countries who achieved better performance in the aspect of adherence to the Maastricht Convergence Criteria (MCC) have a high level of business cycle convergence. Therefore, these EMU members may find the ECB’s interest rate policy is more likely to be appropriate to their own domestic economic circumstances. In contrast, for the IIGSP countries, since their cycles are poorly synchronised with the Eurozone’s business cycles, the ECB’s monetary policy may have inappropriate impacts on their economies. Then the possibilities of overuse of national-level fiscal policy increase.

Since our model tried to contain key variables that are related to different key channels of the MTM, therefore we have also identified the existence of an equity channel and a household balance sheet channel inside the Eurozone. Nevertheless, the results also show the possible heterogeneity among different regions of EMU. That, in turn, supports the conclusions of previous empirical studies, which suggested that the heterogeneity of MTM does, exists inside EMU (Mojon 2001, Clausen and Hayo 2006). The equity channel is found to exist in both the original area of the Eurozone (Euro12) and the current Eurozone (Euro17). ECB monetary policy has a statistically significant impact on the level of share index across both regions, and real GDP growth of EMU members is also sensitive to the price of the shares. However, the timing and magnitudes are slightly different. In contrast to the equity channel, the household balance sheet channel is found to be statistically significant in the Euro17 area, but we have not found strong evidence to prove the real GDP growth of Euro12 area is, to some extent, dependent on the wealth of households in terms of housing price. Furthermore, the results also suggested that the housing price boom, which occurred before the outbreak of the 2007–8 financial crisis in the Eurozone, is hardly to be dampened by interest rate policy given that no statistically significant impulse response of housing price to a monetary shock has been discovered for either Euro12 or Euro17 areas.
Finally, we added exchange rate into our model, mainly trying to discover whether the critical one-to-one exchange pass-through phenomenon exists in the Eurozone. If this one-to-one relationship between exchange rate and domestic price does exist among EMU members, then depreciation of exchange rate will not only help restore international competitiveness in the form of export price; it will also lead to increase in domestic price levels through rising prices of imports, thus slowing down the recovery of the economy by raising the general costs of production across the whole economy. The finding here suggests the degree of exchange rate pass-through within EMU is low, which confirms the arguments of early studies of Campa et al. (2005) who argue that the exchange rate pass-through to domestic inflation should become continuously weaker as the result of enlargement and convergence of Eurozone economies. Moreover, this result also shows it is more appropriate to treat EMU as a closed economy since the domestic price level is obtuse to exchange rate shocks which are line with the trading pattern of the Eurozone. The key/main trading partners are their fellow members inside the euro area, and with the adoption of the single currency, no exchange rates exist among members, and intra-Eurozone trade has been encouraged since the establishment of the euro area.

Overall, the findings we have obtained in this chapter have generally confirmed the previous studies, which tried to estimate the impacts of ECB monetary policy and argued it can be effective for controlling inflation for EMU given that the ECB’s fiscal independent position automatically enhances the credibility of its interest rate policy. However, our results can be seen as more comprehensive than those of the earlier literature. We have considered all members of EMU together through the panel data approach. This has allowed us to see the impacts of the ECB’s monetary policy on the Eurozone economies based on the collective analysis of all members’ national data.

The combination of panel data and the VAR approach enabled the dynamics among all endogenous variables (e.g. monetary instrument variable and macro-variables) to be recovered without falling into the issue of low degrees of
freedom, which is the problem that would arise from the short history of EMU if a time series VAR was applied. Moreover, the richness of the sample size in this chapter allows the analysis to be carried out with little worry of the estimation bias that can arise when the data set is small, which is a problem the DSGE model approach might suffer if the attention of the research specifically draws on the post-EMU period.

In terms of the consistency of the economic theory – the NCM model, which the ECB adopts for its policy implementation – with the actual economic performance of EMU, the credibility of ECB monetary policy appears to be high given that interest rate shock can effectively influence the level of the price while it has relatively insignificant impacts on the level of economic growth. In other words, the price expectations in the euro area are sensitive to the variation of ECB base rates. However, this also implies a shortcoming of ECB monetary policy, which is that of having weak impacts on real economic activities. This can be a pronounced issue for EMU during the time of economic hardship; the interest rate is insufficient to stimulate economic recovery. This problem can be due to the presence of imbalanced business cycle synchronisation among members, and heterogeneity of the MTM. Policy that has been designed based on union-level data may not able to fully address ‘local’ problems. For a sovereign country, some regions may see national-level monetary policy as less appropriate to them, whilst national-level fiscal transfer and other fiscal measures can compensate for the loss due to this problem. Unlike a sovereign nation, fiscal policies are decentralised in EMU; hence, there is no union-level fiscal measure that can be used to move resources around members for correcting the inappropriateness of a union-wide single monetary policy.

Fiscal federalism may not guarantee full compensation of the loss of monetary sovereignty and possible inappropriateness of ECB monetary policy, but it can be a partial solution, at least: a supplementary measure that can be used to stabilise economic fluctuations at both union and member level. However, it would require much deep political co-ordination and integration, which may require a
different definition of the European Union from the one we have at the moment. Furthermore, the results we obtained suggest that the monetary aggregates, e.g. monetary base, are more influential of real economic activities than interest rates. NCM particularly focuses on the use of interest rate as the momentary instrument for achieving its policy goal. It might be fine when the economy is not under the threat of recession. However, the ‘money matters’ argument of post-Keynesians can be more relevant to stimulation of economic recovery for EMU.

Overall, the findings in this chapter show the ECB’s interest rate policy is effective in respect of maintaining a low level of inflation, but with relatively small impact on economic growth, at least, of those countries who have high levels of business cycle synchronisation and also had good adherence to the MCC before the establishment of EMU. The results suggest that the ECB’s monetary policy can be appropriate, or effective, only if membership of the single currency area is carefully granted rather than mainly being driven by the political wills of participating countries. Moreover, given the economic enlargement and integration inside EMU over recent decades, the heterogeneity of the MTM still exists among members, which makes conducting a union wide appropriate policy even more difficult for the ECB. Since the analysis we conducted in this chapter focused on the Euro17, Euro12, and Euro12 with IIGSP areas, and also used different variables, the outcomes of these analyses are not only for identifying the different reactions of macroeconomic variables to monetary shocks among different groups of members in the euro area: it can also be seen as a method for testing the robustness of our model, and has confirmed that the model does perform robustly as it is capable of analysing the effectiveness of ECB monetary policy for different sets of members and variables.

Finally, our results indicate the existence of a ‘one size fits all’ issue inside EMU, which underlines the root of the poor adherence to EMU fiscal rules and constant rise in national debts of some EMU members, especially amongst those peripheral members. The high level of national debts combined with the outbreak of the 2007–8 global credit crunch collectively caused the current
economic recession and Eurozone sovereign debt crisis. Clearly, the poor fiscal discipline of EMU members, which can be partially blamed on inappropriate ECB monetary policy at national level for some countries, suggests that the fiscal policy disciplinary mechanism had failed to enforce members’ fiscal behaviours. That, in turn, can be crucial to the sustainability of EMU in terms of achieving ‘price stability’ and sustainable fiscal policy. This leads us to the next key question of this thesis, which focuses on investigating the Euro Fiscal Dividend phenomenon.
Chapter 5 Fiscal stance and long-term interest rates in EMU – investigating the existence of a ‘Eurozone Fiscal Dividend’

5.1 Introduction

Following the 2007–8 financial crisis, a sovereign debt crisis broke out inside the Eurozone among some of its members (e.g. Greece, Spain, Portugal, Ireland, Cyprus etc.), which has drawn much attention from policymakers in EMU. In fact, the key feature of EMU’s infrastructure had already lain down the seed of fiscal crisis of the Eurozone before the 2007–8 financial crisis. The centralised monetary framework in EMU means that fiscal policy may become the only available stabilisation mechanism members can use to counter economic shocks at the national level, given that labour mobility and wage flexibility in the Eurozone are insufficient to provide adequate automatic adjustments (Feldstein 2005).

Although, within EMU, there is supposed to be a dual fiscal disciplinary mechanism available to monitor and enforce the fiscal activities of its members, it seems that there were some failures among these two disciplinary mechanisms to prevent reckless use of fiscal policy. First, based upon the reference values from the Maastricht Convergence Criteria (MCC), the Stability and Growth Pact (SGP) was established to monitor and enforce members’ fiscal behaviour. However, poor administration of the SGP had failed to discipline the fiscal behaviour of EMU members since the creation of the Eurozone. Hence, the
question is whether the financial market, which should perform as an alternative fiscal disciplinary device in the Eurozone, also failed after the establishment of EMU.

Fiscal activities can be better disciplined if the financial market is able to correctly identify the risks of public debt borrowers in different debt situations (Warin and Wolff 2005). However, membership of EMU can cripple the market discipline mechanism through providing extra credibility to those national bonds which are issued by EMU members. Hence, the long-term interest rates, which reflect risk premiums of bonds, may just serve as a weak mechanism for discipline fiscal activities among EMU members given that the market may have an overly optimistic view on risks of EMU members’ sovereign debts. This fiscal benefit of EMU membership is known as the ‘Euro Dividend’, initially proposed by Marattin and Salotti (2010). It describes a ‘fiscal shield’ that EMU members may have experienced in the past, especially before the 2007–8 financial crisis.

Among previous studies, which focused on the relationship between fiscal stance and long-term interest rates, there is more literature on the US than EMU given that the sample size of EMU data is small due to its short history. They generally found a positive relationship between fiscal stance and the level of long-term interest rates over different time periods (e.g. Codogno et al. 2003, Bernoth et al. 2004 & 2006, Faini 2006, Ardagna et al. 2007). Compared with previous literature (Favero et al. 1997, Reinhart and Sack 2000, Ang and Piazzesi 2003, Engen and Hubbard 2004, Bernoth et al. 2004, Chinn and Frankel 2007, Faini 2006, Ardagna et al. 2007, Marattin and Salotti 2010 etc.), instead of using projections of national debt, which usually generate statistically significant results, we employed the actual data on debt in our estimation. This specification of data enables us to identify the relationship between actual debt level and long-term interest rates. If the rise in actual debt cannot lead to increasing or at least casing an insignificant response of long-term interest rates on government bonds, then we are able to say that the market has an optimistic view on EMU members’ debt status regardless of the worsened fiscal stance of these debtors.
For the econometric method, we adopted the panel vector autoregression (PVAR) method to recover the dynamic response of long-term interest rates to the shock of debt developments. The method of PVAR enables us to advance the current study by considering the Eurozone as a whole, but without losing national-level information. Moreover, given that the PVAR is based on the panel data, this can overcome the key shortcoming of time series VAR, which requires a large number of observations that are not usually available to those periphery members of EMU. The PVAR method had already been employed by Marattin and Salotti (2010), who also look at the relationship between debt and long-term interest rates in EMU. Compared with this previous study, we employed quarterly data rather than annual data. It covers the period 2000:Q1–2012:Q1, and has obtained direct and statistically significant evidence of the existence of the Euro Fiscal Dividend in EMU. Moreover, since the data set we used here is sufficiently large, in contrast to the previous study, we have also investigated whether the ‘Euro Fiscal Dividend’ has changed since the outbreak of the 2007–8 global financial crisis, which had not been covered by the previous study, possibly due to the small sample size of its analysis.

This chapter is organised as follows. Subsection 5.2 reviews the economic theory, which explains the necessity of fiscal rules and their performance in EMU. In Subsection 5.3, we explain the possible cause of weak signalling from financial markets; then follows the review of existing empirical studies. Subsection 5.5 discusses the empirical methodology and data of this chapter. In Subsections 5.6 and 5.7 respectively, the empirical results and concluding remarks of this chapter will be presented.
5.2 EMU fiscal rules – their necessity and performance

Fiscal policy is downgraded in the NCM model. The attention to it in view of NVM theory has been focused on its impacts on the ‘price stability’ goal of monetary policy, which has been seen as the crucial and major policy objective for policymakers. In this subsection, through reviewing relevant economic theory, we will discuss the necessity of the fiscal policy rule, especially in relation to EMU. Moreover, the adherence to EMU fiscal rules (EMUFR) among Eurozone members since the time of its creation will be discussed here as well.

5.2.1 Time inconsistency issue of monetary and fiscal policy

• 5.2.1.1 Time inconsistent monetary policy and inflation bias

The common problem usually faced by the policymaker and private economic agent is the timing of the policy and reactions to the policy from each side of the game. The game played between these two parties can lead to suboptimal equilibrium between inflation and unemployment. This issue is known as the time inconsistency policy, which has an influential role on the view of economic stabilisation policy (Kydland and Prescott 1977, Barro and Gordon 1983a&b). Although the original work was initially developed by the new classical economists to question the necessity of discretionary monetary policy, it also has implications for the fiscal rules of the European Monetary Union. In the following subsection, we will explain how the time inconsistency issue of monetary policy would have some linkages to the fiscal rules.

In the Kydland and Prescott model (Kydland and Prescott 1977), they demonstrate how the time inconsistency problem can significantly affect the credibility of announced policy that eventually may lead to a suboptimal equilibrium in the economy. The model is essentially based on the new classical assumptions of rational expectation behaviours of economic agents and of
unemployment being temporarily altered by unexpected inflation shock to private agents. So the Kydland and Prescott model can be represented by the following:

\[ U_t = U_{nr} + \alpha(\pi^e_t - \pi_t) \]  
\[ \pi^e_t = E(\pi_t / \Omega_{t-1}) \]  
\[ W_S = W_S(\pi_t, U_t) \]

\( U_t \) is the current level of unemployment, \( U_{nr} \) is the natural rate of unemployment of a particular economy; hence part (1) in Equation (5-1) represents how the level of actual unemployment can deviate from its natural rate due to inflation surprise. The expected inflation at time \( t \): \( \pi^e_t \) is subject to the information available at the period \( t-1 \); private agents’ expectations are backward-looking. Part (3) in Equation (5-1) shows that social welfare is the function of current inflation and unemployment rate. Moreover, it satisfies the following:

\[ \frac{dW_S}{d\pi_t} < 0 \quad \text{and} \quad \frac{dW_S}{dU_t} < 0 \]

This implies that social welfare will be improved by the decrease in the level of either inflation or unemployment, or a combination of both. The economic policy, which aims to maximise the social welfare function, is subject to the given Phillips curve in Equation (5-1) (1).
Figure 5-1 Time inconsistency and inflation bias

We can graphically see from Figure 5-1 how the game, which is played between policymakers and private agents, will lead to time inconsistency problems. The four curved lines $S_1$, $S_2$, $S_3$ and $S_4$ represent the indifference curve of social welfare function. Since the $\frac{dW_s}{d\pi} < 0$ and $\frac{dW_s}{dU} < 0$, the inward indifference curve implies a higher value of social welfare where $S_1 > S_2 > S_3 > S_4$. The downward-sloping lines $\pi_{e1}$ and $\pi_{e2}$ are the expectation-augmented Phillips curves.

In the dynamic game, each player will try to maximise its own objective function upon the perceptions of the strategies of the other participator. Kydland
and Prescott (1977) adopt the Stackelberg game and assume that the monetary authority (government dependent and able to determine the rate of inflation) is the dominator and the private agent is the follower in this game. The optimal equilibrium which maximises the social welfare objective locates at \( O_1 \), associated with natural-rate unemployment and zero inflation. Assume the initial time consistent equilibrium is at \( O_4 \) where the Phillips curve \( \pi_{t1}^c \) tangent with indifference curve \( S_3 \). Now, the monetary authority has the intention to achieve the optimal equilibrium \( O_1 \), and thus announces a deflationary policy e.g. reducing the growth rate of the money supply. If this is a credible announcement, private economic agents will revise downwards their price expectation; therefore, the Phillips curve \( \pi_{t1}^c \) will shift down to \( \pi_{t2}^c \).

Since the monetary authority is not independent, it is likely governments may cheat private economic agents by imposing an inflation surprise through unannounced monetary policy at \( O_1 \). From part (1) of Equation (5-1), we can see that raising inflation above the current expectation level will impose negative impacts on the level of current unemployment rate, thus causing current unemployment to deviate below its natural rate. Therefore, government is able to move the economy to \( O_2 \), which is superior to \( O_1 \) and \( O_4 \). However, this is not a stable position, as unemployment is below the natural rate and inflation is higher than the expectation of private agents. Private agents will learn this very soon and revise their price expectation upwards, hence we will move back to point \( O_4 \). Even under the assumption of imperfect information, if the monetary authority has a history of discretionary behaviour, private agents know the objective function of the monetary authority and understand government is likely to cheat on their policy (Blackburn 1992). This implies that given time inconsistency behaviour and low reputation of monetary policy, the optimal point \( O_1 \) cannot be maintained and \( O_4 \) will be achieved in this non-cooperative game. Moreover, since the natural rate of unemployment can be achieved at zero inflation, therefore the suboptimal equilibrium \( O_4 \) that represents the occurrence of inflation bias can only be eliminated if the government intends to
pre-commit to a non-contingent monetary rule which is consistent with price stability (Taylor 1985).

The solution to the issue of inflation bias is to remove/limit the discretionary behaviour of the monetary authority by delegation of monetary policy to a ‘conservative central bank’ that has an inflation-driven policy preference (Svensson 1997). The non-political independent central bank can receive a ‘credibility bonus’ and is the right form of this ‘conservative central bank’ for its disinflationary policy to be accomplished (Cukierman 1992 and Goodhart 1994). The Treaty of European Union ensured the independence of the European Central Bank (ECB), which has the legal right and politically neutral position to fulfil the objective of ‘price stability in the Eurozone’. The ECB has a defined power to conduct an inflation-driven monetary policy; however, the credibility and outcome of price stability monetary policy can hardly be achieved without controlling fiscal behaviour of individual members in the monetary union (Woodford 2001, Brück and Zwiener 2006, Chair and Kehoe 2008). Chair and Kehoe (2008) argue that union members tend to have a free-rider mentality which induces them to purse lax non-monetary policy that benefits themselves individually.

Since the interest rate policy of the ECB can be trumped by the fiscal activities of individual governments, if there is low coordination and government set its policy after the ECB makes its decision on monetary policy (Buti et al. 2001), in order to restrict members’ fiscal activities EMU designed and implemented a set of fiscal rules which any Eurozone candidates or existing members have to obey, at least according to the Maastricht Treaty. The fiscal rules of EMU are set out in the Stability and Growth Pact which aims to increase coordination among members and the ECB through enforcing a strict boundary of fiscal activities.
5.2.1.2 Deficit/debt bias and common pool problem

Besides the issue of time inconsistency on monetary policy (i.e. inflation bias and price stability), development of fiscal activities such as discretionary fiscal policy is also relevant (Kydland and Prescott 1977). For instance: the fiscal authority (government) may announce a fiscal policy that aims to adjust the fiscal imbalance problem; however, ex post, they may discretionarily renege on their previous commitment for political reasons. This discretionary use of fiscal power is likely to cause the issue of budget/debt bias during the democratic process in view of political economics (Alesian and Perotti 1995, Balassone Francese 2004, Eslava 2011).

The explanation of this opportunistic behaviour of government, which leads to budget/debt bias, is generally twofold. First, the fiscal illusion (see Nordhaus 1975, Buchanan and Wagner 1977) model assumes that policymakers are interested in maximising the numbers of votes rather than social welfare; on the other hand, voters can be fooled by ‘fiscal illusion’, given that they value the government spending by its expansionary effects or spending hikes and usually underestimate the future costs of current expansionary fiscal policy, since they have no knowledge of government intertemporal budget constraints. Hence, government has the intention of conducting expansionary fiscal policy or breaking their promise of adjusting fiscal imbalance. Nevertheless, this model has an unrealistic assumption, which is that private agents have no learning ability and are consistently fooled by ‘fiscal illusion’ (Alesian and Perotti 1995, Drazen 2000).

The second and more recent contribution to political macroeconomic view on deficit/bias emphasises the quality of information which may lead to the rational private agents having an incorrect view of the fiscal programme, hence, voting for the incumbent. Rogoff and Sibert (1988) and Rogoff (1990) argue that voters only have imperfect information about the competence level of politicians; therefore, voters will extract the information of politicians’ competence from
their previous fiscal choices. Given the decision of voters is based on their knowledge of governments’ previous fiscal choices, it will induce government to run an expansionary fiscal programme before the election to attract votes. In fact, this type of behaviour has been discovered to have occurred among the European countries before the creation of EMU (Hughes et al. 2001, Buti and van den Noord 2003).

Under these political intentions, it is not hard to understand the motivation of government to renege on any of their previous commitments on fiscal programmes, hence the existence of deficit/debt bias. In relation to EMU, the outcome of irresponsible and discretionary fiscal policy may not only lead to a higher level of bond interest rates of their own, but it causes an increase in other members’ bond interest rates too (Schuknecht 2004). This negative spill-over effect has strong links with the integration of financial markets where the international factor (i.e. other countries’ economic/debt performance) can largely explain the development of domestic bond interest, especially in Europe (Bernoth et al. 2004, Sgherri and Zoli 2009, Schuknecht et al. 2010, Favero and Missale 2010, Bolotn and Jeanne 2011). The recent financial integration was stimulated by several rounds of capital account liberalisation, financial deregulation and innovation, and the introduction of the euro (Lane and Milesi-Ferretti, 2008). Moreover, sovereign bond markets have become more interconnected, whereas in the past only countries with high domestic savings and developed financial systems based on bank financing could issue public bonds easily (Caballero and Krishnamurthy, 2004). Given the highly integrated financial market in EMU, where it is unusual to see banks holding large quantities of other fellow members’ sovereign debts, there could be an increase in the possibility of lender countries being forced to bail out borrowers.

Generally speaking, economists have found that it is not easy to design fiscal rules which can perfectly solve the time inconsistency issue and deficit/debt bias problem by constraining government behaviour, since the rules can hardly be contingent, which makes it very costly to be compliant in difficult situations (i.e.
recession) (Buchanan 1985, Wyplosz2012). However, with good implementation of the rules, it is still considered as a means to at least lessen these problems (Wyplosz 2012).

5.2.2 The implementation of EMU fiscal rules

Here we will review the implementation according to the timeline of the establishment of EMU and changes in the content of the SGP. Therefore, the first period runs from 1992 up to 1997 when the reference values of 3% budget deficit and 60% gross debt were put into force by the Maastricht treaty. The second period is from 1999 until 2005 when the SGP was relaxed. The final period looked at is the one since 2005.


In 1992, the Maastricht Treaty entered into force, setting out the ceiling of EMU candidates’ fiscal activities in terms of their budget deficit and government debt level. According to the Maastricht Convergence Criteria (MCC), the EU version of single currency criteria for entry to EMU, the fiscal rules are qualified by the provision that a 3% deficit limit and 60% government debt ceiling or otherwise sufficiently diminishing and approaching the reference value at a satisfactory pace (art. 104 of the EU Treaty). The ‘Maastricht effect’, which refers to fiscal consolidations in the Eurozone, was discovered among EMU candidates during the run-up period of EMU, from 1992 to 1997\(^{28}\). The previous empirical studies (Buti and Giudice 2002, Hughes, Hallet and Lewis 2008) have found that since the imposition of the fiscal rules in the MCC fiscal consolidation happened during the run-up period among all EMU candidates.

\(^{28}\) The year 1997 and not 1998 is taken as the last year of the ‘Maastricht period’, given that the decision on entry into EMU was taken in 1998 on the basis of data from 1997. Hence, as from 1998, fiscal outcomes were no longer influenced by the incentive to comply with the Maastricht criteria.
1999–2005

The Stability and Growth Pact (SGP) was introduced to the members of EMU after those candidates obtained their formal membership of the Eurozone. Since the SGP came into force, the fiscal performance of members did not show evidence of obeisance to the official fiscal rules which were designed by its creators. Fiscal stances of EMU members deteriorated since the first years of EMU. The structural primary balance of the Euro area (i.e. the budget balance corrected for interest payments and the effects of the economic cycle) decreased from a surplus of 2.7% GDP in 1997 to 0.6% GDP in 2003. During 2001–2004 six countries – France, Germany, Greece, Italy, the Netherlands and Portugal became formally subject to the excessive deficit procedures for breaking the 3% GDP limit. Instead of the rules and being enforced and sanctions applied to those members, a dramatic event took place inside EMU.

In November 2003, tensions with respect to the rules reached a climax when the ECOFIN refused to take a decision on the basis of a recommendation by the European Commission to move to the next step in the sanction procedure for Germany and France. After the European Commission had brought the case to the Court of Justice, the court ruled that the Council had not been allowed to take its own decisions outside the scope of the EU Treaty (European Court of Justice, 2004). At the same time it also confirmed the discretion of the Council on whether or not to move forward in the sanction procedures. This dramatic event implies there were no intentions of strictly applying the SGP among EMU and its members.

There was no – or maybe just a little – peer pressure among EMU government and council members to enforce the SGP, especially when Germany and France were involved in this event. The study of de Hann et al. (2004) argues that there is no credible enforcement mechanism available inside EMU to control the fiscal discipline of its members. Moreover, the authors also refer back to the previous study by Inman (1996) which had already raised strong doubts as to the ability of EMU fiscal rules to effectively correct the deficit bias given the lack of
independent monitoring and enforcement of Eurozone national-level fiscal activities.

2005–present

Following the dispute of the SGP among members and EMU itself, the SGP was reformed in March 2005 in order to meet the requirements of more flexibility and the need of national ownership of the rules (EC 2004). The ‘new’ SGP did not change the reference value of the original SGP since the 3% and 60% ceiling is bound with the Treaty of European Union. However, the discretionary power of the ECOFIN was formally extended after the European Court of Justice acquiesced to it during the 2003 conflict. Moreover, the reform also loosened the escape clauses, lengthened deadlines for taking action and reclassified the circumstances for permitting a longer adjustment period under ‘exceptional and temporary’ situations.

The reform of the SGP in 2005 improved flexibility, which was the main issue of EMU fiscal rules when they were created in June 1997\(^\text{29}\). However, the issue of enforcement was left unresolved (Beetsma and Debrun 2006, Morris et al. 2006). These authors argued that the extended discretion power of the ECOFIN in the application of the rules has created room for unsound economic judgement on excessive deficits; and, moreover, the proliferation of escape clauses bears the risk of more lenient enforcement decisions. With the more flexible SGP and no improvements in enforcement mechanisms in EMU fiscal rules, it is not surprising to see that the Eurozone went into the current sovereign debt crisis, given that the increased unemployment benefits and decline in tax revenues after the late-2000s financial crisis had a significant impact on the already worsened fiscal stance.

Given that except Luxembourg and Finland is not under excessive deficit procedure and in order to prevent a future fiscal crisis, the EU brought a

legislative package of six legal acts (known as the ‘Six Pack’) into force in December 2011\textsuperscript{30}, which aims to reinforce the current SGP. The ‘Six Pack’ focuses on two major areas:

**Macroeconomic imbalances:**
- Prevention and correction of macroeconomic imbalances
- Enforcement action to correct excessive macroeconomic imbalances in the euro area

**Fiscal policy:**
- Strengthening of budgetary surveillance and coordination of economic policies
- Speeding up and clarifying the implementation of the excessive deficit
- Effective enforcement of budgetary surveillance in the euro area
- Requirements for the fiscal framework of the member states

In fact, this new EU legislation, which aimed to provide stronger economic and budgetary coordination for the Eurozone in particular, was proposed in September 2010 and initially scheduled to be approved by June 2011. However, due to the disagreements among members over the decision procedures of sanctions, the ‘Six Pack’ was eventually adopted five months later in November 2011. The opposing views amongst countries delaying the approval of new budgetary rules under the ‘Six Pack’ throughout 2011 have further undermined the SGP’s credibility (Ferré 2012).

In concluding this subsection, we have shown that the independent central bank is the solution to the issue of inflation bias. Hence, the establishment of the ECB has reflected this theoretical/practical problem by adopting strict price-stability-driven monetary policy. The ECB should gain an extra ‘credibility bonus’

given that it is a monetary authority which has non-discretionary behaviour and is fully politically independent; meanwhile, the credibility and outcomes of ECB monetary policy can be affected by discretionary and reckless fiscal policy. This is the reason why the fiscal rules were introduced in the early stages of EMU to enforce member states’ fiscal activities. However, the instruments of economic governance were too weak to force governments of EMU members to commit to the SGP after the memberships were granted to them (Eichengreen 2005, Larch et al. 2010). Moreover, the reform of the SGP in 2005 was unanimously perceived as evidence that the most EMU members had no intention of complying with the original SGP and required more flexibility (Bonatti and Cristini, 2008). The current Eurozone debt crisis can be, at least partially, blamed on the poor implementation of the SGP which failed to curb the deficits and accumulations of debts among EMU member states. However, poor performance of the SGP, which has led to the reckless fiscal behaviours among member states, may not be the only issue the Eurozone had during the pre-crisis period, the financial market, where governments finance their budget, may also fail to prevent the current debt crisis inside the Eurozone.

5.3 Determinacies of relationship between fiscal stance and long-term interest rates in EMU

In the above section, we have reviewed the necessity of fiscal policy rule and discipline in EMU. Despite the SGP having been established to monitor and enforce the fiscal behaviour of members’ fiscal policy implementation, adherence to the SGP among EMU members had been poor, which shows EMU fiscal rules (EMUFR) had failed to achieve their purpose. Alongside EMUFR, the centralised monetary regime also constrains the development of national fiscal stance. Individual members are no longer able to finance their debt by creating
more money, due to the centralised monetary system. For example, government can sell its bonds to the central bank, therefore, to use the newly printed money to finance its fiscal programme. As the result of this, national debts and budget deficits have to be financed through issuing government bonds in financial markets. This implies that the market may have a crucial role in public borrowings. There will be fewer risks of free-rider issues if the financial market is able to identify the risk premiums of public debt borrowers in different debt situations (Warin and Wolff 2005).

As the interest rates offered on government bonds can be treated as signals to both the lender and borrowers in the financial markets, if the national fiscal stance is approaching an unsustainable path, the ‘signal’ should provide an extra safety net to Eurozone fiscal sustainability. However, the establishment of EMU and the ECB may possibly cripple the signalling ability of the financial market. In this subsection, we will review the economic theories/hypotheses that provides explanations of the relationship between fiscal stance and the long-term interest rate, which are particularly relevant to EMU, and therefore to understand the possible theoretical reasons for the existence of the Euro Fiscal Dividend phenomenon.

31 For instance, high-risk government will be charged much higher risk premiums in order to finance the budget deficit and debt payment. This means that the high-risk country may find it difficult to attract investors to hold their bonds in the market than low-risk countries. Therefore, the risk premium of national debt is possibly reflected by the long-term interest rates on government bonds, as the unsustainable fiscal stance may cause rising of bond yields in these countries. If this is the case, the relationship between fiscal stance and interest rates of government bonds may have an important role in disciplining the fiscal behaviour of high-debt countries (Bayoumi et al. 1995, Mosley 2003). This would be especially relevant to the Eurozone as each member can issue their own debt, but does not have the opportunity to monetise and inflate away excessive debts (Warin and Wolff 2005).

32 For instance, the high interest rates on national debt would make it difficult for this country to finance its debts and budget, unless satisfactory progress can be made to ease the debt problem of the government (Bayoumi et al. 1995).
5.3.1 Fiscal dominance and monetary dominance – inflation

Expansionary fiscal policy or monetary measures may stimulate domestic expenditure in the short term; however, their long-term implication, especially in view of monetary and classical economists, is high future levels of inflation. Therefore, the potential impact of monetisation of debt is to raise inflation expectations among private economic agents. Such high expectations of future inflation may cause worries of macroeconomic uncertainty and aggravation of fiscal solvency, which can consequently drive up the risk premium of sovereignty debt (Baldacci et al. 2011).

The view of fiscal dominance is that high government debt could well constrain the ability and willingness of the central bank to maintain the target inflation by controlling the central bank base rates (Turner 2011). By allowing the upward movements of inflation, which is due to pressure from the heavily indebted central government, the real value of their debt is eventually reduced. Such a devaluing process of national debt is more likely to be seen in those countries where the central bank is not independent (Beetsma and Bovenberg 1997). For example, during the late 1960s and 1970s, the sharp rise in inflation in the UK reduced the debt/GDP ratio significantly, which can be, at least partially, explained by the less active reactions of the Bank of England before and during the early stage of the 1970s economic crisis (Turner 2011).

In contrast, if a country that has an independent central bank is experiencing high inflation pressure, the central bank should raise the real interest rate to eliminate the inflationary effects of an unsustainable fiscal policy. This behaviour of central banks, which is opposite to fiscal dominance, is known as monetary dominance (Sargent and Wallace 1981, Jeanne 2012). The implication of monetary dominance is not only about achieving price stability; moreover, it also indicates that as the rise in real interest rate, which is due to downward movement of inflation, the cost of government debt will remain high (Turner 2011). The author refers his argument to the study by King (1995) which states...
that a successful deflationary monetary policy may not immediately bring down the nominal long-term interest rates on government bonds, given that the adjustment of expected inflation is slower than the movement of actual inflation. Since the prospect of rising in services costs of government debt under the regime of monetary dominance, governments need to reduce their primary deficits; hence, fiscal behaviour can be disciplined (Buiter 2010). Moreover, due to tight monetary policy, expectation of inflation may eventually adjust down, which can reduce the level of long-term interest rates on government bonds. However, a tighter monetary regime may take many years to earn the credibility for the market to start responding to its monetary signal.

In the real world, the fiscal authority may have political influence over the monetary authority. This would force the central bank to compromise their primary objective of price stability; instead, they may facilitate the needs of fiscal policy (Buiter 2010). In the case of EMU, the institutional structure of the ECB may help it face less direct pressure from fiscal authorities in the Eurozone. The ECB is formally independent from any members’ treasury departments; no individual government can have direct influence on the ECB’s policy rate settings. Moreover, national fiscal interests are hardly aligned among all member states. This leads to a weak ability of divided EMU members to bring sufficient and effective pressure to bear on the ECB. Fiscal dominance may become weaker relative to the situation of a non-EMU country. Furthermore, the fiscal neutrality of the ECB can create an immediate credibility to the monetary authority, which implies that the market may expect and believe in a sufficient level of monetary dominance in EMU; accompanied by the recent decline of the fiscal dominance regime (Moreno 2003, Buiter 2010), confidence in price stability in the Eurozone should be improved. This would weaken the inflationary expectation; therefore, the market would charge less inflation premium on the national debt (Gürkaynak et al. 2006, Baldacci et al. 2011).
5.3.2 Fiscal regime

One dimension of economic analysis takes a distinct perspective on the implications of large government debt for the long-term interest rate; that is, the Ricardian versus the non-Ricardian view of the private sector response. Aiyagari and Gertle (1985) distinguish these two regimes as follows: Ricardian equivalence means households are forward-looking and treat present government debt as future taxation; for governments, the future fiscal revenues are expected to be used as the source of repayment of current government liabilities. Furthermore, the economy having Ricardian equivalence suggests that the fiscal policy may have little or even zero impact on the real side of the economy. In a non-Ricardian regime, since at least some future repayment of current debt can be financed through issuing new money, policymakers may not use future tax completely to match government debt.

The Ricardian equivalence hypothesis argues that ‘Ricardian’ consumers who are forward-looking and aware of government intertemporal budget constraints will react to government fiscal policy rationally, which may eventually cancel out its impacts (Buchanan 1976, Dimand 2002). For instance, in order to finance government expenditure, the government needs to either raise current tax or issue bonds. In the case of tax-financed fiscal policy, consumers will save today’s private spending to compensate current higher taxes. In the other case, consumers will react to the fiscal activities in the same way. Since the consumer takes future tax liabilities fully into account in today’s consumption/saving decisions, government bonds will not be treated as net wealth. The future tax payments will be discounted and the present value of them will be perceived exactly to offset the value of bonds. Private savings will increase as a result of cutting down present private spending to finance increase in taxation of consumers in the future. If this were the case, the decrease in private spending could offset the impacts of fiscal policy on aggregate demand; therefore, the ‘Ricardian’ behaviour of consumers indicates that government expenditure is an
ineffective policy tool to alter the level of output by affecting the level of aggregate demand (Barro 1974).

Ricardian equivalence supports the main argument of the classical economists regarding the ineffectiveness of fiscal stimulation, which is represented by downgrade of fiscal policy and upgrade of monetary policy in the new consensus macroeconomics (NCM) model (Fontana 2009). However, the Ricardian equivalence model has been heavily criticised by other economists (e.g. Keynesians) as an unrealistic theoretical model which relies on assumptions of long-time/infinite horizons, absence of liquidity constraints of private economic agents (Blinder 2006, Arestis and Sawyer 2003) and lack of empirical support (Hemming et al. 2002).

The first issue of the Ricardian equivalence model is the assumption of the infinite time horizon (Tobin 1980, Feldstein 1982, Snowdon and Vane 2005). The lifetime of the economic agent is finite rather than infinite; this means that if the future tax liabilities fall on a future generation, then the current generation may feel wealthier, hence their current spending may not be affected. Barro (1989) defines the RE model through intergenerational altruism theory, which argues that current generations are usually far-sighted and care about their future heirs; therefore, current generations will raise savings by reducing present consumption to increase their bequests to their next generation in order to pay for the future tax liabilities.

Although the intergenerational altruism theory was raised to validate the RE model, this defence is also questioned by others (e.g. Blinder 2006) who argue that most bonds issued to cover deficits will usually mature in no more than 10 years, which is a time frame when most of the current generation will still be around and tax liable, and therefore, intergenerational altruism is not relevant. The author also questioned if current consumption is, or mostly, dependent on the present-value budget constraints. Blinder (2006) argues that current income will matter more than future income because it loosens current liquidity
constraints. In that case, a debt-financed tax cut will raise spending since the liquidity constraints are binding. Even if only a portion of the population is liquidity constrained, Ricardian equivalence will fail.

In relation to fiscal activities, the Ricardian regime has usually been used to describe a well-behaved government that keeps the present value of tax liabilities constant by using spending cuts or increasing tax to match present government borrowing (to finance tax cuts today) (Elmendorf and Mankiw 1998). Moreover, in the context of assessing the sustainability of public finance, being in a Ricardian fiscal regime and satisfying the intertemporal budget constraint is a necessary condition of fiscal sustainability (Hemming et al. 2002, Afonso 2008). In its aspect of the long-term interest rates, having full Ricardian equivalence, the desired bond holdings rise by the exact increase in government debt issuance; private consumption declines to offset the increase in public expenditure which leaves GDP unchanged, and therefore the long-term interest rate remains constant (Turner 2011).

According to the terminology used by Sargent and Wallace (1981), the Ricardian regime represents a situation of monetary dominance where the monetary authority has some independence from government and actively conducts price stability policy. The fiscal authority has to attain a primary budget at some point, in order to maintain the consistency of budget constraints with repayment of the initial stock of debt, or at least have some tendency to use primary budget surplus to ease debt level (i.e. debt-GDP ratio) (Afonso 2008). The Ricardian regime was empirically confirmed for Europe throughout the pre-EMU period and also the early stage of the post-EMU period (Favero 2002, Galí and Perotti 2003, EC 2004, Ballabriga and Martinez-Mongay 2005, Afonso 2008). These studies generally confirmed that the negative relation between budget surplus and debt level, which is the synonym of the Ricardian regime, exists among most EMU members. Since the Ricardian regime exists inside EMU, at least during the run-up to and early stage of EMU, the impact of large government debt on long-
term interest rates could be limited given that government has the intention to curb the debt level by controlling their budget deficit (Woodford 2001).

5.3.3 Financial integration and fiscal discipline

Fiscal discipline in EMU can be monitored and enforced by fiscal rules e.g. EMUFR and the SGP. However, the effectiveness of such rules heavily depends on the level of obedience among member states and the degree of policy administration at EMU level. Besides EMU fiscal rules, the sovereign bond market may also provide an alternative mechanism that should bring pressure on national fiscal discipline (Schuknecht et al. 2008). This market discipline mechanism can be defined as the financial market participants pricing different risk premiums on EMU members’ risks of default (Bernoth et al. 2004, Warin and Wolff 2005, Manganelli and Wolswijk 2007, Schuknecht et al. 2008,). A country with unsound fiscal policies will be penalised for their lack of fiscal discipline in the bonds market by being charged with high-risk premiums on their sovereign debt. This signal not only helps the risk-averse investor discriminate the quality of different national bonds, it also puts pressure on high-risk countries. Therefore, governments have to take into account the high level of financing costs when they plan their fiscal policies. As unsound fiscal policies are penalised by the market force, the fiscal discipline need to be improved to reduce the costs of debt financing (Favero et al. 1997, Ardagna et al. 2007, Manganelli and Wolswijk 2007).

This kind of market mechanism is more relevant to a region or country such as EMU and the USA where the governments of member states can issue their own bonds, but are restricted in their ability to respond to financial shocks since they have no control of monetary policy (Restoy 1996). As the monetary policy is centralised at the union level, inflation surprise or monetisation is no longer available to member states; in times of fiscal crisis, such governments are likely to require bail-outs from fellow members and the union central bank. Such incidents will cause the spread of the costs (i.e. risk premiums of other members’
government debt may rise) of their profligate fiscal policies to the rest of the monetary union (Detken, Gaspar and Winkler, 2004).

If the market discipline mechanism does exist and work effectively, it should lead to more prudent national fiscal policies, thus protecting the union from fiscal crisis (Manganelli and Wolswijk 2007, Bauer and Zenker 2012). The market mechanism is more effective in situations where government has access to the capital markets on the same terms as other private borrowers, and the full financial consequences of a possible default have to be taken by the governments (Bishop 1989, Lane 1993, Manganelli and Wolswijk 2007). In contrast, the disciplinary function of the financial market can be impaired if pricing distortions exist due to direct or indirect pressure to favour government debt securities in the market (Schuknecht 2008).

Lane (1993) points out that the borrower must not face a captive market in which lenders cannot deny it funds. In case of borrowing by a sovereign government, if under effective capital controls, government might able to increase its debt without driving up interest rates by limiting domestic residents' ability to seek alternative assets abroad. Therefore, free and open financial markets are required so that interest rates can respond to the level and nature of borrowing. In Europe, the Treaty of Rome provided for the free movement of capital for the first time in Europe, but the abolition of capital restrictions between member states was to be ‘to the extent necessary to ensure the proper functioning of the common market’. As part of the drive towards Economic and Monetary Union, the freedom of capital movements gained the same status as the other internal market freedoms with the entry into force of the Maastricht Treaty.

From 1st January 1994, not only were all restrictions on capital movements and payments between EU member states prohibited, but so were restrictions between EU member states and third countries (Articles 63 to 66 of the TFEU). The barriers to trade and capital movements were eliminated by the TFEU, which
implies a wider and fairer European financial market where financial integration among members increases the efficiency of financial markets. The more efficient the market is, the more accurate risk assessments of national bonds can be (Warin and Wolff 2005). Therefore, financial integration, which is the product of the European single market, reinforced the market mechanism as the device of fiscal discipline.

However, the creation of EMU may also impair the function of the market discipline mechanism which is implied by the convergence of government bond spreads among EMU members, especially between Germany and other high-debt countries (Pagano 2004). Germany is usually recognised as the leading and stable economy in the Eurozone: bond interest rates have been kept low for decades, and it is commonly used as the benchmark bond for measuring bond yield spreads. The other high-debt EMU members had sizeable spreads compare with Germany before the creation of EMU, which implies a high-risk premium of their sovereign debt securities (Condogno et al. 2003). Despite the high debt level and deterioration of the fiscal stance of high-debt EMU member states, the convergence of government bond spreads happened during the run-up period of the Eurozone and the first few years of the post-EMU period (Barrios et al. 2009). Such a phenomenon, especially the convergence of bond spreads after the creation of EMU, may indicate the single currency and EMU had caused the market discipline mechanism to deteriorate. The elimination of future uncertainty about economic circumstances (e.g. exchange rate movements and price stability), which are used by the financial market to determine the risk premiums, can be treated as the possible reason why markets fail to discriminate EMU members’ debt risks (Manganelli et al. 2007).

### 5.3.3 Market mechanism and fiscal rules

The EMU is designed to be a fiscal crisis safe zone, if both fiscal rules and the market mechanism can work efficiently and simultaneously. There are a few
conditions the financial market must meet, in order to allow the market discipline to work (Bishop 1989, Lane 1993). Generally, the required conditions which allow markets to enforce fiscal discipline generally fall into the following. First, the free movement of capital markets is required, which ensures governments will face similar conditions to other borrowers when they enter the financial market. Second, timely and standardised fiscal information of borrowers has to be available on a regular basis for investors to assess risk premiums of sovereign debts. Third, the monetary authority needs to be independent from the fiscal authority, which prohibits the government from solving debt issues in monetary ways. Finally, no bail-out clause is allowed, which would prevent the investors underestimating the risks of default.

Meeting these conditions allows the market to perform as a fiscal discipline device; however, even assuming no other factors affect the capability of the market mechanism, fiscal discipline cannot be guaranteed by market forces alone given that the reactions of the market to changes in the fiscal and macroeconomic conditions are unstable (Delors 1989). In contrast, Bayoumi et al. (1995) studied the US state-level bond interest rates and conclude that, even when the market cannot sufficiently identify the risk premium of government debt, the level of interest rates on government bonds it is still useful to provide a signal to market participants about the probability of default. However, the low level of long-term interest rates with poor obedience to EMU fiscal rules among some Eurozone member states before the late 2000s financial crises and EMU fiscal crises afterwards seems to suggest the failure of both safety devices in EMU.

The SGP does not necessarily guarantee existing members will obey the rules. In fact, it heavily depends on competition and coordination in EMU and the political will of its member states (Eichengreen 2005, Larch et al. 2010, Bonatti and Cristini 2008). The poor performance can be blamed on the weak administration of EMUFR inside EMU by the EU Committee. In the case of the market mechanism, the fiscal rules and market mechanism are not isolated from
each other. In fact, the fiscal rules and market mechanism can work together. For instance, Bayoumi et al. (1995) proposed increasing the role of market forces in fiscal rules, for instance by using interest rates rather than budgetary data for triggering non-compliance procedures or for determining the size of sanctions. In the other direction, fiscal rules provide general guidance about the borrower’s fiscal stance which can be used by lenders to evaluate the changes in risks of sovereign debt stances (Mosley 2003). For example, a member who has breached EMUFR and continues in non-compliance with Council recommendations could be seen as raising the risks of exiting EMU, and thus promote concerns of possible default in the future.

However, Manganelli et al. (2007) raise doubts about the reinforced relation between fiscal rules and market discipline by arguing that the deterrent and correcting effect of the Pact might reduce monitoring by financial markets of fiscal activities given that lenders may have some confidence in the peer pressure and sanctions which will lead governments to reduce budgetary positions to below the deficit and debt reference values. Poterba and Rueben (2001) also argue that the tight fiscal rules will weaken the relationship between the interest rate and the development of undue fiscal stance, and find that US states with tight fiscal rules have smaller interest rate changes in response to the rise in deficits than in other states that have no tight fiscal control. In the case of EMU, EMUFR, which are recognised as a very tight set of fiscal rules that do not provide enough flexibility to member states (de Grauwe 2009), may had provide the extra confidence to investors during the early stages of EMU. Lenders in the bonds market may believe that peer pressure and sanctions from EMU can sufficiently improve the fiscal stance of high-debt members. Therefore, the breaching of the fiscal ceiling of EMUFR can be treated as a temporary issue that may not necessarily pose a long-term permanent impact on the members’ fiscal path (Manganelli et al. 2007).

In conclusion to this subsection, the possibility of a country using sudden depreciation of domestic currency or inflation to reduce the real value of debt
payments can be, at least, mostly eliminated by membership of EMU given that the TEU assured the full independence of the ECB. Since inflation uncertainty is, to some extent, being removed inside EMU (Caporale and Kontonikas 2009), the risk premiums of national debts of EMU members may be revised downwards by the lenders. In addition to this, the Ricardian fiscal regime of EMU countries should also have a negative effect on the sensitivity of financial markets to the fiscal behaviours of euro member states. Finally, the SGP, which forms the fiscal rules formal EMU members have to obey once they join the Eurozone, may also have some contribution here. However, later evidence proved that the SGP failed to enforce the fiscal developments of EMU member states after their membership was granted. Therefore, the impacts of the SGP on the relation between bond interest rates and fiscal stance remain questionable.

5.4 Previous literature – investigating the relationship between fiscal stance and long-term interest rates

A substantial amount of previous literature was conducted to investigate the effects of fiscal policy on interest rates in terms of sign and magnitude. Gale and Orszag (2003) provide a comprehensive survey of previous studies conducted during the early 2000s. They reviewed 59 papers and suggested that, despite the large production of studies in this field, the results are still rather mixed. Among them, 29 papers have found a significant positive effect between government debt and interest rate; 19 papers have found a predominantly insignificant effect; and 11 papers produced mixed results. Although any answer to the relation between debt level and long-term interest rates remains controversial, there is one consensus among most literature, which involves using projections of budget deficit and government debt rather than their actual value.
The reason for using the projection rather than actual data is twofold. First, by using the projection value, the estimation includes the information regarding forward-looking behaviour of the financial market; second, by using the projected data from independent economic institutions, e.g. OECD and IMF, researchers can avoid the optimistic bias from the actual government figures (Dell’Erba and Sola 2011). Beetsam and Giuliodori (2010) and Cimadomo (2008) argue that the budget plans announced by government are usually more optimistic in terms of the expected fiscal outcome than forecasts from independent authorities/organisations. Moreover, studies like those of Canzoneri et al. (2002), Gale and Orszag (2003), Laubach (2009) and Afonso (2010) find that the results of estimation will become more statistically significant when using projected values of fiscal stance than the actual data. However, our argument on using projection data is that this methods only looks at the reaction of long-term interest rates to the changes in the level of future expected fiscal outcomes, therefore the relation between current existing debt stance and long-term interest rates is omitted, whereas it should also play a role in setting long-term interest rates on bonds.

In the past, more studies focused on the US than other economies which is probably due to the better availability of US data in terms of time horizon. However, the number of studies conducted for other economies, e.g. OECD countries and Europe, have increased, as a result of improvements in those countries' data availability. By using annual fiscal projections from the OECD, Reinhart and Sack (2000) estimate the effects of fiscal policy in a panel of 19 OECD countries. They find that a one percentage increase in the budget deficit to GDP ratio increases interest rates by 9 basis points in the OECD; moreover, the effects would be bigger if they only included G7 countries (i.e. France, Germany, Italy, Japan, the United Kingdom, and the United States) in their model: a one percentage increase in deficit/GDP can lead to interest rates rising by 12 basis points. Chinn and Frankel (2007) also use projections (i.e. expected debt/GDP ratio was selected for the measurement of the fiscal policy) from the OECD, and find mixed evidence about the effects of expected debt for the UK, France,
Germany, the US, Italy, Spain and Japan. However, by including the US interest rate as a proxy for the ‘world’ interest rate in the model, the results seem to be significant. Ardagna et al. (2007) use a dynamic GLS model to estimate the effects of fiscal policy in a panel of 16 OECD countries with actual annual data, which cover the period 1960 to 2002. They find that a one percentage increase in the primary fiscal deficit to GDP increases long-term interest rates by 10 basis points, a result which is similar to that of Reinhart and Sack (2000).

Faini (2006) focuses on nine EMU countries with data for the period 1979–2002, and adopts the three-stage least squares method, finding that an expansionary fiscal policy in one EMU member has effects on both its spread and on the overall level of interest rate for the currency union. Furthermore, the author also confirms the evidence of more significant spill-over effects for high-debt countries. Bernoth et al. (2004) use a panel data analysis, with data covering the period 1991 to 2002, on 13 EMU member countries to investigate the effects of fiscal imbalances on bond spreads with the German bond interest being treated as the benchmark value. They find that an increase of one per cent in the deficit/GDP differential with Germany increases spread by 3.39 basis points. However, the relation between deficit/GDP differential and spread has a non-linear character. For example, a 25 per cent differential in debt/GDP ratios leads to increase in spread by 30 basis points, whereas 50 per cent corresponds to 47.5 basis points. They also find that EMU membership has a negative effect on the spreads.

Overall, those studies mentioned above generally find a positive relationship between expected/actual fiscal outcomes and long-term interest rates in the industrial countries (i.e. European countries, OECD members and the USA). However, the question of how the creation of EMU affected the reaction of long-term interest rates to fiscal developments was barely answered in the early stages of EMU.
Broadly, in terms of the methodology of estimation, previous literature could be divided into VAR (e.g. Favero et al. 1997, Ang and Piazzesi 2003, Engen and Hubbard 2004) and non-VAR literature (e.g. Reinhart and Sack 2000, Bernoth et al. 2004, Chinn and Frankel 2005, Faini 2006, Ardagna et al. 2007). Compared with the non-VAR-method literature on the effects of fiscal policy on government bonds yields, there are only a few VAR-method papers, most of which are focused on the US. The VAR method can consume a substantial number of degrees of freedom; therefore, it requires a large data set to run the estimation. This could be the reason why the majority of VAR-method literature focuses on the US, rather than other economies.

Among these VAR studies, Engen and Hubbard (2004) use conventional reduced form specifications with projected debt variables. They find that a one unit increase in projected US federal debt increases the expected and the current five-year Treasury bonds interest rates by 1.5 and 2.5 basis points respectively. Evans and Marshall (2007), using a monthly data set which covers the US economy from 1959 to 2000, find no evidence to confirm the effects of fiscal shock on interest rates. Ang and Piazzesi (2003) investigate the role of macroeconomic factors in explaining bond interest rates, over the same time span and frequency as Evans and Marshall (2007). The authors use a traditional VAR analysis, imposing an identification restriction, which assumes a no-arbitrage condition, and confirm that macroeconomic factors can explain up to 85 per cent of the forecast variance for long forecast horizons at short and medium maturities of the yield curve. From these previous studies, the VAR method has been approved as a workable model which can be used to study the reaction of long-term interest rates to the developments of fiscal stances. However, the main drawback of the VAR approach (i.e. needing a large data set for estimation) may still limit its application in this type of study.

There are a few VAR-method studies focusing on EMU. For example, Favero et al. (1997), who assess the functioning of the exchange rate mechanism during the turbulent period from 1993 to 1995 – in particular, the high-frequency
fluctuations of three high-yielders in Italy, Spain and Sweden – find that the existence of a common long-run stochastic trend between Italian and Spanish interest rate spreads was driven by international factors and was independent of country-specific shocks. In contrast, in the previous literature focusing on EMU or EU countries, studies mainly use standard panel data methods for estimation (Reinhart and Sack 2000, Bernoth et al. 2004, Chinn and Frankel 2005, Faini 2006). Hence, the VAR method has not been treated as a mainstream method for estimating the effects of fiscal policy/stance on the interest rates for EMU/EU cases. This low popularity is mainly due to the relatively poor past performance of VAR estimation, which usually produces less significant results than the non-VAR methods (Miller and Russek 1996). Especially in the case of EMU, where the time horizon data is much shorter than data sets for the US, the time series VAR could be the least favourite method as it requires a large data set than other time series methods. However, the availability of the Eurozone data has improved since the increase in the time span of EMU. In addition to this, the new VAR approach of panel vector autoregression (PVAR) can dramatically improve the ‘size’ of EMU data set which is seen as a common weakness of VAR methods.

The contribution of this chapter is to fill the current gap in the literature – few VAR-method studies focus on the Eurozone, and using the PVAR method will allow the study to benefit from the rich data set feature of the panel method, to overcome the problem of the small EMU data set.

To the best of my knowledge, in terms of the methodology that we are proposing to use for this chapter, there is one previous study by Marattin and Salotti (2010) that also employs the PVAR method to investigate whether a weak relation exists between fiscal stance and long-term bond interest rates in the Eurozone. The authors conducted the study for 11 Eurozone countries by using the annual economic projections between 1970 and 2008. This study attempted to estimate the existence of the ‘Euro Fiscal Dividend’ for the entire Euro11 area; however, statistically significant results were only obtained for the period 1970–1996. The author also split the sample into high- and low-debt country groups, but the results are similar as the whole sample estimation. Statistically significant
results are only recovered during the period 1970–1996. Furthermore, since the authors were using annual data for the research, the insufficient sample size implies the reason of why this paper did not conduct a separate estimation for EMU period alone.

In contrast to previous studies, this chapter will investigate the response of long-term government bond interest rates to the level of government debts in the Eurozone by using the actual data on debt. The reason for using the actual debt data is that, first, we are trying to fill the gap in the existing research where projections were usually used to obtain the statistically significant results; and second, by using the actual data, we would be able to evaluate the impact of actual government debt level on the long-term interest rates. Another contribution of this chapter is that we will use the PVAR method instead of the conventional time series VAR approach, which is rarely used in this field due to the lack of sufficient sample size, to recover the dynamics between debt levels and long-term interest rates. Since the PVAR approach will be employed with quarterly data for this research, we can also focus on the post-EMU period that was missing from previous PVAR-approach research.

5.5 Methodology and data

The lack of a sufficient sample size can be seen as the main difficulty the VAR approach can face when adopted for investigating the dynamics between fiscal stance and long-term government bonds rate for a country where the number of observations is low. Moreover, for the case of EMU, besides the problem of its relatively small sample size, the unique feature of this economic and monetary union (i.e. made up by sovereign countries) requires the research to pay attention to national-level information rather than treating EMU as a single entity (e.g. a sovereign country). In this chapter, we will present the econometric
method which we adopt to fulfil the needs of this research, which are: 1) recover the dynamic relation between fiscal stance and long-term bond rates by using a large volume of data; 2) consider EMU as whole, but without losing national-level information.

5.5.1 Methodology – PVAR approach

Since the VAR method requires a large sample size to provide sufficient degrees of freedom for conducting the estimation, thus the conventional time series VAR approach may not be a convenient model to use for the research, which may include some countries that have a problem of poor data availability. Moreover, the objective of this research focuses on the Eurozone as a whole by using national-level information rather than union-level aggregates. Therefore, the panel vector autoregression (PVAR) approach can be an appropriate model for this research. It would enable us to consider all selected countries as a whole without losing national-level information. Moreover, by pooling the time series data for each country together, we will have a sufficiently large sample size to overcome the common issue which previous studies usually faced if the time series VAR approach were employed.

We will continual to use the PVAR model, which was defined in Chapter 4. Thus, the standard form of our PVAR model can be written as:

\[ Y'_{i,t} = B^1 + F_i + \sum_{p=1}^{P} B^2(p) Y'_{i,t} + \delta'_{i,t} \]  

(5-2)

where \( Y'_{i,t} \) is \( k \times 1 \) column vector of endogenous variables of each N entity, \( i = 1,2,...,N \). \( B^1 \) is \( i \times 1 \) vector of common intercept. \( B^2(p) \) is the \( k_p \times i \) matrix of slope coefficients of \( K \) endogenous variables of the N entities; \( p \) is the lag order. \( F_i \) is country-specific fixed effects. \( \delta'_{i,t} \) is the \( i \times 1 \) column vector of white noise error term.
Chapter 5 Fiscal stance and long-term interest rates

The standard way to estimate a VAR system like Equation (5-2) is to employ OLS methods, which is severely dependent on the numbers of observations. This is known as a Hurwicz-type bias that is inherent in dynamic modelling. As the Hurwicz-type bias approaches zero if numbers of observations go to infinity, it may not always receive much attention in time series analysis because VAR studies usually contain sufficiently large numbers of observations. However, it could be a common issue to the panel data approach, as the Hurwicz-type bias does not depend on the size of cross sections (Nickell 1981). Even when cross sections goes to infinity, the size of the bias still negatively depends on the numbers of time series dimensions in panel dynamic models with fixed effects.

In order to overcome this weakness of panel dynamic estimation, an alternative estimator – GMM – has been proposed to replace the standard OLS estimator (Arellano and Bond 1991, Arellano and Bover 1995). Since the fixed effects may cause bias due to the correlation between our country-specific effects $F_i$ and lags of depended variables, we can apply the Helmert procedure (Arellano and Bover 1995) to eliminate this bias, which is also referred to as forward mean differencing, i.e. the contemporaneous correlation can be removed by applying forward mean differencing after time-demeaning our variables instead of normal mean differencing (Bos and Stam 2011). Since the Helmert transformation preserves the transformed variables and lagged regressors are orthogonal, coefficients can be estimated under the GMM system by using lagged regressors as instruments.

5.5.2 Data

For the objective countries in this chapter, we have selected 12 Eurozone members which are: Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal and Spain. The countries besides Greece are the original 11 members of the Eurozone. Given that Greece joined EMU only two years later than the original 11 members, this would mean there
would be sufficient post-EMU data available for Greece. Furthermore, since Greece has the worst sovereign debt crisis of all the members, which has imposed a severe threat on the stability of the Eurozone, it is necessary to include Greece in our selected country group of EMU. Our sample does not include Malta, Cyprus, Slovakia, Slovenia or Estonia for two reasons. First, these five countries only joined the Eurozone recently, therefore there is only a relatively short period of post-EMU data for these five new members. Second, compared with the other 12 members of the Eurozone these five new members only hold a very small proportion of Eurozone’s overall economic activities, which may suggest a very limited impact of these countries’ economic performance on the entire Eurozone.

The quarterly data will be employed here, covering the period 1994:Q1–2012:Q1. The levels of sovereign debt level are measured as a percentage of each country’s GDP. The quarterly general government debt GDP ratio is collected from the Eurostat database; however, it only covers the period 2000 to 2012. Only the annual debt data is available for these countries in the database of IMF and OECD, and the Eurostat database does not provide data which is for the pre-EMU period. Therefore, the quarterly debt/GDP ratios for the period 1994:Q1–1999:Q4 are measured indirectly. We collect the debt securities issued by Euro12 governments in both domestic and international markets from the Bank of International Settlements (BIS) database. Then we convert the monetary value of these governments’ debt securities into debt securities to GDP ratio. Hence, we can use this quarterly government debt securities to GDP ratio as the approximation to the general government debt to GDP ratio. Since the Eurostat database does not provide (or provides only some) GDP data on the pre-EMU period for Greece, Ireland, Portugal and Spain, thus real GDP growth rates are collected from the OECD main economic indicators database. For the same reason as the GDP data, long-term interest rates, which are measured by the bond yields of 10 years’ government bonds, are also collected from the OECD main economic indicators database. Data for these three variables is seasonally adjusted.
5.5.3 Ordering of variables

The focus of this chapter is to produce impulse response functions that help us to estimate the response of one variable in the system to the shocks of another in the PVAR system while others are holding constant. A particular order has to be set up due to the assumption of identification, which is that the variable that comes earlier in the order affects the following ones contemporaneously as well as with a lag. The variable coming later only affects the previous one with a lag. This is a usual convention of the VAR system: since the variance–covariance matrix of errors is unlikely to be diagonal, to isolate shocks to one of the VAR errors it is necessary to decompose the residuals in a way that they become orthogonal (Durlauf and Blume et al. 2010).

In our estimation the orthogonalised shocks will be recovered by adopting the Cholesky decomposition with the following order of variables:

\[
Y = [DEBT \quad RGDPG \quad LIR]
\]

where DEBT represents the debt/GDP ratio, RGDPG is real GDP growth, and LIR is the nominal long-term interest. In setting this order of variables, we are assuming that the lagged real GDP growth will affect current level of debt stocks, and the lagged value of LIR will also affect today’s debt stock through interest payments on the sovereign data. Also, the current debt level will affect overall economic activities and long-term interest rates contemporaneously as well as with a lag. This ordering of data is the same as the setting in the previous literature (Marattin and Salotti, 2010) that also employed the PVAR approach. We have tried different types of ordering for our analysis, e.g. moving the RGDPG to the first variable in our model, and the results do not change significantly.
5.6 Empirical results – does the ‘Euro Fiscal Dividend’ exist in the Eurozone?

In this section, we will present our empirical analysis of the investigation of the existence of the Euro Fiscal Dividend. This is to see whether the creation of the Eurozone has affected the ability of financial markets to provide screening to fiscal stances of sovereign countries and risk levels of their sovereign debt. We begin with the estimation of the whole sample period (i.e. since 1994, which is the year the project of EMU started, to the current period and post-EMU period). Then we re-estimate the model without Germany and France, to see how the rest of EMU members’ national debt developments influence the long-term interest rates, which enables us to see if the possible existence of the Euro Fiscal Dividend is only the case of those key economies of Eurozone. Moreover, to benefit from the richness of the panel data, which is based on quarterly national-level data, we also performed an analysis on the period of the post-2007–8 financial crisis to see if this fiscal shield has become weaker.

5.6.1 Unit-root test

Panel regression estimation is also likely to be affected by the presence of unit roots, which are also a common issue in time series analysis. Hence, in order to perform a PVAR analysis on the chosen variables above, it is necessary to carry out a unit-root test as a standard procedure. In this chapter, as mentioned in the Chapter 4, we are continually employing Im, Pesaran and Shin (IPS), which is based on the well-known Dickey-Fuller procedure. The advantage of IPS is that it suggests a more flexible and computationally simple unit-root test for panel data, which allows error variance and heterogeneity of the dynamics across entities (Barbrer 2006). It also requires fewer time observations, but still maintains the power of the test. Moreover, unbalanced panel data is allowed for IPS test, and its $t$-bar test has a better performance when N and T are small (Im et al. 1997 & 2003).
In Table 5-1, we present the results of the IPS unit-root test for debt/GDP ratio (GDEBT), real GDP growth rate (RGDPG) and long-term interest rates (LIR). The test is carried out at levels for these three variables. The null hypothesis can be rejected at the 5% significant level. Although the estimation results for GDEBT and LIR are negative, since the p-values for both variables are extremely high, we cannot reject the null hypothesis of all panels containing unit roots. In order to render our data stationary, we will take log difference transformation to GDEBT and LIR. Due to this data transformation, instead of looking at the volume of debt and long-term interest rates, we are focusing on the growth rate of DEBT and LIR. The variables we are using in this research now are: [LDGDEBT RGDPG LDLIR].

5.6.2 Lag length selection

Before we start conducting the analysis through the PVAR model, it is essential to select an appropriate lag length, just as in running a conventional regression of time series VAR. We will carry on using the information criterion approaches that were employed in Chapter 4, which are:

$$AIC = \ln|\hat{V}| + \frac{2M^2 \times P}{N^*}$$
\[ BIC = \ln|\hat{\gamma}| + \frac{\ln(N^*) \times k}{N^*} \]

\[ HQIC = \ln|\hat{\gamma}| + \frac{2\ln[\ln(N^*)] \times (M^2 \times p)}{N^*} \]

It is not unusual to find that the results of the above three IC methods are different. Hence, the subjective selection of lag length may not be fully avoided. In this case, we may follow Lütkepohl (2004), who suggested that the BIC and HQIC may be more preferable to the AIC. This is because when the sample tends towards infinity, the AIC is usually a more conservative method that usually gives a relatively big lag length. In contrast, BIC and HQIC will tend to choose a smaller lag length. The bigger lag length can significantly consume degrees of freedom; hence, BIC and HQIC are more relevant to the relatively small sample.

<table>
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<td>Lag</td>
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</tr>
<tr>
<td>10</td>
<td>-5.64096</td>
<td>-4.84988</td>
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Source: produced by the author

We employed AIC, BIC and HQIC for the estimation of lag length selection; the results are presented in Table 5-2. We performed these three IC with 10 lags; the
lag length with the highest value represents the optimal lag length suggested by each IC. For the whole sample period, BIC and HQIC both suggest lag length 5 is the appropriate selection for our analysis, and AIC suggests lag length 9. Since AIC tends to suggest a big lag length, which may consume more degrees of freedom, and, moreover, since our sample size is just 804 observations which is still relatively small comparing with large-scale models, e.g. micro level and industrial level data, therefore we will select a lag length of 5 for the whole sample period analysis. In the case of the sub-sample set, which covers Euro12 countries for the post-EMU period, all three IC methods suggest a lag of 1 should be the optimal lag length for the PVAR model.

5.6.3 Estimation of the ‘Euro Fiscal Dividend’ – whole sample period vs. post-EMU period

Following the unit-root and lag length selection tests, in this section we will present the empirical results for detecting the existence of the Euro Fiscal Dividend. First, we estimated the PVAR model with the full sample set and calculated the orthogonalised impulse response to capture the dynamic relation between fiscal stance and long-term interests for the Euro12 area as whole. In order to see whether the establishment of the Eurozone had created a fiscal safe haven for its participating members, PVAR will be applied to the post-EMU period sample as well.

By comparing the results of impulse response from both sample sets, we are able to see the possible changes to the dynamics between DEBT and LIR after the creation of EMU. The sample for the post-EMU period starts from 2000:Q1–2012:Q1; this will provide us with 588 observations. We did not choose a start

33 Ideally, we should also run an analysis on the pre-EMU period independently. However, the data for quarterly debt is not available for most Eurozone countries, and BIS debt securities data only starts from 1993:Q3, and thus the available pre-EMU data for Euro12 countries is limited. We tried the PVAR model with a sub-data set which covers the second stage of EMU (1994 to 1999). The results are statistically insignificant for this period of time. This could be due to the issue of small sample size.
year of 1999 because Greece was not a member at that time. However, in June 2000 EMU formally announced that membership of the Eurozone would be granted to Greece by 1\textsuperscript{st} January 2001. This suggests that, for Greece and the financial market, membership of EMU was guaranteed at that time. So, we could assume that it was possible for Greece to start to benefit from the Euro Fiscal Dividend if it did exist. We have also estimated the PVAR with data that starts from 2001:Q1; however, no significantly different results were obtained.

**Figure 5-2 Impact of sovereign debt shock on growth rate of long-term interest rates and real GDP growth in the Euro12 area (1994:Q2–2012:Q1)**

The results of the PVAR model for Euro12 are displayed in Figure 5-2. It shows the 15-quarter impulse responses of real GDP growth, percentage change of LIR to one standard deviation of growth rate of debt/GDP ratio implied by the panel.
regression, together with two standard error bands (i.e., 5% and 95%), obtained by Monte-Carlo simulation 1000 repetitions. The impulse responses are typically significantly different from zero at the 95% level, because of the large amount of information that comes from using the panel approach. The first graph in Figure 5-2 displays the dynamic responses of long-term interest rates in Euro12 to the one-unit shock in the growth rate of debt/GDP ratio in Euro12 countries. With a one-unit shock in growth rate of debt/GDP ratio (one per cent point increase in the growth rate of debt/GDP ratio), the dynamic response of long-term interest rates remains positive within our estimation period.

This result is similar to the previous paper (Marattin and Salotti 2010) that also employed PVAR to investigate the relation between Eurozone debts and long-term interest rates. Although the authors have also captured the positive dynamic relation between national debt and long-term interest rates, the results of impulse response analysis for entire estimation periods (6 quarters) are statistically insignificant. According to our results, except periods 2, 3, 10 and 11, the responses of changes in long-term interest rates are statistically significant. From Figure 5-2, soon after the shock of growth rate of debt/GDP ratio, the growth rate of long-term interest rate will increase by 0.16 percentage points. At quarter 5, the magnitude of response reaches its peak value at 0.33 per cent points; afterwards, the impact of debt on long-term interest rate still remains positive but with a diminishing rate.

In Table 5-3, we present the statistically significant response of long-term interest rates to the shock of debt GDP ratio. The accumulation value of response within 15 quarters is 0.015. It indicates that, with one per cent point increase in the growth rate of debt/GDP ratio, the growth rate of long-term interest rate will increased by 1.5 percentage points in the Euro12 area within 15 quarters. Since the VAR model only allows an individual shock to happen at one time, therefore the accuracy of impulse response analysis will decline with the increase in the length of the estimation period. However, if we only consider the first 5 quarters in our impulse response analysis, the accumulation of the
response is 0.0073. This still suggests that the long-term interest rates do have a pronounced relation with national debt levels in the Euro12 area. With a one-unit shock in the growth rate of debt/GDP ratio, the growth rate of long-term interest rates will increase by 0.73 percentage points in the short term.

| Table 5-3 Statistically significant response of long-term interest rates (1994:Q2–2012:Q1) |
|---------------------------------|---------------------------------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| Period | 1 | 4 | 5 | 6 | 7 | 8 | 9 | 12 | 13 | 14 | 15 | Response | 0.0016 | 0.0024 | 0.0033 | 0.0014 | 0.0009 | 0.0014 | 0.0012 | 0.0009 | 0.0007 | 0.0006 | 0.0006 | Total response within 15 periods | 0.015 |
| Source: produced by the author |

In Figure 5-2, we also present the impulse response graph for the impacts of debt/GDP ratio to the growth of real GDP in the Euro12 for the period 1994–2012. Interestingly, with a one-unit shock in the growth rate of debt/GDP ratio, the responses of the rate of real GDP growth are negative over the entire 15 estimation periods. Moreover, as the zero line is not within the area between the two 5% error bonds, it suggests that the estimation results for each period are statistically significant. The negative response will reach its peak at quarter 2, which is -0.0039; however, the negative response will decline over time (see Figure 5-2 and Table 5-4). Within the first four quarters since the initial one-unit shock in the growth rate of debt/GDP ratio, the accumulated response of real GDP growth is -0.013. This means with one per cent point increase in the growth rate in debt/GDP ratio, within a year the real GDP growth can decline by 0.013 percentage points. For the Euro12 area as a whole, the building up of government debts that reflect aggressive national fiscal policies seems have no real positive impact on the growth of output. Instead, there will be a minor decline of the level of real GDP growth in the Euro12 area. This result confirms those of other studies which focus on the macroeconomic effects of fiscal policy in EMU and suggests that fiscal policy shock has uneven or very minor impacts on
Chapter 5 Fiscal stance and long-term interest rates


| Table 5-4 Statistically significant response of real GDP growth (1994:Q2–2012:Q1) |
|----------------------------------|------------------|
| Period                          | 1    | 2    | 3    | 4    | 5    | 6    | 7    | 8    |
| Response                        | -0.0034 | -0.0039 | -0.0027 | -0.0033 | -0.0036 | -0.0031 | -0.0029 | -0.0025 |
| Period                          | 9    | 10   | 11   | 12   | 13   | 14   | 15   |
| Response                        | -0.0025 | -0.0024 | -0.0021 | -0.0021 | -0.002 | -0.0018 | -0.0018 |
| Total response after 15 periods |       |          |          |          |       |          |        |
| Source: produced by the author  |       |          |          |          |       |          |        |

In order to investigate whether the response of the long-term interest rates to government debts have changed since the creation of the Eurozone, which will help to indicate the existence of the fiscal shield that is created by the single currency area, we conducted the PVAR analysis with the same variables for the post-EMU period from 2000:Q1. Lag length for this sub-sample analysis is 1, which is suggested by all three IC methods that were employed in this chapter (see Table 5-2).

In Figure 5-3, we have shown the impulse response diagrams of long-term interest rate growth and real GDP growth. By looking at the fluctuation of the response curve of long-term interest rates, the difference between full sample and sub-sample analysis is strikingly clear. With a one-unit shock in the growth rate of debt/GDP ratio, in the full sample analysis, the dynamic response of long-term interest rate growth is positive over the 15-quarter estimation period, and most of the responses are statistically significant, which eventually leads to increase in the growth rate of long-term interest rates. Compared to the results of the full sample analysis, the dynamic response of long-term interest rates changes became completely different after the creation of the euro. During the period 2000:Q1–2012:Q1, with a one-unit shock of the growth rate of debt GDP ratio, the growth rate of long-term interest rates will only increase during the
first quarter. From quarter 2, the response of long-term interest rate growth in the Euro12 becomes negative. Although the negative response of long-term interest rates is minor relative to the positive response at quarter 1 and quarter 2, the negative impacts on the growth rate of long-term interest rates have longer effects. The estimation is statistically significant from quarter 4 to quarter 14.

**Figure 5-3 Impact of debt shock on growth rate of long-term interest rates and real GDP growth in the Euro12 area (2000:Q1–2012:Q1)**

Response of long–term interest rate

Response of real GDP growth

Note: errors are 5% on each side generated by Monte-Carlo with 1000 repetitions

In Table 5-5, we can see the magnitude of each statistically significant response. Over 15 estimation periods, the accumulated response of long-term interest rate
growth is -0.0011. This implies that with one per cent point change in the growth rate debt/GDP ratio, the growth rate of long-term interest rates on government bonds will actually decline by 0.11 percentage points over the full estimation period. Within a year, the impacts of debt/GDP ratio shock will only lead to 0.2 per cent points increase in long-term interest rates growth in the Euro12 area. This is only half of the size of the impacts that were estimated using the full sample set. The results here do suggest a significant change in the relationship between government debt and long-term interest rates happened after the creation of the Eurozone for Euro12 members. In the short run, the aggressive use of fiscal policy, which can lead to a substantial increase in debt stocks in Euro12 countries, may not receive sufficient attention from financial markets. This is represented by the weak signalling phenomena in the market, hence members of EMU could find themselves more able to access and serve funds due to the fiscal shield that is created by the Euro Fiscal Dividend.

| Table 5-5 Statistically significant response of long-term interest rate (2000:Q1–2012:Q1) |
|-----------------------------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| Period                                       | 1               | 4               | 5               | 6               | 7               | 8               | 9               |
| Response                                     | 0.0024          | -0.0005         | -0.0005         | -0.0004         | -0.0004         | -0.0003         | -0.0003         |
| Period                                       | 10              | 11              | 12              | 13              | 14              |                 |                 |
| Response                                     | -0.0003         | -0.0002         | -0.0002         | -0.0002         | -0.0002         |                 |                 |
| **Total responses after 15 quarters:**       | -0.0011         |                 |                 |                 |                 |                 |                 |

Source: produced by the author

Besides presenting the impulse responses of long-term interest rates change, we also report the dynamics of real GDP growth due to the shock of the growth rate of debt/GDP ratio in Figure 5-3. Compared to the case of long-term interest rates, there is no significant difference between the estimation results of full and sub-sample sets. As with the result of the full sample set analysis, the response of real GDP growth to the shock of debt/GDP ratio changes is also negative and statistically significant over the 15-quarter estimation period. In Table 5-6, we can see that over the 15-quarter estimation period, the accumulated response of
real GDP growth is -0.0344, which means, with a unit debt/GDP ratio shock, real GDP growth will decline by 0.0344 percentage points over 15 quarters.

<table>
<thead>
<tr>
<th>Period</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Response</td>
<td>-0.005</td>
<td>-0.004</td>
<td>-0.0036</td>
<td>-0.0032</td>
<td>-0.0029</td>
<td>-0.0025</td>
<td>-0.0022</td>
<td>-0.002</td>
</tr>
<tr>
<td>Period</td>
<td>9</td>
<td>10</td>
<td>11</td>
<td>12</td>
<td>13</td>
<td>14</td>
<td>15</td>
<td></td>
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<tr>
<td>Response</td>
<td>-0.0018</td>
<td>-0.0016</td>
<td>-0.0014</td>
<td>-0.0012</td>
<td>-0.0011</td>
<td>-0.001</td>
<td>-0.001</td>
<td>-0.0009</td>
</tr>
</tbody>
</table>

Total responses after 15 quarters: -0.0344

However, as we said before, the accuracy of impulse response analysis will decline with the increase in the length of estimation. Therefore, we may be more interested in the short-term effects rather than long-term impacts. The peak of response occurs at period 3, which has a value of -0.0036. This is only 0.0003 points smaller than the peak value that was estimated by using the full sample set (see Table 5-4). Moreover, the total response of the first four quarters is -0.0158, which is also very close to the result of the full sample analysis. As a result of this estimation, we can see that the fiscal policy remains ineffective on real output growth in the Eurozone.

5.6.4 Estimation of the ‘Euro Fiscal Dividend’ – the case of excluding Germany and France

In the previous subsection, we conducted the investigation of the existence of the Euro Fiscal Dividend by using the panel vector autoregression (PVAR) method. By pooling the time series data of each country to create a panel data set, we are able to recover the dynamic relationship among variables of debt, output and long-term interest rates. The advantage of this method is to enable the estimation to be conducted by considering national-level information in the Eurozone, rather than relying on union-wide aggregates.
Since the panel data is created by pooling national time series data together, we can take some countries off our sample set to run the analysis on the remaining sub-group. Therefore, to investigate whether the results of the previous section are heavily influenced by a few key economies of the Eurozone; or the Eurozone has been treated as a whole in view of the financial market, helps us to understand if those relatively small/poorly performing economies have also benefited from the Euro Fiscal Dividend. In order to perform this analysis, we will take Germany and France off our panel data. The reason for choosing these two countries is that: first, the debt/GDP ratio and long-term interest rates for these two countries are relatively low, especially in the case of Germany; second, compared with other low-debt countries, given the size of their economy, we could assume a significant influence by these two counties on the Eurozone. In Table 5-7, we present the results of the AIC, BIC and HQIC estimations. All three IC methods have a common suggestion of the lag length for the sub-sample (Euro10 area): that is, lag = 1. Therefore, we will implement the PVAR model with lag order 1.

<table>
<thead>
<tr>
<th>Lag</th>
<th>AIC</th>
<th>BIC</th>
<th>HQIC</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>-4.94581*</td>
<td>-4.60122*</td>
<td>-4.81024*</td>
</tr>
<tr>
<td>2</td>
<td>-4.86946</td>
<td>-4.43838</td>
<td>-4.69971</td>
</tr>
<tr>
<td>3</td>
<td>-4.85803</td>
<td>-4.33753</td>
<td>-4.65288</td>
</tr>
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<td>4</td>
<td>-4.87267</td>
<td>-4.25965</td>
<td>-4.63083</td>
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<td>-4.86727</td>
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<td>7</td>
<td>-4.70649</td>
<td>-3.79551</td>
<td>-4.34608</td>
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<td>8</td>
<td>-4.69539</td>
<td>-3.67756</td>
<td>-4.29232</td>
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<td>-4.77047</td>
<td>-3.64191</td>
<td>-4.32327</td>
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<td>-4.63342</td>
<td>-3.38916</td>
<td>-4.13696</td>
</tr>
</tbody>
</table>

Source: produced by the author
Figure 5.4 Impact of sovereign debt shock on growth rate of long-term interest rates and real GDP growth in the Euro10 area (2000:Q1–2012:Q1)

In Figure 5.4, we present the diagrams of impulse responses of growth of long-term interest rates and real GDP to the one-unit shock of growth of debt/GDP ratio for the Euro10 area. The dynamics of growth rate of long-term interest rates have a similar shape as the results for the Euro12 area (see Figure 5.2). The growth rate of long-term interest rates will increase during the first quarter, and then it will become negative through the remaining 14 quarters. However, from quarter 2, the zero line stays between the upper and lower error bonds, which suggests that the results are only statistically significant for quarter 1. Therefore,
the only statistically significant response of long-term interest rates has the value of 0.0030 (see Table 5-8). This is 0.0006 higher than the peak value of Euro12 that also occurs in quarter 1. With one per cent point increase in the growth rate of debt/GDP ratio, the maximum response of growth rate of long-term interest rates for Euro10 area is only 0.06 percentage points higher than the case of the Euro12 area. Given the minor difference between the response of long-term interest rates among the Euro10 and Euro12 areas, it seems financial markets treat those members as a whole. There is no pronounced discrimination between low-debt key economies and high-debt/small economies. Instead, Euro12 members had been treated as part of a large union only.

<table>
<thead>
<tr>
<th>Period</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.0030</td>
</tr>
</tbody>
</table>

We have also presented the impulse response of real GDP growth to the shock of debt/GDP ratio growth in Figure 5-4. Compared to the results for the Euro12 area, there is no significant difference in results for the Euro10 area. The dynamics of real GDP growth remain negative over the 15-quarter estimation period. The accumulated response of real GDP growth over 15 quarters is -0.036 (see Table 5-9), which is only -0.002 points higher than the total response for the case of the Euro12 area.

<table>
<thead>
<tr>
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<tbody>
<tr>
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<td>-0.005</td>
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<tr>
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<tr>
<td>5</td>
<td>-0.003</td>
</tr>
<tr>
<td>6</td>
<td>-0.003</td>
</tr>
<tr>
<td>7</td>
<td>-0.002</td>
</tr>
<tr>
<td>8</td>
<td>-0.002</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>Period</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
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</tr>
<tr>
<td>11</td>
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</tr>
<tr>
<td>12</td>
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</tr>
<tr>
<td>13</td>
<td>-0.001</td>
</tr>
<tr>
<td>14</td>
<td>-0.001</td>
</tr>
<tr>
<td>15</td>
<td>-0.001</td>
</tr>
</tbody>
</table>

**Total response after 15 quarters:** -0.036

Source: produced by the author
5.6.5 Estimation of the ‘Euro Fiscal Dividend’ – has it changed since the recent financial crisis?

During the recent late-2000s global financial crisis, expansionary fiscal policy has been widely and rapidly used by the members of the Eurozone. Given the imbalance of business cycle synchronisation among EMU members, it is more difficult for the ECB to design a union wide appropriate monetary policy. Hence, the rapid growth of national debt should not be seen as a surprising consequence of loose monetary sovereignty, especially for those countries that have a long history of high levels of government debt. This rapid use of fiscal policy has led to another economic crisis which is particularly relevant to the Eurozone – the sovereign debt crisis. In this subsection, we will look at the period between 2007 and the present, to investigate whether the Euro Fiscal Dividend has become weaker which allows the financial market to act as a signalling device again to the market participants.

- 5.6.5.1 Focus on the union as a whole

Given the results of the three IC approaches that are displayed in Table 5-10, we will apply the PVAR model with lag length 1 for the post-crisis period (2007:Q1–2012:Q1). The IC results for the pre-crisis period (2000:Q1–2006:Q4) differ between these three IC approaches. BIC suggests lag length 1, but AIC and HQIC suggest lag length 9. Since there are only 28 observations for each country in the sub-panel data set for the pre-crisis period, lag length 9 will seriously consume the degrees of freedom. Moreover, for the HQIC approach, the result of lag length 9 is only 0.07675 higher than the value of lag length 1 in absolute terms. Therefore, we will also choose lag length 1 for the analysis of the pre-crisis period.
### Chapter 5 Fiscal stance and long-term interest rates


<table>
<thead>
<tr>
<th>Lag</th>
<th>AIC</th>
<th>BIC</th>
<th>HQIC</th>
<th>AIC</th>
<th>BIC</th>
<th>HQIC</th>
</tr>
</thead>
<tbody>
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<td>-7.02272</td>
<td>-6.48286</td>
<td>* -6.80696</td>
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<td>* -3.01604</td>
<td>* -3.41980</td>
</tr>
<tr>
<td>3</td>
<td>-6.81726</td>
<td>-6.01598</td>
<td>-6.49615</td>
<td>-2.84415</td>
<td>-1.81943</td>
<td>-2.42963</td>
</tr>
<tr>
<td>4</td>
<td>-6.23075</td>
<td>-5.28630</td>
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<td>-0.85829</td>
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<td>-1.25327</td>
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<tr>
<td>9</td>
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<td>-1.19467</td>
</tr>
<tr>
<td>10</td>
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<td>-5.44195</td>
<td>-6.66234</td>
<td>-2.96960</td>
<td>-0.04273</td>
<td>-1.78099</td>
</tr>
</tbody>
</table>

Source: produced by the author

Figure 5-5 shows the graphs of impulse response of long-term interest rate growth to the one-unit shock of debt/GDP ratio growth rate for both pre- and post-crisis periods. The difference between these two results is that the reactions of long-term interest rates to the debt shock are completely different, which indicates a structure break may exist around the year 2007. During the pre-crisis period, with a unit debt/GDP shock, the growth rate of long-term interest rates will decline rather than increase, and this negative response will die out around the sixth quarter. However, only the response at quarter 2 is statistically significant, since the values of both 95% error bonds are different from zero. With an increase in the level of debt stocks, the financial markets should adjust upwards the risk premium of these countries’ government debts by charging higher interest rates on long-term government bonds. However, the result here suggest that during the pre-crisis period the financial market failed to act as a signalling device to prevent the Euro12 area from irresponsible and excessive usage of fiscal policy at national level.
Figure 5-5 Impact of debt shock on growth rate of long-term interest rates in the Euro12 area (2000:Q1–2006:Q4 and 2007:Q1–2012:Q1)

Pre-crisis period

Post-crisis period

Note: errors are 5% on each side generated by Monte-Carlo with 1000 repetitions

In the results of the post-crisis period, the behaviour of long-term interest rates is back to the normal truck. With a shock of one per cent point increase in the growth rate of debt/GDP ratio, the growth rate of long-term interest rates will increase from the first quarter. The total reaction of long-term interest rates is positive but with a diminishing rate. Similar to the result of the pre-crisis period, the debt/GDP ratio only has a short-term effect on the growth rate of long-term interest rates. The statistically significant impulse response occurs in the first quarter after the initial debt shock. With a one-unit shock of debt/GDP growth ratio, the growth rate of long-term interest rates on government bonds will
increase by 0.48 percentage points (see Table 5-11). This is twice as high as the value of response for the full post-EMU period analysis (see Table 5-5).

Table 5-11 Statistically significant response of long-term interest rate (pre-crisis and post-crisis)

<table>
<thead>
<tr>
<th></th>
<th>Pre-crisis</th>
<th>Post-crisis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Period</td>
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<td>2</td>
</tr>
<tr>
<td>Response</td>
<td>-0.001</td>
<td>0.0048</td>
</tr>
</tbody>
</table>

Source: produced by the author

In Table 5-11, we present the results of statistically significant impulse responses of long-term interest rates. During the pre-crisis period, with a debt/GDP ratio shock, the growth rate of long-term interest rates will have a negative response associated with a 0.1 percentage points decline. However, as we have mentioned in the previous paragraph, for the post-crisis period, with the same level of debt shock, the growth rate of long-term interest rates responds positively in the second quarter. According to these two completely different responses of long-term interest rates to the debt shock, we can see that since the outbreak of the late-2000s financial crisis, given the surge of national debt level across the Eurozone, especially among those countries which have a long history of high debt, the dynamics of long-term interest rates changes have performed as the indicator of the risk premium of government bonds again.

- 5.6.5.2 Euro12 vs. Euro10

So far in this subsection, we have obtained some evidence to show that the Euro Fiscal Dividend has started to disappear since the recent financial crisis. The analysis in this section has focused on Euro12 as a whole by pooling the national-level data together to create a panel data set; thus, by taking out some key economies which still have relatively low-level debts and long-term interest rates, we are able to see whether the market has started to discriminate between core
and periphery members of EMU. Following the same procedure as the previous subsection, we will run the PVAR model based on the Euro10 area, which excludes Germany and France from the sample. According to the IC results in Table 5-12, three IC approaches all suggest that a lag length of 1 for the subsample of the Euro10 area during the post-EMU period.

<table>
<thead>
<tr>
<th>Lag</th>
<th>AIC</th>
<th>BIC</th>
<th>HQIC</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>-3.49608*</td>
<td>-2.82959*</td>
<td>-3.22610*</td>
</tr>
<tr>
<td>2</td>
<td>-3.19849</td>
<td>-2.34704</td>
<td>-2.85326</td>
</tr>
<tr>
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<td>-2.68260</td>
<td>-1.63018</td>
<td>-2.25495</td>
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<td>-0.82656</td>
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<td>0.58571</td>
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<td>1.69100</td>
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<tr>
<td>10</td>
<td>0.02100</td>
<td>3.14720</td>
<td>1.28623</td>
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</tbody>
</table>

Source: produced by the author

From Figure 5-6, we can see that the general shapes of the impulse responses for both the Euro12 and Euro10 areas are almost identical. The debt shock only has a statistically significant impact on the growth rate of long-term interest rates in the short term. From the fourth quarter since the initial shock of the growth rate of debt/GDP ratio, the impact of the shock will completely die out. Since, for both the Euro10 and Euro12 areas, the impact will die out within the first four quarters after the initial shock, and only the response of long-term interest rate in the first quarter is statistically significant for both samples, we should therefore conclude that in terms of timing the dynamics of long-term interest rates as responses to debt shock are identical between key/low-debt EMU members and periphery/high-debt countries.
Figure 5-6 Impact of sovereign debt shock on growth rate of long-term interest rates in the Euro10 and Euro12 areas (2007:Q1–2012:Q1)

Note: errors are 5% on each side generated by Monte-Carlo with 1000 repetitions


<table>
<thead>
<tr>
<th>Period</th>
<th>Post-crisis</th>
<th>Pre-crisis</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Euro10</td>
<td>Euro12</td>
</tr>
<tr>
<td>Response</td>
<td>0.0065</td>
<td>0.0048</td>
</tr>
</tbody>
</table>

Source: produced by the author

Although we have seen the evidence which shows that the timings of responses between two areas are the same, this is not sufficient to reject the possibility of discrimination of risk premiums on government debts between EMU members.
In Figure 5-6, we are able to see that the levels of impact are different between the Euro10 and Euro12 areas. Furthermore, the values of statistically significant responses of long-term interest rate growth in pre- and post-crisis periods for both areas are displayed in Table 5-13, which enables us to identify clearly the changes of the behaviour of long-term interest rates between Euro12 and Euro10 throughout periods of pre- and post-crisis.

During the pre-crisis period, with a one-unit shock in the growth rate of debt/GDP ratio, the responses of both the Euro12 and Euro10 areas are the same to three decimal places. The growth rate of long-term interest rates will decrease by 0.1 percentage points after the initial debt shock in both regions. This indicates that the Euro Fiscal Dividend has existed during the pre-crisis period since the year 2000. The market failed to provide a signal to alert market participants about the accumulation of public debts in the Eurozone. Moreover, the market also did not discriminate between key/low-debt members – France and Germany – and other relatively small or high-debt countries in that period. In comparison to the results of the pre-crisis period, the Euro Fiscal Dividend seems dispersed, or at least weakened, during the post-crisis period. With one per cent points increase in the growth rate of debt/GDP ratio, the level of long-term interest rate growth will change positively by 0.48 percentage points in the Euro12 area. In the case of the Euro10 area, the response of the growth rate of long-term interest rates will be greater than the result for the Euro12 area. With the same level of debt shock, the long-term interest rates will increase by 0.65 percentage points, which is 35.4 per cent stronger than the response in the Euro12 area.

From the results present here, it is clear that, after breaking out of the 2007-8 financial crisis, the financial market seems to have performed again as a signalling device to public debt. The level of long-term interest rates will react to changes in debt/GDP ratio positively. Moreover, the results in Figure 5-6 and Table 5-13 also imply that from 2007 the financial market started to discriminate between Euro12 members. The level of long-term interest rate growth is more
sensitive to the growth rate of debt/GDP ratio in the Euro10 area than the Euro12 area.

5.6.5.3 Discrimination between high-debt and low-debt regions

In the above subsection, we have looked at the existence of the Euro Fiscal Dividend at the level of the Eurozone as a whole. The results show that the financial market has responded to the development of national debt positively since the occurrence of the late-2000s global financial crisis. Furthermore, we have also presented the evidence of possible discrimination of borrowers among euro members by comparing the analyses of the Euro12 and Euro10 areas. Further to the results which are presented above, we have also conducted PVAR analysis on some of EMU members that have a relatively long history of debt issues and have been especially affected by the current crisis since 2007, to provide further evidence of discrimination of borrowers during the post-crisis period in the Euro12 area.

We have split our sample of the Euro12 area for the post-crisis period into two sample sets. The first is made up by groups of countries which have had long histories of high levels of public debt and also those who suffered high-debt issues during the recent global financial crisis. They are Greece, Italy, Ireland, Spain and Portugal (GIISP). The second group34 is the rest of the Euro12 members, which generally have a low level of debt relative to the GIISP countries. By comparing the results of these two groups, we are able to see whether there will be any discrimination by the financial markets between low- and high-debt regions in the Euro12 area. The PVAR model of the GIISP area and non-GIISP area will be conducted at lag lengths of 1 and 4 respectively.

---

34 Luxembourg has been excluded from this group. PVAR was also conducted for the second group which does include Luxembourg; however, the results of the impulse response function are statistically insignificant in every period. Since there are only seven countries in the second group, and Luxembourg is a micro economy in the Eurozone but has an extremely low level of debt/GDP ratio, this could impose a potential problem of an outlier to the estimation. Therefore, we decided to exclude Luxembourg from this analysis.
Figure 5-7 Impact of sovereign debt shock on growth rate of long-term interest rates in GIISP (2007:Q1–2012:Q1)

Note: errors are 5% on each side generated by Monte-Carlo with 1000 repetitions

| Table 5-14 Statistically significant response of long-term interest rate GIISP(2007:Q1–2012:Q1) |
|-----------------|------------------|
| Period          | Response         |
| 1               | 0.0145           |

Source: produced by the author

In Figure 5-7, we present the graph of impulse responses of long-term interest rates growth among the area of GIISP. In terms of the timing of response, as in the case of the Euro12 and Euro10 areas, the growth rate of long-term interest rates will increase from the first quarter after the initial debt shock, and the statistically significant response only lasts during the first few quarters in our estimation period. Despite the time horizon of responses being the same across the GIIPS, Euro12 and Euro10 areas, the magnitude of responses is different among these sub-samples. From Table 5-14, we can see that the statistically significant response of long-term interest rate growth is 0.0145. The relation between growth rates of debt/GDP and long-term interest rates are much closer in GIIPS than in the case of the Euro10 or Euro12 areas.
As with the previous results for GIIPS and union-level samples, the debt/GDP growth only has a short-term impact on the growth rate of long-term interest rates. As can be seen from Figure 5-8, following the initial debt shock in the non-GIISP region within the Euro12 area, the statistically significant response also occurs in the first quarter. However, compared with the results for GIISP, instead of having a positive reaction to the debt shock, the response of long-term interest rate growth remains at a similar level as the result for Euro12 at the pre-crisis period (see Figure 5-5). The long-term interest rate growth will decline during the first quarter after the initial debt shock takes place (Table 5-15).

These results suggest a complicated story of the Euro Fiscal Dividend during the post-crisis period. According to the analysis at the union level, the reaction of
long-term interest rate to the debt shock switched back to a positive relationship during the post-crisis period, which may imply that the Euro Fiscal Dividend was at least significantly weakened during/after the late-2000s global financial crisis. Since, the analysis at this stage is only looking at Euro12 as a whole, this may not be sufficient to conclude that the Euro Fiscal Dividend has disappeared/weakened for each different part of the Euro12 area.

In order to investigate whether the Euro Fiscal Dividend has changed and the financial market has started to discriminate between borrowers from the Eurozone, we conducted two sets of further analysis. First, by comparing the Euro12 and Euro10 areas, we show some evidence of market discrimination between key/low-debt economies and periphery/high-debt members. Moreover, the result for the Euro10 area also suggests the Euro Fiscal Dividend seems weakened since 2007. However, the second analysis provides us with a relatively shocking story, which is perhaps the most interesting part of this subsection. By splitting our sample into the GIISP area and the non-GIISP Euro12 area, we compared the reactions of long-term interest rates to debt shock between high-debt and low-debt regions in the Euro12 area.

The results provide further evidence for market discrimination between high- and low-debt regions in EMU. The membership of the single currency no longer provides the fiscal shield to those high-debt countries from which they benefited before the recent financial crisis. More importantly, the result suggests that the Euro Fiscal Dividend seems weakened at the union level; however, this may not be true at the regional level. The impulse response analysis for the non-GIISP Euro12 area shows the Euro Fiscal Dividend still exists inside the low-debt region of the Eurozone. Moreover, the extent of this fiscal protection is twice as strong as the level for the Euro Fiscal Dividend during the pre-crisis period for Euro12 as a whole (see Table 5-11 and Table 5-15).

A similar type of analysis was also implemented in the previous study that also used the PVAR method to investigate the phenomenon of the Euro Fiscal
Dividend (Marattin and Salotti 2010). The authors use annual projections for the period 1970–2008 to compare the different levels of Euro Fiscal Dividend between low- and high-debt region in the Eurozone. However, the impulse response analysis did not deliver any statistically significant results in the previous literature for this particular focus. Therefore, the authors conclude that the pre-existing debt level does account for the fluctuations of long-term interest rates in the Eurozone after the creation of the single currency.

By using more high-frequency and real-time (rather than projection) data, we have not only proven that the Euro Fiscal Dividend exists after the creation of the single currency area, with support from statistically significant results: we have also shown that the reaction of long-term interest rates to fiscal stance has diverged due to the impact of the recent crisis. For low-debt countries, the membership of Euro still provides, perhaps, an even better fiscal shield than the pre-crisis period. However, for high-debt GIISP countries, the financial market has clearly discriminated against them relative other members of the Eurozone. We may not be able to say that euro membership has completely failed to provide any fiscal protection to the GIISP region. Their situation may be worse if these countries were not members of EMU. However, at least, we can conclude that the fiscal benefit of membership of EMU/the Euro Fiscal Dividend has changed and become a weaker element for high-debt regions in the Euro12 area.

5.7 Summary of results and conclusions

Over the last decade, the creation of the European Monetary Union and its single currency – the euro – has attracted much attention among academics as it is, probably, the biggest economic project in modern economic history. Among the controversial debates about the fulfilment of optimal currency area criteria, many pro-EMU theories have been established to support the movement of the
Chapter 5 Fiscal stance and long-term interest rates

euro. Specific to the issue we are concerned with in this chapter, which is looking at the relation between Eurozone fiscal stance and long-term interest rates of EMU members, many theories have been raised to argue that the creation of EMU would enforce fiscal discipline and lower the risks of sovereign debts of EMU members. Such arguments may indicate that the financial market, where public debt can be assessed by its risk premiums, may be overly optimistic about the level of risk.

Due to the institutional feature of EMU whereby fiscal policy is decentralised at the national level, the SGP was created to monitor and enforce the fiscal discipline of its members. In addition to this, the financial market should also provide extra enforcement to fiscal discipline by penalising those countries that have irresponsible behaviour regarding fiscal policy and thus hold high levels of public debts. Despite the Eurozone having a dual fiscal/debt safety device available to prevent the union from sovereign debt crisis, among developed countries the Eurozone has been badly affected by the debt crisis, which can be seen as the by-product of the late-2000s global financial crisis. No doubt the poor administration of the SGP can be treated as one of the main causes of the recent sovereign debt crisis in the Eurozone.

Nonetheless, the financial market, which can be treated as a second safety device for the Eurozone, should work alongside the SGP to monitor and enforce fiscal behaviours in EMU. However, it seems that the market has also failed to correctly assess the risk premiums of Eurozone debts. Thus, high-debt countries could easily obtain and serve their debts without receiving sufficient penalties from the market. This phenomenon can be treated as a Euro Fiscal Dividend which provides a fiscal shield to its members to prevent financial markets operating normally as a signalling and penalising mechanism regarding sovereign debt and fiscal stance of EMU members. If this Euro Fiscal Dividend does exist in EMU, then we can conclude that the financial market also failed to monitor and enforce the fiscal stance of euro members, which contributed to the outbreak of the Eurozone debt crisis. Therefore, in this chapter we investigated the existence
of the Euro Fiscal Dividend, and whether it has changed since the late-2000s financial crisis.

In contrast to previous studies (Favero et al. 1997, Reinhart and Sack 2000, Ang and Piazzesi 2003, Engen and Hubbard 2004, Bernoth et al. 2004, Chinn and Frankel 2005, Faini 2006, Ardagna et al. 2007, Marattin and Salotti, 2010 etc.), instead of using projections of national debt, which usually generate statistically significant results, we employed real-time data on debt in our analysis. This specification of data enables us to identify the relationship between actual debt level and long-term interest rates. Although the financial market is usually assumed to operate in a forward-looking manner, since long-term interest rates are regularly reviewed at a relatively high frequency and also consider the actual debt level of every borrower, we therefore cannot rule out the role of actual debt in the determinacy of long-term interest rates.

We have applied the panel vector autoregression (PVAR) method to recover the dynamics of long-term interest rates in relation to the shock of debt developments. The method of PVAR enables us to consider the Eurozone as a whole, but without losing national-level information. Moreover, given that the PVAR is based on the panel data, this can overcome the shortcoming of time series VAR which requires a large number of observations that are not usually available on peripheral members of EMU.

The PVAR method had already been employed by Marattin and Salotti (2010), who also look at the relationship between debt and long-term interest rates in EMU. The authors use annual projections for debt variables for the period 1970–2008 to investigate the existence of the ‘Euro Dividend’. Due to the small numbers of observations for the post-EMU period, the authors were unable to run the analysis for the post-EMU period only. Therefore, there is no direct evidence of the Euro Fiscal Dividend in the previous literature. Moreover, Marattin and Salotti (2010) also experience the same problem as other VAR-method literature; most of the results in Marattin and Salotti (2010) are
statistically insignificant. Compared with this previous literature, we employed quarterly data which covers the period 1994:Q1–2012:Q1, and have obtained direct and statistically significant evidence of the existence of the Euro Fiscal Dividend in EMU. Moreover, since the data set we used here is sufficiently large, we have also investigated whether the Euro Fiscal Dividend has changed since the outbreak of the late-2000s global financial crisis.

First, we have estimated the dynamic response of long-term interest rates to debt shock for both the full sample period (1994:Q1–2012:Q1) and the post-EMU period (2000:Q1–2012:Q1). The results indicate that the response of long-term interest rates did change after the creation of the Eurozone. During the full post-EMU period, the response of long-term interest rates to debt shock has significantly reduced compared with the result from the full sample period. We also performed the same estimation on the Euro10 area for the full post-EMU period; the results have shown that there is no pronounced discrimination between key and peripheral high-debt countries.

However, after the outbreak of the late-2000s global financial crisis, which was followed by the Eurozone debt crisis, we did see the some dramatic changes to the fiscal stance and level of long-term interest rates in some high-debt EMU members. This implies that there could have been a possible change to the Euro Fiscal Dividend since the outbreak of the late-2000s global financial crisis. Therefore, we also tried to estimate the impulse response of long-term interest rates for pre- and post-crisis periods. The results have shown a remarkable change since the outbreak of the crisis. The Euro Fiscal Dividend seems to disappear from year 2007 onwards based on the evidence at the union level.

Nevertheless, the actual story is far more complicated than the evidence from the union-level estimation. We spilt our post-crisis sample into groups of high-debt and low-debt countries. We found that the Euro Fiscal Dividend did disappear in the region of high-debt countries, but still existed and actually became stronger among the low-debt countries. This implies that, given the
deepening of the deterioration of the fiscal stance in the Eurozone and the weak recovery of and long struggle for fiscal coordination among EMU members, the fiscal shield which was initially offered to Euro12 countries has become decayed. In the short term, since the market has started discriminating between members of EMU, this would mean that for the high-debt countries it has become more difficult to seek finance and serve their debt.

It is evident from the results obtained in this chapter that the Euro Fiscal Dividend did occur in the Eurozone after the creation of the single currency area. The financial market failed to operate as a signalling device to monitoring and enforce the national fiscal stances, with poor administration of EMU fiscal rules among members of EMU; thus, before the outbreak of the global financial crisis, EMU members could relatively easily access and operate their fiscal policy on a continuously high level of public debt without penalty by either the market or EMU itself. Therefore, the failure of both the SGP and the financial market can be blamed for the current Eurozone debt crisis which could have been prevented or at least lessened if there had been strict implementation of the SGP and sufficient/accurate market monitoring/penalisation.
Chapter 6

General summary and conclusion

It has been nearly fourteen years since the Eurozone was finally launched in 1999. However, the doubt and worries about this currency union had never been eased among academics, and debates and arguments have been continually raised as to the Eurozone. With the outbreak of the recent 2007–8 global credit crunch, which was followed by the Eurozone sovereign debt crisis, tempers have risen again among academics in Eurozone debates. Benefiting from both the increase in the quantity of EMU members’ national-level data and the econometric methods applied in this thesis, in comparison to previous studies, we are able to review what has happened to EMU as a whole with consideration of state-level information. This has enabled us to see whether the Eurozone can be and has been a sustainable system.

6.1 Summary of key results

In this thesis, we have targeted three questions. First, we evaluated the level of business cycle synchronisation among existing members of EMU, therefore enabling us to see whether the membership of the single currency area enhanced the convergence of growth dynamics between EMU members, which indicates if the ECB single monetary policy could more likely be appropriate union-wide. The second question reviewed the effectiveness of ECB monetary policy. By estimating the dynamic responses of key macroeconomic variables to a shock of ECB monetary policy, we evaluated if the ECB’s monetary policy can be
an effective tool to achieve its inflation-averse goal, and also its impacts on economic activities. Finally, we looked at the relation between long-term interest rates in EMU and the fiscal stance of its member states, to see how financial markets reacted to the development of national debts of Eurozone countries before and after the 2007–8 financial crisis. This would allow us to see whether membership of EMU brought additional credibility to Eurozone members, which in fact caused optimistic views on risk premiums of national debts within the financial markets. That, in turn, can explain the reason why EMU members may have found it easy to obtain funds even when some of them already had a high level of national debt before the 2007–8 financial crisis. Moreover, we also tried to find out if this Euro Fiscal Dividend phenomenon has changed since the onset of the crises.

The arguments that were made against the creation and operational ability of the single currency union mainly criticise EMU as a non-optimal currency in the first place. Moreover, if business cycle synchronisation is low among EMU members, even with a homogenous MTM across different countries in the Eurozone, a union-wide monetary policy is still unlikely to be appropriate to suit the needs of member countries who are on a different cycle (Artis et al. 2004, Grauwe 2009, Savva et al. 2010, Soares et al. 2009). However, the modern view of optimal currency area theory (OCA), which is heavily influenced by Frankel and Rose (1998), provided a theoretical solution to EMU on the question of low degrees of business cycle convergence among the potential members of the euro area before EMU was formally created.

Frankel and Rose’s (1998) endogeneity hypothesis of OCA argues that cycles will tend to be more synchronised, due to increase in trade, if the intra-industry trade dominates the inter-industry trade. This modern view of OCA theory suggests that due to economic integration members will tend to share the same, or at least very similar, business cycles. Therefore, different countries will be more likely to be subject to common patterns of economic shocks. Moreover, due to the synchronisation of business cycles across the currency union,
fluctuations of price also tend to be similar among them. This indicates that cross-country relative prices are constant; therefore, the exchange rate policy is not needed. Indeed, trade intensity is found to lead to more synchronisation within the euro area. Hence, if evidence for increased the level of business cycle convergence can be found among EMU member states, then the results may indicate EMU is a sustainable system, or at least tends to be one, given that the requirements of the monetary policy are more likely to be the same at the national level inside the Eurozone.

In Chapter 3, we adopted the dynamic factor model (DFM) to evaluate the level of business cycle synchronisation within the original Euro12 area. In contrast to previous empirical studies for EMU that employed the second-generation DFM approach (Breitung and Eickmerir 2005, Lehwald 2012, Lee 2011), we have employed the first generation approach and have shown that for the case of the Eurozone, this finite variable approach is capable of producing statistically significant results for research on the regional scale.

First, we estimated the unobserved common factors which can capture the co-movements of Euro12 members’ growth dynamics. Then a conventional correlation test was used to investigate to what extent the movement of national growth trends are on a similar path to Euro12 common trends. The results show that the correlation between national real GDP growth and Euro12 common factors is generally improved after the creation of the Eurozone, except for Portugal. Then a graphic and variance decompositions analysis was carried out after we obtained the correlation coefficients for Euro12. These results suggested a mixed answer to our question. For Austria, Belgium, France, Germany, Italy, the Netherlands and Spain, the synchronisation of cycle (i.e. in respect of the volatility of national trends in relation to movements of common factor that capture the co-movements of Euro12 general economic activities) are improved significantly. However, for the rest of the countries in the Euro12 area, there were no pronounced improvements. In particular, in the case of Portugal, the synchronisation of cycles declined rather than improved.
Overall, the results in Chapter 3 suggest that the synchronisation of business cycles is improved for most countries in the Euro12 area except Portugal and Greece. Our findings are in line with other empirical studies (Kaufman 2003, Montoya and Haan 2007, Giannone et al. 2010, Lehwald 2012), but have drawn different conclusions from those of a recent empirical study (Lee 2011) which suggests that the synchronisation of cycles only increased during the run-up period to EMU, with no evidence to show that the improvement continued after the creation of EMU. However, our results also indicate that only correlation of trends is generally improved for most countries. The degree of volatility between national growth dynamics and trends of common growth factors is only improved within those countries from the core group of Euro12. Rather than having union-wide improvements in the convergence of economic activities, as argued by the endogeneity of OCA theory, instead, an imbalance between core and peripheral countries occurred after the creation of Eurozone. This confirms the argument that has been put forward by Sinn et al. (2011), who suggest that the introduction of EMU may encourage imbalance between member states rather than delivering universal enforcement of economic convergence. The establishment of EMU has caused a divergence between core and periphery groups of Euro12. Therefore, after 12 years’ operation of EMU, in terms of business synchronisation, there is still a substantial challenge for the ECB to deliver an union wide appropriate monetary policy.

So far, what has been found in our thesis seems to suggest that EMU would be better left with only those core members rather than including periphery members. However, withdrawing membership can be a costly and painful process to troubled members and EMU from both economic and political perspectives. The key issue is whether the degree of business cycle synchronisation can be improved, especially for periphery members.

To address this concern, we conducted further analysis to investigate which key components are more important for explaining business cycle convergence within EMU. We found export, as the key element of overall economic activities,
to be more important than the other two components of output (consumption and investment). It can be used to explain the co-movements of economic activities for every member of Euro12. However, it is weak in Greece and Ireland. This reflects our results of basic estimation in Chapter 3 which suggest the endogeneity hypothesis is only true for some parts of the Eurozone. Overall, the integration of trade is key to improving the convergence of cycles inside the Eurozone, and should be treated as the main policy objective by EMU members, thus improving the probability of implementing an appropriate monetary policy union-wide.

In Chapter 4, we used the panel vector autoregression (PVAR) method to estimate the effectiveness of the ECB’s single union-wide monetary policy. In contrast to previous studies (e.g. Butzen et al. 2001, Peersman 2001, Valderrama 2001, Chatelain et al. 2002, Vermuelen 2002, Rabanal 2003, van Aare 2003, Peersman 2004, Rafiq and Mallick 2008, Favero and Giavazzi 2008, Martinz-Carrascal and Frenando 2008, Weber et al. 2009, Peersman 2011), we consider EMU as a whole through use of national-level data. Moreover, by adopting PVAR we are able to be independent from any specific channel of the MTM, thus evaluating the overall impacts of monetary policy on EMU’s economic activities. Finally, this method allows recovery of dynamics among endogenous variables without falling into the problem of low degrees of freedom.

Our results show the ECB’s interest rate policy is effective in terms of maintaining a low level of inflation, but with relatively small impacts on economic growth, at least in those countries that have high levels of business cycle synchronisation and also had good adherence to the MCC before the establishment of EMU. The results suggest that the ECB’s monetary policy can be appropriate, or effective, only if membership of the single currency area is carefully granted rather than mainly being driven by the political wills of participating countries. Moreover, in the context of economic enlargement and integration inside EMU over recent decades, the heterogeneity of the MTM still exists among members, which makes conducting a union wide appropriate policy
even more difficult for the ECB when some of its members’ cycles are less synchronised with Eurozone union-level activities.

Although the interest rate policy is effective in controlling price, the weak response of real GDP growth to the interest rate shock has indicated a crucial weakness of ECB interest rate policy. That is, the ECB’s conventional monetary policy may not be sufficient to stimulate or encourage economic growth given that real GDP growth does not actively respond to interest rate shock across the euro area. This issue may be due to the existence of MTM heterogeneity among EMU members, or it also could reflect the different level of business cycle convergence among different groups of euro participants. In contrast to the interest rate policy, EMU’s GDP growth is more sensitive to changes in the level of monetary base, which has less influence on domestic inflation across the Eurozone than the inflationary impact of the ECB’s interest rate policy. The ECB probably missed the opportunity to conduct an expansionary monetary policy that contains both conventional and unconventional monetary policies, in order to prevent the Eurozone’s economy sliding into the slump that is badly affecting some of its members at present.

Finally, in Chapter 5, by recovering the dynamic response of financial markets (changes in long-term interest rates on government bonds) to the developments of national-level fiscal stance (changes in the debt to GDP ratio), we tried to see if the Euro Fiscal Dividend can be blamed for the poor fiscal behaviours of some EMU members before the 2007–8 financial crises. In contrast to previous studies which also focused on this area (e.g. Favero et al. 1997, Reinhart and Sack 2000, Ang and Piazzesi 2003, Engen and Hubbard 2004, Bernoth et al. 2004, Chinn and Frankel 2007, Faini 2006, Ardagna et al. 2007, Marattin and Salotti 2010), instead of using projections of national debt, which usually generate statistically significant results, we employed the actual data on debt in our estimation. This specification of data enables us to identify the relationship between actual debt level and long-term interest rates.
Moreover, in contrast to the study of Marattin and Salotti (2010), which proposes the term Euro Fiscal Dividend and also adopts the PVAR method as its econometric technique, we employed a much larger data set through using quarterly data and have obtained direct and statistically significant evidence of the existence of the Euro Fiscal Dividend in EMU. Furthermore, since the data set we used here is sufficiently large, in contrast to the previous study, we have also investigated whether the Euro Fiscal Dividend has changed since the outbreak of the 2007–8 global financial crisis, which had not been covered by the previous study, possibly due to the small sample size of its analysis.

The results here indicate that the response of long-term interest rates did change after the creation of the Eurozone. During the full post-EMU period, the response of long-term interest rates to debt shock has significantly reduced compared with the result of the full sample period. We also performed the same estimation on the Euro10 area for the full post-EMU period, and the results have shown that there is no pronounced discrimination between key and peripheral high-debt countries. However, since the outbreak of the 2007–8 global credit crunch which was followed by the Eurozone debt crisis, we did see deterioration of fiscal stance and level of long-term interest rates in some high-debt EMU members. This implied that there could have been a possible change to the Euro Fiscal Dividend since the outbreaks of the 2007–8 global financial crisis.

To address this, we also tried to estimate the impulse response of long-term interest rates for pre- and post-crisis periods separately. The results have shown a remarkable change since the outbreak of the crisis. The Euro Fiscal Dividend seems to disappear from year 2007 onward based on the evidence at the union level. Nevertheless, the actual story is far more complicated than the evidence from the union-level estimation. We spilt our post-crisis sample into groups of high-debt and low-debt countries. We found that the Euro Fiscal Dividend did disappear in the region of high-debt countries, but still existed and actually became stronger among the low-debt countries. This implies that given the deepening of the deterioration of the fiscal stance in the Eurozone and the weak
recovery of and long struggle for fiscal coordination among EMU members, the fiscal shield which was initially offered to Euro12 countries has become decayed. In the short term, since the market has started to discriminate between members of EMU, this would mean that for the high-debt countries it has become more difficult to serve their debt. In other words, the financial market, which can perform as an alternative tool for monitoring and enforcing fiscal behaviours, has now become available again in the Eurozone.

6.2 General Conclusion

The successful implantation of economic policies within the currency union is crucial for a sustainable EMU. Questions arise such as: can current monetary policy be effective in controlling inflation and influencing overall economic activities, and can fiscal activities be closely monitored? These are the important questions to consider as they would directly influence the economic performance and stability of the Eurozone and its member countries. Moreover, the convergence of Eurozone members’ business cycles is another key factor for evaluating the sustainability of EMU, given that it forms an essential foundation for conducting a union wide appropriate monetary policy.

The 2007–8 credit crunch, which was followed by the global recession and Eurozone sovereign debt crisis, imposed one of the greatest economic hardships faced by EMU members. However, some countries were affected much worse than other members. Unbalanced economic performance and hardships within the euro area have caused fears of the collapse of this single currency area. This can be seen as a sign of EMU becoming unsustainable during this time of economic crisis. The understanding we require is that of whether the current economic issues are solely caused by external shocks or whether inherent weakness/problems of the Eurozone have made their contribution.

By comparing the overall economic performance of the Eurozone members, we see that the core members (Northern European countries) generally achieved
better performance than peripheral members (mainly Southern European countries). Monetary policy can effectively influence the fluctuations of price level for the Eurozone. However, overall economic activities (real GDP growth) are more sensitive to the adjustments of the ECB’s base rates among peripheral members than core members. That, in turn, means the peripheral members’ economic growth is more likely to be dampened by the inflation-averse-type ECB monetary policy, whilst core members are more likely to have their inflation stabilised without substantive weakening of economic activities. This might be due to the existence of MTM heterogeneity among member countries, or it also can be explained by the lack of business cycle synchronisation among EMU members.

The endogeneity hypothesis of OCA theory advocates the creation of EMU through arguing that the co-movements of aggregate economic activities will be enhanced and will eventually converge due to the surge of intra-union trade among members. According to this view, a currency can be created with members whose business cycle co-movements are not all highly converged. The creation of EMU occurred under the influence of this pro-EMU theory and was established with members who have different levels of business cycle synchronisation. Intra-trade does play a key – and the biggest – part of the trading patterns of EMU and its members. However, the predicted outcome of the endogeneity hypothesis can only be found among some members of the Eurozone, most of which belong to the core group of EMU. This reflects the different reactions of core and peripheral members to the ECB single monetary policy.

The ECB is the only monetary authority of the Eurozone. It should not offer any privileges towards any member when monetary policy is being designed or implemented. However, considering the core group of EMU holds a substantial weight of the combined Eurozone economy and their aggregate economic activities are highly converged with overall economic performance of EMU, the averaged economic indicators of the Eurozone, which are used by the ECB for
policy design, are more likely to be influenced by core members than peripheral members. Therefore, ECB monetary policy is more likely to be appropriate to the core group than the peripheral group. This can lead to imbalanced reactions to monetary policy shocks within the single currency area. The ‘one size fits all’ issue can exist inside EMU if some members’ (e.g. Greece, Portugal, Ireland etc.) business cycles remain divergent from the other members’ economic activities.

Moreover, unbalanced business cycle synchronisation among core and peripheral EMU members can not only be used to explain the different reactions to the ECB’s monetary policy. Considering it along with divergent impacts of monetary policy on Eurozone members’ aggregate economic activities, the Eurozone sovereign debt crisis seems to have already taken root when the single currency was formed. Countries who see the ECB’s monetary policy as inappropriate to their domestic needs may inevitably rely on fiscal measures to address domestic economic issues, whilst the automatic fiscal stabiliser may further the deterioration of fiscal stance of those EMU member countries. In addition to this, the poor adherence to and implementation of SGP combined with the impacts of the Euro Fiscal Dividend have meant EMU countries have found it was easy to access cheap money to finance their budget deficits and existing government debts. However, with the outbreak of the 2007–8 credit crunch and global recession, fiscal stances among EMU members were badly affected, especially among those peripheral members whose debt/GDP ratios were already above EMU debt ceiling. Subsequently, this led EMU into its own economic crisis – the sovereign debt crisis.

Overall, EMU, which was established with imbalanced levels of business cycle synchronisation, weak policy instruments for enforcing the SGP and disciplining the fiscal behaviours of its member states, and the existence of MTM heterogeneity, indicates the euro area still cannot be treated as a sustainable economic system. The EMU’s economy does not fully behave as the new consensus macroeconomics (NCM) model assumed. Although the creation of EMU established a creditable independent central bank, which can effectively
deliver an inflation-averse monetary policy as has been emphasised by the NCM model, however, the existence of less synchronised business cycles among members and the existence of heterogeneity of the MTM indicate that ECB monetary policy can be effective at the union level, but is still likely to be inappropriate to some of its members.

Therefore, although the NCM model, as the theoretical foundation of EMU’s implementation of economic policy, assumes that fiscal policy has no real impact on economic activities but only leads to high inflation, since the ECB’s monetary policy may not always address the national-level needs of its participating members, inevitably, national-level fiscal policy would be used to compensate the loss of monetary sovereignty and lack of union-level fiscal policy. However, the rapid use of fiscal policy can lead to accumulation of national debt, which eventually contributed to the current Eurozone debt crisis. The financial market, which is assumed by NCM to be efficient and rationally behaved, has failed to enforce fiscal discipline. Economic agents were overly optimistic about the stability of the economy and national debts, and thus failed to penalise high-debt countries. This market behaviour, which was a response to the accumulation of Eurozone debt, has shown strong evidence to prove the failure of the efficiency market hypothesis that is a key element of the NCM model.

The EMU is currently facing its most difficult time since its creation in 1999, and doubts about its unity and sustainability have been raised among academics and policymakers. However, generally, the Eurozone can improve its sustainability if business cycle convergence can be improved through enhancement of intra-trade, thus allowing monetary policy to become more appropriate to the union’s members. Moreover, in addition to the return of a market enforcing mechanism for fiscal behaviour, EMU also requires better coordination and corporation in terms of enforcing and monitoring the fiscal activities of its member countries. Fiscal federalism can be a solution to enhancing fiscal discipline by making fiscal transfers between member countries to reduce the possibility of overuse of national-level fiscal measures. Moreover, it can be used to compensate the loss
of national-level monetary sovereignty when the ECB’s monetary policy is less appropriate to some members of EMU. Then EMU can really operate as a single entity, just like any other sovereign country. However, this would require a huge step forward in European political integration and coordination compared to what is achieved at present.

Moreover, the lesson we see for the existing Eurozone is that the decisions on the granting of euro membership in the future needs to be done more carefully. The eastern enlargement of the EU has brought potential new members from Central and Eastern Europe to EMU, for which membership is an obligation that is binding with their EU membership agreement. Since the initial creation of EMU has not fully addressed potential issues such as selecting countries with similar business cycles and good adherence to the MCC, these poor practices of EMU have created a single currency area where union-wide monetary policy is still hardly appropriate to every member of the currency union. This problem can happen again, and will get worse if the approval of new membership is again driven by political will rather than based upon adequate economic justification.

Finally, based upon this thesis, we can take the study further from following aspects. First, it failed to capture the spill-over effects for most of the selected countries in Chapter 3. This problem can be due to the nature of the spill-over effects, which can probably be more appropriately explained by using high-frequency variables or other indicators rather than industrial production index, which focuses on a relatively narrow range of economic activities. Moreover, the key argument which being put forward by the endogeneity hypothesis of OCA theory is the enhancement of trading relationship can enforce the synchronisation of business cycle among EMU countries. The result suggests that the theory does reflect what being happened inside EMU, at least, for the core and some periphery members. Trade has an important role for business cycle convergence, but EU itself has also encouraged more trading to be conducted among its members disregarding whether those countries are members of eurozone or not (e.g. UK, Sweden, Central and Eastern European Countries).
Therefore, in future research, it will be interesting to see if the other EU members who are outside EMU have also experienced similar trend as EMU members. Hence, further investigate whether the tight trading relations can drive cyclical convergence and also find out if those new EU members are ready for single ECB monetary policy from business cycle perspective.

Secondly, given that Chapter 4 used a model which is independent from any specific channel of the MTM, our results cannot be used to provide detailed analysis on the MTM to see each particular step that explains how monetary policy transformed from interest rate variations to fluctuations of real economic activities. Moreover, the model we used can contain more variables to provide wider understanding of the effects of the ECB’s monetary policy on the real side of the economy. For example, in further research, we could consider labour market conditions such as unemployment rate and the natural rate of unemployment, thus seeing how the labour market reacts to a monetary shock inside EMU. In terms of application of PVAR method, the research in this chapter was being implemented through impulse response analysis that can be sensitive to the choice of lag length in the model. Even though, the information criteria e.g. AIC, BIC, HQIC were used for making decision of lag length. However, in order to improve the accuracy and appropriateness of chosen lag length, in future research, in addition to information criteria, the neighbouring length value should also be used, hence to select the appropriate lags for PVAR analysis.

Finally, for analysis of the Euro Fiscal Dividend, we confirmed its existence by showing how the market failed to adjust the interest rate upwards when national debts were rising. The same approach could be employed to test if the bond yield spreads have similar pattern of reaction as bond rates in our future research. Hence, it would enable us to have further understanding of the level of discrimination when EMU members were ‘protected’ by the Euro Fiscal Dividend.
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Appendices

Menu cost theory

According to the menu costs theory, the market is assumed to be imperfectly competitive; therefore, rather than being price takers, as had been described by the new classical model, firms are price makers. This means that firms are able to operate with a price that diverges from the optimal level without it having significant impacts on their profits. The barrier to firms’ willingness to adjusting price back to its optimal level is known as menu costs. It can be the cost of renegotiation of price and contract with customers and suppliers, cost of printing new catalogues and price lists etc. These costs may only be a small fraction to an individual firm; however, it can have much larger impacts on overall economic activities if a large number of firms are experiencing menu cost (Akerlof and Yellen 1985, Mankiw 1985, Parkin 1986).

Let us assume a firm is in an imperfectly competitive market; therefore, it should look like Figure A1. Initially, the firm is supplying at its initial equilibrium level $Q_0$ with optimal price level $P_0$ where marginal cost $MC$ equals marginal revenue $MR_0$. The firm’s demand is assumed to be dependent on general economic conditions (e.g. aggregate demand) and relative price. If there is a demand-side shock that causes a shrinkage in the level of aggregate demand; given that a firm’s demand depends on the overall economic conditions, the demand curve will shift to $D_1$ from $D_0$. Under these circumstances, since we are under imperfect competition, the firm can choose to change or not change its price. If a firm decides to maintain its price at its initial level $P_0$, the volume of current profit after the demand shock will be the area of $P_0EFG$, which is much smaller than its initial profit-maximising level $P_0AGB$. However, when the demand curve is $D_0$ and the marginal revenue curve is $MR_1$, maintaining its price at $P_0$ does not provide the optimal outcome given that the profit maximisation
condition is MR₁=MC. Therefore, if firms foresee this and behave rationally, in order to maximise their profit according to the new economic conditions they should lower their price to P₁.

**Figure A1 New Keynesian nominal rigidities**

![Diagram showing economic principles](image)

Source: figure drawn by the author

However, since firms are price makers in this imperfectly competitive market, a firm’s intention of reducing the price to the optimal level P₀ will depend on the size of new profit-maximising level P₁CDG relative to the level of profit when price is at P₀(P₀EFG). If P₁CDG is smaller than P₀EFG, then a firm will choose to maintain its price at P₀, though this implies a non-optimal level of price and profit. Therefore, the total revenue a firm is making now is lower than the maximum level it can achieve when price is at P₁, but the profit is higher. Such decisions by firms would mean a reduction in the level of total surplus (EHC+HCDF). This is clearly a non Pareto-optimal condition as society is worse off, but firms are gaining higher level of profits. From the macroeconomic point of view, as firms are trying to avoid the loss of profit due to ‘menu cost’, they will hire less labour
and supply at a lower level. Although this is just a small fraction to firms, collectively, this will cause much greater impact on real economic activities at the aggregate level (e.g. employment and output).

**The Efficiency wage model**

The Efficiency Wage Model is an approach that uses real wage rigidity to answer the question of observed unemployment and economic fluctuations. The model suggests that it is not in firms’ interest to reduce the level of real wages, even if there is an economic downturn and the presence of high unemployment should impose a downward pressure on wages. However, lowering the real wage implies the loss of efficiency/productivity as the labour’s motivation for working depends on the level of real wages (Yellen 1984, Akerlof and Yellen 1986, Haley 1990).

This model can be seen in Yellen (1984) and is based on the basic structure provided by Solow (1979). So, the model can be expressed as Equation (A1):

\[ Q_f = AF[e(w)L], e'(w) > 0 \quad \text{(A1)} \]

where \( Q_f \) is the output of a firm, \( A \) measures the level of productivity shift, \( e \) is the effort of a worker that is dependent on the level of real wage \( w \), and \( L \) is the size of labour force. Since the efforts of workers are positively related to the real wages they receive from firms, the output of a firm depends on the efforts

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35 There are also another two alternative approaches to addressing the issue of wage rigidities, which are the insider–outsider model and the implicit model. Due to the length of the chapter, they are not included here. For details of these two theories see Bailey (1974), Azaridas and Stiglitz (1983), Ball (1990) and Sanfey (1995).

36 There are four key microfoundations of the efficiency wage model: 1) the shirking model, 2) the fairness model, 3) the labour turnover model, and 4) the adverse selection model. For details, please see Shapiro and Stiglitz (1984), Akerlof and Yellen (1990), Salop (1979) and Weiss (1980), respectively.
workers put into their job, which is then multiplied by the productivity shift factor $A$. Moreover, the profit a firm can achieve will depend on the output and the level of labour costs; hence, the profit of a firm that tries to maximise it can be illustrated by Equation (A2):

$$PT = AF[e(w)L] - wL$$  \hspace{1cm} (A2)

Since profit $PT$ depends on the difference between the value of output and labour costs, by maximising the efforts of worker $e(w)$ through offering higher wages, the firm is able to gain higher profits by maximising the productivity of their workers.

This can be more easily demonstrated by using Figure A2. Curve $E$ represents how the effort of a worker may change if real wage changes. Before point $M_0$, the effort of a worker is more elastic to changes in real wage. Once point $M_0$ is reached, where effort function $E$ tangent to line $A$ (measures the unitary relationship between effort and real wage), the effort ratio $e/w$ will reach its peak value. Meanwhile, the wage cost per efficiency unit curve $(w/e)$ is at its minimum level $x$ on Figure A2(b). Hence, by offering wages at $w^e$ firms are able to extract the highest possible efforts from their labour force, and therefore the maximum level of productivity, hence gaining the maximum level of profit. Moreover, another condition for profit maximisation is that a firm has to hire labour until its marginal product equals the level of the efficiency wage. For instance, in Figure A2(c), the efficiency wage $w^e$ is higher than the equilibrium wage $w$, which indicates the occurrence of involuntary unemployment. This excess supply of labour should bring up the downward pressure on the wage in the labour market; however, given firms can maximise their profit by offering a higher wage to motivate their workers, there is no intention for firms to change the situation. Therefore, if the efficiency wage is higher than the level of market-clearing wage, then the unemployment is not entirely voluntary; though we still see this as an equilibrium condition since no one is willing to change their behaviour (Stiglitz 1987).
Figure A2  Efficiency wage model

Since the efficiency wage rate is neutral to the level of employment and the available technology to a firm, changes in economic performance (e.g. a decline in aggregate demand due to an exogenous shock) can only affect the level of employment, not the efficiency wage. The efficiency is rigidity to such changes.
Assuming there is a demand shock, which subsequently causes the downward shift of the labour demand curve from $D_L^1$ to $DL_2$, the efficiency wage is at $w^e$ and remains unchanged due to its rigidity nature. Involuntary unemployment will increase from $L_s-L_1$ to $L_s-L_2$. The flexibility of wage is dismissed in this case, thus the instant and continuous market-clearing. Necessary government intervention has to be implemented in order to reduce involuntary unemployment. However, as the new Keynesian model does not claim absolute fixed price/wage, there are some slow adjustments to wage and price which can lead to a slow self-correcting of an economy. Suppose long-lasting high unemployment has made impacts on workers as they become more afraid to be laid off by employers. The effort of a worker can increase for any given level of real wage, which leads to the upward shift of the effort curve from $E_0$ to $E_1$. Consequently, the efficiency wage will decrease and involuntary unemployment will fall.