Some aspects of the OECD business cycle – The effects of EMU –*

Yasuyuki Komaki

Professor, Nihon University

Nobuo Iizuka

Director and Senior Economist , Japan Center for Economic Research

Abstract

In this paper, the effects of economic and monetary union on business cycles in the euro area are described. In particular, the following two points will be examined: i) whether co-movement of business cycles in the euro area from the introduction of the Economic and Monetary Union (hereinafter referred to as the "EMU") was caused by the factors unique to Europe, or whether it is a phenomenon that could be also observed in other areas, and ii) how the restrictions on monetary and fiscal policies in the euro area before and after the introduction of EMU impacted the business cycles.

The results obtained in this paper can be summarized as follows.

1) As a worldwide tendency, it is confirmed that the co-movement of business cycles has increased after the 1990s.

2) In the euro area, after the mid-1990s, during the effort period toward the introduction of the EMU, the convergence of business cycles was remarkable. However, after the EMU was introduced in 1999, the co-movement of business cycles in the euro area has decreased again.

3) While the U.K., Norway, and other non-member countries of the EMU have different business cycles from the euro area, their business cycles show stronger co-movement with that of Euro rather than that of U.S. economy. In particular, since the first quarter of 1999, the introduction of the euro, it is worth noting that the U.K. has exhibited a lower co-movement with the U.S. economy while maintaining its co-movement with the Euro economy. Canada has shown increasingly stronger co-movement with both the U.S. economy and the Euro economy. This means that the existence of a business cycle in the Euro economy, as argued in Stock and Watson (2005), was confirmed; however, the existence of a business cycle in the English-speaking world (the U.S., the U.K., Canada, etc.) was not confirmed.

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4) It is thought that the restrictions on monetary and fiscal policies by the introduction of the EMU system have had a great influence on the co-movement of business cycles in the euro area. It has been confirmed that the fiscal policies implemented in the euro area in the 1990s were those for satisfying the EMU membership criteria, which were the fiscal policies for business cycles rather than their own countries' economic conditions. Also the policies tended to converge. However, after the introduction of the EMU, the fiscal policies may have been implemented according to each country's individual circumstances.

5) In the euro area, the autonomy of monetary policies has been lost by the introduction of the EMU. However, what cannot be controlled by monetary policies and the policies in line with each country's economic condition are addressed by fiscal policies.

In recent years, the co-movement of business cycles in the euro area seen in the 1990s has decreased. A future subject of study will be investigating whether the co-movement of business cycles will increase again by further development of economic integration or whether the business cycles of each country will become more irregular by diversification of economic activities in the euro area.

Keywords; Business cycles, Symmetry and co-movement of cycles, Policy mix, Taylor Rules for Fiscal policy.
JEL Classification: E32, F15, H30

I. Introduction

Since 1970, the movement for economic integration has been progressing step by step in Europe. Especially, in Jan 1999, the euro currency was introduced into the 11 euro countries. Around that time, many earlier studies were made on the influence of the introduction of the euro currency in the euro area[1]. Some studies showed that during the period before the introduction of the EMU, the convergence of business cycles was remarkable in euro area (e.g. Angeloni and Dedola (1999)).

The purpose of this study is to examine the influence of the EMU on business cycles in euro area. In particular, the following two points will be examined: i) whether the co-movement of business cycles in the euro area from the introduction of EMU is caused by the factors unique to Europe or whether it is a phenomenon that is observed in other areas and ii) how the restrictions on monetary and fiscal policies in the euro area before and after the introduction of the EMU impacted the business cycles.

The following three matters are considered in order to analyze the characteristics of the euro area's

[1] In this context, the "euro area" means countries joined in the EMU. The euro currency was introduced as the official currency in 16 out of 27 member states of the European Union (EU) as of January 2009. But in this study we have regarded 12 countries as the euro area because of data availability: Austria, Belgium, Germany, Spain, Finland, France, Greece, Ireland, Italy, Luxembourg, Netherlands, and Portugal.

business cycles in this study.

First, we examine whether the similarity of business cycles is caused by euro unique factors or common worldwide factors, using principal component analysis. The subject of many earlier studies was to analyze the similarities between the euro and the USA. However we use long term data for not only the euro area but also other OECD countries.

Second, we set the estimation period according to the stage of introduction of the EMU. We found that there are different results about the effect of the EMU among earlier papers. We regarded that the difference in the results was caused by differences in the estimation period in each paper. In this paper, we have set five periods: (1) around the introduction of the EMS (before 1979:1), (2) a state of confusion after the introduction of the EMS (1979:2-1985:4), (3) the period of stability in the EMS (1986:1-1993:4), (4) just before the EMU (1994:1-1998:4), (5) since the EMU (1999:1-2007:4).

Third, we examine the effects of fiscal policy under the restrictions on monetary policy, using the Taylor rule on policy mix. After the introduction of the euro currency, an independent central bank, the ECB, has the sole authority to set monetary policy in the euro area. So it is impossible for euro-area countries to accommodate the monetary policy to a peculiar economic environment in each country. On the other hand, even though financial policy is under the discretion of each country, there are strong restrictions on fiscal policy according to the Maastricht Treaty. In fact, after the 1990s, financial deficit of each country has reduced rapidly.

This paper is organized as follows. In Section 2, we overview the effect of the introduction of the EMU according to earlier papers. In Section 3, we examine whether the co-movement of business cycles in the euro area is caused by the factors unique to Europe or whether it is also a phenomenon observed in other areas, using the principal component method. In Section 4, we estimate the effect of fiscal policy using the Taylor rule on policy mix. Section 5 concludes the paper.

II. The influence of the EMU

II.1. Toward the introduction of the EMU

II.1.1. Introduction of the ERM

In the first half of the 1970s, the Snake system was introduced in order to reduce the fluctuation of the Foreign exchange rate. But the Snake system was so imperfect that the Snake participating countries withdrew. After that, the European Exchange Rate Mechanism system, the "ERM" as part of the European Monetary System (EMS), was introduced by the European Community in 1979. In the ERM, participating countries were required to control the volatility of the bilateral foreign exchange rate within 2.25%. As in the 1980s, the world economy was not stable because of the oil shock in 1970s, and the ERM was so unstable that some participating countries had to make a realignment (see **Table 1**).

Table 1: History of the EMU

	Integration of Economy			Integration of Monetary system			
		number	member nation		number	member nation	withdrawal
～1973	EC	6	Belgium, Germany, France, Italy, Luxembourg, Netherlands				
4/24/1972				Start of Snake system	6	Belgium, Germany, France, Italy, Luxembourg, Netherlands	
1/1/1973	Expansion EC member	9	Denmark, Ireland, United Kingdom	Expansion Snake member	9	Denmark, Ireland, United Kingdom	
3/11/1973				Reduction Snake member	6		Ireland, Italy, United Kingdom
1/1/1974				Reduction Snake member	5		France
3/13/1979				Start of EMS	5	Belgium, Germany, France, Luxembourg, Netherlands	
1/1/1981	Expansion EC member	10	Greece				
1/1/1986	Expansion EC member	12	Spain, Portugal				
1989				Expansion EMS member	6	Italy	
6/29/1989				Expansion EMS member	7	Spain	
4/20/1992				Expansion EMS member	8	Portugal	
7/1/1990				Start of EMU first Stage			
10/8/1990				Expansion EMS member	9	United Kingdom	
2/7/1992	Maastricht Treaty						
9/16/1992				Pound Crisis, Reduction EMS member	7		United Kingdom, Italy
11/1/1993	Effective Maastricht Treaty						
1/1/1994				Start of EMU second Stage			
1/1/1995	Expansion EU member	15	Austria, Finland, Sweden				
1/9/1995				Expansion EMS member	8	Austria	
10/14/1996				Expansion EMS member	9	Finland	
11/24/1996				Expansion EMS member	10	Italy	
5/1/1998				Decision of Starting member in Euro area			
1/1/1999				Start of EMU third Stage, Introduction Euro	11	Austria, Belgium, Germany, Spain, Finland, France, Ireland, Italy, Luxembourg, Netherlands, Portugal	
				Start of EMU third Stage			
1/1/2001				Introduction Euro Currency	12	Greece	
5/1/2004	Expansion EU member	25	Cyprus, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Slovakia, Slovenia				
6/28/2004				Expansion ERM Ⅱ member	4	Estonia, Lithuania, Slovenia	
5/2/2005				Expansion ERM Ⅱ member	7	Cyprus, Latvia, Malta,	
1/1/2007				Expansion Euro member	13	Slovenia	

II.1.2. The integration of the economy and currency in euro

The EU set up the Delors Commission in order to discuss the EMU in June 1988. In April 1989, the Report of the Delors Committee showed the implementation of the EMU in 3 stages as follows:

The first step (1 July 1990 to 31 December 1993) was the start of the EMU process. It sought to remove all the restrictions on capital movement in the euro area, and set economic convergence criteria, concerning the inflation rate, fiscal deficit, interest rates and exchange rate stability. The Treaty of

Maastricht (1992) entered into force on 1 November 1993.

The second step (from 1 January 1994 to 31 December 1998) established the watching of the accomplishment of the economic convergence criteria. The EU also set a time limit for changing over to the EMU. If a majority in euro area achieved the economic convergence criteria by January 1997, the EMU would begin to work at that time. Even if it could not, from January 1999, EMU would begin to work among some countries in accomplishment of the criteria. In this way, we can assume that euro countries made an all-out effort to achieve the economic convergence criteria in the second step. As a result, the countries lost their independence in monetary policy, and their fiscal policy was restricted to discretionary power.

Lastly, in the third stage (from 1 January 1999), the euro currency was introduced in the euro area. Monetary policy was carried out uniformly by the European Central Bank (hereinafter referred to as the ECB), and fiscal policy was limited by the objectives of the fiscal structural reform in the Maastricht Convergence Criteria.

II.2. The influence of the EMU

II.2.1. Renunciation of independence in monetary policy

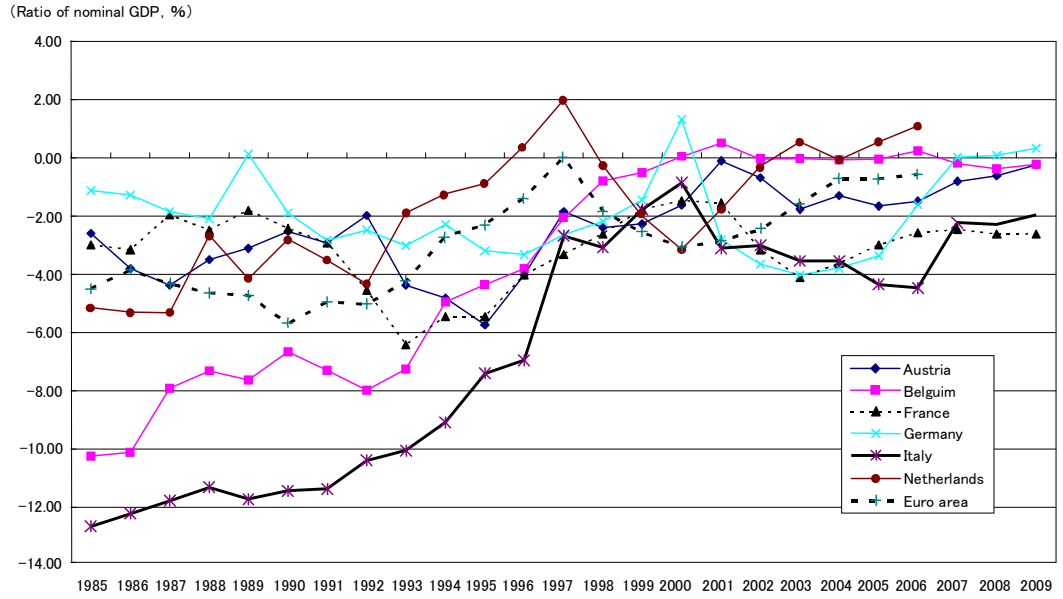
After the introduction of the EMU in 1999, monetary policy was placed under ECB control. More concretely, the principles of monetary policy are decided by the European System of Central Banks (ESCB), and individual countries carry out operations in their own market according to the principles. As a result, monetary policy is not managed for specific matters in individual countries, and we can expect interest rates in the euro area financial market to converge.

In earlier studies, the convergence of interest rates has been pointed out. Brada and Kutan (2001) show that the relationship between Finland, Austria (which joined EMS later) and Germany was cointegrated on monetary base using a test of rolling cointegration to measure the convergence. Arits and Zhang (1998) find that interest rates work together highly within the euro area. These studies show that monetary policy and interest rates in the euro area converge and monetary policy does not operate on individual specific matters.

II.2.2. Restrictions for fiscal policy

Financial reconstruction from the Maastricht Convergence Criteria laid the responsibility on the euro area. Under this criteria and then the Stability and Growth Pact, the abilities of EU governments to conduct stabilizing fiscal policy have significantly been restricted as follows: an annual budget deficit of no higher than 3% of GDP and a national debt lower than 60% of GDP, or approaching that value. In fact, we find that the decline in financial deficit is the trend of euro area countries after Maastricht Convergence Criteria (see **Figure 1**).

Figure 1: The fiscal deficit (EMU countries)



But Fiscal policy leaves matters to an individual country's discretion. In earlier studies there are different opinions.

De Bandt and Mongelli (2000) examined whether there was convergence in key fiscal variables across the euro area using contemporaneous cross-correlation, dispersion and cointegration tests over the 1970-1998 period. They found that for euro area countries, cross-correlation had increased steadily over the sample period and that fiscal dispersion had been declining at a sustained pace among all countries in the sample. There is evidence of cointegration across the euro area on fiscal policy.

On the other hand, Gali and Perotti (2003) analyzed how fiscal policy was influenced by introduction of the EMU using financial variables over the 1980-2002 period. They shows that discretionary fiscal policies in euro area countries have become more counter-cyclical over time, following what appears to be a trend that affects other industrialized countries as well. And recently financial deficits can increase according to individual country's discretion, so Euro commission corresponds to extend the term of the accomplishment of reconstruction of public finance.

We assumed that the two different views in earlier studies were occurred by a different estimation period, so we set the estimation period according to the introduction stage of the EMU.

II.2.3. Limitations on Commodity prices, Foreign Exchange rates and interest rates

The Maastricht criteria obliges the achievement of three conditions before a country is admitted to the euro area except two conditions of government budget deficits:

1) Inflation rate of no more than 1.5 percentage points above the average of the three countries with the lowest inflation rates
2) nominal long-term interest rates not exceeding by more than 2 percentage points those for the three countries with the lowest inflation rates
3) no exchange rate realignment for at least two years

We assess the effect of the Maastricht criteria for these three conditions using the average of the coefficient of variation in cross-country. A low coefficient of variation indicates that euro area countries take their course to the EMU. We found that the coefficient of variation for long term interest rates and foreign exchange rates fell in the euro area, after the mid-1990s, during the effort period toward the introduction of the EMU because of a rapid decline in fiscal deficit except commodity price and short-term interest rate (see **Table 2**). These three convergence criteria are designed to ensure monetary stability by supporting a fixed exchange rate regime among member countries.

Table 2: The fluctuation of Macroeconomic variables

	EMU Countries				non-EMU Countries (Europe)				non-EMU Countries (other)			
	Price	S-rate	L-rate	Fox	Price	S-rate	L-rate	Fox	Price	S-rate	L-rate	Fox
1971/q1～79/q1	0.416	0.503	0.462	0.570	0.673	0.417	0.562	0.678	0.422	0.498	0.463	1.465
1979/q2～85/q4	0.561	0.457	0.524	0.356	1.047	0.544	0.562	0.782	1.074	0.512	0.438	1.652
1986/q1～93/q4	0.857	0.418	0.506	0.161	1.167	0.654	0.535	1.144	1.238	0.581	0.455	1.841
1994/q1～98/q4	0.673	0.486	0.275	0.034	1.113	0.806	0.522	1.369	1.334	0.867	0.727	1.934
1999/q1～2007/q1	0.393	0.058	0.058	0.000	0.756	0.671	0.450	1.545	0.764	0.636	0.477	1.969

Note)
1. The value indicates the average of coefficient of variation in cross-country.
2. We use CPI as Price.
3. S-rate indicates short term interest rate; L-rate is long term interest rate. Fox means Foreign Exchange rate.
4. The region indicates as follow;
1) EMU countries; Austria, Belgium, Germany, Spain, Finland, France, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal
2)non-EMU countries (Europe);Switzerland, Czech Republic, Denmark, United Kingdom, Hungary, Iceland, Norway, Poland, Slovak Republic, Sweden
3) Non-EMU countries (other); Australia, Canada, Japan, Republic of Korea, Mexico, New Zealand, United States

II.2.4. The Comovement of business cycles

There are many studies of the characteristics of business cycles after the EMU. Some studies have found that the business cycles of the euro area countries become similar after introduction of the EMU (see **Table 3**). Angeloni and Dedola (1999) analyze the characteristics of business cycles according to the progress of the EMU, so they divided the estimate periods as follows: pre-ERM (1965-1979), soft ERM (1979-1985), hard ERM (1986-1992) and pre EMU (1993-1997). They show that cross-country correlation of cycles and inflation have risen significantly in recent years among EMU participants, implying a tendency towards the fulfillment of the Optimal Currency Area conditions. They also find that the monetary policy rules followed by the EMU participating central banks have tended to converge.

But some other studies show that business cycles in euro area countries are the same as the US rather than the original EMU cycle. Agresti and Mojon (2001) show stylized facts about the business cycle of the euro area economy. Using consumption, investment, prices, inflation, interest rate and monetary

aggregates, they find that the magnitude and the timing of the euro area fluctuations in business conditions are very similar to the ones observed in the US while they differ from the ones of the individual countries participating in the EMU.

On the other hand, some papers analyze the factors of world business cycles. Some papers find the common world factors of business cycles are more important than specific regional factors, while others show that there are different factors between euro area countries and English-speaking countries.

Kose, Otrok, and Whiteman（2003）analyze the common dynamic properties of business cycle fluctuations across countries, regions, and the world, using Bayesian dynamic latent factor model over1960-1990. They show that common worldwide factors are an important source of volatility for the aggregates in most countries, providing evidence for a world business cycle.

Stock and Watson（2005）examine how the world economy fluctuates using a factor structural VAR model over the period 1960:1-2002:4. They found that although there has not been a general increase in international synchronization among G7 business cycles, there have been important changes, in particular the emergence of two groups: the one consisting of euro area countries and the other of English-speaking countries. The correlations has increased within each group and decreased across the groups. They also found that cyclical movements in the UK became less correlated with Euro-zone countries and more correlated with North American countries.

So we examine whether the co-movement of business cycles in the euro area from the introduction of EMU is caused by the factors unique to Europe or whether it is also a phenomenon observed in other areas.

Table 3: Earlier studies on the co-movement of business cycles

Reference	Data	Frequency	Sample Period	Correlation						
				UK				Germany		
				EuroArea	Germany	France	USA	EuroArea	France	USA
Angeloni,I and Dedola, L. (1999)	IIP	quarterly	6501-7901	–	0.61	–	0.61	0.56	0.59	0.52
			7902-8504	–	0.53	–	0.27	0.76	0.73	0.55
			8601-9204	–	−0.14	–	0.80	0.39	0.51	−0.45
			9301-9701	–	0.42	–	0.71	0.82	0.93	0.44
	GDP	quarterly	7902-8504	–	0.55	–	0.42	0.63	0.30	0.62
			8601-9204	–	−0.46	–	0.76	−0.03	0.01	−0.59
			9301-9701	–	0.76	–	0.64	0.88	0.91	0.48
Artis, M (2000)	IIP	monthly	6505-7903	–	0.64	–	0.75	–	0.65	–
			7903-9706	–	0.16	–	0.35	–	0.69	–
Artis, M (2003)	GDP	yearly	1970-1999	0.73	0.39	0.49	0.80	0.82	0.75	0.50
	OECD	monthly	6101-7903	–	0.50	–	0.70	–	0.60	–
			7904-9303	–	0.30	–	0.45	–	0.80	–
			9401-0012	–	negative	–	negative	–	0.90	–
Agresti, A. and Mojon, B. (2001)	GDP	quarterly	7001-0003	–	–	–	–	0.87	–	0.57
Danthine and Donaldson (1993)	GDP	quarterly	5701-8902	0.33	–	–	0.45	–	0.61	–
Imbs (2000)	GDP	quarterly	5901-9304	–	0.40	–	0.52	–	–	–
Konotolemis and Samiei (2000)	GDP	quarterly	6001-9704	0.38	–	–	0.58	–	0.48	–
Wynne and Koo (2000)	GDP	yearly	1963-1992	–	0.45	–	0.67	–	0.64	–

Note;
1. Euro Area in Angeloni,I and Dedola, L. (1999) is France, Italy and Spain.
2 In Artis(2003),
1) the estimation figure is read by graph of cross-correlation
2) Data "OECD" is"OECD trade cycle database".
3) EuroArea is 15 EU countries.
3 In .Agresti, A. and Mojon, B. (2001), Danthine and Donaldson (1993), Konotolemis and Samiei (2000), EuroArea is EMU 11 countries at Jan 1999.

III. Co-movement of business cycles among OECD countries

In this section, we examine the co-movement of business cycles among OECD countries[2]. Similar to the method used in earlier studies, we extract business cycle factors from the real GDP, using the Band-pass filter following to Christiano and Fitzgerald (2003), and calculate pairwise coefficients of correlation.

In addition, we extract common factors within each country's business cycle by principal component analysis. We examine whether the reason for rising synchronization is due to the increasing economic relationship between any of the two countries or the common factors to OECD countries.

III.1. Data

We acquired the real GDP figures from the OECD Economic Outlook database. The estimation sample is from 1970/1-3 to 2007/1-3. Although our analysis focuses on OECD countries (30 countries) and the euro area aggregate, we exclude Austria, Hungary, and Turkey. This is because data was not available. Also the Czech Republic is analyzed since the first quarter of 1990; Slovakia and Poland from the first quarter of 1993.

In addition, Germany before the fourth quarter of 1990 was retroactive by the use of the growth rate of old West Germany because the former data existed only after the first quarter of 1991. Also the euro-area aggregate data exists only after the first quarter of 1990, and it is retroactive before the fourth quarter of 1989 by the use of the growth rate of the euro area until 1991 and with West Germany.

III.2. Changes in the correlation of business cycles

First, we examine the changes in correlations of business cycles between any of the two OECD countries. The estimation period is divided into five periods by the epochs of EMU: (1) until the start of EMS (1960/1-3～79/1-3), (2) the confusion period of EMR (1979/4-6～85/10-12), (3) the steady period of EMR (1986/1-3～93/10-12), (4) the effort period of introduction of EMU (1994/1-3～98/10-12), (5) after EMU (1999/1-3～2007/10-12).

We also examine the 3rd period excluding from 1st Quarter in 1989 to 4th Quarter in 1990 to consider the influence before and after the reunification of Germany.

Because most OECD countries are in the Europe, there is a possibility that the status of progress of economy and the monetary union in the European region has a lot of influence on the co-movement of business cycle fluctuations.

We calculate 26 pairwise coefficients of correlation values（23 values from the 1st Period to 3rd

[2] We also analyze business cycle co-movement using the Index for Total industry covers sectors corresponding to C (Mining), D (Manufacturing) and E (Electricity, gas and water) of the ISIC or NACE classification in appendix. The results are not so different from those for GDP.

Period) for each country, and show the median in Table 4. A high median value means that the country is highly correlated with OECD countries. For example, a country where the median value is above 0.5 has above 0.5 coefficients of correlations with the majority of OECD countries. On the contrary, a country where the median value is below zero is negatively-correlated with the majority of OECD countries.

III.2.1. Overview of OECD countries

The number of countries where the median value is above 0.5 was 15 in the 1st period (of 24 countries; a share of 62.5%). It decreased to 10 in the 2nd period (of 24 countries; a share of 41.7%, and also decreased to zero out of 24 countries[3]. In the 4th period, the number of countries where the median value was above 0.5 increased again to 15 out of 27 (a share of 55.6%). Finally, it decreased again to 6 out of 27(a share of 22.2%) in the recent 5th period.

In contrast, the number of countries where the median value was below zero was 1 in the 1st period (a share of 4.2%). It increased to 3 in the 2nd period (a share of 12.5%, and also increased to 6 (a share of 25%) in the 3rd period. After that, it decreased to 2 out of 27 (a share of 7.4%) in the 4th period, and increased a little to 3 out of 27(a share of 11.1%) in the recent 5th period (see **Table 4**).

In the above mentioned, the co-movement of business cycles in OECD countries has decreased to the 3rd stage as the EMS entered a period of stability. At the same time, the number of countries that are negatively-correlated with the majority of OECD countries has increased.

In the 4th period, co-movement increased; however, it decreased again after the EMU introduction.

[3] High synchronization in the 1st period is partly influenced by the oil shock occurred in 1973.

Table 4: Co-movement of business cycles in OECD countries

Country		All sample	Period Ⅰ	Period Ⅱ	Period Ⅲ	Period Ⅳ	Period Ⅴ	*Period Ⅲ☆*
Euro Area	Belgium	0.488	0.615	0.409	0.355	0.660	0.566	*0.335*
	Germany	0.488	0.679	0.529	0.190	0.651	0.497	*0.490*
	Greece	0.349	0.473	0.538	0.182	0.499	0.055	*0.259*
	Spain	0.408	0.640	−0.095	0.175	0.629	0.439	*0.191*
	Finland	0.379	0.414	0.340	0.257	0.742	0.398	*0.259*
	France	0.527	0.735	0.274	0.431	0.570	0.561	*0.324*
	Ireland	0.255	0.310	0.202	0.230	0.331	0.421	*0.090*
	Italy	0.471	0.547	0.627	0.331	0.637	0.562	*0.330*
	Luxemburg	0.406	0.620	0.572	−0.089	0.450	0.285	*0.027*
	Netherlands	0.303	0.445	0.576	0.105	0.750	0.526	*0.229*
	Portugal	0.430	0.734	0.000	0.070	0.335	0.159	*0.160*
Europe without Euro Area	Switzerland	0.488	0.549	0.540	0.318	0.584	0.596	*0.198*
	United Kingdom	0.469	0.686	0.267	0.175	0.706	0.460	*0.049*
	Iceland	0.220	0.587	0.061	−0.173	0.068	0.137	*0.036*
	Denmark	0.424	0.651	0.423	0.071	0.582	0.482	*0.169*
	Norway	0.279	0.408	0.645	−0.157	0.006	0.498	*0.020*
	Sweden	0.245	−0.081	0.580	0.394	0.643	0.613	*0.259*
	Czech Republic	0.388	na	na	na	0.415	0.464	*na*
	Poland	0.224	na	na	na	0.591	0.417	*na*
	Slovakia	0.105	na	na	na	−0.353	−0.112	*na*
North America	Canada	0.424	0.684	0.515	0.020	0.630	0.478	*0.013*
	Mexico	0.139	0.356	0.463	−0.202	−0.218	0.319	*−0.077*
	United States	0.419	0.656	0.479	−0.045	0.316	0.275	*−0.183*
Asia	Japan	0.402	0.541	0.519	0.306	0.022	0.458	*0.291*
	Republic of Korea	0.247	0.517	−0.157	0.195	0.408	0.398	*0.236*
Oceania	Australia	0.267	0.452	0.474	−0.032	0.571	−0.078	*−0.255*
	New Zealand	0.262	0.301	−0.152	0.362	0.560	−0.050	*0.244*

Note : Each Column shows each country's median coefficient of correlation of real GDP fluctuations with OECD countries

We exclude Austria in Euro Area because it doesn't have quarterly data

Analisys Period in this article is as follows ,

Period Ⅰ:1970 1Q～1979 1Q

Period Ⅱ:1979 2Q～1985 4Q

Period Ⅲ:1986 1Q～1993 4Q

Peirod Ⅳ:1994 1Q～1998 4Q

PeriodⅤ:1999 1Q～2007 1Q

Period Ⅲ☆:1986 1Q～1993 4Q(excluding 1989 1Q～1990 4Q)

III.2.2. Euro area

In the euro area, the number of countries where the median value was above 0.5 increased after the 4th period, the effort period for monetary union (see **Table 4**).

In **Table 5**, we examine the coefficients of correlations within the euro area and find out such tendency is further remarkable. In the 4th period, the number of countries where the median value was above 0.5 was 9 out of 11 countries[4], and the median value of Germany, Spain, Finland, and Italy was

[4] 15 countries take part in the Euro currency system now, but we have focused on the countries which had already

above 0.8. In the 5th period, the number of countries where the median value was above 0.5 is 6, and 2 countries were around 0.4.

In the meantime, Greece and Portugal were exceptional cases. Their median of the correlation coefficients decreased rapidly in the 5th period (see **Table 5**).

Table 5: Co-movement of business cycles in euro area countries

Country	All sample	Period I	Period II	Period III	Period IV	Period V	*Period III☆*
Belgium	0.611	0.746	0.469	0.447	0.782	0.607	*0.543*
Germany	0.588	0.699	0.521	0.269	0.883	0.528	*0.565*
Greece	0.352	0.373	0.569	0.371	0.566	−0.012	*0.505*
Spain	0.436	0.636	0.059	0.259	0.802	0.566	*0.358*
Finland	0.299	0.399	0.444	0.094	0.851	0.430	*0.220*
France	0.614	0.773	0.321	0.418	0.796	0.533	*0.579*
Ireland	0.262	0.267	0.132	0.273	0.507	0.492	*0.313*
Italy	0.594	0.616	0.681	0.458	0.850	0.583	*0.557*
Luxemburg	0.548	0.667	0.590	−0.107	0.291	0.319	*0.073*
Netherlands	0.362	0.444	0.441	0.185	0.688	0.553	*0.279*
Portugal	0.473	0.836	−0.020	0.147	0.418	0.081	*0.304*

Note : Each Column shows each country's median coefficient of correlation of real GDP fluctuations with Euro Area countries
We exclude Austria in Euro Area because it doesn't have quarterly GDP data
Analisys Period show in table 4

III.2.3. Other European countries

In the other European countries, the median value of the United Kingdom, Denmark and Sweden increased in the 4th period (see **Table 4**). The median value of Switzerland was above 0.5 except in the 3rd period. The Czech Republic and Poland also maintained higher correlations.

One of the reasons for higher correlation for Sweden may be joining the EU in 1995. For the Czech Republic and Poland, it is possibly the introduction of a series of capitalistic economic systems since the 1990s and joining the EU in 2004.

On the other hand, the UK and Denmark already joined the EU in 1973, so their reasons for recent higher correlation with OECD countries are other than the effect of joining the EU.

Switzerland has never joined the EU, but it is said to be the "treasurer of the world" as well as of Europe. This may be one reason for a higher correlation with OECD countries.

In addition, Iceland's median of correlation coefficients is small since the 2nd period, and Slovak business cycle is rather negatively-correlated with the majority of OECD countries.

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taken part in the Euro as of the 1st quarter of 2007. And we exclude Austria where quarterly data was not available.

III.2.4. North America

The United States, Canada, Mexico signed the North American Free Trade Agreement (NAFTA) in 1992. Since NAFTA came into effect in 1994, they have a close economic relationship. But, recently, each country's business-cycle correlation with OECD countries has become diversified.

All of the NAFTA country's correlations with OECD countries decreased substantially from the 1st period to 3rd period. After that, from the 3rd period to the 4th and 5th period, only Canadian co-movement increased remarkably. The US correlation to OECD countries increased a little in the 4th period, but it was below those in the 1st and 2nd periods. Mexican correlation remained below zero even in the 4th period (see **Table 4**).

On the other hand, the co-movement within NAFTA countries increased in the 4th period and 5th period. The transition of the correlation coefficients from the 3rd period to 5th period was as follows.

Between the United States and Canada: 0.525→0.834→0.613

Between the United States and Mexico: 0.139→0.565→0.874

Between Canada and Mexico: －0.203→0.104→0.611

Especially, the increasing co-movement between Mexico and the other two NAFTA countries is substantial. Part of this increase is thought to be affected by NAFTA.

Differences of co-movement with the OECD between the United States and Canada may derive from different co-movement with European countries. We will examine this point in the next section.

III.2.5 Asia

Many earlier studies including Stock and Watson（2005）insist Japan has lost co-movement with the world economy. Most of these works analyze only the data for the 1990s. Our result shows that the co-movement of Japan has increased in 5th period, since 1st quarter in 1999 (see **Table 4**).

Co-movement of the Korean Republic with OECD countries has increased since the 4th period.

III.2.6. Oceania

Co-movement of Australia and New Zealand decreased in 5th period. The transition of the correlation coefficient between Australia and New Zealand from the 3rd period to 5th period was 0.624→0.431→0.795. We can see that Oceania as a whole may have decreased its co-movement with the world economy (see **Table 4**)。

III.2.7. The effect of the reunification of Germany

After we exclude the reunification period, from the 1st quarter of 1989 to the 4th quarter of 1990, German correlation with OECD countries in the 3rd period increases from 0.19 to 0.49, (see **Table 4**).

Also correlations within the euro area in the 3rd period increases. The number of countries where their median values are above 0.5 increases from zero to 5. Thus, the influence of the reunification of Germany is not small to see the co-movement within the euro area.

But except Germany, the correlations of the euro area with OECD countries do not change so much. The number of countries where the median values are above 0.5 remains zero, after we exclude the reunification period.

From the above mentioned, the effect of the reunification of Germany is thought to be limited to the euro area from the viewpoint of the influence on the co-movement of business cycles.

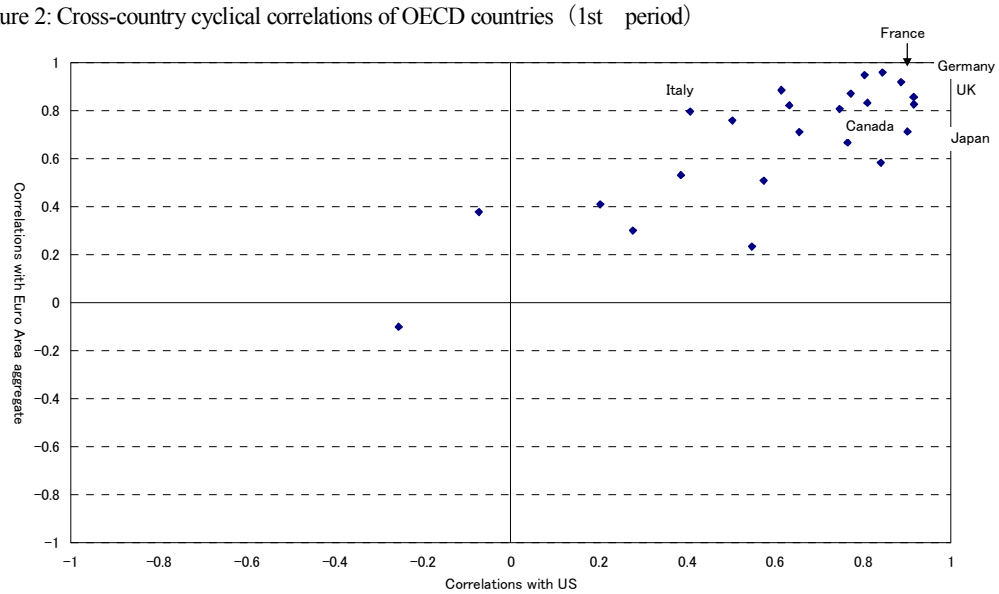
III.3. Co-movement of business cycles of OECD countries with the US and the euro area

In this section, we compare the cross-country correlation of business cycles between individual countries and the euro area aggregate and the USA.

In the 1st period and 2nd period, the countries of highly correlation with the USA are also highly correlated with the euro area aggregate (see **Figure 2-3**). In the 1st period, 21 countries out of 23 countries[5] are in the 1st quadrant (positively-correlated with the USA and the euro area). In the 2nd period, 19 countries out of 23 countries are in the 1st quadrant and 4 countries are in the 3rd quadrant (negatively-correlated with the USA and the euro area).

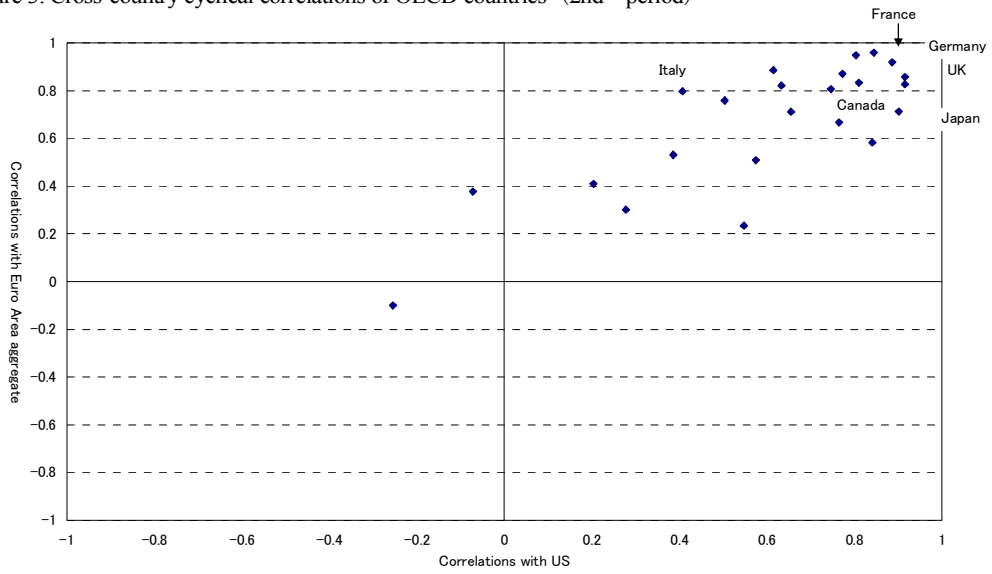
G7 countries are upper right in the 1st quadrant. In the 1st and 2nd quadrant, G7 countries are highly correlated.

Figure 2: Cross-country cyclical correlations of OECD countries（1st　period）



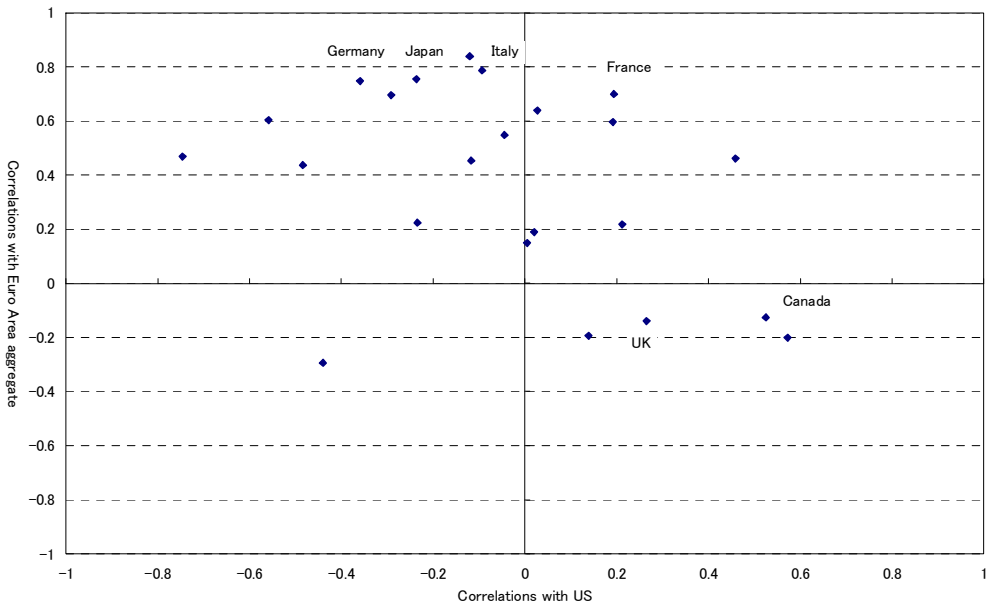
[5] Excluding Czech Republic, Poland, Slovakia where data was not available from 1st period to 3rd period, and the United States.

Figure 3: Cross-country cyclical correlations of OECD countries（2nd period）



In the 3rd period, the co-movement in OECD decreased. Only 7 countries are in the 1st quadrant (see **Figure 4**). On the contrary, 11 countries are in the 2nd quadrant (negatively-correlated with the USA and positively-correlated with the euro area). Of 11 countries, 9 countries except Japan and Republic of Korea are in Europe. And out of 9 countries, 6 countries are in the euro area. This phenomenon seems to be what Stock and Watson（2003）call the euro area business cycle.

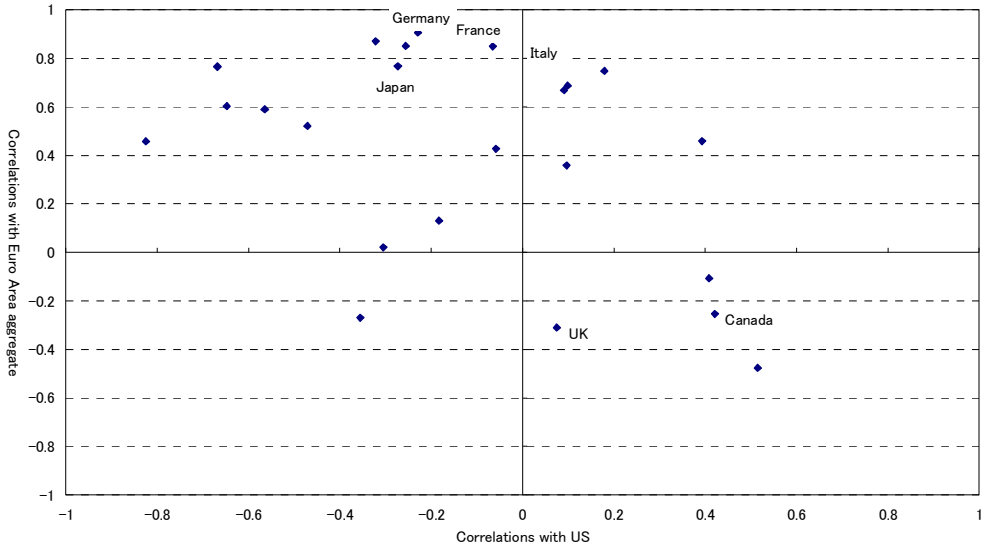
Figure 4: Cross-country cyclical correlations of OECD countries（3rd period）



On the other hand, the UK, Australia, Mexico, and Canada are in the 4th quadrant (positively-correlated with the USA and negatively-correlated with the euro area).

In addition, we see little change after we exclude the reunification period (see **Figure 5**).

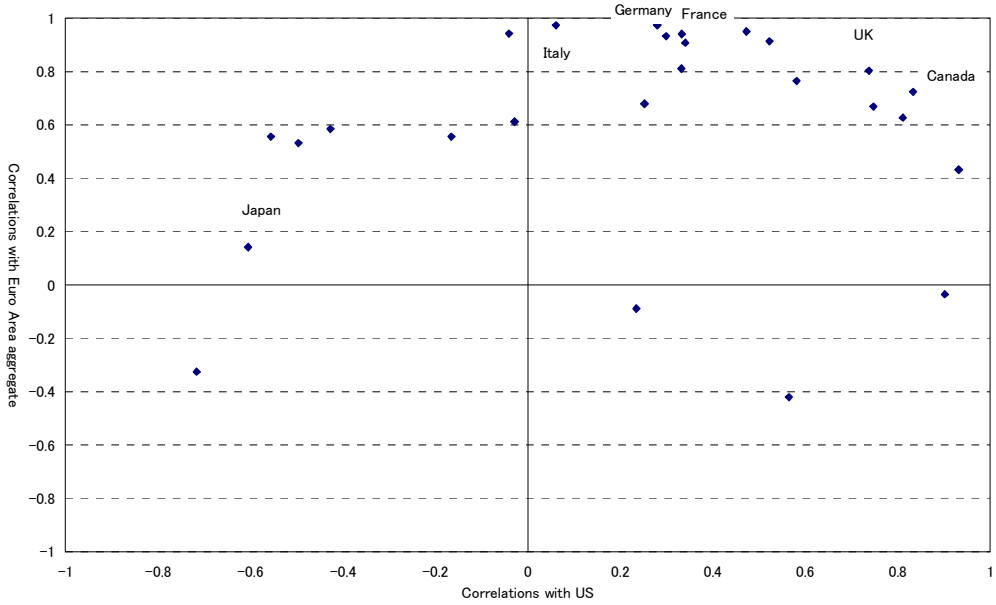
Figure 5: Cross-country cyclical correlations of OECD countries（3rd period ,excluding 1989～90）



In the 4th period, the co-movement in OECD increased again. The 15 countries out of 26 countries[6] are in 1st quadrant (see **Figure 6**). Out of G7 countries, the UK, Canada, Germany, France, Italy are in the first quadrant. The UK and Canada are highly correlated with both the US and the euro area.

[6] Excluding the United States

Figure 6: Cross-country cyclical correlations of OECD countries（4th　period）



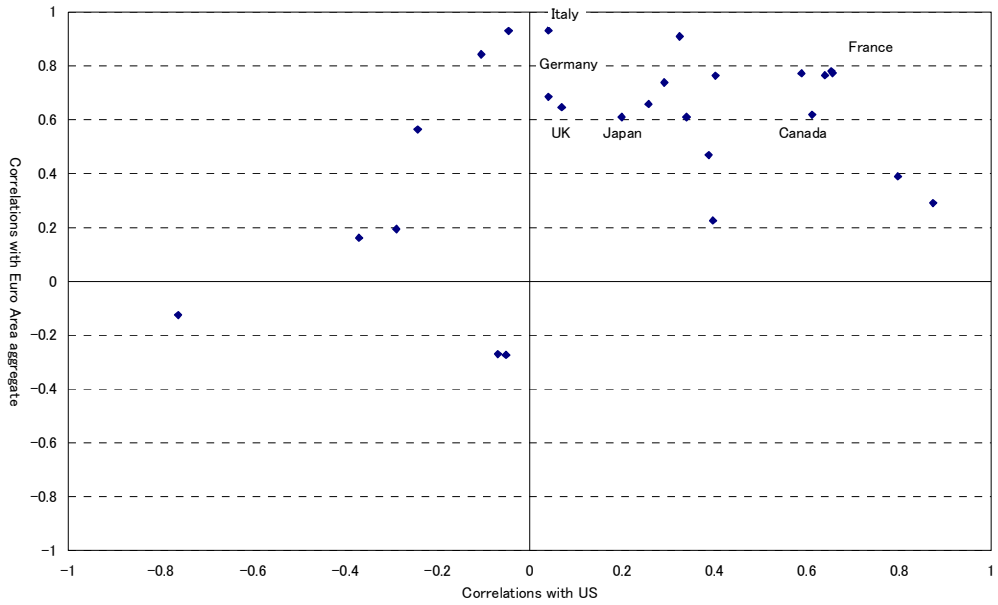
On the other hand, 6 countries still remain in the 2nd quadrant. They are Japan, the Korean Republic, the Czech Republic, Spain, Greece, Ireland, and Portugal. Since the 4th period, US accelerated its economic growth rate, boosted by the "New Economy". Countries in the 2nd quadrant can be described as countries that have not benefited from the "New Economy"[7].

The number of countries in the 4th quadrant has decreased to 3 (Iceland, Mexico and Norway). The median values of correlation of Iceland and Norway with OECD countries are rather small but they are highly correlated with the US.

In the 5th period, the number of countries in 1st quadrant increased to 18 (see **Figure 7**). But compared to the 4th period, countries are in the bottom left of the 1st quadrant, and we find each country's correlation with both the US and the euro area has decreased. It is worth noting that the UK's correlation with the US has decreased.

[7] Of course, there is a possibility that a new wave of synchronization with Asian business had been born in Japan and South Korea as Miyakawa and Imamura (2003) pointed out.

Figure 7: Cross-country cyclical correlations of OECD countries（5th　period）



On the other hand, 5 countries are still in the 2nd quadrant. All of them are in Europe: Italy, the Czech Republic, Finland, Greece, and Portugal.

In the North America area, Canada is highly correlated not only with the US but also with the euro area. But Mexico is highly correlated with the US but not so correlated with the euro area. This is the reason why the correlations of Mexico with OECD countries are different, from those of Canada as we saw in the previous section.

Given the facts that (1) the co-movement in the euro area increased after the 4th period, and (2) the co-movement between the US and the UK decreased, it is thought that the existence of English-Speaking Countries' business cycles argued by Stock and Watson (2005) is not confirmed in the 5th period.

The other characteristic developments in the 5th period are as follows:

1) Japan, which recorded the longest recovery phase, and Ireland, which recorded a higher growth rate, move from the 2nd quadrant in the 4th period to the 1st quadrant in the 5th period.
2) Both Austria and New Zealand have become negatively-correlated with the US and the euro area.
3) Iceland is highly correlated with the US and only slightly correlated with euro area.
4) Slovakia is negatively correlated with the US and the euro area.

III.4. Estimating common components using principal component analysis

In this section, we first estimate common components within OECD business cycles using principal component analysis. Next, we examine correlations between common components and each country's business cycle. Through these analyses, we examine the two possible reasons for rising synchronization: the economic relationship of any of the two countries and the business cycle factors common to OECD countries.

III.4.1. Estimation results using all samples (1970/1-3 – 2007/1-3)

We conducted principal component analysis (PCA) using data for 24 countries from 1970/1-3 to 2007/1-3. Six principal components were detected when we set a cumulative proportion target of 80%. We show each country's correlations (factor loading: each PC's square root of Eigenvalue times Eigenvectors) in **Table 6**.

Table 6: Pairwise correlation with common factors in OECD business cycles (1)

Country		1st PC	2nd PC	3rd PC	4th PC	5th PC	6th PC
		42.1%	13.0%	10.0%	6.5%	5.8%	4.4%
Euro Area	Belgium	**0.839**	0.255	−0.060	0.175	−0.157	0.148
	Germany	**0.787**	−0.417	0.018	−0.013	−0.340	0.102
	Greece	**0.611**	−0.535	0.083	−0.321	0.125	−0.200
	Spain	**0.727**	0.185	0.322	0.214	0.272	0.272
	Finland	**0.485**	0.713	0.110	−0.259	−0.040	−0.008
	France	**0.849**	0.073	0.303	0.099	0.023	−0.146
	Ireland	**0.402**	0.003	0.206	−0.553	0.111	0.572
	Italy	**0.790**	0.327	−0.025	0.256	−0.283	−0.002
	Luxemburg	**0.782**	−0.063	−0.073	0.272	0.035	−0.102
	Portugal	**0.722**	0.006	0.307	0.350	0.287	0.036
	Netherlands	**0.679**	−0.293	−0.233	0.117	−0.517	−0.019
Europe without Euro Area	Switzerland	**0.834**	0.151	−0.276	0.102	0.059	0.192
	United Kingdom	**0.724**	0.049	0.384	−0.166	0.142	−0.375
	Iceland	**0.431**	−0.167	−0.327	0.402	0.464	0.081
	Denmark	**0.725**	−0.521	0.082	0.145	−0.101	−0.098
	Norway	**0.486**	−0.456	−0.514	0.018	−0.216	0.171
	Sweden	**0.384**	0.528	0.030	−0.234	−0.525	0.029
North America	Canada	**0.758**	0.263	−0.334	−0.213	0.137	−0.247
	Mexico	**0.333**	0.030	−0.741	−0.149	0.211	0.212
	United States	**0.768**	−0.310	−0.130	−0.235	0.146	−0.250
Asia	Japan	**0.697**	−0.208	0.280	−0.346	0.180	0.260
	Republic of Korea	**0.408**	−0.120	0.645	−0.045	−0.109	−0.016
Oceania	Australia	**0.451**	0.392	−0.470	−0.364	0.154	−0.295
	New Zealand	**0.293**	0.807	−0.011	0.251	0.045	0.018

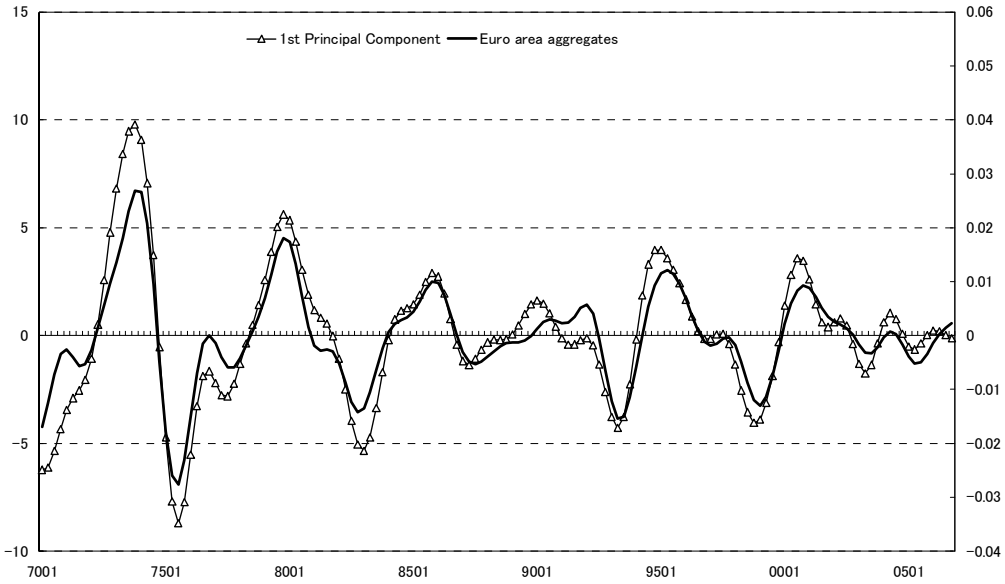
Note: Estimation Sample is from 1970 1Q to 2007 1Q
1st PC indicates the first Principal Component.

1st principal component's proportion was 42.1%, so we can think of this as the common business cycle factor to OECD countries. Countries in the euro area, other European countries, and G7 countries

other than Europe (US, Canada, Japan) are highly correlated with the 1st principal component.

As we also can see in **Figure 8,** the aggregate of business cycles in the euro area is highly correlated with the 1st principal component. This leads to the conclusion that European business cycles are similar to that of the world economy, and this conclusion is similar to that reached by Kose, Otrok, and Whiteman (2003).

Figure 8: Comparison of 1st PC and business cycle components in euro area



On the other hand, Scandinavian countries (Finland, Norway and Sweden) and small countries (Ireland and Iceland) are not correlated with the 1st principal component so much.

Finland, Sweden and New Zealand are highly correlated with the 2nd principal component. This shows the possibility that another business cycle exists in Europe.

The 3rd principal component may be an Asian business cycle, because the Republic of Korea is highly correlated with this component, but Japan is not correlated with this component. The 3rd principal component is negatively correlated with the US but positively correlated with the UK.

4th and 5th principal component are highly correlated with Iceland.

III.4.2. Estimation using samples after the effort period of introduction of the EMU (1994/1-3 – 2007/1-3)

Next, we conducted principal component analysis using 24 countries[8] data from the 4th period (1994/1-3 - 2007/1-3). This is because, as we have seen in previous analysis, the co-movement increased

[8] In this sample, we could have added 3 countries (Czech, Mexico, and Slovakia) but to compare with full sample estimation we conducted this analysis with 24 countries data.

from the period of the introduction of EMU.

Four principal components were detected when we set a cumulative proportion target of 80%. We show each country's correlation in **Table 7**.

Table 7: Pairwise correlation with common factors in OECD business cycles (2)

Country		1st PC	2nd PC	3rd PC	4th PC
		42.1%	21.3%	10.6%	6.6%
Euro Area	Belgium	**−0.911**	−0.053	−0.147	−0.153
	Germany	**−0.801**	0.019	−0.337	0.058
	Greece	**−0.377**	0.645	0.402	−0.090
	Spain	**−0.810**	0.300	−0.140	0.246
	Finland	**−0.775**	0.329	0.203	0.005
	France	**−0.890**	−0.116	0.017	0.319
	Ireland	**−0.509**	0.395	−0.553	−0.151
	Italy	**−0.886**	0.300	−0.141	0.129
	Luxemburg	**−0.518**	−0.730	0.152	−0.092
	Portugal	**−0.384**	0.728	−0.028	0.207
	Netherlands	**−0.764**	−0.393	−0.332	0.029
Europe without Euro Area	Switzerland	**−0.831**	−0.264	−0.193	0.010
	United Kingdom	**−0.832**	−0.004	0.474	−0.028
	Iceland	**−0.171**	−0.738	−0.101	0.228
	Denmark	**−0.687**	−0.522	−0.229	0.083
	Norway	**−0.336**	−0.195	−0.126	−0.602
	Sweden	**−0.897**	0.017	0.162	0.297
North America	Canada	**−0.791**	−0.430	0.311	0.036
	Mexico	**0.047**	−0.718	−0.089	−0.512
	United States	**−0.382**	−0.796	0.199	−0.191
Asia	Japan	**−0.340**	0.608	−0.420	−0.365
	Republic of Korea	**−0.611**	0.460	−0.183	−0.387
Oceania	Australia	**−0.391**	0.078	0.878	−0.084
	New Zealand	**−0.425**	0.421	0.491	−0.428

Note: Estimation Sample is from 1994 1Q to 2007 1Q
See Note of Table 6

The 1st principal component is negatively correlated with most of the OECD countries but its proportion is 42.1%, so we can think that this is the common business cycle factor to OECD countries.

The difference from the full sample estimation is that Finland and Norway are also highly (negatively) correlated with 1st principal component. This result shows that correlations in the euro area increased after the effort period of the introduction of EMU. Out of the euro area, Greece and Portugal have little correlation with the 1st principal component.

On the other hand, the correlation of the US and Mexico with the 1st principal component is smaller than the full sample estimation.

The US, Mexico, Luxemburg and Iceland are highly (negatively) correlated with the 2nd principal component. The US had accelerated growth in 4th period boosted by the financial and IT sectors. Luxemburg was also boosted by its financial sector. It can be concluded that the 2nd principal component is related to the financial sector.

On the contrary, Japan, Portugal and Greece are highly (positively) correlated with the 2nd principal

component. This might be interpreted as showing that these countries were not able to ride on the wave of the economic expansion of the United States style.

III.5. Summary

In this section, we extracted the business cycle components from real GDP and examined the co-movement in OECD countries.

Stock and Watson（2005）have pointed out that there have been important changes in the world business cycle, and in particular the emergence of two groups: the one consisting of euro area countries and the other of English-speaking countries. Through the analysis in this section, we also confirmed that the recent business cycles in Europe are highly correlated with each other not only within the euro area but also with the US and other European countries.

Of course, the co-movement in the euro area is highly correlated with the co-movement in OECD countries, and an increase in business cycle co-movement in the euro area may be due to an increase in world business cycle co-movement, as Kose, Otrok and Whiteman (2003) have pointed out.

But it can be said that the contribution of the monetary union to the rise of the synchronization of business is not small, when we see the fact that the euro area synchronization of Scandinavian countries rose after 1994 when they faced European Currency Unification.

On the contrary, we are not able to confirm the co-movement within English-speaking countries. Canada is one of the English-speaking countries but is highly correlated not only with US, but also with Europe and OECD countries. In addition, the UK has recently increased the synchronization with the euro area and European countries, as well as with the US.

Meanwhile, as the correlation between the US and common components in OECD business cycles have decreased, we can affirm that the US has had a particular business cycle since middle of the 1990s. But it is not necessarily English-speaking countries that increased their synchronization with the US. Mexico, Luxembourg, and Iceland increased their synchronization with US, when we exclude the influence of common components in OECD countries.

Mexico has a close relationship with the US through NAFTA. Luxemburg‘s economy is boosted by its financial sector as well as the US. However, Iceland’s synchronization is a puzzle[9].

IV. Why has the co-movement of business cycles in the euro area occurred?

We find that the euro-area business cycles became highly synchronized on introducing the EMU (1994/1-3～1998/10-12). This fact has also been recognized in many previous studies. But, after the introduction of the Euro currency, the euro area economic conditions became more individual. We consider that this individuality occurred because of the differences in monetary and fiscal policy in the

[9] After we finished this article, a financial crisis occurred in Iceland.

euro area. As we showed the influence of the EMU in Section 2, the euro area countries carried out the operations against their own markets according to ECB principles. As a result, monetary policy is not managed for specific matters in individual countries. But fiscal policy leaves matters to an individual country's discretion, although under financial reconstruction from Maastricht Convergence Criteria. In this section, we analyze the effects of discretional fiscal policy.

IV.1. The Relationship between Business cycles and Fiscal Policy

IV.1.1 Analyzing fiscal deficit (surplus)

We can analyze fiscal deficit (surplus) as cyclical components and structural components. Cyclical components of fiscal deficit are influenced by economic conditions. Structural components are affected by the discretionary policy of fiscal authorities and this shows automatic stabilizers for fiscal policy. According to the method of Nood (2000), we estimate the cyclical components and structural components.

IV.1.2. The relationship between structural components and business cycles

The structural components are not affected by business conditions because they reflect the results of discretionary policy by fiscal authorities. On introduction of the EMU, euro area countries were required to reduce their fiscal deficit. At that time, almost all the countries reduced their number of civil servants, pension benefits and other matters, including structural components of fiscal deficit. We examine the relationship between structural components, business cycles and the GDP gap.

Until the mid 1980s, we find a counter-cyclical fiscal policy in euro countries (correlations: 7902～8504, 0.84), but after 1994, the euro countries changed to a cyclical fiscal policy of reducing fiscal deficit. But non-euro countries had different policies. For the UK, we find a counter-cyclical fiscal policy, and especially after 1990, this tendency became stronger. Sweden is typical case in this matter. We consider that euro and non-euro countries had quite different policy during the 1990s (see **Figures 9～12**).

Figure 9: The relation between fiscal policy and business cycles (Euro 12 countries)

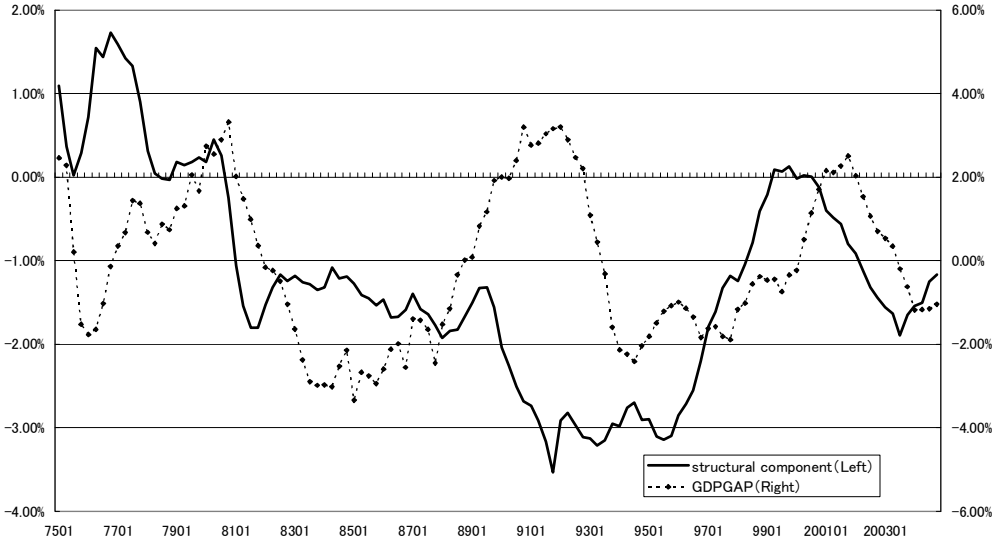


Figure 10: The relation between fiscal policy and business cycles (UK)

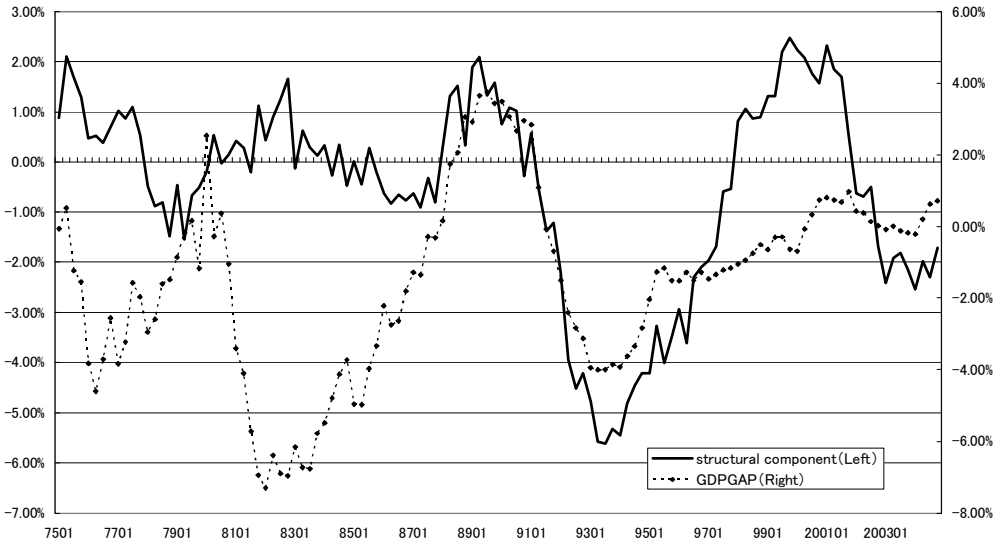


Figure 11: The relation between fiscal policy and business cycles (Netherlands)

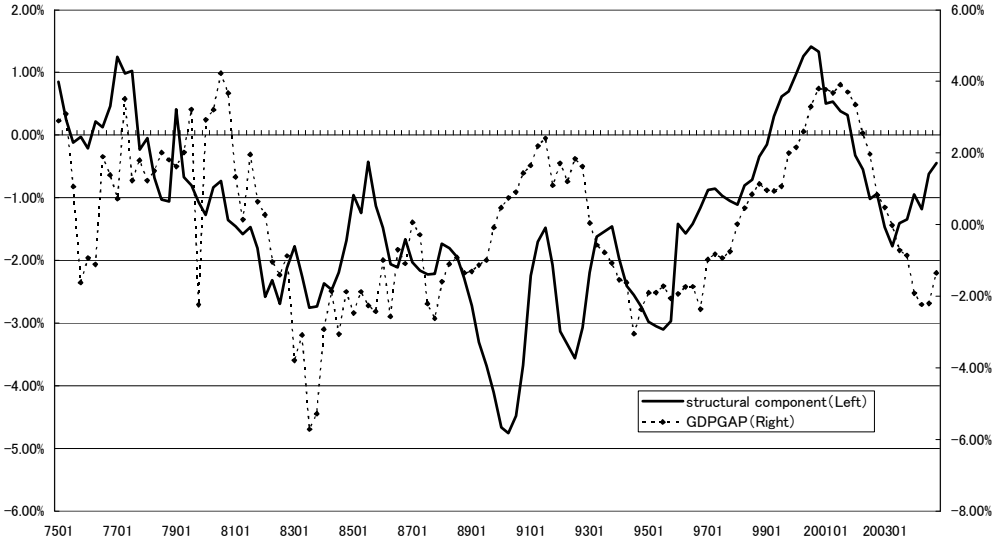
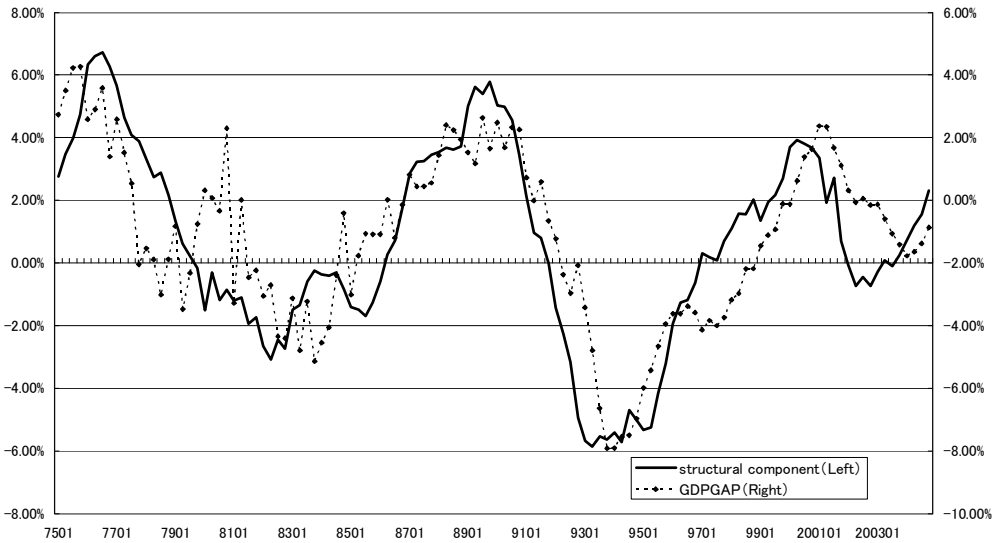


Figure 12: The relation between fiscal policy and business cycles (Sweden)



IV.2. Analysis of policy mix

Euro area countries carry out the operations against their own markets, following to ECB principles. As a result, monetary policy is not managed for specific matters by individual countries. But fiscal policy leaves matters to an individual country's discretion, although under financial reconstruction from Maastricht Convergence Criteria. We examine the relation between monetary and fiscal policies, based on Jinushi (2006).

We use Taylor type rules (Taylor(1993)). Our original Taylor rule is composed of the level of natural rate, response to the divergences in actual GDP from potential GDP and the divergences in actual rates of inflation from target rates of inflation. Based on Jinushi (2006), we can show the rule as follows:

$$i_t = \alpha\left(\pi_t - \pi^*\right) + \beta\left(y_t - y^*\right) + \gamma\left(p_t - p^*\right),$$

where π_t denotes the inflation rate at that time "t ", π^* shows a target rate of inflation. y_t denotes actual GDP at that time "t ", y^* shows potential GDP. p_t is foreign exchange rate at that time "t ", p^* shows average foreign exchange rate[10].

On the other hand, for fiscal policy, we use a fiscal version of Taylor type rules (Taylor (1995, 1997)). We use the fiscal policy rule,

$$s_t = \alpha\left(\pi_t - \pi^*\right) + \beta\left(y_t - y^*\right) + \gamma \cdot Gap$$

where s_t shows the current surplus as a percentage of nominal GDP, Gap is the divergence of actual rates from a target rate of monetary policy, following equation (1). Our original fiscal version Taylor rule, s_t is composed of structural components of total surplus and divergences of actual GDP from potential GDP. In order to estimate the policy mix under the restriction of monetary policy, we use a Gap variable. The Gap variable shows that monetary policy cannot be assigned to economic conditions, because of the restrictions after the EMU.

We use our estimation periods of the total sample period (1972/1-3～2007/1-3) and a sub-sample period (1994/1-3～2007/1-3) in euro countries. In 1994/1-3, the European Monetary Institute (EMI) was established, and for introducing euro currency, the power of individual monetary policy in euro countries became smaller and was restricted. On the other hand, for the UK, we divide the sample in 1979/4-6 because the UK economic policy changed since Margaret Thatcher became Prime Minister in May 1979,

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[10] The independent variables are as follows:
Inflation (euro): We estimate the trend from euro inflation using time trends and calculate the gap between the trend and the level of inflation.
Inflation (UK): We calculate the gap between 2.5% and the level of inflation. 2.5% is the target of the BOE.
GDP (Both): We use the values that OECD estimates.
Foreign Exchange rate (Both): We estimate the trends from Foreign exchange rates using time trends, and calculate the gap between the trends and the level of Foreign exchange rate.
Gap (Monetary Policy Gap): We use the gap between actual rates and rates estimated by Taylor rule.

with a mandate to reverse the UK's economic decline and to reduce the role of the state in the economy. We use GMM method for problems of endogeneity. Also we use the 2-period-lagged variable of all variables as the instrumental variables, and implement J test for identification.

Table 8 shows the result of policy mix. The result of the J test is clear. In euro area countries, monetary policy was assigned to work to stabilize inflation for EMU countries, and fiscal policy was assigned to work to stabilize business condition statistically significantly. The Gap variable was not statistically significant. But after introducing the restriction of monetary policy, the Gap variable is statistically significant. This means that in the euro area, autonomy of monetary policies has been lost with the introduction of the EMU. However, what cannot be controlled by monetary policies and policies in line with each country's economic conditions are allocated to and managed by fiscal policies.

On the other hand, in the UK, monetary policy was assigned to work to stabilize prices and foreign exchange rates, and fiscal policy was assigned to work to stabilize business conditions and prices statistically significantly from 1972/1-3～2007/1-3. The Gap variable is not statistically significant. This tendency has not changed since May 1979.

Table 8: Results of policy mix

1. Euro Area (12 countries base)

(1)Estimation period：1972/1-3～2007/1-3

		Coefficient	Std.Error	t-Stat	Prob	Adjusted-R	J Test
Monetary Policy	Constant	7.74	0.54	14.26	0.00	0.188	1.00
	Inflation	0.83	0.26	3.14	0.00		
	GDP	0.52	0.46	1.13	0.26		
	Foreign Exchange rate	4.14	5.13	0.81	0.42		
Fiscal Policy	Constant	−0.72	0.30	−2.37	0.02	0.273	1.00
	Inflation	−0.09	0.18	−0.49	0.63		
	GDP	0.52	0.22	2.33	0.02		
	Gap (Monetary Policy Gap)	0.12	0.08	1.43	0.16		

(2)Estimation period：1994/1-3～2007/1-3

		Coefficient	Std.Error	t-Stat	Prob	Adjusted-R	J Test
Monetary Policy	Constant	4.15	0.61	6.81	0.00	0.122	1.00
	Inflation	−0.57	0.27	−2.12	0.04		
	GDP	−0.40	1.22	−0.33	0.74		
	Foreign Exchange rate	2.83	9.68	0.29	0.77		
Fiscal Policy	Constant	−1.01	0.23	−4.49	0.00	0.563	1.00
	Inflation	0.28	0.21	1.33	0.19		
	GDP	0.54	0.17	3.10	0.00		
	Gap (Monetary Policy Gap)	0.62	0.11	5.42	0.00		

2. United Kingdom

(1)Estimation period：1972/1-3～2007/1-3

		Coefficient	Std.Error	t-Stat	Prob	Adjusted-R	J Test
Monetary Policy	Constant	7.22	0.52	14.00	0.00	0.414	1.00
	Inflation	0.53	0.15	3.52	0.00		
	GDP	0.32	0.34	0.95	0.35		
	Foreign Exchange rate	6.54	3.96	1.65	0.10		
Fiscal Policy	Constant	−0.78	0.44	−1.78	0.08	0.273	1.00
	Inflation	0.18	0.06	3.21	0.00		
	GDP	0.40	0.13	3.02	0.00		
	Gap (Monetary Policy Gap)	−0.12	0.11	−1.13	0.26		

(2)Estimation period：1979/1-3～2007/1-3

		Coefficient	Std.Error	t-Stat	Prob	Adjusted-R	J Test
Monetary Policy	Constant	6.27	0.26	24.04	0.00	0.790	1.00
	Inflation	1.12	0.13	8.67	0.00		
	GDP	0.33	0.16	2.10	0.04		
	Foreign Exchange rate	9.05	1.60	5.66	0.00		
Fiscal Policy	Constant	−0.96	0.46	−2.07	0.04	0.250	1.00
	Inflation	0.20	0.09	2.31	0.02		
	GDP	0.44	0.15	2.99	0.00		
	Gap (Monetary Policy Gap)	−0.60	0.39	−1.53	0.13		

Note;
1) We use GMM method for problem of endogeneity. Also we use the 2 lag variable of all variables as the instrumental variables, and test as estimating identified.
2) The independent variables show as follow;
Inflation (euro): We estimate the trend from euro inflation using time trend and calculate the gap between the trend and the level of inflation.
Inflation (UK): We calculate the gap between 2.5% and the level of inflation. 2.5% is the target of BOE.
GDP (Both): We use the value that OECD estimates.
Foreign Exchange rate (Both): We estimate the trend from Foreign exchange rate using time trend and calculate the gap between the trend and the level of Foreign exchange rate.
Gap (Monetary Policy Gap): We use the gap between actual rate and estimated rate by Taylor rule.

IV.3. The effect for business conditions

We found some reasons that the euro area economic integration has affected the synchronization of business cycles in those countries. Many of the countries have made an effort to achieve euro area economic integration since 1994, especially. For the sake of this, a cyclical fiscal policy was adopted in many euro area countries. But in the UK, a counter-cyclical fiscal policy was adopted. So the business cycle was different between the euro area countries and the UK (see **Figure 13**).

On the other hand, after the achievement of EMU economic integration, many countries turned to their individual economic situation. There were several types of countries with fiscal deficit conditions after 2000. Finland and Belgium have kept a balanced-budget financial policy. Italy, Germany and Portugal have expanded the fiscal deficit. Because of the different fiscal policies, euro area countries' business cycles have not become more similar (see **Figure 14**).

Figure 13: Fiscal deficit before the introduction of EMU

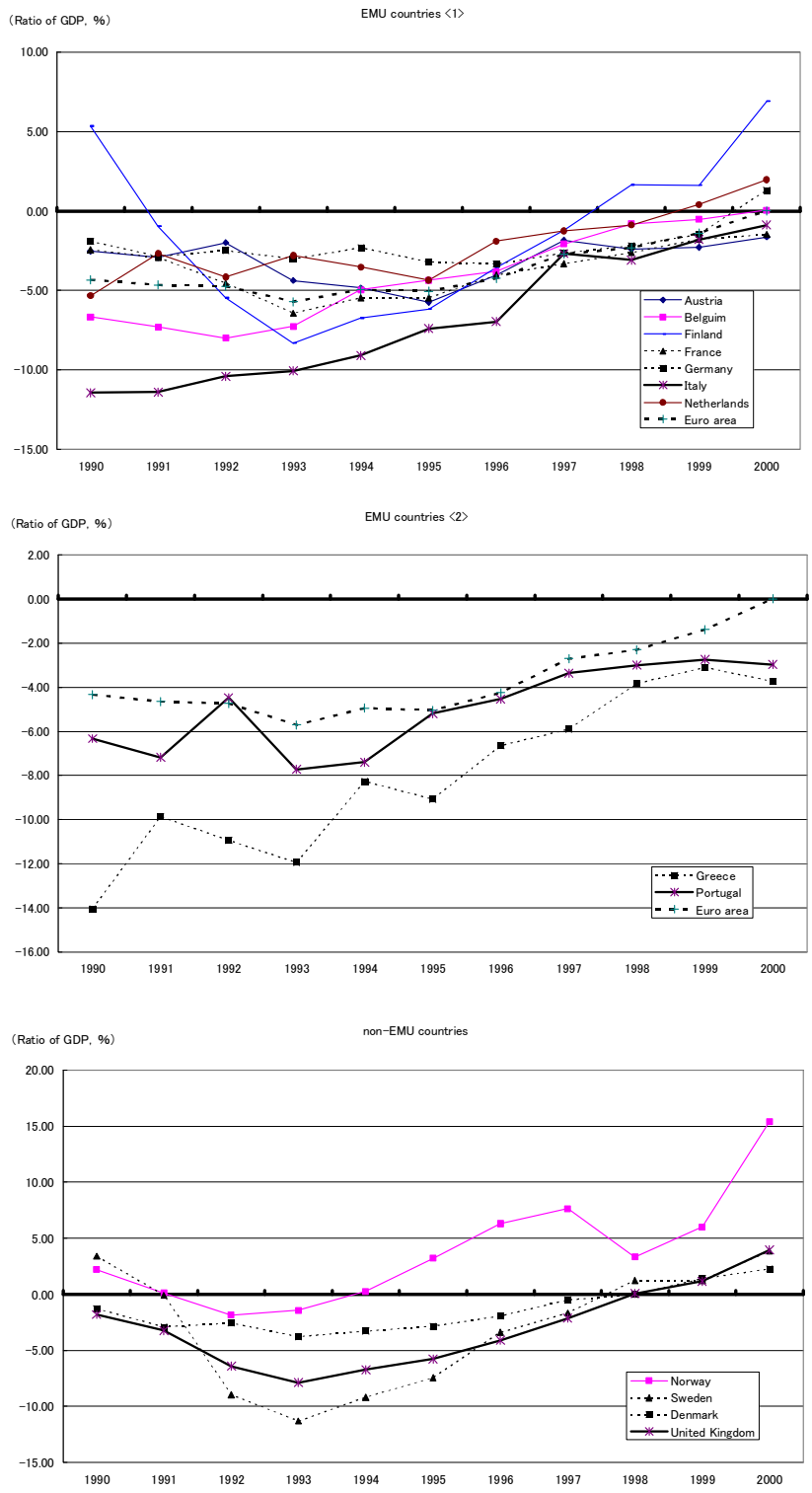
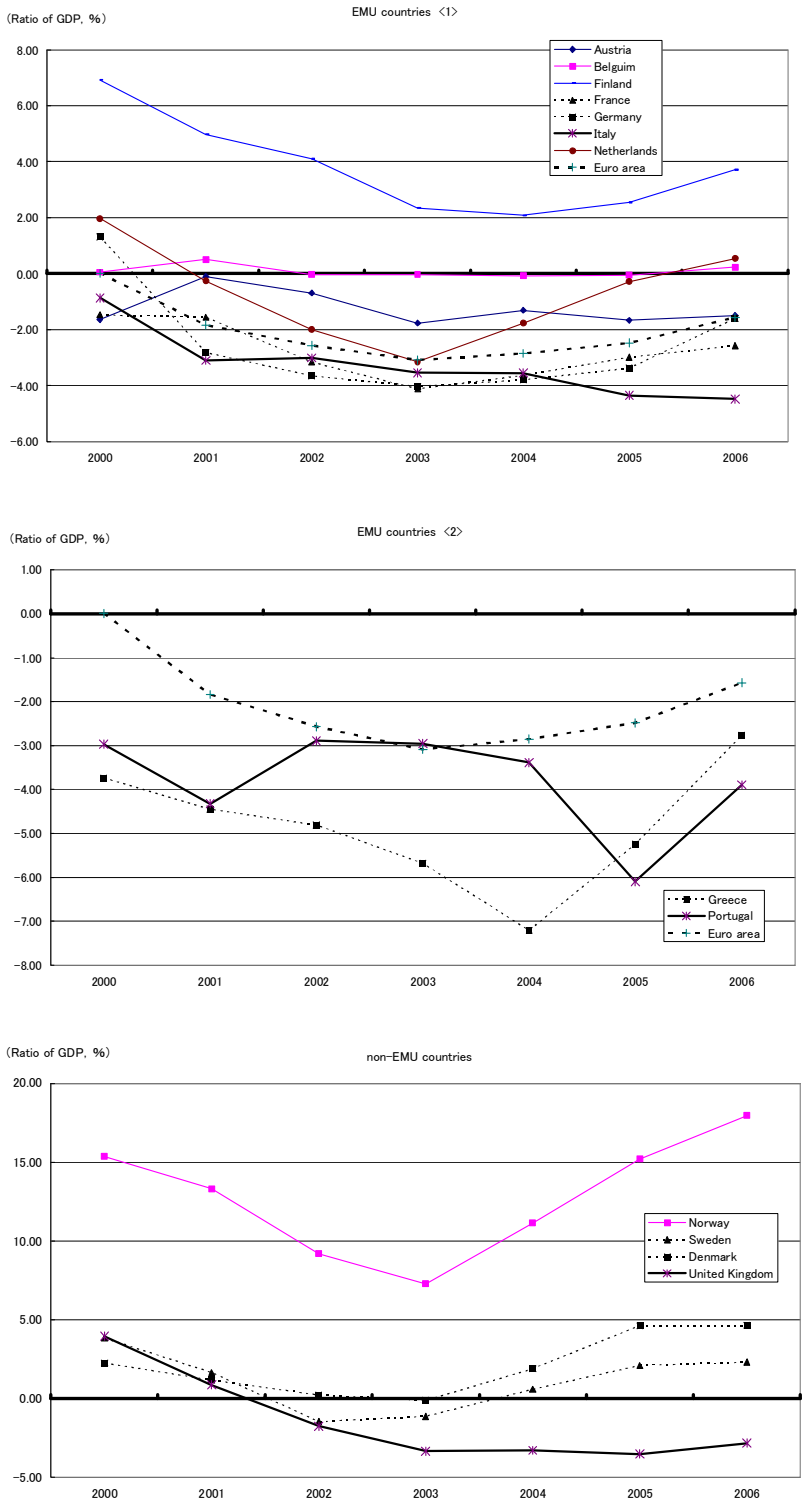


Figure 14: Fiscal Deficit after the introduction of EMU



V. Concluding remarks

This paper has examined the effects of economic and monetary union on business cycles in the euro area. As major results, we have shown the following:

1) As a worldwide tendency, it is confirmed that the co-movement of business cycles has increased since the 1990s.
2) Euro area economic integration has affected the synchronization of business cycles in euro countries. Many countries have made an effort to achieve euro area economic integration since 1994, especially. This result is the same as that found in many previous studies. But after the achievement of euro area economic integration, many countries have turned to their individual economic situation. There were several types of business cycle among these countries.
3) While the U.K., Norway, and other countries, non-members of the EMU, have had different business cycles from the euro area, they also show a stronger co-movement with the Euro economy than with the U.S. economy. In particular, since the first quarter of 1999, the introduction of the euro, it is worth noting that the U.K. has exhibited a lower co-movement with the U.S. economy, while maintaining its co-movement with the euro area economy. Canada has shown increasingly strong co-movement with both the U.S. and the Euro economy. This means that the existence of the business cycle in the euro area economy, as shown in Stock and Watson (2005), was confirmed in this study; however, the existence of a business cycle in the English-speaking world (the U.S., the U.K., and Canada, etc.) was not confirmed.
4) After introducing the restrictions on monetary policy, fiscal policy was assigned the monetary policy role to work to stabilize individual economic situations. On the other hand, in non-euro area countries, monetary and fiscal policy had their original, individual role. As a result, euro countries' business cycles became more similar.
5) After the achievement of euro area economic integration, many countries turned to their individual economic situation. There were several types of countries with fiscal deficit conditions after 2000.

For the period of effort to introduce the EMU only, the euro area economic integration affected the synchronization of business cycles in euro countries. Because many countries were required to succeed in the introduction of EMU, euro countries made efforts to reduce fiscal deficit without managing for specific matters in individual countries.

A future subject for study will be investigating whether co-movement of business cycles will increase again by further development of economic integration or whether the business cycles of each country will become more irregular by the diversification of economic activities within the euro area.

References

[1] Agresti, A. and Mojon, B. (2001), 'Some stylised facts on the euro area business cycle,' ECB Working Paper, No.95.

[2] Angeloni, I and Dedola, L. (1999), "From the ERM to the euro: new evidence on economic and policy convergence among EU countries," European Central Bank Working Paper Series No.4.

[3] Artis M.J. (2000), "The UK and EMU", EUI Working Papers, RSC forthcoming。

[4] Artis M.J. and W. Zhang (1997), "International business cycles and the ERM," International Journal of Finance and Economics, 2, 1-16.

[5] Bergman, M. (2004), "How similar are European business cycles?" Lund University, Department of Economics Working Paper no 2004:9.

[6] Bayoumi T. and B. Eichengreen (1993), "Shocking aspects of European Monetary Integration," in Torres F. and F. Giavazzi (eds.), Adjustment and Growth in the European Monetary Union, Cambridge University Press: Cambridge。

[7] Camacho, M, Perez-Quiros, G and Saiz, L (2005), "Do European business cycles look like one?" Banco de España Working Papers No.0518.

[8] Christiano, Lawrence J. and Terry J. Fitzgerald (2003). "The Band Pass Filter," International Economic Review, 44(2), 435-465.

[9] Giorno, C., P. Richardson, D. Roseveare and P. van den Noord (1995), "Potential Output, Output Gaps and Structural Budget Balances," OECD Economic Studies, No. 24, 1995/I.

[10] HM Treasury (1999b) 'Fiscal Policy: Public Finances and the Cycle.' Evidence on the UK economic cycle.

[11] Iizuka, Nobuo and Asako Kazumi（2003）"Japanese business cycle," Business cycle and forecast of business condition, University of Tokyo Press (in Japanese).

[12] IMF World Economic Outlook (2002), 'Recessions and recoveries.'

[13] Jinushi, Toshiki（2006） "Japanese Macro economic policy in the latter of 1980s -The estimation of Policy mix," Monetary Policy in USA, Toyokeizai, pp.161-179 (in Japanese).

[14] Katsuura, M and A. P.Layton (2001), "Examining Similarities among Phases of Business Cycles - Is the 1990s US Expansion Similar to the 1960s?" - Journal of the Japan Statistical Society, vol.31, 2001, pp.129-152.

[15] Kose, M. Ayhan, Otrok, Christopher and Whiteman, Charles H. (2003) "International Business Cycles: World, Region, and Country-Specific Factors," The American Economic Review, Vol. 93, No. 4., pp. 1216-1239.

[16] Michael Artis (2003), "Analysis of European and UK business cycles and shocks," HM Treasury Working Paper.

[17] Miyagawa, Tsutomu and Imagawa Yuriko（2003） "International business cycle and spillover effect," Business cycle and forecast of business condition, University of Tokyo Press (in Japanese).

[18] Nood, P. (2000) "The Size and Role of Automatic Fiscal Stabilizers in the 1990s and Beyond",

OECD Economics Department Working Papers, No.230, January 2000.OECD, OECD Economic Outlook, June 2000.

[19] Stock, James H.and Mark W. Watson (2005), "Understanding Changes In International Business Cycle Dynamics," Journal of the European Economic Association ,September 2005, Vol. 3, No. 5, Pages 968-1006.

[20] Taylor, J. B. (2000), "Reassessing Discretionary Fiscal Policy," Journal of Economic Perspectives, Summer 3, pp.21-36.

[21] Taylor. J. B.［1997］"The Policy Rule Mix: A Macroeconomic Policy Evaluation," prepared for the Robert A. Mundell Festschrift Conference, October 24, 1997.

[22] Takeda, Yosuke, Komaki, Yasuyuki and Yajima Yasuhide（2005） "An actuality of Policy Rules –Estimation of Fiscal Policy rule-," Heterogeneity in expectation formation and Macro economic Policy," Toyokeizai, (in Japanese).

Appendix: More analysis on business cycles using the Index of Industrial products

1. Which is the better business cycle indicator, GDP or the Industrial product index ?

We examine the co-movement of business cycles in the euro area using GDP in section 3. In fact, there are many earlier papers which also use GDP. The coverage of GDP is larger than that of the Industrial product index (IIP). But both have weak points. GDP is composed of all industries, but GDP also includes non-market divisions, like government service. These sectors are not sensitive to business cycles. As the data of these sectors may become noise, we cannot analyze the business cycle accurately. On the other hand, though IIP has smaller coverage, IIP is more sensitive to business cycles because IIP includes the fluctuation of inventories. The fluctuation of inventories shows the movement of supply and demand.

We reexamine the co-movement of business cycles in the euro area using IIP, which are collected using OECD "Main Economic Indicators".

2. Cross-country cyclical correlations in Europe

We extract business cycle factors from IIP using a Band-pass filter following Christiano and Fitzgerald (2003). Our estimate period is divided by the epochs of EMU: (1) until the start of EMS (1960/1-3～79/1-3), (2) the confusion period of EMR (1979/4-6～85/10-12), (3) the steady period of EMR (1986/1-3～93/10-12), (4) the effort period of the introduction of EMU (1994/1-3～98/10-12), (5) since EMU (1999/1-3～2007/10-12). We compare cross-country correlation of cycles between individual countries and each of EMU (Germany) and the USA.

(1) Until the start of EMS (1960/q1～1979/q1)

Until the start of EMS, each country in the euro area had a high correlation with EMU and the USA (see **Fig. 1**). But the UK and southern euro countries had higher correlation with USA.

(2) The confusion period of EMR (1979/q2～85/q4) and the steady period of EMR (1986/q1～1993/q4)

In the confusion period of EMR and the steady period of EMR, this tendency became stronger. This fact is also recognized in many previous studies. But after the mid 1980s, the euro area cycle had not become similar to the USA cycle. On the other hand, the UK had become more similar to the USA (see **Fig. 2, Fig. 3**).

(3) The effort period of the introduction of EMU (1994/q1～1998/q4) and since the EMU (1999/q1～2007/q4)

In the euro area, after the mid-1990s, during the effort period toward the introduction of the EMU, the convergence of business cycles was remarkable. However, since 1999, when the EMU was introduced, the co-movement of business cycles in the euro area has decreased again (see **Fig. 4, Fig. 5**).

Fig-1 Cross-country cyclical correlations in OECD countries （1960/q1-1979/q1）

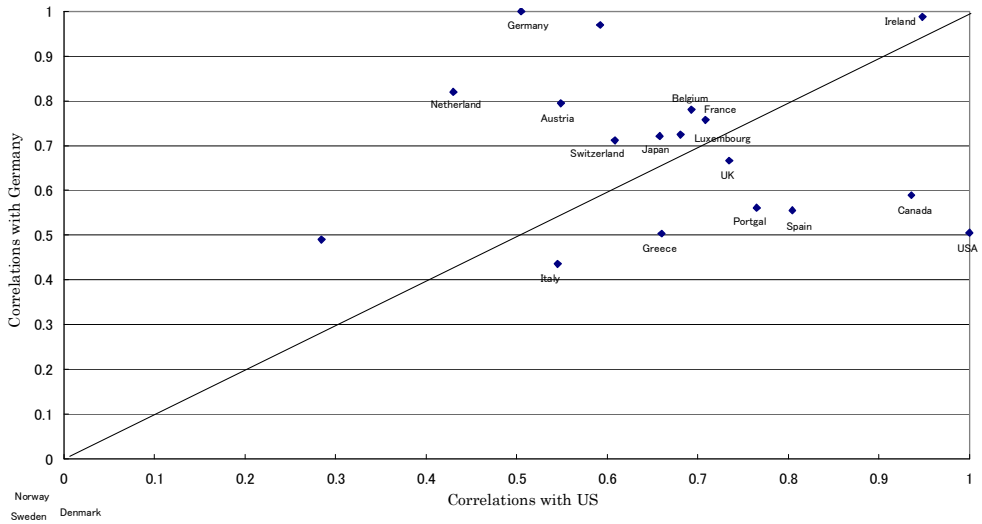


Fig-2 Cross-country cyclical correlations in OECD countries （1979/q2-1985/q4）

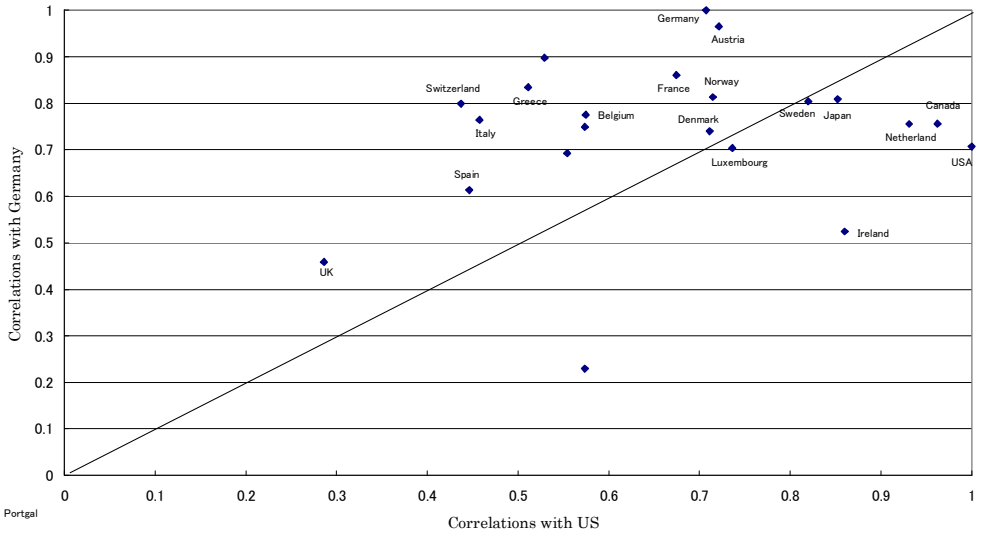


Fig-3 Cross-country cyclical correlations in OECD countries （1986/q1-1993/q4）

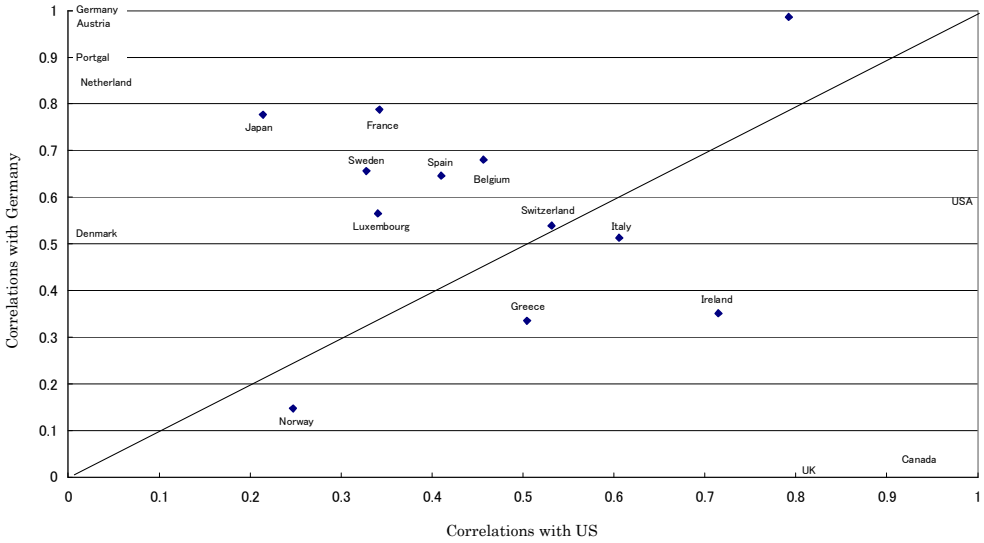


Fig-4 Cross-country cyclical correlations in OECD countries （1994/q1-1998/q4）

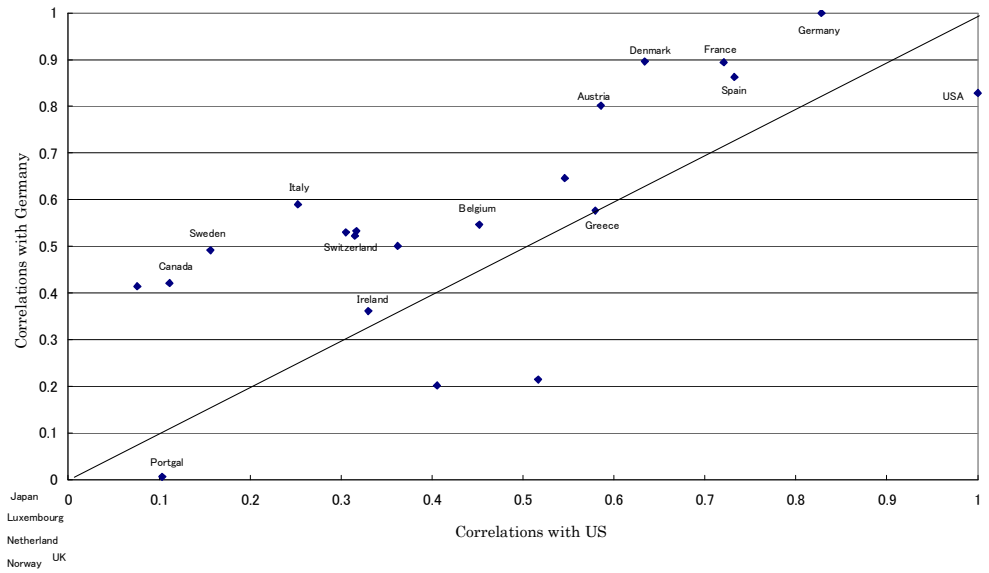


Fig-5 Cross-country cyclical correlations in OECD countries （1999/q1-2007/q1）