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THE ENDOGENEITY OF THE OPTIMUM CURRENCY AREA: BUSINESS CYCLES CORRELATION TRADE INTENSITY INTRA-INDUSTRY TRADE AND TRADE PATTERN IN THE EUROPEAN MONETARY UNION

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THE ENDOGENEITY OF THE OPTIMUM CURRENCY AREA: BUSINESS CYCLES CORRELATION, TRADE INTENSITY, INTRA-INDUSTRY TRADE, AND TRADE PATTERN IN THE EUROPEAN MONETARY UNION

by

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ABSTRACT

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The concern of a sovereign debt crisis in the euro zone has become particularly intense since 2010, as several countries' sovereign debts have increased sharply due to bank bailouts. The Optimum Currency Area (OCA) theory suggests that countries that have close trade links, similar business cycles, labor mobility across the region, and a risk sharing system such as an automatic fiscal transfer mechanism are suitable candidates to form a common currency union. A study by Frankel and Rose (1998) claims that trade intensity and business cycles correlation are endogenous and strongly correlated. Hence, a country is more likely to satisfy the criteria for entry into a currency union "ex post" than "ex ante".

This paper aims to investigate the determinants of the correlation of business cycles in the euro zone. My hypothesis is that trade structure causes the convergence of business cycles, and only countries with similar trade structures are suitable candidates for a common monetary union.

My regression model is based on the endogeneity hypothesis of the OCA criteria pioneered by Frankel and Rose (1998). The dataset is a time-series panel data for 17 euro zone members from 2002-2010. The dependent variable is business cycle correlation, and the independent variables include trade intensity, intra-industry trade, and trade structure. The regression results suggest that trade structure heavily influences the correlation of business cycles, while intra-industry trade has no direct impact on the correlation of business cycles.

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Chapter One: Introduction

1.1 History behind the Development of the European Monetary Union

The signing of the Maastricht Treaty that created the euro and a central bank was not a sudden decision. The development of the European Monetary Union (EMU) and the economic integration between the European nations was the result of a long-term development that started in the aftermath of World War II.

After World War II, the European Union was established with the aim of building a new order for peace, freedom, and prosperity. The first attempt to unite Europe was the signing of the Schuman Plan. The Schuman Plan united European nations both politically and economically by joining the two strategically crucial industries, coal and steel, under common management within the European Coal and Steel Community (ECSC). The six founding member states were France, Germany, Italy, Belgium, the Netherlands, and Luxembourg. In 1957, the Treaty of Rome founded the European Economic Community (EEC), also known as the "common market". The chief objective of the EEC was to create a common market where goods, services, capital and persons could freely circulate under common rules and institutions. Rapid progress was accomplished after the adoption of the Treaty of Rome, and the customs union was completed by 1968, allowing the removal of all custom duties on goods and encouraging cross border trade. The creation of the "common market" became the basis of the integration process in the four decades that

followed and represented the most important founding act of a united Europe (European Commission).

In 1972, EU members decided to allow member countries' currencies to fluctuate against each other, but at very narrow rates. This exchange rate mechanism (ERM) was the first plan for a single currency and the first step towards the introduction of the euro. In 1979, the European Monetary System was first enforced. The EMS was the first fixed, but adjustable exchange rate system between European countries since the demise of the Bretton Woods system. The EMS was built on the concept of stable but adjustable exchange rates, and the primary goal was to reduce exchange rate instability, which was seen as damaging to trade, investment, and economic growth. Under the EMS, countries were committed to interventions in the foreign exchange market once their currencies had reached the limits of the band. This obligatory intervention procedure meant that central banks of countries with stronger currencies were obligated to buy weaker currencies whose value had fallen below the prescribed range. Likewise, the central banks of countries with weaker currencies were obligated to sell their currencies to the central banks of financially stronger countries. Central rates could not be changed unilaterally but instead, the partners had to agree upon the rates. Moreover, a number of mutual credit facilities were established among central banks to assist participating countries in fulfilling their obligation to intervene. Belgium, Denmark, France, Ireland, Italy, Luxembourg, the Netherlands, and West Germany participated in the EMS initially. Spain became a full participating member in 1989, as did the United Kingdom in 1990 and Portugal in 1992 (European Commission).

A central feature of the EMS is a common unit of currency known as the European currency unit (ECU), a basket currency based on a weighed average of EMS currencies. The amount of currency deposited by each member country was related to the economic strength of that country. One argument against the EMS is that it established the principle that one monetary policy can suit all member states; however, unless the correct rate is set and changed appropriately, a national economy can be forced to pursue policies that are not best suited to domestic conditions in order to maintain international stability. For example, after the German reunification in 1990, Germany's inflation rates started to rise, but the Bundesbank controlled the inflation rates by raising the interest rates. Consequently, all other currencies were forced to follow its lead. The other countries that tried to maintain their currencies fixed against the Deutsche Mark by matching Germany's high interest rates, were forced into a recession, creating dissatisfaction among most countries. The fact that a fixed exchange rate system is too rigid and much more prone to speculative attacks ultimately led to the demise of the EMS and led to a full monetary union—the European Monetary Union (European Commission).

In 1992, the treaty on the European Union was signed in Maastricht, setting clear rules for the future of a single currency. Maastricht convergence criteria were designed in order to ensure that a member state's economy was sufficiently prepared for EMU entry. The criteria required that a country could join the union only if:

1. Its inflation rate was not more than 1.5 percentage point higher than the average of the three lowest inflation rates among the EU-member states;

2. Its nominal long-term interest rate must not be more than 2 percentage point higher than in the three lowest inflation member states;
3. It had joined the exchange rate mechanism of the EMS and had not experienced a devaluation during the two years preceding the entrance into the union;
4. Its government budget deficit was not higher than 3% of its GDP (if it was, it should be declining continuously and substantially and coming close to the 3% norm. Alternatively, the deviation from the reference value should be exceptional and temporary and remain close to the reference value);
5. Its government debt should not exceed 60% of GDP (if it did it should diminish sufficiently and approach the reference value at a satisfactory pace.)

In 1998, 11 EU countries (Austria, Belgium, Finland, France, Germany, Ireland, Italy, Luxembourg, the Netherlands, Portugal, and Spain) satisfied these convergence criteria to join the EMU, but it was not until January 1, 1999, that the EMU was instated. Greece qualified for the convergence criteria in 2000 and was admitted on January 1, 2001. The common currency—the euro—was introduced on January 1, 2002. Between 2007 and 2011, five new states acceded: Estonia, Malta, Slovenia, Slovakia, and Cyprus.

1.2 Reflecting on the EMU: Benefits and Flaws

Until the beginning of 2009, even after the collapse of Lehman Brothers, the EMU had been regarded as a success. However, since late 2009, some fiscally

conservative investors have sensed the fears of a sovereign debt crisis in some European states including euro zone members such as Greece, Ireland, Spain, Portugal and some European Union (EU) countries that are not within the euro zone. This concern became particularly intense in early 2010 when several countries' sovereign debts increased sharply due to bank bailouts. A crisis of confidence has emerged with the widening of bond yield spreads and the risk insurance on credit default swaps between these countries and other EU members, particularly Germany.

The European economy is in its deepest recession since the 1930s. German Chancellor Angela Merkel recently claimed, "If the euro collapses, then Europe and the idea of the European Union will fail."[1] On the other hand, the European common currency has already required a rescue package close to a trillion euro; the big European bailout that was supposed to be temporary is now becoming permanent. While the political upheaval in Athens is making the once unspeakable Greek debt default a possibility, Italy is becoming the next battleground with its slow growth and political paralysis. Germany, the largest economy in Europe, just reported a sharp decline in orders for industrial goods due to the decrease in demand from its euro zone partners. A restless flow of negative economic news related to the euro zone has continued. The euro zone is suffering from a recession and the future of the euro remains in doubt.

Over the past decade, EMU membership has brought both significant benefits and fundamental flaws to its members. According to a recent study by McKinsey Germany (2011), there are three major benefits:

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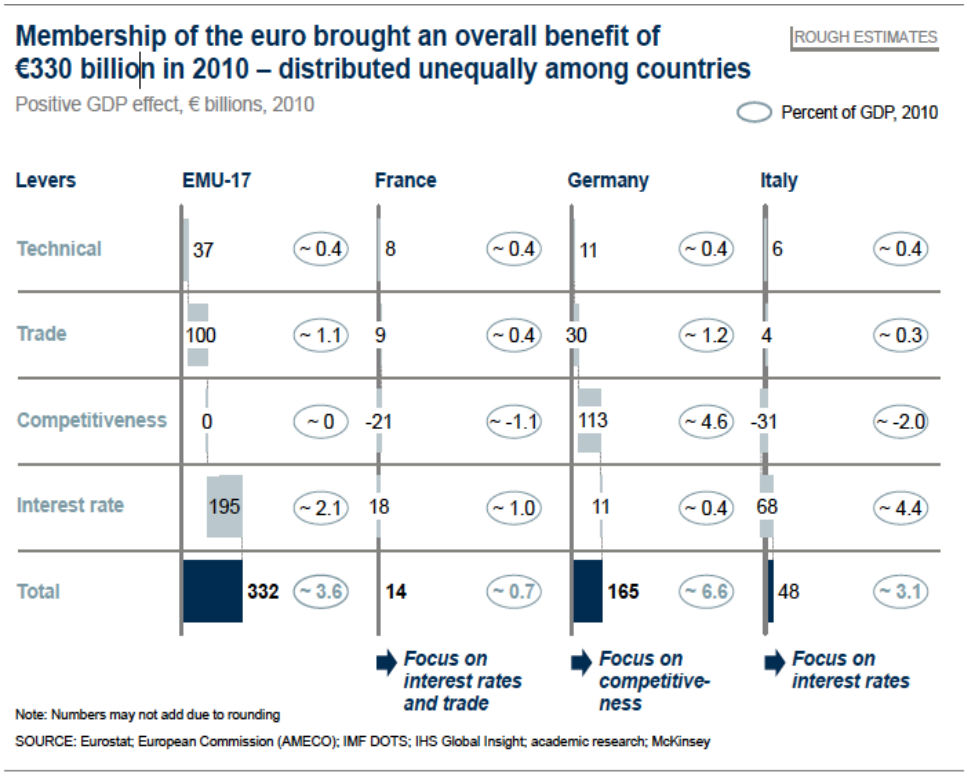
[1] Spiegel International (http://www.spiegel.de/international/germany/0,1518,694696,00.html)

1. The removal of nominal exchange rates lowered transaction costs and encouraged trade within the euro-zone.
2. Firms within the euro-zone tend to profit more from economies of scale and their competiveness increased.
3. The low interest rates stimulated investment and consumption within the euro-zone.

Mckinsey (2011) reports that the total benefits to the euro zone amounted to an annual €330 billion in 2010. Exhibit 1-1 shows the breakdown of benefits brought by the euro to EMU-17, Germany, Italy, and France in 2010. Even though all the EMU countries felt a positive impact from the euro, the benefits are not equally distributed among different EMU states. For example, Germany has largely benefited from enhanced competitiveness and received half of the total benefits from the first decade of the euro's existence. Germany's GDP has increased approximately 6.6% due to euro membership in 2010. However, most other countries benefited from the euro to a much smaller extent. Italy, for instance, enjoyed lower interest rates, but such a benefit was offset by its weak competitive performance, resulting in an overall benefit of 3.1% of GDP. France also performed poorly in terms of its competitiveness and mainly benefited from interest rates and trade. The total benefit to France in 2010 was only 0.7% of GDP (Mckinsey, 2011).

Exhibit 1-1: Breakdown of Benefits Brought by the Euro (2010)



Mckinsey (2010) also stresses the fundamental flaw in the construction of EMU: EMU lacks sufficient adjustment mechanisms to rebalance the divergent performance among its economies. Before the introduction of the euro, countries could depreciate their nominal exchange rate to balance any loss of competitiveness due to increases in unit labor costs. However, EMU shows little capability to implement any of the three main adjustment mechanisms from the optimal currency union: flexible real wages and industry adaptability, capital and labor mobility, and fiscal transfers. Exhibit 1-2 demonstrates the poor performance of EMU in the implementation of these three mechanisms (Mckinsey, 2011).

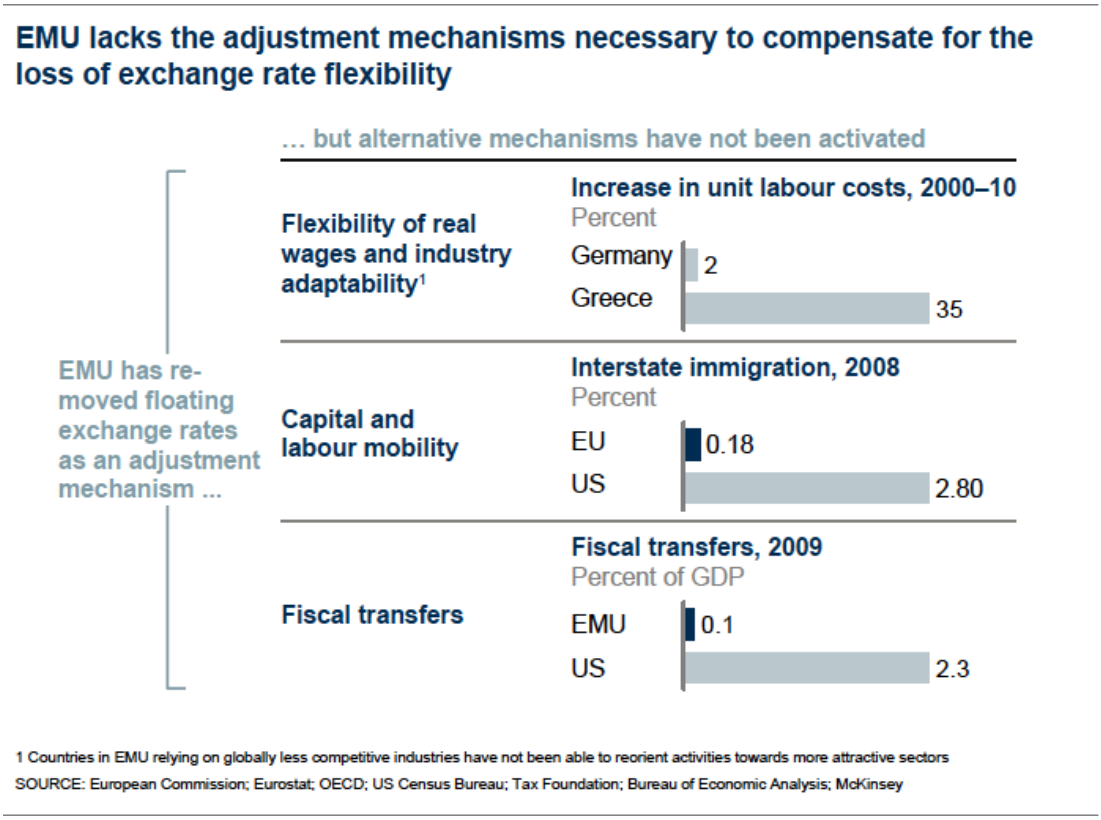
Firstly, wages should reflect a country's relative productivity. However, wages in the euro zone do not agree with that of competitiveness. Between 2000

and 2010, unit labor costs increased by 35% in Greece, while they increased by only 2% in Germany. The EMU countries that are strong in labor-intensive industries are facing the fierce price competition resulting from the low unit labor costs of competitors. Consequently, these countries are forced to make structural changes towards new industries that are less focused on cost to avoid price competition from low-cost countries (McKinsey, 2011).

Secondly, cross-border labor mobility has remained low since the introduction of the euro. Migration of the unemployed from low-growth regions to fast growing regions can reduce unemployment in less competitive areas, while easing the upward pressure on wage inflation. However, in 2008, only 0.18% of the EU working population migrated to other countries, compared to 2.8% in the US (McKinsey, 2011).

Thirdly, fiscal transfers have historically been crucial to compensate for regional divergence in all common currency union. However, fiscal transfers from the EU budget are too small to balance the divergence of the economies. In 2009, the net fiscal transfers among the EMU members were less than 0.1% of euro zone GDP. Transfer payments in other currency unions are significantly higher (McKinsey, 2011).

Exhibit 1-2: Performance of the EMU's Adjustment Mechanisms to Maintain Competitiveness and Overcome Divergence



1 Countries in EMU relying on globally less competitive industries have not been able to reorient activities towards more attractive sectors
SOURCE: European Commission; Eurostat; OECD; US Census Bureau; Tax Foundation; Bureau of Economic Analysis; McKinsey

To conclude, the EMU has brought substantial benefits to its member countries in terms of trade, competitiveness, and interest rates. On the other hand, the EMU lacks effective adjustment mechanisms, and hence causes increasing divergence among the countries of the euro zone, especially imbalances between the North and South.

1.3 Introduction to My Study

In light of the current European intra-area imbalances and the sovereign debt crisis, many scholars and policy makers have looked back and started questioning the optimality of the EMU: What are the requirements to form an

optimum currency union? Have all the EMU members satisfied the requirements to form an optimum currency union?

Mundell (1961), McKinnon (1963), and Kenen (1969) laid the foundation for the "Optimum Currency Area" theory and suggested that countries that have close trade links, similar business cycles, labor mobility across the region, and a risk sharing system such as an automatic fiscal transfer mechanism are suitable candidates to form a common currency union. Additionally, Frankel and Rose (1998) established the OCA endogeneity theory and claim that trade intensity and business cycles correlation are endogenous and strongly correlated. In the case of the EMU, the EMU entry provides impetus for trade expansion, which leads to closely correlated business cycles.

The current situations in the euro zone do not seem to align with the findings from Frankel and Rose (1998). Even after several stages of economic integration, such as free trade arrangements and custom unions, and a period of convergence defined by the Maastricht Treaty, the business cycles of the so-called core (Germany, Austria, the Netherlands, etc) and the business cycles of the periphery countries (Spain, Greece, Portugal, Ireland, etc) seem to be asynchronous. The periphery countries, compared to the core countries, are experiencing slower growth, progressive loss of international competitiveness, persistent current account deficits, and the accumulation of foreign debt. Exhibit 1-3 shows the current account divergence among the EMU members. Germany, Austria, and the Netherlands experienced relatively high current accounts surplus in the last decade, while Greece, Portugal, and Spain have high current accounts deficit. Exhibit 1-4 illustrates the imbalances of public debt ratios in the euro zone. Greece and Italy particularly suffered from public debt. Exhibit 1-5

demonstrates the situation of the capital markets of the euro zone. Ireland, Portugal, and Greece were the first to experience sharply higher borrowing rates since the end of 2009. The contagion has also spread to Italy, Spain, and France.

Exhibit 1-3: Imbalances of Current Accounts in the EMU

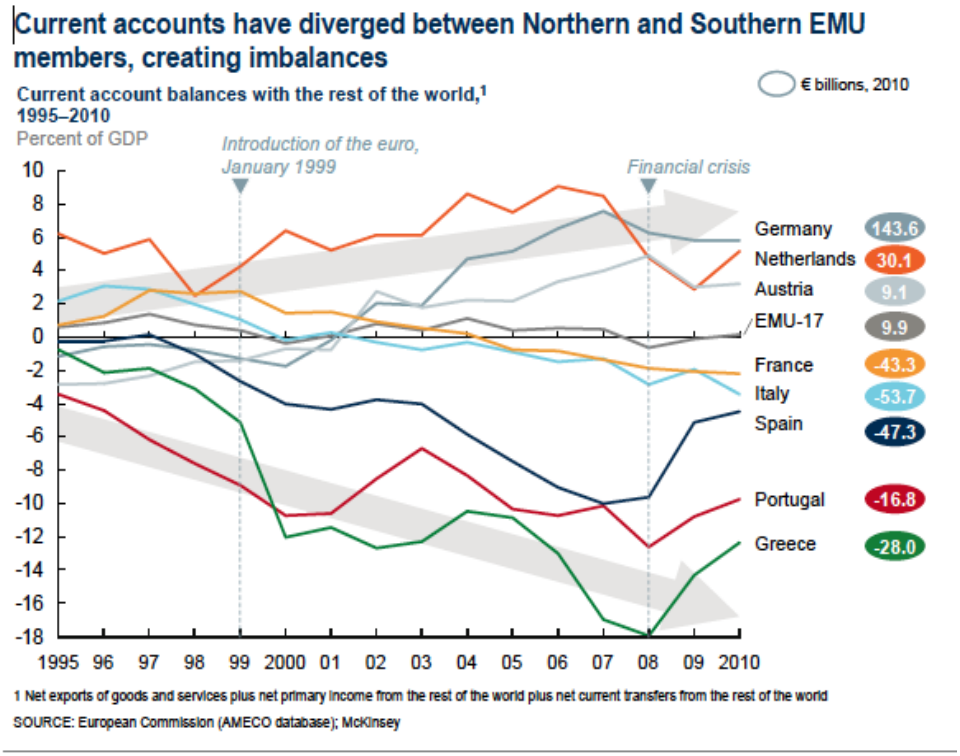
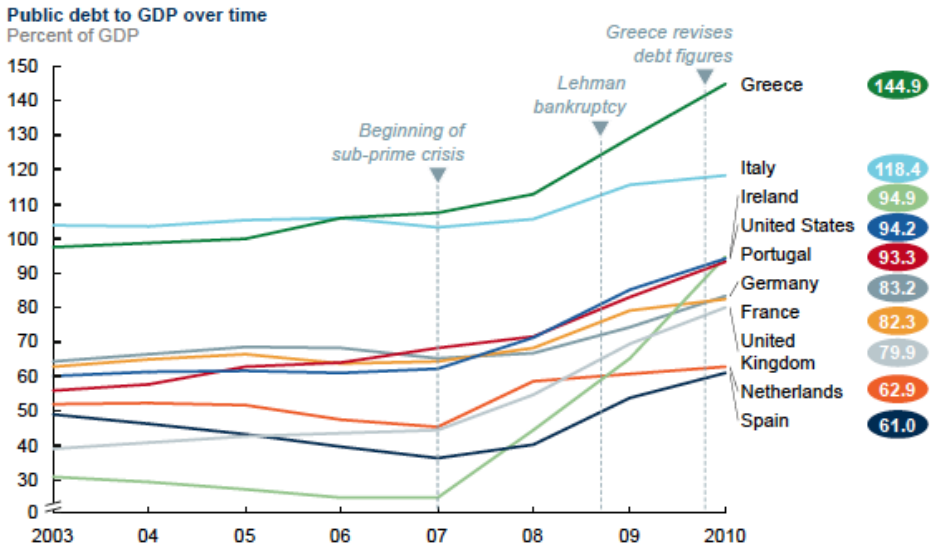


Exhibit 1-4: Imbalances of Public Debt Ratios in the EMU

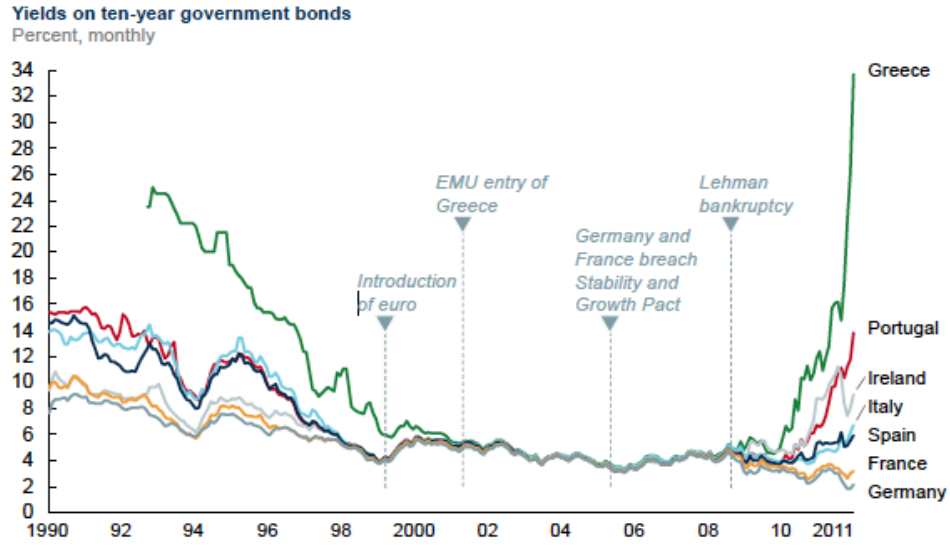
The financial and economic crisis of 2008 and 2009 triggered increasing public debt ratios in the eurozone



SOURCE: Eurostat; OECD; McKinsey

Exhibit 1-5: Imbalances of Capital Markets in the EMU

Capital markets did not account for different credit qualities, creating the illusion of permanently cheap funds



SOURCE: Thomson Reuters Datastream; Eurostat; McKinsey

In this thesis, I focus on the endogeneity of the OCA criteria and try to find the determinants for the convergence of business cycles within the euro zone. My hypothesis is that similar trade structure, more specifically, the similarities of the trade patterns of each country causes the convergence of business cycles, and only countries with similar trade structures are suitable candidates for a common monetary union. My regression analysis, presented in Chapter Three, investigates whether trade intensity, intra-industry trade, or similar trade structure causes the convergence of the business cycles in the EMU. Chapter Three ends with the analysis of the suitability of the EMU members. This paper concludes in Chapter Four with closing remarks about the results and suggestions for further research.

Chapter Two: Literature Review

This chapter discusses a number of influential studies on the "Optimum Currency Area" theory and the OCA endogeneity theory. This chapter starts with the fundamental framework of the OCA theory and the four criteria to form a common currency union. This chapter is then followed by the OCA endogeneity theory and Frankel and Rose's (1998) argument that trade intensity is positively correlated with business cycles. This chapter ends with the critique of Frankel and Rose's belief and proposes that intra-industry trade and similar trade structure can have a direct effect on the correlation of business cycles.

2.1 "The Optimum Currency Area" Theory

The Optimum Currency Area (OCA) theory was developed by three highly influential papers, which were written by Mundell (1961), McKinnon (1963), and Kenen (1969). Mundell in 1961 discussed the appropriate domain of a currency area. Like most of the Keynesian believers in the postwar period, Mundell started his argument by stating that national monetary and fiscal policies could successfully manipulate the aggregate demand to offset asymmetrical macroeconomic shocks. Even though a common currency would reduce the transaction costs associated with trading goods and services between countries with different money, countries with close international trade relations would potentially benefit from the common currency. Mundell (1961) focused on the cost-side effect of a common currency area and leans toward making the

currency areas smaller and more homogeneous rather than larger and heterogeneous. Mundell used a simple model of two entities to illustrate the advantages of exchange rate flexibility:

> Consider a simple model of two entities (regions or countries), initially in full employment and balance of payments equilibrium, and see what happens when the equilibrium is disturbed by a shift in demand from the goods in entity B to the goods in entity A. Assume that money wages and prices cannot be reduced in the short run without causing unemployment, and that monetary authorities act to prevent inflation …
>
> The existence of more than one (optimum) currency area in the world implies variable exchange rates … If demand shifts from the products of country B to the products of country A, a depreciation by country B or an appreciation by country A would correct the external imbalance and also relieve unemployment in country B and restrain inflation in country A. This is the most favorable case for flexible exchange rates based on national currencies.
>
> (Mundell, 1961, pp. 510–11)

Mundell (1961) also argued that an OCA with fixed exchange rate could be less costly if each country has labor and capital mobility both internally and externally. In other words, the movement of the unemployed workers from country A, where there is a negative demand shock, to country B, where there is an excess demand for labor, will eliminate the need for each country to use its monetary policy to correct external imbalance. Under labor mobility, the unemployment problem in country A disappears, whereas the inflationary pressure in country B vanishes.

After Mundell pioneered the theory of OCA, McKinnon (1963) and Kenen (1969) further contributed to the framework of the OCA by identifying some more characteristics that potential members of a monetary union should possess in order to relinquish their own monetary authorities and achieve stabilization in a common currency area with a fixed exchange rate.

McKinnon (1963) pointed out that "openness of an economy" should be a criterion for judging optimality regarding a common currency area. McKinnon (1963) first argued that currency depreciation would be felt more strongly on an aggregate price level by open economies that trade more extensively with one another than closed economies. This is because when the economy's nominal exchange rate depreciates due to a negative terms-of-trade shock and leads to a rise in price level of tradable goods and services. The more open an economy, the larger the share of tradable goods and services in output and the larger the required contraction in domestic demand to push down the price of non-tradable goods and services to achieve a stabilized overall price level. McKinnon (1963) then concluded that the use of monetary policy to stabilize output and employment that leads to exchange rate movements would result in greater price variability in the more open economy than in the relatively closed economy. The use of national monetary policy is more costly in an open economy, and a common currency area where each country surrenders a national monetary policy is likely to be more suitable for an open economy. This conclusion established by McKinnon (1963) is the same as the view from the European Commission.

Kenen (1969) focused on the level of fiscal integration, the similarity of economic structures between two economies, and the degree of product

diversification. Kenen (1969) believed that fiscal integration positively correlates with the optimality for participation in a common currency area. Kenen also stressed that only countries with similar trade structures are suitable candidates for a common monetary union, because these countries are likely to experience a terms-of-trade shock symmetrically rather than asymmetrically, if there is high labor mobility between them.

Based on the findings developed by Mundell (1961), McKinnon (1963), and Kenen (1969), a country's suitability for entry into a currency union can be summarized as the following four criteria (the closer the courtiers are linked to each other regarding any of these criteria, the more suitable a common currency area):

1) Labor mobility across national boundaries. (Mundell, 1961)
2) The intensity of trade with other potential member countries of the common currency union. (McKinnon, 1963)
3) The similarities of shocks and cycles resulting from the similarity of economic structures and the degree of product diversification. (Kenen, 1969)
4) The system of fiscal transfers. (Kenen, 1969)

These four classic OCA criteria have been applied extensively, and many researchers and policy makers have used these four criteria to judge the suitability of potential European countries to form a common currency area—the European Monetary Union.

2.2 The OCA Endogeneity Theory

Frankel and Rose (1998) used the empirical study to show that courtiers with closer trade links tend to have more tightly correlated business cycles; countries are more likely to satisfy the criteria for entry into a currency union after taking steps toward economic integration than before. Frankel and Rose used the dataset across 21 industrialized countries in the period of 1959 though 1993 to estimate the relation between trade intensity and correlation of business cycles. Frankel and Rose used imports exclusively, exports exclusively, both exports and imports as proxies for intensity of trade, and real GDP, an index of industrial production, total employment, the unemployment rate as proxies for business cycles. Frankel and Rose's belief that business cycle correlations and trade intensity are endogenous is also the relationship pictured by the famous "One Market, One Money" published by the European Commissions (1990).

However, Frankel and Rose's thinking is being scrutinized and is being weighed against other forces. Authors such as Eichengreen (1992), Kenen (1969), and Krugman (1993) opposed the argumentation established by Frankel and Rose (1998) and have pointed out that as trade becomes more integrated, countries specialize more in production in which they have comparative advantages. If the specialization is inter-industry, the countries might be more sensitive to industry-specific shocks, and business cycles tend to be less symmetrical. On the other hand, if the specialization is intra-industry, and intra-industry trade accounts for most trade, then business cycles will be more synchronized. For example, if Germany trades with Italy, and Germany is specialized in cars, while Italy is specialized in wine. When there is an external

shock in car industry, the business cycles of Germany will be affected, while the business cycles in Italy will not.

Eichengreen (1992), Kenen (1969), and Krugman (1993) also stressed that only countries with similar trade structures are suitable candidates for a common monetary union, because these countries are likely to experience a terms-of-trade shock symmetrically rather than asymmetrically, if there is high labor mobility between them. Kenen (1969) concluded that countries with less diversified output structures are subject to more asymmetric shocks, making them less suitable to form a monetary union. Highly diversified economies are better candidates for a common currency area, since diversification reduces the chance of an asymmetric shock due to sector-specific or industry-specific shocks.

Fidrmuc (2001) conducted an empirical study across the OECD countries between 1990 and 1999 to prove that intra-industry trade causes the convergence of business cycles, while there is no direct relationship between business cycles and bilateral trade intensity. Fidrmuc's methodology is based on Frankel and Rose's OCA endogeneity hypothesis, but he added a structural variable to explain the impact of intra-industry trade on correlation of business cycles. Fidrmuc used the Grubel-Lloyd indices as a proxy for intra-industry trade.

Antonio, Silvestre, and Passos (2011) applied the ordinary least squares and the two-stage least-squares estimates to euro zone data between 1967-2003 and confirmed Frankel and Rose's endogeneity hypothesis. However, Antonio, Silvestre, and Passos (2011) used a non-linear model based on a Beta distribution and found a negative marginal effect of trade intensity on correlation of business cycles. They concluded that trade flows are important during the first stage of economic integration, but become less important as

trade intensity increases. Trade is loosing importance in explaining business cycle synchronization, and their study proposed the question:" what are the other factors behind business cycles correlation in the EMU?"

The review of several past studies on the "Optimum Currency Area " endogeneity theory suggests that trade intensity and correlation of business cycles are endogenous and positively correlated. However, trade structure and intra-industry trade specialization can also affect correlation of business cycles. In the next chapter, my regression analysis includes these variables to determine the cause for businesses cycles' convergence.

Chapter Three: Empirical Analysis of the OCA Endogeneity Theory

3.1 Empirical Methodology

The empirical models used within this study draw upon the endogeneity hypothesis of the OCA criteria used by Frankel and Rose (1998). Frankel and Rose (1998) reported a significant and positive relationship between trade intensity and the correlation of business cycles as measured by various indicators of economic activity (real GDP, index of industrial production, total employment, total unemployment) in a cross-section of OECD countries between 1959 and 1993. Frankel and Rose's (1998) economic model can be stated as:

$$Corr(Q_i^a, Q_j^a) = \alpha + \beta \log(TI_{ij}^a), \; where \; TI_{ij}^a = \frac{T_{ij}^a}{T_i^a + T_j^a}$$

$Corr(Q_i^a, Q_j^a)$ stands for the correlation of business cycles between countries i and j during period a. TI_{ij}^a is the trade intensity between countries i and j during period a. T_{ij}^a denotes the total bilateral trade from country i to country j during period a. T_i^a denotes the total global trade from country i during period a, and T_j^a is the total global trade from country j during period a. In Frankel and Rose's research, trade was defined in relation to exports exclusively, imports exclusively, and both exports and imports.

3.2 Description of Model

Frankel and Rose's (1998) model does not include any structural variable to explain the correlation of business cycles. Kenen (2000) argued that the correlation between two countries' output changes increases with the intensity of trade links between these two countries. However, this does not mean that asymmetric shocks are reduced at the same time. In this study, to address the question of whether trade integration alone, or intra-industry trade, or similar trading structure causes the convergence of business cycles in the euro zone, I use three different regression models.

The first model is the same as Frankel and Rose's model, and I estimate the relation between the correlation of business cycles and trade intensity in a cross-section of 17 euro zone countries from 2002 to 2010. In the second model, I add one variable that measures the intra-industry trade to estimate the relation between correlation of business cycles and intra-industry trade. In the third model, instead of intra-industry trade, I add a variable that measures the difference of trade structure between two countries in order to estimate the relationship between business cycle correlation and trade structure.

3.2a Model Statement 1: Business Cycle and Trade Intensity

The first model is the original model used by Frankel and Rose (1998) and it tests the relation between trade integration and the correlation of business cycles:

$$Corr(Q_i^a, Q_j^a) = \alpha + \beta \log(TI_{ij}^a), \text{ where } TI_{ij}^a = \frac{T_{ij}^a}{T_i^a + T_j^a} \qquad (1)$$

where the variables are defined as:

- $Corr(Q_i^a, Q_j^a)$ denotes the correlation of business cycles between countries i and j during period a, measured by real GDP
- $\log(TI_{ij}^a)$ denotes the log of the total bilateral trade from country i to country j during period a, measured by the exports from country i to country j. The higher the value of TI_{ij}^a is, the greater the trade intensity is between countries i and j— β is expected to be positive
- T_i^a denotes the total global trade from country i during period a, measured by the total exports from country i to the world
- T_j^a denotes the total global trade from country j during period a, measured by the total exports from country j to the world

3.2b Model Statement 2: Business Cycle, Trade Intensity, and Intra-industry Trade

The second model looks at the impact of intra-industry trade on correlation of business cycles. In this model, I use two different methods to measure intra-industry trade. The first method is the widely accepted Grubel-Lloyd Index (GL Index) introduced by Herb Grubel and Peter Lloyd. The GL Index is also the method used by Fidrmuc (2004) as a measurement of intra-industry trade. The econometric equation can be stated as:

$$Corr(Q_i^a, Q_j^a) = \alpha + \beta \log(TI_{ij}^a) + \gamma IIT_{ij} \qquad (2)$$

$$where: \quad TI_{ij}^a = \frac{T_{ij}^a}{T_i^a + T_j^a}$$

$$IIT_{ij}^a = \frac{\sum_{k=1}^{99}\left[1 - \frac{\left|X_{ij}^{ka} - M_{ij}^{ka}\right|}{(X_{ij}^{ka} + M_{ij}^{ka})}\right]}{99} \quad (Grubel - Lloyd \ \ Index)$$

where $Corr(Q_i^a, Q_j^a)$, $\log(TI_{ij}^a)$, T_i^a, and T_j^a are defined in the same way as in equation 1, the additional variables are defined as :

- IIT_{ij}^a denotes the level of intra-industry trade between countries i and j during period a, measured by the average of the GL Index of each of the 99 two-digit SITC commodity groups between country-pair i and j at time a. k is the index for the 99 commodity groups, the summation is carried out over the 99 two-digit SITC commodity groups. The value of the Grubel-Lloyd index is some where between zero and one. If IIT_{ij}^a=1, there is only intra-industry trade. Conversely, if IIT_{ij}^a=0, there is only inter-industry trade — γ is expected to be positive
- X_{ij}^{ka} denotes the exports from country i to country j in k^{th} group during period a
- M_{ij}^{ka} denotes the imports from country j to country i in k^{th} group during period a

Eichengreen (1992), Kenen (1969), and Krugman (1993) argue that if the specialization is inter-industry, the countries might be more sensitive to industry-specific shocks, and business cycles tend to be less symmetrical. If the specialization is intra-industry, then business cycles will be more synchronized.

While the GL Index is a good way of measuring the level of intra-industry trade, it does not capture the different specializations for each country. When computing exports and imports by different commodity groups, the GL Index gives the same weight to all the groups and ignores the fact that some groups that a country is specialized in are more important than other groups. This problem can be vital when trying to determine whether trade liberalization forces increased specialization in the euro zone due to comparative advantage of countries and leads to a divergence in business cycles.

A simple example to demonstrate the potential limitations of using GL index in this study can be: assume there is only one industry: cars. Germany is specialized in producing cars and exports only a small portion of its cars to Cyprus. On the other hand, Cyprus does not produce lots of cars and exports most of its cars to Germany. The values of X_{ij}^{ka} and M_{ij}^{ka} are very close, and hence the GL Index between these two countries is close to one, there is only intra-industry trade, and the business cycle is expected to be highly correlated. However, Germany is specialized in cars and exports a lot more cars to the rest of the world than to Cyprus. Consequently, Germany is very sensitive to the external shock from car industry, while Cyprus is not, and the business cycle between Germany and Cyprus is not correlated.

In order to include the role of specialization into the regression model, I use an alternated GL Index that gives more weight to the group that a country is specialized in to measure the level of intra-industry trade. The equation can be stated as:

$$Corr(Q_i^a, Q_j^a) = \alpha + \beta \log(TI_{ij}^a) + \gamma WIIT_{ij} \qquad (3)$$

$$where: \quad TI_{ij}^a = \frac{T_{ij}^a}{T_i^a + T_j^a}$$

$$WIIT_{ij}^a = \frac{\sum_{k=1}^{99}\left[1 - \frac{\left|X_{ij}^{ka} - M_{ij}^{ka}\right|}{(X_{ij}^a + M_{ij}^a)} * \frac{X_i^{ka} + M_j^{ka}}{TX_i^a + TM_j^a}\right]}{99} \quad (Weighed\ Grubel - Lloyd\ Index)$$

where $Corr(Q_i^a, Q_j^a)$, $\log(TI_{ij}^a)$, T_i^a, T_j^a are defined in the same way as in equation 1, the additional variables are defined as :

- $WIIT_{ij}$ denotes the weighed Grubel-Lloyd Index. X_{ij}^{ka}, M_{ij}^{ka}, and k are defined in the same way as equation 2. The higher the $WIIT_{ij}^a$ is, the more the specialization is intra-industry trade — γ is expected to be positive
- X_i^{ka} denotes the exports in k^{th} group from country i to the world during time a
- M_j^{ka} denotes the imports in k^{th} group from the world to country j during time a
- TX_i^a denotes the total exports from country i to the world in all groups during time a
- TM_j^a denotes the total imports from the world to country j in all groups during time a

3.2c Model Statement 3: Business Cycle, Trade Intensity, and Trade Structure

The third model tests the relation between correlation of business cycles and trading structure. I use the "difference in export structure" (DIF) as a proxy for trade structure. DIF is the method used by Dutt et al (2008) in their paper

discussing the relation between stock market and industrial structure. The econometric equation can be stated as:

$$Corr(Q_i^a, Q_j^a) = \alpha + \beta \log(TI_{ij}^a) + \gamma DIF_{ij} \qquad (4)$$

$$where: \quad TI_{ij}^a = \frac{T_{ij}^a}{T_i^a + T_j^a}$$

$$DIF_{ij}^a = \sum_{k=1}^{99} (xshare_i^{ka} - xshare_j^{ka})^2 \qquad (Difference\ in\ Export\ Structure)$$

$$xshare_i^{ka} = \frac{X_i^{ka}}{TX_i^a}, \quad xshare_j^{ka} = \frac{X_j^{ka}}{TX_j^a}$$

where $Corr(Q_i^a, Q_j^a)$, $\log(TI_{ij}^a)$, T_i^a, T_j^a are defined in the same way as in the equation 1, the additional variables are defined as :

- DIF_{ij}^a denotes the difference in export structure, measured by the sum of the squared difference in export shares ($xshare_i^{ka}$ and $xshare_j^{ka}$)between country-pair i and j at time a, where the summation is carried out over 99 two-digit SITC commodity groups. k is the index for the 99 commodity groups. Countries with the same trade pattern will have a value of 0. Differences in trade pattern will be reflected in higher values of the index. For countries that specialize only in one industry (which is different from the industry of the other country in the pair), the index will reach its maximum value of 2— γ is expected to be negative
- X_i^{ka} is the exports in k^{th} group from country i to the world during time a
- M_j^{ka} is the imports in k^{th} group from the world to country j during time a
- TX_i^a is the total exports from country i to the world in all groups during time a

- TX_j^a is the total exports from country j to the world in all groups during time a

3.3 Data Description

3.3a Database: Time Series Structured Panel Dataset

The database used in this study is a time-series structured panel dataset of 17 euro zone countries for years 2002-2010. A panel dataset was necessary to capture the difference between different countries in the euro zone. Unlike Frankel and Rose's study, I do not include other OECD countries in the regression analysis. This is because the focus of this research is to determine whether trade integration, intra-industry trade, or similar trading structure determines the convergence of business cycles of the countries within the euro zone.

In addition, it was important to include a specific time series to capture how the variables within each country-pair have changed. The year 2002 is a reasonable starting point because even though EMU was established in 1999 and the 11 original members had already satisfied the convergence criteria by 2000, euro officially entered circulation on 1 January, 2002. Hence, the 11 original members of EMU might not see a full effect until 2002 because the transaction costs of currency exchange might not have been fully eliminated before 2002. 2010 dataset is the most recent data available.

3.3b Overview of All Variables: Data Source and How They Were Calculated

The data for this research has come from a number of different sources. See Exhibit 3-1 for a description of sources for each variable.

Exhibit 3-1: Description of Sources for Variables

Variables	Data Source	Computed by
Business Cycle	World Development Indicators	GDP, Constant 2000 US dollars
Trade Intensity	International Trade Center	Exports, value of US dollars
Intra-industry Trade	International Trade Center	Exports/Imports by two-digit SITC commodity groups, value of US dollars
Trading Structure	International Trade Center	Exports/Imports by two-digit SITC commodity groups, value of US dollars

- Business cycle correlation

I use real GDP as a proxy for business cycle to measure the real economic activity. The real GDP data was taken from the World Development Indicators (constant 2000 USD). All data are yearly, covering the 17 euro zone countries during 2002-2010. I transform the variable in two steps. First, I take natural logarithms of the real GDP, as I am interested in the growth rate of each country. Second, I apply the well-known Hodrick- Prescott filter (using the smoothing parameter of 100) to de-trend the data in order to remove the short-term fluctuations that are associated with the business cycle, and obtain a smoothed long-term trends. In order to compute the bilateral correlation for business cycles, I conduct a correlation matrix for the 17 euro zone countries over the period 2002-2011. Since there are 17 countries, I reach to a sample size of 136 [(17*16)/2] bilateral country-pair correlations. The correlation matrix of the business cycle correlations in the Euro zone can be found in the Appendix.

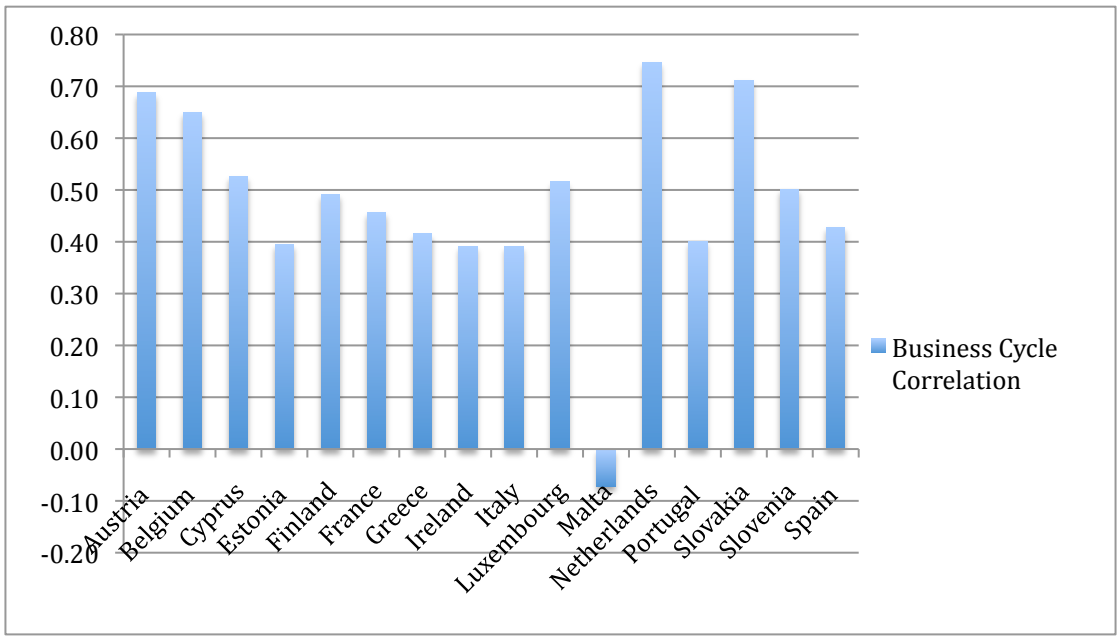
As Germany has a leading role in the euro zone, it is interesting to look at the business cycle correlations between Germany and other euro zone members.

Exhibit 3-2 and Exhibit 3-3 show the business cycle correlations of all euro zone countries with Germany for the years 2002-2010. Germany and the Netherlands have the highest business cycle correlation of 0.75. Germany and Malta has the lowest business cycle correlation of -0.07. Not surprisingly, being a so-called core country in the euro zone, Germany's business cycle is relatively highly correlated with other core countries (e.g. Austria, Belgium), while not very closely correlated with the periphery countries (e.g. Spain, Greece, Portugal, Ireland). Italy used to be a core country, but due to its slow growth and political paralysis, Italy's business cycle is poorly correlated with Germany.

Exhibit 3-2: Business Cycle Correlations of Euro Zone Countries with Germany (2002-2010)

Country	Business Cycle Correlation
Austria	0.69
Belgium	0.65
Cyprus	0.53
Estonia	0.40
Finland	0.49
France	0.46
Greece	0.42
Ireland	0.39
Italy	0.39
Luxembourg	0.52
Malta	-0.07
Netherlands	0.75
Portugal	0.40
Slovakia	0.71
Slovenia	0.50
Spain	0.43

Exhibit 3-3: Business Cycle Correlations of Euro Zone Countries with Germany (2002-2010)



- Trade Intensity (TI)

I use exports to compute the variable for bilateral trade intensity index. The export data are taken from the International Trade Center (based on the UN COMTRADE statistics). The data are annual and cover the 17 euro zone countries from 2002 through 2010. One potential problem of the method to compute TI is that one country pair can yield two different values, depending on whether TI_{ij}^{a} is interpreted as exports from j to i, or exports from i to j. Frankel and Rose (1998) tried to correct this problem by using three different proxies for bilateral trade intensity: exports exclusively, imports exclusively, both exports and imports. In this study, I decide to use exports only, because Frankel and Rose's study results

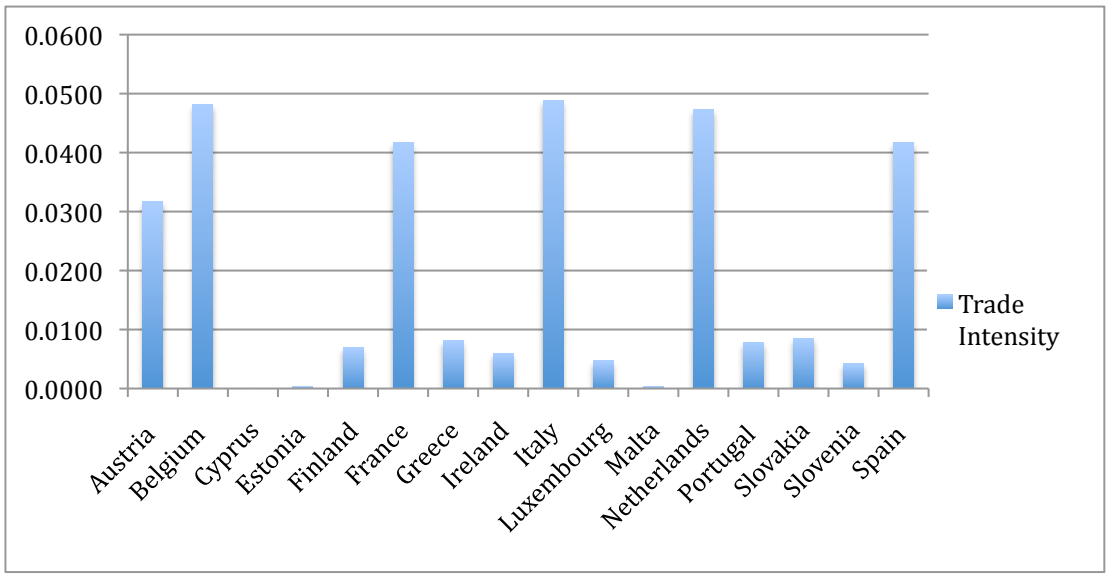
appeared to be the same for all three different methods. Additionally, all three different measures are highly positively inter-correlated.

Exhibit 3-4 shows the levels of trade intensity between euro zone countries and Germany for the years 2002-2010, and Exhibit 3-5 provides a graph of each euro zone member's trade intensity with Germany through 2002-2010. Germany trades most intensively with Belgium, while least intensively with Cyprus. From Exhibit 3-5, we can see that Belgium, Italy, Netherlands, Spain, and France are on the upper ends in terms of trade links with Germany; while Cyprus, Finland, Estonia, Greece, Ireland, Luxembourg, Malta, Portugal, Slovakia, and Slovenia are on the lower ends. Austria's trade link with Germany is some where in the middle among all the euro zone countries.

Exhibit 3-4: Trade Intensity Between Euro Zone Countries and Germany (2002-2010)

Country	Trade intensity
Austria	0.0318
Belgium	0.0482
Cyprus	0.0001
Estonia	0.0004
Finland	0.0069
France	0.0417
Greece	0.0081
Ireland	0.0060
Italy	0.0488
Luxembourg	0.0047
Malta	0.0004
Netherlands	0.0474
Portugal	0.0078
Slovakia	0.0085
Slovenia	0.0042
Spain	0.0417

Exhibit 3-5: Trade Intensity Between Euro Zone Countries and Germany (2002-2010)



- Intra-industry trade (IIT)

I use exports and imports by two-digit SITC commodity groups to compute the intra-industry trade index. The exports and imports data are from the International Trade Center (based on the UN COMTRADE statistics). The data are annual and cover the 17 euro zone countries from 2002 through 2010.

Exhibit 3-6 and exhibit 3-7 show the levels of intra-industry trade between euro zone countries and Germany for the years 2002-2010, measured by both GL index and weighed GL index. According to both GL index and weighed GL index, Germany's biggest intra-industry trade partner is France, and the smallest intra-industry trade partner is Cyprus. Austria, Belgium, and France are the countries that have the most intensive intra-industry trade relation with Germany, followed by Italy, the Netherlands, Slovakia, and Slovenia. Note that while most of the countries' intra-industry trade with Germany increase after adjusting for specialization, Ireland's intra-industry trade with Germany decreases. This

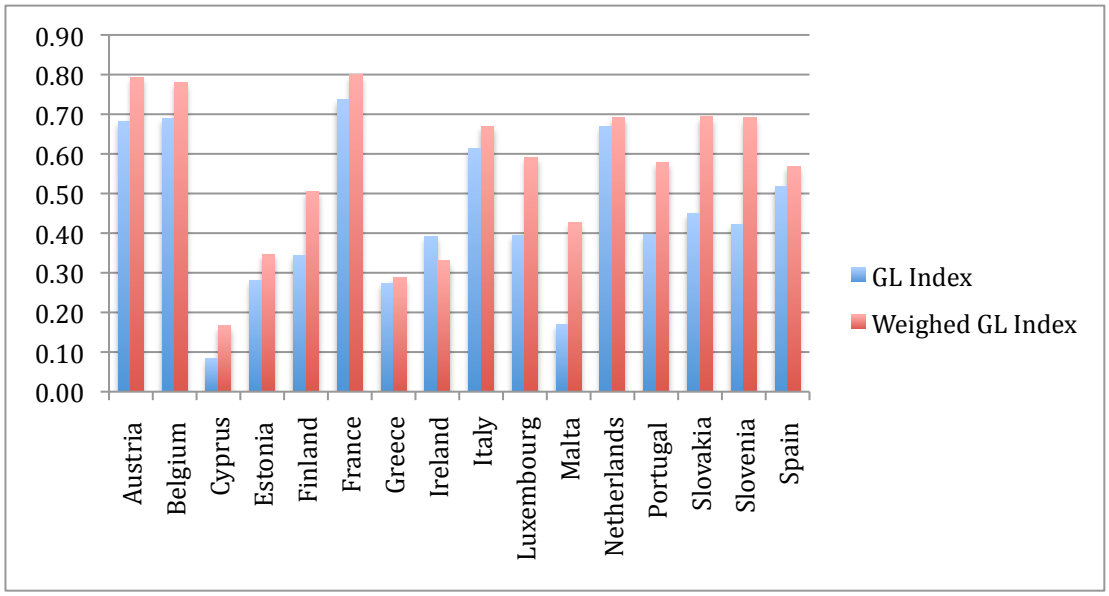
means that the specialization is more in inter-industry trade rather than intra-industry trade between Germany and Ireland.

Exhibit 3-6: Intra-industry Trade Between Euro Zone Countries and Germany

(2002-2010)

Country	GL Index	Weighed GL Index
Austria	0.68	0.79
Belgium	0.69	0.78
Cyprus	0.08	0.17
Estonia	0.28	0.35
Finland	0.34	0.51
France	0.74	0.80
Greece	0.27	0.29
Ireland	0.39	0.33
Italy	0.61	0.67
Luxembourg	0.39	0.59
Malta	0.17	0.43
Netherlands	0.67	0.69
Portugal	0.40	0.58
Slovakia	0.45	0.69
Slovenia	0.42	0.69
Spain	0.52	0.57

Exhibit 3-7: Intra-industry Trade Between Euro Zone Countries and Germany (2002-2010)



- Trade Structure (DIF)

I use exports and imports by two-digit SITC commodity groups to compute the DIF index. The exports and imports data are from the International Trade Center (based on the UN COMTRADE statistics). The data are annual and cover the 17 euro zone countries from 2002 through 2010. Exhibit 3-8 shows the trade structure between euro zone countries and Germany for the years 2002-2010. Exhibit 3-9 graphs Germany's trade structure with euro zone countries through 2002-2010. Germany's trade structure is the most different from Malta's trade structure. Countries like Cyprus, Estonia, Finland, Greece, Ireland, and Luxembourg all have relatively high different trade structures from that of Germany. On the other hand, Austria, France, Italy, and Slovenia have relatively similar trade patterns from that of Germany.

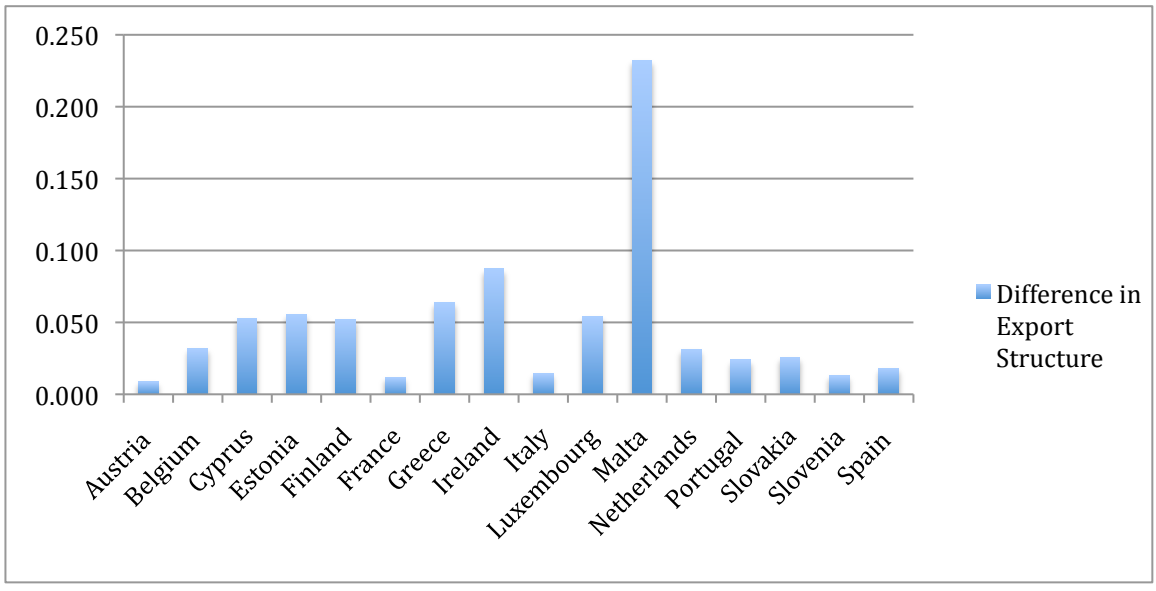
Exhibit 3-8: Trade Structure Between Euro Zone Countries and Germany

(2002-2010)

Country	Difference in Export Structure
Austria	0.009
Belgium	0.032
Cyprus	0.053
Estonia	0.055
Finland	0.052
France	0.012
Greece	0.064
Ireland	0.087
Italy	0.014
Luxembourg	0.054
Malta	0.232
Netherlands	0.031
Portugal	0.024
Slovakia	0.026
Slovenia	0.013
Spain	0.018

Exhibit 3-9: Trade Structure Between Euro Zone Countries and Germany

(2002-2010)



3.3c Descriptive Statistics of All Variables

The descriptive statistics for all three models are shown in Exhibit 3-10, Exhibit 3-11, and Exhibit 3-12. The maximum for business cycle correlation was 0.999979, which occurred between Estonia and Ireland, while the minimum was -0.945583 between Italy and Malta. The percentage change in trade intensity was greatest between Belgium and France with a value of 0.074118, while the minimum was 0.0000146 between Cyprus and Portugal. The index for intra-industry trade was highest between France and Germany with a value of 0.737842 when using the GL-index, while the lowest was 0.017521 between Cyprus and Luxembourg. When using weighed GL-index, the highest intra-industry trade level was at 0.779382 between Austria and Germany, while the lowest was 0.006165 between Cyprus and Luxembourg. The biggest difference in trade structure occurred between Ireland and Malta at 0.271505, while the smallest difference in trade structure was between Austria and Italy at 0.007585.

Exhibit 3-9: Descriptive Statistics for Model Statement 1

Explanatory Variables	*mean*	*median*	*max*	*min*	*stdev*
Business Cycle Correlation	0.712863	0.971811	0.999979	-0.945583	0.588918
Log of Trade Intensity	0.008197	0.002194	0.074118	0.0000146	0.014383

Exhibit 3-10: Descriptive Statistics for Model Statement 2

Explanatory Variables	*mean*	*median*	*max*	*min*	*stdev*
Business Cycle Correlation	0.712863	0.971811	0.999979	-0.945583	0.588918
Log of Trade Intensity	0.008197	0.002194	0.074118	0.0000146	0.014383
Intra-industry Trade (GL Index)	0.275704	0.257401	0.737842	0.017521	0.176280
Intra-industry Trade (Weighed GL Index)	0.359526	0.352038	0.779382	0.006151	0.213769

Exhibit 3-11: Descriptive Statistics for Model Statement

Explanatory Variables	*mean*	*median*	*max*	*min*	*stdev*
Business Cycle Correlation	0.712863	0.971811	0.999979	-0.945583	0.588918
Log of Trade Intensity	0.008197	0.002194	0.074118	0.0000146	0.014383
Trade Structure	0.066831	0.045221	0.271505	0.007585	0.064031

3.4 Regression Results

3.4a Result from Model Statement 1: Business Cycle and Trade Intensity

I regress trade intensity on business cycle correlation. Exhibit 3-12 reports the regression result for Model Statement 1. Trade intensity has a significant and positive effect on correlation of business cycles. One percentage point increase in trade intensity causes a 0.075 percentage point increase in business cycle correlation. This result agrees with Frankel and Rose's findings. However, the coefficient for trade intensity is relatively low. In Frankel and Rose's (1998) study, the coefficient for trade intensity was 0.059, while here the coefficient is 0.075. Frankel and Rose used the data across 21 industrialized countries in the period of 1959 though 1993. The slightly higher coefficient estimates for trade intensity means that the role of trade relations within the euro zone is higher than the role of trade relations in the previous decades within the industrialized countries. The adjusted R-Squared is fairly low at 0.068.

Exhibit 3-12: Regression Result of Model Statement 1

Dependent Variable: Business Cycle Correlation	
Explanatory Variable	
Constant	1.188 (7.452)***
Trade Intensity (TI)	0.075 (3.132)***
No. of observation	136
Adjusted R-Squared	0.068
Durbin-Watson Statistic	1.69

T-Statistics are in parentheses
*** Significant at 1%
** Significant at 5%
* Significant at 10%

3.4a Result from Model Statement 2: Business Cycle, Trade Intensity, and Intra-industry Trade

In this model, I add intra-industry trade as a structural variable. I regress trade intensity and intra-industry trade on business cycle correlation to test whether trade intensity or intra-industry trade plays a dominating role in determining business cycle correlation. Exhibit 3-13 reports the regression results for two specifications: the first specification uses the weighed GL index as a measurement for intra-industry trade; the second specification uses the original GL index.

In specification one, the coefficient of trade intensity remains significant and has a positive impact on business cycle correlation, while the estimate for intra-industry trade is not significant. This indicates that intra-industry trade has no direct effect on correlation of business cycles. The coefficient of trade intensity is slightly higher than the estimate from model 1. One percentage point increase in trade intensity causes a 0.096 percentage point increase in business cycle correlation. The adjusted R-Squared also increases slightly from model 1, yet is fairly low at 0.072.

In specification two, both the coefficients of trade intensity and intra-industry trade are insignificant. This result is not surprising as GL index is not an appropriate measurement for intra-industry trade in this study, especially when looking at the trade data across different sectors.

From model 2, we can conclude that trade intensity has a positive impact on business cycle correlation, while intra-industry trade has no effect on correlation of business cycles. This finding is opposite from what Fidrmuc (2001) argued: intra-industry trade causes the convergence of business cycles,

while there is no direct relation between business cycles and bilateral trade intensity. Fidrmuc (2001) conducted the similar research in a cross-section of OECD countries[2] between 1990-1999, prior to the introduction of euro.

Exhibit 3-13: Regression Result of Model Statement 2

Dependent Variable: Business Cycle Correlation		
Explanatory Variable	(1) WGL	(2) GL
Constant	1.417 (4.137)***	0.898 (2.007)**
Trade Intensity (TI)	0.096 (2.614)***	0.046 (0.959)
Intra-industry Trade (IIT)	-0.266 (-0.756)	0.388 (0.694)
No. of observation	136	136
Adjusted R-Squared	0.072	0.072
Durbin-Watson Statistic	1.71	1.66

T-Statistics are in parentheses
*** Significant at 1%
** Significant at 5%
* Significant at 10%

3.4a Result from Model Statement 3: Business Cycle, Trade Intensity, and Trade Structure

As concluded from model 2, trade intensity has a positive impact on business cycle correlation, while intra-industry trade has no effect on correlation of business cycles, I drop the intra-industry trade variable and add a trade structure variable. In this model, I regress trade intensity and trade structure on business cycle correlation to test my hypothesis that trade structure plays a predominate role in determining business cycle convergence.

Exhibit 3-14 reports the regression result of model 3. In specification one, the coefficient of trade intensity is significant, but the sign changes to negative.

[2] Fidrmuc's country sample includes Switzerland, Norway, the US, Canada, Australia, New Zealand, Turkey, and Israel in addition to 14 EU countries

This result indicates that close trade link causes business cycle divergence, when adjusting for trade structure. The estimate of trade structure is highly significant and the sign is negative, as expected. One percentage point increase in trade structure, measured by the difference in export structure, causes an 8.1 percentage point decrease in business cycle correlation. Clearly, trade structure is playing a more important role in shaping the correlation of business cycles. The value of the adjusted R-Squared is 0.72, demonstrating a significant increase from the previous models. In specification 2, I drop TI and test the impact of trade structure on correlation of business cycles. The estimate of TI is significant at 1% level. One percentage point increase in the difference of trade structure, leads to a 7.8 percentage point decrease in business cycle correlation.

Exhibit 3-14: Regression Result of Model Statement 3

Dependent Variable: Business Cycle Correlation		
Explanatory Variable	(1)	(2)
Constant	1.091 (12.438)***	1.232 (31.397)***
Trade Intensity (TI)	-0.026 (-1.790)*	
Trade Strucuture (DIF)	-8.100 (-17.634)***	-7.772 (-18.296)***
No. of observation	136	136
Adjusted R-Squared	0.72	0.71
Durbin-Watson Statistic	1.47	1.48

T-Statistics are in parentheses
*** Significant at 1%
** Significant at 5%
* Significant at 10%

3.5 Two-Stage Least Squares with Instrumental Variables

One of the limitations in the empirical analysis is that I did not include geographic proximity in the econometric model, which may cause bias in the estimates. The gravity model (Rose, 2000) states that countries that are closer in

distance will trade more intensively with each other because of the low transportation costs. Moreover, Baxter and Kouparitsas (2004) proves that distance is negatively related to business-cycle correlation. Countries that are located closer to each other have more highly correlated business cycles. Hence, omitting the geographic proximity causes bias in the estimate of trade intensity.

Moreover, the Ordinary Least Squares (OLS) estimate of the impact of trade indicators on business cycles correlation may also reflect a simultaneity problem in this context. This is because the data used in this research pertain to an area that is already a common currency union. Irrespective of whether it is an optimum currency area or not, countries of the euro zone had already experienced a period of economic integration and negotiation to design their monetary policies and fix the exchange rates towards other potential important trading partners within the euro zone, based on their economic situation, prior to the creation of the euro zone. The bilateral trade might already reflect the adoption of common exchange rate policy, and business cycles correlation, and not vice verse. Hence, the regression model needs to be instrumented by exogenous determinants of bilateral trade flow to overcome the omitted variables bias in estimates of causal relationship.

The instrumental variables used in this analysis are from the gravity model. The gravity model predicts bilateral trade flows and distance between two units. In practice, many researchers extend the model by including variables to account for language relations, tariffs, contiguity, access to sea, colonial history, exchange rate regimes, etc. In this case, I use income (in logs), common language, distance, and shared border as instrumental variables. Exhibit 3-15 shows the description of sources for instrumental variables. Income is measured by the GDP per capita

of the 17 euro zone countries. Distance is measured by the distance between the capital cites of two countries. I use dummy variables for common language and shared border.

Exhibit 3-16 shows the regression result of the two-stage least squares regression analysis. The estimate for trade intensity becomes insignificant, while the estimate for trade structure is significant at 10% level. One percentage point increase in the difference of trade structure, leads to a 6.6 percentage point decrease in business cycle correlation. The value of the adjusted R-Squared is 0.69. The result confirms that correlation of business cycles is better explained by trade structure than trade intensity.

Exhibit 3-15: Description of Sources for Instrumental Variables

Variables	Data Source	Measured by
Income	World Development Indicators	GDP/capita, Constant 2000 US dollars
Common Language	CEPII (Centre d'Etudes Prospectives et d'Informations Internationales)	dummy variable (1 if share an official common language and 0 if not)
Shared Border	CEPII (Centre d'Etudes Prospectives et d'Informations Internationales)	dummy variable (1 if share a border and 0 if not)
Distance	CEPII (Centre d'Etudes Prospectives et d'Informations Internationales)	Kilometers (distance between capital cities)

Exhibit 3-16: Regression Result of the Two-Stage Least Squares Analysis

Dependent Variable: Business Cycle Correlation	
Explanatory Variable	(1)
Constant	0.990 (5.135)***
Trade Intensity (TI)	-0.026 (-0.400)
Trade Strucuture (DIF)	-6.601 (-1.767)*
No. of observation	136
Adjusted R-Squared	0.69
Durbin-Watson Statistic	1.55

T-Statistics are in parentheses
Instrumental Variables: log(income), common language, shared border, distance
*** Significant at 1%
** Significant at 5%
* Significant at 10%

3.6 Answering the Question: What Causes Business Cycles Convergence in the Euro Zone?

The regression results from the three models and the two-stage least squares estimate show that trade structure plays the predominate role in determining the convergence of business cycles. The more different the trade structure between the two countries is, the less the business cycles correlate with each other. Intra-industry trade has no direct impact on business cycles correlation. Trade intensity is positively correlated with business cycles correlation, but when adjusting for trade structure, the impact of trade intensity on business cycles correlation becomes negative and minor. Business cycles correlation and similar trade structure are endogenous and strongly correlated.

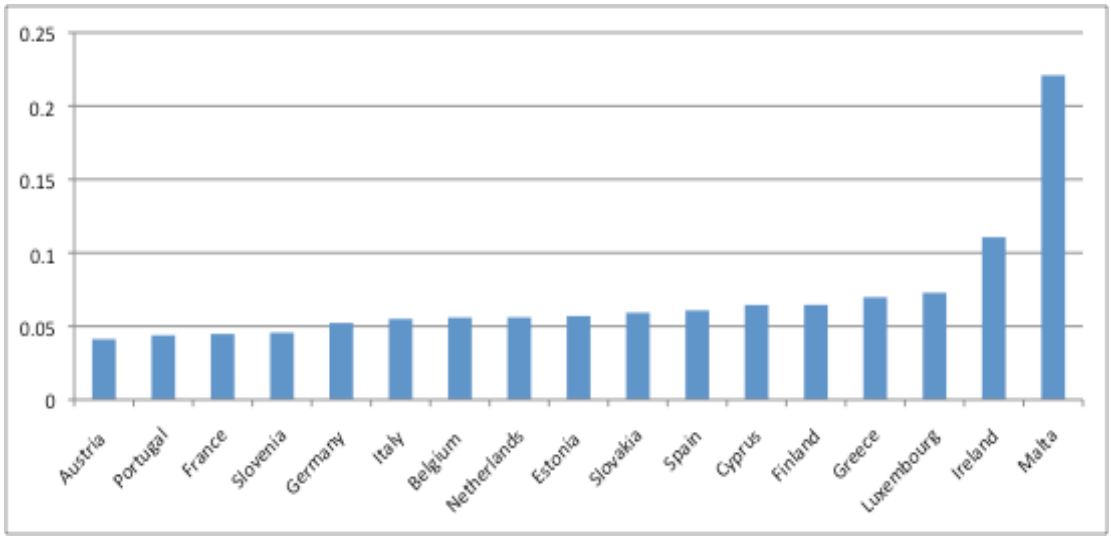
Based on this finding, I calculate the average value of each country's DIF with other euro zone members to see which countries have relatively different

trade structure with other countries, and which countries have relatively similar trade structure with other countries (Exhibit 3-16, Exhibit 3-17). Austria has the lowest average value of DIF, indicating that Austria has the most similar trade structure with the rest of the euro zone members. Malta has the highest average value of DIF and hence has the most different trade structure with other countries. Malta and Ireland's average value of DIF are significantly higher than the rest of the countries. Luxembourg, Greece, Finland, Cyprus, Spain, and Slovakia's average value of DIF are on the upper ends, while Austria, Portugal, Slovenia, and France's average value of DIF are on the lower ends. As difference in trade structure leads to lower correlation of business cycles, and business cycles correlation is one important criterion for forming an optimum currency union, Malta and Ireland's EMU memberships are most likely to destroy the optimality of the EMU.

Exhibit 3-16: Average Trade Structure (DIF) of the Euro Zone Members

Country	Average DIF
Austria	0.041
Portugal	0.044
France	0.045
Slovenia	0.046
Germany	0.052
Italy	0.055
Belgium	0.056
Netherlands	0.056
Estonia	0.057
Slovakia	0.059
Spain	0.061
Cyprus	0.065
Finland	0.065
Greece	0.070
Luxembourg	0.073
Ireland	0.111
Malta	0.221

Exhibit 3-17: Average Trade Structure (DIF) of the Euro Zone Members



Source: Compiled from the formula on page 27 (DIF). Data obtained from the International Trade Center

Chapter Four: Conclusions

4.1 Conclusions

Using a time-series panel dataset across 17 euro zone members from 2002-2010. This paper aims to examine the endogeneity hypothesis of the OCA criteria introduced by Frankel and Rose (1998) in the euro zone. In contrast to the previous literature, my study focuses on the EMU specifically, and I investigate the determinants of the correlation of business cycles from three different perspectives: trade intensity, intra-industry trade, and trade structure.

The results of this empirical analysis suggest that trade structure plays the predominate role in determining the convergence of business cycles in the EMU. Countries with similar trade structure are more likely to experience business cycles synchronization. Intra-industry trade has no direct impact on business cycles correlation. Trade intensity is positively correlated with business cycles correlation, but when adjusting for trade structure, the impact of trade intensity on business cycles correlation becomes negative and minor compared to the impact from trade structure. Therefore, trade intensity and correlation of business cycles are not necessarily endogenous, and the theory that a country is more likely to satisfy the criteria for entry into a currency union "ex post" than "ex ante" (Frankel and Rose, 1998) is not confirmed. The finding agrees with the argument from Eichengreen (1992), Kenen (1969), and Krugman (1993): countries with similar trade structures are suitable candidates for a common monetary union, because these countries are likely to experience a terms-of-trade shock symmetrically rather than asymmetrically, if there is high labor

mobility between them. Trade links alone do not ensure the convergence of business cycles if countries are not sufficiently similar in terms of trade structures.

4.2 Policy Implications

This finding shed light on the structural flaws of the euro zone and provides at least two policy suggestions. Firstly, trade structure needs to be incorporated into the EMU entry criteria. Trade links alone is not sufficient to ensure the convergence of business cycles in the euro zone. Countries with similar trade structures are suitable candidates to form an optimum currency union. Secondly, difference in competitiveness contributes to the divergence of trade structure in the euro zone. The EMU and each state need to come up with a competitiveness and growth agenda to address the intra-area imbalances in the euro zone. More specifically, countries need to invest in education, R&D, and infrastructure, and to reform labor markets, regulation, and tax and social security systems. Only when the competitiveness of the struggling euro zone economies improves, the market confidence can be restored and the sovereign debt levels can be reduced in the EMU.

4.3 Suggestions for Further Research

Future research could be helpful in further exploring the relationship between trade intensity and trade structure. What are the characteristics for the countries that have both close trade links and similar trade structure? Moreover, the optimality of a common currency area needs to be examined under other criteria from the OCA theory. A more comprehensive study on the optimality of

the EMU, using both the pre-euro data and the current data would be helpful to provide further policy suggestions.

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Appendix

Correlation Matrix for the Business Cycle Correlations in the Euro Zone

	AUSTRIA	BELGIUM	CYPRUS	ESTONIA	FINLAND	FRANCE	GERMANY	GREECE	IRELAND	ITALY	LUXEMBOURG	MALTA	NETHERLANDS	PORTUGAL	SLOVAK REPUBLIC	SLOVENIA	SPAIN
AUSTRIA	1.000	0.999	0.978	0.937	0.970	0.959	0.688	0.945	0.936	0.935	0.976	-0.769	0.996	0.938	0.999	0.972	0.949
BELGIUM	0.999	1.000	0.986	0.953	0.980	0.972	0.650	0.959	0.952	0.951	0.985	-0.799	0.990	0.953	0.996	0.982	0.963
CYPRUS	0.978	0.986	1.000	0.989	0.999	0.996	0.527	0.992	0.988	0.988	1.000	-0.884	0.959	0.989	0.971	0.999	0.994
ESTONIA	0.937	0.953	0.989	1.000	0.994	0.998	0.395	1.000	1.000	1.000	0.991	-0.944	0.906	1.000	0.925	0.993	0.999
FINLAND	0.970	0.980	0.999	0.994	1.000	0.999	0.492	0.996	0.994	0.993	1.000	-0.902	0.946	0.994	0.961	1.000	0.997
FRANCE	0.959	0.972	0.996	0.998	0.999	1.000	0.457	0.999	0.997	0.997	0.998	-0.919	0.932	0.997	0.949	0.999	0.999
GERMANY	0.688	0.650	0.527	0.395	0.492	0.457	1.000	0.415	0.391	0.390	0.516	-0.072	0.746	0.400	0.711	0.501	0.428
GREECE	0.945	0.959	0.992	1.000	0.996	0.999	0.415	1.000	1.000	1.000	0.993	-0.936	0.915	0.999	0.934	0.995	1.000
IRELAND	0.936	0.952	0.988	1.000	0.994	0.997	0.391	1.000	1.000	1.000	0.990	-0.945	0.904	1.000	0.924	0.992	0.999
ITALY	0.935	0.951	0.988	1.000	0.993	0.997	0.390	1.000	1.000	1.000	0.990	-0.946	0.903	1.000	0.923	0.992	0.999
LUXEMBOURG	0.976	0.985	1.000	0.991	1.000	0.998	0.516	0.993	0.990	0.990	1.000	-0.890	0.955	0.991	0.968	1.000	0.995
MALTA	-0.769	-0.799	-0.884	-0.944	-0.902	-0.919	-0.072	-0.936	-0.945	-0.946	-0.890	1.000	-0.714	-0.942	-0.748	-0.897	-0.931
NETHERLANDS	0.996	0.990	0.959	0.906	0.946	0.932	0.746	0.915	0.904	0.903	0.955	-0.714	1.000	0.907	0.999	0.950	0.921
PORTUGAL	0.938	0.953	0.989	1.000	0.994	0.997	0.400	0.999	1.000	1.000	0.991	-0.942	0.907	1.000	0.926	0.993	0.999
SLOVAK REPUBLIC	0.999	0.996	0.971	0.925	0.961	0.949	0.711	0.934	0.924	0.923	0.968	-0.748	0.999	0.926	1.000	0.964	0.939
SLOVENIA	0.972	0.982	0.999	0.993	1.000	0.999	0.501	0.995	0.992	0.992	1.000	-0.897	0.950	0.993	0.964	1.000	0.997
SPAIN	0.949	0.963	0.994	0.999	0.997	0.999	0.428	1.000	0.999	0.999	0.995	-0.931	0.921	0.999	0.939	0.997	1.000

Raw regression results for the first model statement (Exhibit 3-12)

Dependent Variable: Business Cycle Correlation
Method: Least Squares
Date: 02/24/12 Time: 15:39
Sample: 1 136
Included observations: 136

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOG(Trade Intensity)	0.075352	0.024061	3.131710	0.0021
C	1.188003	0.159413	7.452340	0.0000

R-squared	0.068200	Mean dependent var	0.712863
Adjusted R-squared	0.061246	S.D. dependent var	0.588918
S.E. of regression	0.570599	Akaike info criterion	1.730337
Sum squared resid	43.62816	Schwarz criterion	1.773170
Log likelihood	-115.6629	Hannan-Quinn criter.	1.747743
F-statistic	9.807609	Durbin-Watson stat	1.692843
Prob(F-statistic)	0.002134		

Raw regression results for the second model statement (Exhibit 3-13 specification 1)

Dependent Variable: Business Cycle Correlation
Method: Least Squares
Date: 02/24/12 Time: 15:44
Sample: 1 136
Included observations: 136

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOG(Trade Intensity)	0.096475	0.036910	2.613809	0.0100
Intra-industry Trade (WGL)	-0.266277	0.352411	-0.755589	0.4512
C	1.416932	0.342479	4.137278	0.0001

R-squared	0.072182	Mean dependent var	0.712863
Adjusted R-squared	0.058230	S.D. dependent var	0.588918
S.E. of regression	0.571515	Akaike info criterion	1.740759
Sum squared resid	43.44168	Schwarz criterion	1.805009
Log likelihood	-115.3716	Hannan-Quinn criter.	1.766869
F-statistic	5.173559	Durbin-Watson stat	1.713454
Prob(F-statistic)	0.006859		

Raw regression results for the second model statement (Exhibit 3-13 specification 2)

Dependent Variable: Business Cycle Correlation
Method: Least Squares
Date: 02/24/12 Time: 15:49
Sample: 1 136
Included observations: 136

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOG(Trade Intensity)	0.046317	0.048274	0.959464	0.3391
Intra-industry Trade (GL)	0.388024	0.558937	0.694217	0.4888
C	0.897942	0.447313	2.007413	0.0467

R-squared	0.071564	Mean dependent var	0.712863
Adjusted R-squared	0.057602	S.D. dependent var	0.588918
S.E. of regression	0.571705	Akaike info criterion	1.741426
Sum squared resid	43.47064	Schwarz criterion	1.805675
Log likelihood	-115.4169	Hannan-Quinn criter.	1.767535
F-statistic	5.125814	Durbin-Watson stat	1.656840
Prob(F-statistic)	0.007170		

Raw regression results for the third model statement (Exhibit 3-14 specification 1)

Dependent Variable: Business Cycle Correlation
Method: Least Squares
Date: 02/24/12 Time: 15:53
Sample: 1 136
Included observations: 136

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOG(Trade Intensity)	-0.025800	0.014410	-1.790476	0.0757
Trade Structure	-8.099716	0.459323	-17.63402	0.0000
C	1.091488	0.087751	12.43845	0.0000

R-squared	0.720854	Mean dependent var	0.712863
Adjusted R-squared	0.716656	S.D. dependent var	0.588918
S.E. of regression	0.313482	Akaike info criterion	0.539661
Sum squared resid	13.07002	Schwarz criterion	0.603910
Log likelihood	-33.69692	Hannan-Quinn criter.	0.565770
F-statistic	171.7262	Durbin-Watson stat	1.472262
Prob(F-statistic)	0.000000		

Raw regression results for the third model statement (Exhibit 3-14 specification 2)

Dependent Variable: Business Cycle Correlation
Method: Least Squares
Date: 02/24/12 Time: 15:59
Sample: 1 136
Included observations: 136

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Trade Structure	-7.772335	0.424815	-18.29580	0.0000
C	1.232296	0.039249	31.39658	0.0000

R-squared	0.714125	Mean dependent var	0.712863
Adjusted R-squared	0.711992	S.D. dependent var	0.588918
S.E. of regression	0.316051	Akaike info criterion	0.548773
Sum squared resid	13.38505	Schwarz criterion	0.591606
Log likelihood	-35.31654	Hannan-Quinn criter.	0.566179
F-statistic	334.7364	Durbin-Watson stat	1.482545
Prob(F-statistic)	0.000000		

Raw regression results for the 2-stage OLS (Exhibit 3-16)

Dependent Variable: LOGGDP1
Method: Two-Stage Least Squares
Date: 02/10/12 Time: 20:26
Sample: 1 136
Included observations: 136
Instrument specification: LOG(INCOME) BORDER LANG LOG(DISTANCE)
Constant added to instrument list

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOG(WEXPORT)	-0.026026	0.065143	-0.399523	0.6901
DIF	-6.600973	3.735112	-1.767276	0.0795
C	0.989901	0.192778	5.134935	0.0000

R-squared	0.694198	Mean dependent var	0.712863
Adjusted R-squared	0.689599	S.D. dependent var	0.588918
S.E. of regression	0.328108	Sum squared resid	14.31808
F-statistic	9.821174	Durbin-Watson stat	1.549035
Prob(F-statistic)	0.000105	Second-Stage SSR	44.70676
J-statistic	1.002234	Instrument rank	5
Prob(J-statistic)	0.605853		