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국제학석사학위논문

Inflation Differentials in the EMU

유럽 경제통화동맹 국가간의
인플레이션 격차

2021년 2월

서울대학교 국제대학원
국제학과 국제통상 전공

천솔비

Inflation Differentials in the EMU

A Thesis Presented

By

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To

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유럽 경제통화동맹 국가간의 인플레이션 격차

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ABSTRACT

Inflation Differentials in the EMU

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The Maastricht Treaty in 1991 was a major step for the European countries to become more closely integrated and cooperated by introducing the foundations of the European Economic and Monetary Union (EMU). The EMU is an economic integration among the European Union (EU) member states for the purpose of promoting price stability, sustainable economic growth, and maintaining below but close to 2 percent inflation rate in the medium run. Contrary to public expectations on its promising prospects, however, the EMU had confronted two severe financial crises: The Global Financial Crisis in 2008 and the European Sovereign Debt Crisis in 2010. These financial crises in the euro area were primarily driven by economic imbalances, particularly in terms of inflation rates, between the member states. Therefore, large inflation differentials between the member states without the ECB's serious effort to address them had triggered severe financial risk and instability in the euro area during the past decade.

However, there has been a trend reversal in fluctuation of the inflation differentials since 2012; the inflation differentials have now become close to

historic lows due to the global phenomenon of inflation synchronization. Despite extremely small inflation differentials in the EMU at present, however, concerns over the likelihood of another debt crisis in the euro area have recently been raised again. In fact, in contrast to the past decade, larger inflation differentials are more desirable in the present times in order to avoid another debt crisis. This paper explores the key determinants of the inflation differentials in the euro area during the past (1996 – 2012) and the present times (2013 – 2018). Our results suggest that imbalances in unemployment rate, labor market rigidity, product market rigidity, oil dependency, and government balance between the member states had been the key factors in affecting the inflation differentials during 1996 – 2012. However, the effects of these factors have significantly reduced since 2013 and only unemployment rate and oil dependency have continued to remain statistically significant. Based on our estimation results, we further examine which policy measures are needed at individual country level in order to prevent another debt crisis.

Keyword: EMU, inflation differentials, the Global Financial Crisis, the European Sovereign Debt Crisis, financial risk, inflation synchronization.

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CHAPTER I. INTRODUCTION

The Maastricht Treaty in 1992 was a major step for the European countries to become more closely integrated by introducing the foundations of the European Economic and Monetary Union (EMU). The EMU is an economic integration among the European Union (EU) member states for the purpose of promoting price stability, sustainable economic growth, and maintaining below but close to 2 percent inflation rate in the medium run.

After the launch of the EMU with the Maastricht Treaty, the euro was officially adopted on January 1, 1999 by 11 member states: Austria, Belgium, Finland, France, Germany, Ireland, Italy, Luxembourg, Netherlands, Portugal, and Spain. Later, additional countries have joined the monetary union: Greece (2001), Slovenia (2007), Cyprus (2008), Malta (2008), Slovakia (2009), Estonia (2011), Latvia (2014), and Lithuania (2014). Accordingly, the EMU is now composed of 19 total member states.

Since the euro adoption in 1999, the inflation differentials between the member states have continued to persist. The ECB (2005) reported that the inflation differentials are not necessarily harmful but rather desirable in a monetary union, given that the member states can no longer have monetary independence. According to their words, the member states can enhance their international competitiveness through the inflation differentials against each other.

In contrast to what the ECB had argued, indeed, large inflation differentials between the countries had significantly contributed to the increase in

financial risks and vulnerabilities to external shocks. With the onset of the Global Financial Crisis in 2008, several countries who had higher inflation relative to the EMU average had confronted with difficulties in repaying their massive government debts. This eventually led to another financial crisis, called the European Sovereign Debt Crisis, in 2010. Hence, the debt crises were primarily spread among the countries who had experienced relatively higher inflation. It is therefore generally agreed in the literature that the European Sovereign Debt Crisis was primarily driven by large economic imbalances, particularly in terms of inflation rates, between the member states.

However, there has been a trend reversal in fluctuation of the inflation differentials since 2012; the inflation differentials have now become close to historic lows due to the global phenomenon of inflation synchronization. Despite extremely small inflation differentials in the EMU at present, however, concerns over the likelihood of another debt crisis in the euro area have recently been raised again. In fact, in contrast to the past decade, larger inflation differentials are more desirable in the present times for the EMU to maintain economic stability and to avoid another debt crisis. Therefore, as highlighted by the European Parliament (2014), it is important to continuously monitor the inflation differentials in the EMU for its long-term sustainability.

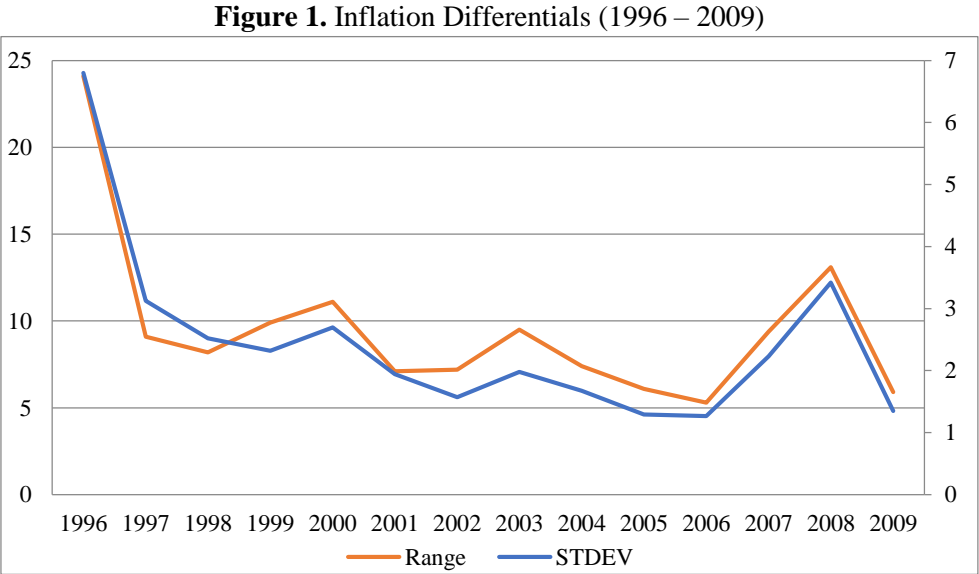
The remainder of this paper is organized as follows: Chapter II explores the evolution of the inflation differentials in the EMU since the beginning of the euro and introduces our research question. Chapter III presents various existing theories on the determinants of the inflation differentials. Chapter IV describes our methodological approach, along with our empirical model, in identifying the key

determinants of the inflation differentials. Chapter V then discusses our empirical results. Finally, Chapter VI presents our conclusions.

CHAPTER II. STUDY BACKGROUND

1. The First Decade of the Euro (1999 – 2009)

Although the first decade of the euro (1999 – 2009) was characterized by a substantial nominal convergence among the member states, the Global Financial Crisis and the European Sovereign Debt Crisis have revealed the structural weaknesses of the EMU. **Figure 1** depicts the evolution of the inflation differentials from 1996 to 2009. Inflation is measured by the annual average rate of change in the harmonized indices of consumer prices (HICP). In order to measure the inflation differentials in the EMU, we use the range¹ and the standard deviation of inflation rates across 19 member states.



Source: Eurostat, computations by the author.

¹ Difference between the highest and lowest inflation rates

With the launch of the euro in 1999, the member states have experienced a drastic reduction in the inflation differentials. It can readily be seen that inflation convergence was stronger before the euro adoption. This is mainly because the member states have put greater effort to fulfill the Maastricht inflation convergence criteria before they join the monetary union (Holmes, 2002). However, after the euro was officially adopted, the inflation differentials between the member states slightly increased but went down again from 2000, except the years 2002 and 2003. Hence, they, though to a lesser extent than in the 1990s, continuously declined in 2000s until the euro area was hit by the financial crises.

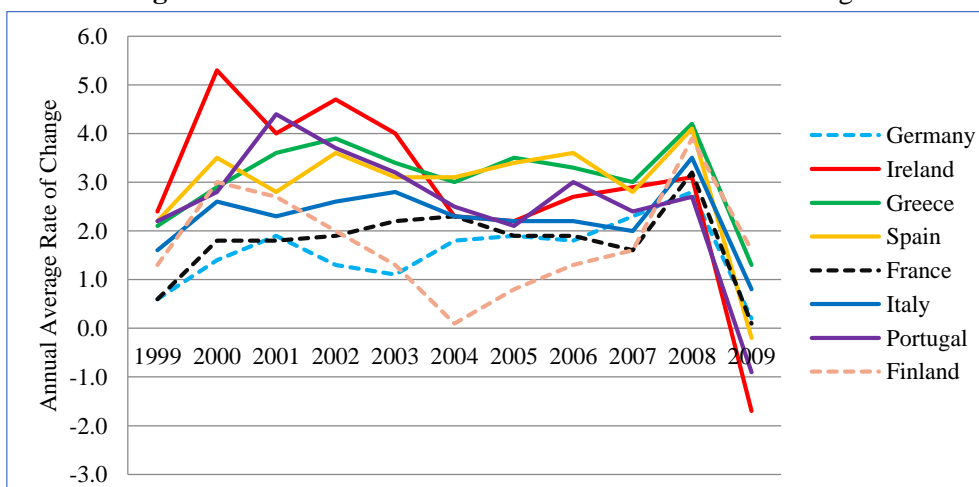
Although substantially declined in the run-up to the euro adoption, inflation differentials have continued to persist since the beginning of the EMU, which raised concerns for many researchers. However, in the words of the ECB, inflation differentials are not necessarily harmful but rather desirable for the member states, given the fact that the member states can no longer use fiscal instruments of nominal devaluation to enhance their national competitiveness. They, therefore, can enhance their international competitiveness through the inflation differentials against each other. Hence, while many researchers concerned about the issues of persistent inflation differentials in the euro area, the ECB announced that some degree of inflation differentials is necessary in a monetary union as far as they do not challenge the macroeconomic stability of the euro area (ECB, 2005).

However, the euro area was severely eroded when hit by the financial crises during 2008 – 2010, unfolding the structural weaknesses of the EMU. As **Figure 1** shows, the inflation differentials markedly increased from 2007 and reached its peak

in 2008. As stressed in the literature, high debt levels, housing bubbles, and less competitive labor market in the euro area were often attributed to the European Sovereign Debt Crisis. However, the reasons come down to a matter of inflation differentials (Haidar, 2015). Macroeconomic imbalances within the monetary union were the root causes of the crisis. The inflation differentials were not carefully monitored and managed because of the implicit assumption that financial integration under the EMU was sufficient to ensure convergence (Blot et al., 2019). However, differences in inflation rates between the member states contributed to the increase in the vulnerability of the euro area to external shocks, such as the financial crisis.

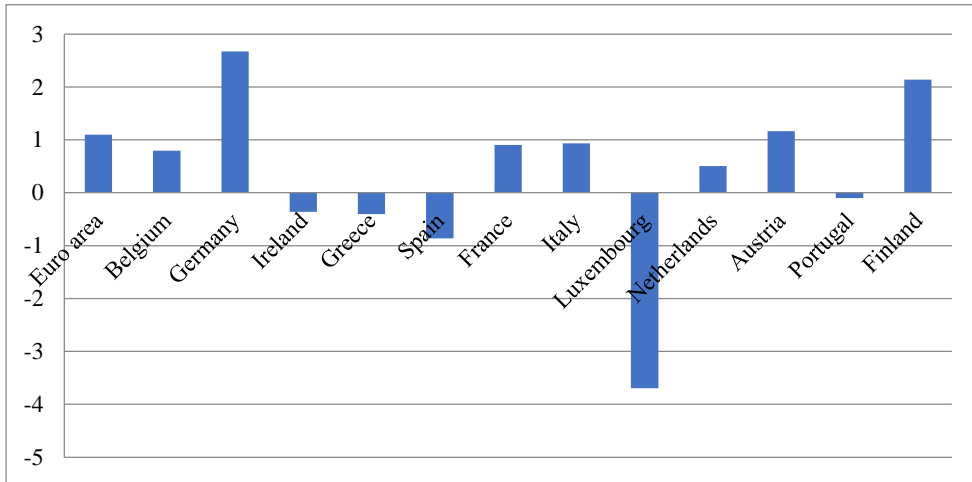
Persistent inflation differentials across the member states can be destabilizing in a monetary union. With a uniform short-term nominal interest rate, inflation divergence generates real interest rate differentials within the monetary union. For instance, countries with above the average inflation will have lower than the average real interest rates. And the opposite holds true as well. (Blot et al., 2019).

Figure 2. HICP Inflation Rate: Annual Inflation rate of change



Source: Eurostat, computations by the author.

Figure 3. Real short-term interest rates, deflator GDP (2006)



Source: Eurostat, computations by the author.

Figure 2 and **Figure 3** clearly show economic imbalances between the core and the periphery countries due to their persistent inflation differentials. **Figure 2** shows the evolution of inflation rates for selected countries during the first decade of the euro. While peripheral countries, such as Ireland, Greece, Spain, and Portugal, were in the midst of catching-up process, they had higher economic growth rates and therefore exhibited higher inflation rates than the core countries.

On the other hand, the core countries, such as Germany, France, and Finland, had relatively low growth rates and low inflation rates. **Figure 3** depicts the consequent real short-term interest rate differentials within the monetary union in 2006, a year before the euro area was hit by the financial crisis. Only three out of 13 member states, namely France, Italy, and Austria, exhibited close to the average real interest rates while the others had either far above or far below than the average real

interest rates. While the periphery had higher inflation rates than the core, their economies were further strengthened by their low real interest rates by encouraging consumption and investment. On the other hand, the core countries were further weakened by their high real interest rates (Pirovano and Poeck, 2011).

Likewise, the short-term nominal interest rates set by the ECB would not have been desirable for all member states. The policy rates may be too restrictive for already below the average inflation countries, such as Germany, while they may be too loose for already above the average inflation countries, such as Greece, Ireland, and Spain. In fact, based on the Taylor rule, the OECD reports that policy rates during 2001 – 2006 were approximately 300-400 basis points low for Ireland, Greece, and Spain while they were about 500 basis points high for Germany. Thus, the single currency across such economically divergent member states eventually triggered financial stability risk in the euro area.

1-1. Global Financial Crisis (2008- 2010) & European Sovereign Debt Crisis (2010 – 2012)

A large literature has often labeled the European Sovereign Debt Crisis in 2010 as the European sequel of the Global Financial Crisis in 2008 (Creel, 2019). Contrary to public expectations on its promising prospects, the EMU had confronted with severe financial crises, exposing the failings of its frameworks. The peripheral countries, who had experienced economic boom due to their low real interest rates, were more severely eroded when hit by the Global Financial Crisis in 2008, compared to the core countries. Consequently, the Global Financial Crisis plunged

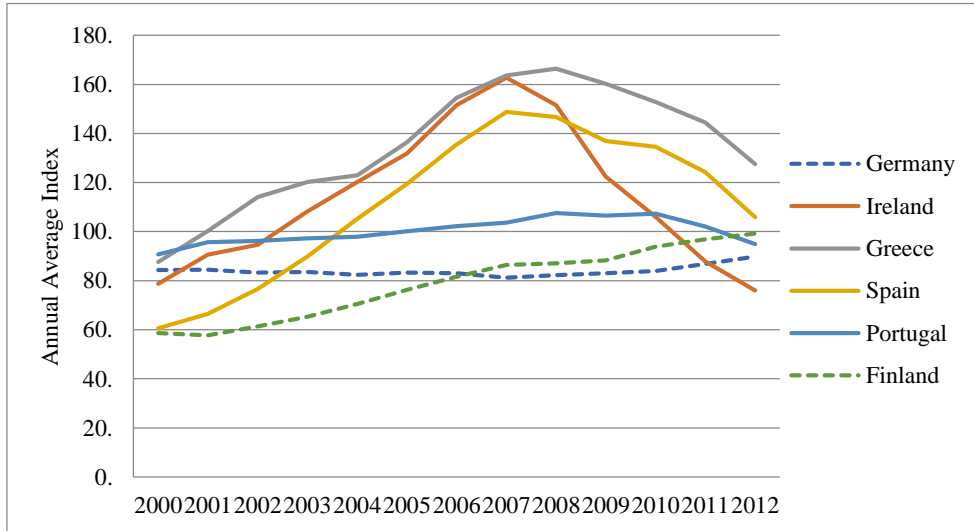
those peripheral countries into another crisis, called by the European Sovereign Debt Crisis, starting from 2010.

In the pre-crisis period, several periphery countries enjoyed economic booms, especially in property investment and construction. The abundant capital inflows from the core due to the increased financial integration under the EMU fueled credit expansion and boosted economic activity in several periphery countries. Further, their low real interest rates encouraged investment spending since higher returns are expected than the cost of borrowing. Higgins and Klitgaard (2011) note that investment demand and saving supply do not depend on nominal interest rates, but rather depend on real interest rates. Therefore, several periphery countries were running large current account deficits (domestic saving minus domestic investment spending) due to their low real interest rates by boosting investment spending. However, their deficits were largely financed by a heavy foreign borrowing and, therefore, they accumulated large external debts. Many researchers, including IMF staff, thought that the internal deficits in the euro area were smoothly financed at that time because the euro area as a whole ran current account surplus (Pisani-Ferry et al., 2011).

With the onset of the global financial crisis in 2008, however, capital inflows that had financed their sizeable deficits suddenly stopped. This weakened their banking system by falling into a liquidity trap. In the aftermath of the global financial crisis, therefore, the sense of prosperity in the periphery countries during the pre-crisis period found to be illusionary. It is because the peripheral boom in the early years of the euro was not driven by improvements in business environment or

productivity (Lin and Treichel, 2012). The demand for housing also started to decline with sudden stop in foreign funds and this eventually triggered the bursting

Figure 4. House Price Index – annual data



Source: Eurostat

of the housing bubble. **Figure 4** shows the evolution of housing prices for the peripheral countries, relative to the core countries (Germany, France).

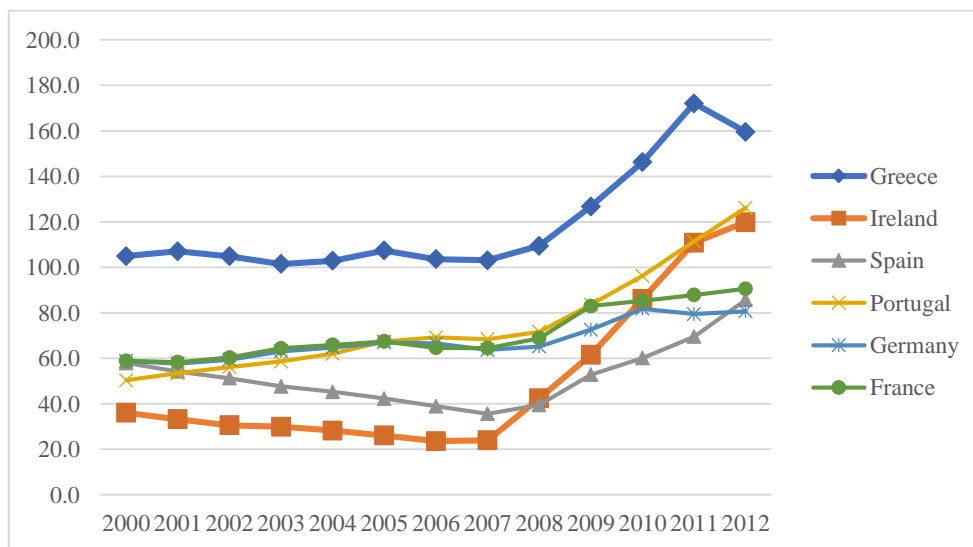
While high inflation countries (Ireland, Greece, and Spain) experienced a classic pattern of boom-and-bust cycle of housing bubble, Germany, Finland, and France (core) showed relatively stable housing prices over the entire period. Although Portugal, different from other periphery countries, did not show the burst of housing bubble, its government expenditure was encouraged by its low real interest rates and therefore accumulated high level of government debt and deficit in the pre-crisis period. This can be shown in **Table 1** and **Figure 5**, which are the evolutions of government deficits and debts.

Table 1. General Government Deficit, percentage of GDP

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Germany	-1.6	-3.0	-3.9	-3.7	-3.3	-3.3	-1.7	0.3	-0.1	-3.2	-4.4
Ireland	4.9	1.0	-0.5	0.3	1.3	1.6	2.8	0.3	-7.0	-13.8	-32.1
Greece	-4.1	-5.5	-6.0	-7.8	-8.8	-6.2	-5.9	-6.7	-10.2	-15.1	-11.2
Spain	-1.2	-0.5	-0.3	-0.4	-0.1	1.2	2.1	1.9	-4.6	-11.3	-9.5
France	-1.3	-1.4	-3.2	-4.0	-3.6	-3.4	-2.4	-2.6	-3.3	-7.2	-6.9
Italy	-2.4	-3.2	-2.9	-3.2	-3.5	-4.1	-3.6	-1.3	-2.6	-5.1	-4.2
Portugal	-3.2	-4.8	-3.3	-5.7	-6.2	-6.1	-4.2	-2.9	-3.7	-9.9	-11.4

Source: Eurostat

Figure 5. Debt-to-GDP Ratio



Source: Eurostat

In sum, low real interest rates in the peripheral countries spurred the buildup of government deficits and debts because of an illusionary sense of prosperity. Particularly, Greece accumulated massive government debts, as shown in **Figure 5**. However, with the outbreak of the global financial crisis, Greece officially defaulted on their debts in 2010 and the debt crisis was quickly spread to other peripheral countries, such as Portugal, Ireland, and Spain, who had also been enjoying economic prosperity. Although over-indebtedness was the common feature among these peripheral countries during the pre-crisis period, there were still substantial differences between the countries on how the debt crisis developed. Therefore, I will provide the case studies on the peripheral countries and examine how the crises were developed in different patterns for each.

1-2. Case Studies

1-2-1. Greece

Greece was the first country falling into great straits in the wake of the global financial crisis. In the pre-crisis period, Greece enjoyed an economic boom, which was largely driven by the expansion of consumption-driven activity. With a sharp increase in foreign funding in Greece, after the introduction of the single currency and lowering of its interest rates, the housing market in Greece rapidly expanded. However, as foreign funds suddenly stopped to flow with the global financial crisis, the housing bubble eventually burst.

Although the housing bubble was an important factor to explain the crisis, low competitiveness and over-indebtedness were in the center of core reasons behind the Greek crisis. According to the standard models, high inflation countries may become less competitive by redirecting demand to foreign goods because domestic prices are higher than foreign prices (Belke and Dreger, 2011). Therefore, despite the fixed short-term nominal interest rates within the monetary union, Greece suffered from a lack of competitiveness due to its high inflation, compared to other member states. Loss of competitiveness, as measured by unit labor costs, is shown in **Table 2**. Unit labor costs in Greece rose by 42.9 percent from 1999 Q1 to 2010 Q1 while they grew by 31.5 percent in Ireland, 25.1 percent in Portugal, 28.1 percent in Spain. Although these countries all suffered a substantial drop in competitiveness compared with those of Germany, Greece showed the largest percent increase in its unit labor cost.

Table 2. Percent Increases in Unit Labor Costs

Country	Percent Increases in Unit Labor Costs (1999Q1 – 2010Q1)
Greece	42.9
Ireland	31.5
Portugal	25.1
Spain	28.1
Germany	8.3

Source: OECD

Moreover, Bibow (2012) argues that the lack of wage coordination in the euro area was the key contributing factor of economic imbalances between the core and the periphery countries. Germany was able to pursue wage moderation policies through a consensus between the employers, workers, and the trade unions, in order to preserve its competitiveness, whereas the periphery countries were unable to do so. The periphery countries, therefore, were unable to avoid wage growth when false sense of prosperity was created with the introduction of the euro. Wage growth and increase in government expenditure eventually triggered growth in aggregate demand. For instance, aggregate demand increased by 4.2 percent from 2002 to 2007 in Greece while it grew by only 1.8 percent in the euro area on average (Lin and Treichel, 2012). However, this large increase in aggregate demand was primarily financed by foreign borrowing, resulting in a deteriorated current account deficit.

The situation for Greece had worsened when the newly elected government reported that its debt-to-GDP ratio was much larger than previously announced by the previous administration, in October 2009. However, the new government also did not adequately respond to fix its deteriorated fiscal situation. The new government, in fact, adopted the measures that further boosted government expenditure and therefore its revenue further collapsed during the first few months in office. Furthermore, the new budget for 2010, which was drafted by the new government in 2009, also failed to convince the markets and its other European partners. Although the spreads of Greek 10-year government bonds over German government bonds remained relatively stable by marking at 136 basis points in October 2009 and at 162 basis points in November, the spreads rapidly rose to 235 basis points in December when the new government failed to present convincing

budget plans. It further increased by marking 477 basis points in April 2010 (Alogoskoufis, 2012).

Despite the effort by the European Union to protect Greece, Greece saw its credit ratings continuously downgraded by rating agencies. Consequently, it became apparent that Greece would be unable to repay its debts because the government faced great difficulties to raise new capitals or refinance maturing debt (Alogoskoufis, 2012). Greece ultimately reported in 2010 that it might default on its debt, bringing another financial crisis called the European Sovereign Debt Crisis in the euro area. In short, relatively higher inflation rates in Greece, compared to other euro area member states, eroded Greece's competitiveness and this led to a deterioration of current account balance. These two interconnected determinants eventually triggered the debt crisis in Greece.

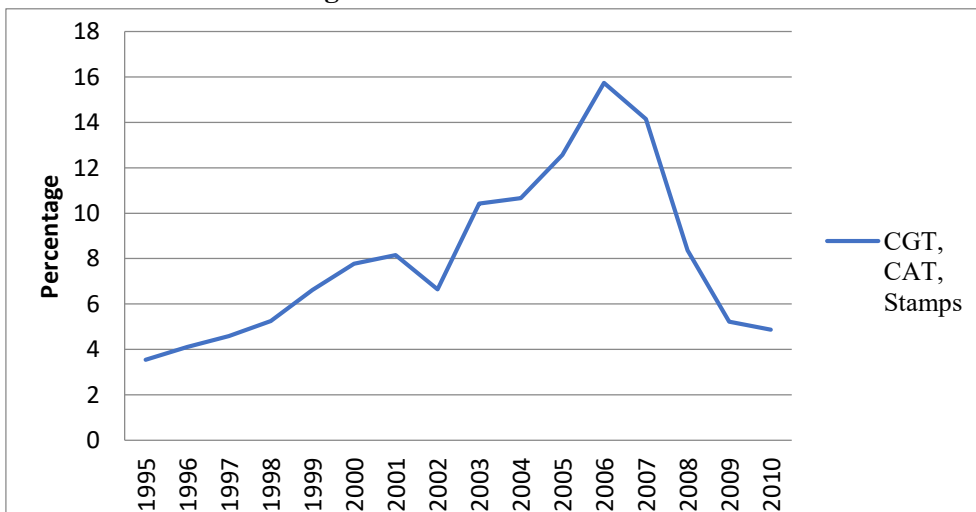
1-2-2. Ireland

The crisis in Ireland was perhaps the most dramatic case among other debt crises in the euro area. During the pre-crisis period, Ireland achieved one of the biggest economic successes in Europe. Ireland became the "Celtic Tiger" during the 1990s by achieving exceptionally high economic growth and low unemployment rates. However, the crisis in Ireland followed a similar pattern to that of Greece. After joining the monetary union, a dramatic fall in nominal and real interest rates led to a substantial increase in capital inflows in Ireland. This growing foreign funding led the housing market in Ireland to expand, resulting in the real estate boom. However, it became apparent that Ireland's "Celtic Tiger" period ended with the global financial crisis. Although Irish banks had largely obtained funds from US,

German, and British banks, they suddenly ceased to flow when the global financial crisis spread across the globe in 2008.

Different from other periphery countries, such as Greece and Portugal, Ireland displayed current account surpluses until 2007 (see **Table 1**) but these surpluses were largely driven by tax revenue from its real estate bubble. As **Figure 6** shows, the percentage share of total tax revenue coming from asset-based taxes, such as capital gains tax (CGT), capital acquisition tax (CAT), and stamp duties, gradually increased during the 1990s. Since 2002, however, they rapidly rose, increasingly relying on tax revenue from booming construction activity. This asset-related revenue, in fact, accounted for more than a third of total current account revenue in 2007 (Lin and Treichel, 2012). Domestic policies, however, did constrain neither the housing boom nor its unsustainable economic growth, thereby increasing the financial instability in Ireland.

Figure 6. Share of Total Tax Revenue



Source: Department of Finance (Databank)

With the collapse of Lehman Brothers in 2008, the global financial crisis quickly spread from the US to the rest of the world, including the Eurozone. When funds from Britain and the US suddenly ceased to flow, booming construction activity in Ireland also collapsed, losing its potential source of tax revenue. This eventually led to sudden surge in government deficits and debts since 2008 (see **Table 1** and **Figure 5**). Despite having had decades of exceptionally high economic growth and fiscal surpluses, it became apparent that Ireland was entering a severe economic downturn by late 2008. The Irish government began to pursue several contractionary measures from late 2008 in order to stimulate its economy by increasing its tax revenue while decreasing its expenditure by €20.8 billion. These budgetary adjustments, in fact, accounted for about 13 percent of GDP in 2010 (Whelan, 2011). However, despite the enormous effort by the government, its adjustments failed to provide a cushion against its economic downturn because the crisis in Ireland was so severe.

In addition to the collapse of housing market and its effects on fiscal balances, the role of the banks in Ireland was also an important factor contributing to financial instability (Whelan, 2011). Although the banks in Ireland had operated in the traditional nature of lending until 2003, they substantially modified their business models from late 2003 onwards. As its banking system ballooned from five times the economy due to its booming housing activity, the Irish banks rapidly increased their mortgage lending. This expansion of lending was heavily financed by short-term wholesale foreign borrowing. With the collapse of Irish housing market in late 2008, however, many Irish banks had extreme difficulties to raise additional funds on bond markets, eventually falling into sovereign debt crisis in

2010. Combining the speculative expansion of housing market and banking system caused by its low real interest rates, Ireland experienced one of the biggest economic boom-and-bust cycles among other crisis countries.

1-2-3. Portugal

Similar in other crisis countries, such as Greece and Ireland, Portugal also received large and sudden capital inflows after the euro adoption. However, the genesis of Portuguese crisis was clearly different from that of others. Contrary to Greece, Ireland, and Spain, Portugal did not experience boom-and-bust cycles of housing market (see **Figure 4**). As Blanchard (2007) observed, Portugal had already been in an economic recession with low economic growth and high unemployment even before the global financial crisis, while other periphery countries enjoyed economic prosperity at that time. In fact, real GDP in Greece grew by 5.9 percent, Ireland by 4.4 percent and Spain by 3.1 percent in 2003, whereas Portugal's real

Figure 7. Annual Growth of TFP



Source: AMECO

GDP growth rate declined by 0.9 percent on the same year. Many researchers therefore found the Portuguese case both interesting and puzzling because the behavior of the Portuguese economy was a distinctively new phenomenon observed in countries affected by the euro crisis.

Portugal, in fact, enjoyed a mild boom between 1995 and 2000 because by then it already became apparent that Portugal would join the monetary union and thereby its long-term interest rates would fall. The current account in Portugal, in the meantime, gradually turned into deficit due to its cheap borrowing costs. Although large capital inflows initially generated a boom during the mid-1990s in Portugal, they eventually triggered an economic stagnation since 2000. Reis (2013) argues that the Portuguese economic slump between 2000 and 2007 was primarily due to its weak productivity, compared to other periphery countries. He explains that Portugal's weak financial market caused large misallocation of capital inflows, leading to a fall in productivity. Braguinsky et al. (2011) find that the firm size distribution in Portugal had shifted to the left during the 1990s and 2000s, suggesting that there was greater number of small-sized firms than medium or large-sized firms. Given that medium or large-sized firms are typically more productive, Portugal exhibited relatively low productivity compared to other member states.

Figure 7 shows the annual growth rate of total factor productivity (TFP) in Portugal and the EMU average during 2000 – 2005. It can readily be seen that Portugal had been less productive than other member states during the pre-crisis period. Braguinsky et al. (2011) argue that a greater presence of small-sized firms in Portugal may be due to strong government support for small-sized firms. Several

provisions in labor law favored firms under specific size threshold, providing incentives for firms to reduce their firm sizes or to remain under the size threshold.

Reis (2013) argues that poor productivity performance in Portugal during the early 2000s explained a fall in output and low growth rates. Encouraged by low borrowing costs due to its low real interest rates, however, Portugal borrowed large amount from abroad in order to encourage steady growth of consumption. Its large foreign borrowing could be sustained because of the expectation that Portuguese economy would soon recover from the economic stagnation. However, different from what had been expected, its growth and consumption both remained stagnant. Therefore, the sudden increase in foreign borrowing led the country to become more exposed to the financial crisis. With a sudden stop in capital inflows after 2010, Portuguese banks found themselves extremely difficult to roll over their international funding. This precipitated a serious debt crisis in Portugal.

1-2-4. Spain

The genesis of the crisis in Spain was similar to that of Ireland. As in Ireland, Spain maintained an excellent fiscal position at the end of 2007. While most of the member states recorded current account deficits in 2007, Spain that year was in surplus of 1.9 percent of GDP (see **Table 1**). Moreover, its government debt-to-GDP ratio was also relatively lower than other member states (see **Figure 5**). Although the average debt-to-GDP ratio in the euro area on average in 2007 was 59 percent, the debts in Spain reached only 36.1 percent of GDP. Likewise, with an excellent fiscal position and high growth rates, Spain enjoyed an economic prosperity during the initial ten years of the euro.

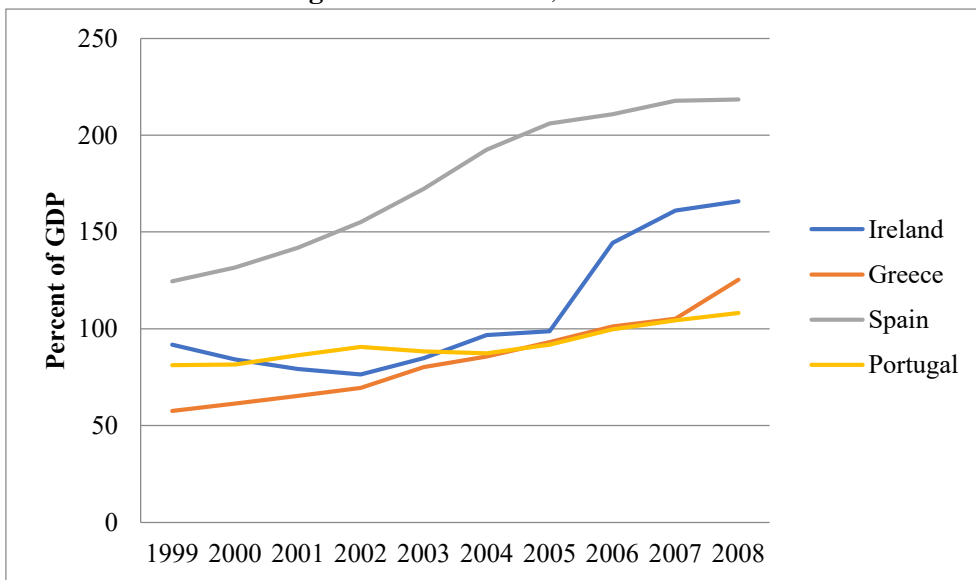
Dehesa (2011) argues that this economic prosperity was primarily achieved through two factors. First, similar in other periphery countries, Spain also received a large capital inflow after the euro adoption. Its low real interest rates and increasing financial integration led to a large expansion of credit, investment, and growth. Second, huge inflow of foreign immigrants during the 2000s in Spain generated a large increase in working-age population. The immigrant population grew by 3.6 million from 2000 to 2007 and even reached its peak in 2010. In fact, the total immigrant population in 2010 was 5.7 million, which represented around 15 percent of total working-age population in Spain.

As in Ireland, Spain largely allocated its foreign capital to finance construction activity. Therefore, huge capital inflow combined with the influx of foreign immigrants during the early 2000s fueled Spain's housing market to rapidly expand (see **Figure 4**). This generated excessive booms in housing market and the construction sector. From 1996 to 2007, the total housing stock increased from 18.3 million to 25.1 million. Further, from 1999 to 2007, residential investment in Spain increased by 6.8 percent per year while in the euro area this increased by only 0.1 percent per year. Additionally, a large inflow of speculative investment in houses that time also fueled the housing market in Spain. Expecting upside values, many investors that time were purchasing a house before it was built in order to make a 10 % down payment, and selling it back when it was finished. The construction sector, in fact, contributed to 20 percent of GDP in Spain, 23 percent of total labor force, and 53 percent of investment from 1998 to 2007 (Dehesa, 2011).

Although Spain followed the similar patterns of Irish crisis by experiencing the housing boom, Spain maintained a unique feature apart from the other crisis

countries. At the heart of the crisis in Spain is its private debt, rather than sovereign debt. While Spain's total consolidated government debt in 2007 was only 35.6 percent of GDP, much lower than the other crisis countries, its non-consolidated private debt was, in fact, 218.4 percent of GDP. **Figure 8** shows non-consolidated stock of private debt from 1999 to 2008. Compared to other crisis countries, Spain had the highest level of indebtedness in private sectors. Its household debt was 81.2 percent of GDP, non-financial corporations' debt was 108.3 percent of GDP, and non-profit institutions servicing households' debt was 0.6 percent of GDP in 2007. Despite its heavy indebtedness in household and non-financial corporations, however, Spain could maintain a good fiscal position until 2007 because of large tax revenues from the housing bubble.

Figure 8. Private Debt, non-consolidated



Source: Eurostat

High private debt in Spain, in fact, particularly made the country more vulnerable than other crisis countries. As Batini et al. (2015) note, a country with

high private debt can be more vulnerable than with high public debt because high private debt usually generates bigger economic contractions when exposed to adverse shocks. With the outbreak of the global financial crisis, therefore, foreign capitals suddenly ceased to flow and Spanish economy sharply eroded in a very short period of time. Its real estate and construction bubbles collapsed and unemployment sharply increased from 7.9 percent in 2007 to 18.6 percent in 2009. As in Ireland, Spain also lost its crucial source of government revenues as the real estate bubble burst, leading to a sudden deterioration of fiscal balance. Therefore, its current account surplus of 1.9 percent of GDP in 2007 quickly turned to deficit of -4.6 percent of GDP in 2008, and further exacerbated to -11.3 percent of GDP in 2009. However, a large fiscal stimulus and the built-in automatic stabilizers, in response to the crisis, at that time were also the crucial contributing factor to the increased fiscal deficits. Therefore, Spain's crisis was primarily driven by a large expansion of inefficient investment in construction by private sectors combined with the Spanish government's inefficient fiscal stimulus.

In sum, the debt-to-GDP ratio in Greece had already been so high even before the outbreak of the crisis in 2007. Due to its chronic fiscal mismanagement, therefore, Greece lost trust in its ability to repay debt when its housing bubble began to burst. Ultimately, it became extremely difficult to borrow abroad any longer and Greece eventually defaulted on its debt. Therefore, the crisis in Greece was mainly caused by its fiscal profligacy and the burst of housing bubble. Ireland was the one

who hit the most by the crisis. Different from Greece, Ireland maintained good fiscal position until 2007. However, when the housing bubble burst, Ireland lost its potential source of revenue. As a consequence, its current account balance suddenly deteriorated from 2008. Portugal, on the other hand, did not experience housing bubble. Also, its fiscal position was almost in line with the Stability and Growth Pact. However, due to its weak financial market, Portugal had low growth rates and poor productivity performance. Encouraged by its low borrowing cost, Portugal began to borrow abroad in order to break away from its economic stagnation. As a consequence, its fiscal position quickly deteriorated from 2009. Following the similar patterns of crisis in Ireland, Spain had also enjoyed the housing bubble and maintained good fiscal position. However, Spanish economy was particularly more vulnerable than others because of its high private debt.

Although there were considerable differences between the countries in terms of the origins and timing of the crisis, sharp increase in current account deficits and high relative inflation were the common themes for these countries (Kang and Shambaugh, 2013). With a uniform nominal interest rate, inflation differentials between the countries led to real interest rate differentials. These real interest rate differentials further translated into fiscal imbalances within the monetary union because they represent different real cost of borrowing. That is, the countries with relatively higher inflation had lower real interest rates and therefore could borrow at cheaper rates. Prior to the global financial crisis, in fact, most Eurozone countries maintained stable government debts with the notable exception of Greece. Encouraged by low borrowing cost, however, some peripheral countries with high

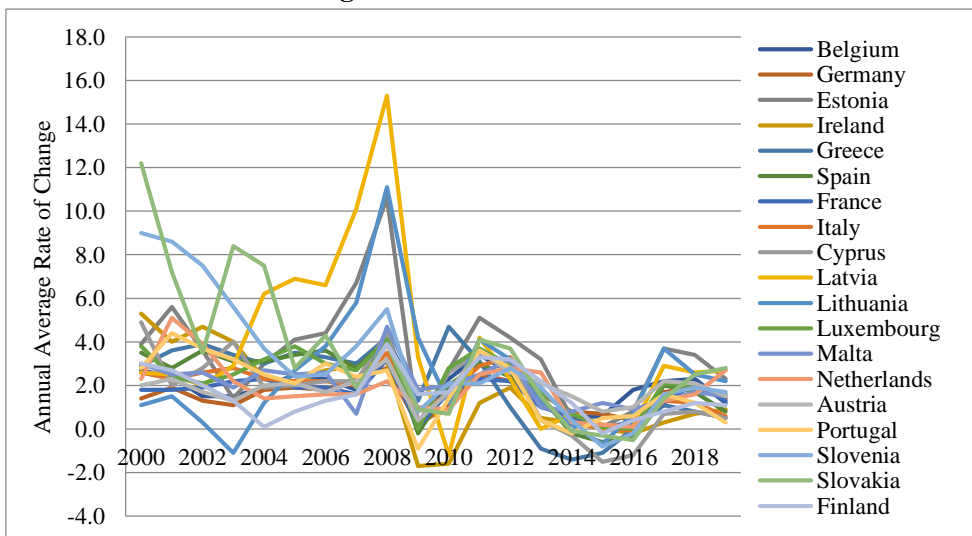
inflation began to borrow heavily abroad and this ultimately fueled fiscal risks in these regions.

With the onset of the global financial crisis in 2008, the inflation differentials suddenly increased and the current account balance also quickly deteriorated in these peripheral countries. When their debt levels even reached the point where they were unable to repay, they faced with another crisis, called the ‘European sovereign debt crisis,’ in 2010. So despite the fact that the EMU had initially successful years of nominal convergence, the financial crises exposed the failure of real convergence in the EMU due to uneven distribution of inflation rates across the member states.

2. The Second Decade of the Euro (2010 – 2018)

2-1. Global Inflation Synchronization

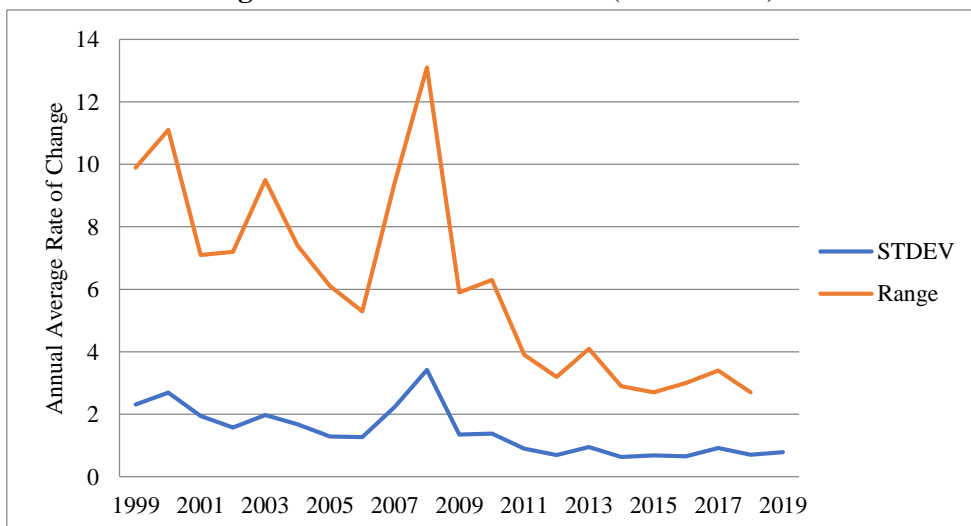
Figure 9. HICP Inflation Rate



Source: Eurostat

As discussed in the previous section, large inflation differentials within the EMU during its first decade without any serious effort to address them contributed to the financial crisis in the euro area. However, the inflation differentials have fallen to historic lows since 2012. This is primarily due to increased global inflation synchronization, as shown in **Figure 9**. Large body of literature examines the global phenomenon of inflation synchronization (see, e.g., Chon, 2020; Szafranek, 2021). Ha et al. (2019) find that international inflation synchronization has significantly increased since 2001 and has gradually become more broad-based. Inflation rates were initially synchronized only among developed economies, but those of emerging economies have also synchronized over time. Hence, inflation rates in both developed and developing countries have now become increasingly synchronized. In that respect, the euro area now has significantly low inflation differentials across the member states because of inflation synchronization phenomenon across the entire euro area, as shown in **Figure 10**.

Figure 10. Inflation Differentials (1999 – 2018)



Source: Eurostat, computation by the author

2-2. Small Inflation Differentials: Potential Risk for Another Debt

Crisis in the EMU

Although the euro area has now small inflation differentials, the EMU's stability is still questionable. As pointed out by Whelan (2014), small inflation differentials are, in fact, worsening the situation for the peripheral countries, which are still in the process of economic recovery from the past financial crises. If the inflation rates in the peripheral countries are much lower than those of the core countries, then the periphery may be able to strengthen their economies by improving their price competitiveness. However, because of global inflation synchronization, the inflation differentials between the core and the periphery are now meager. Hence, small inflation differentials are currently making the peripheral countries to become more difficult to improve their economies against the core countries. In other words, larger inflation differentials in the euro area are more desirable in the present situation in order to keep the EMU economically stable – the reverse from the first decade.

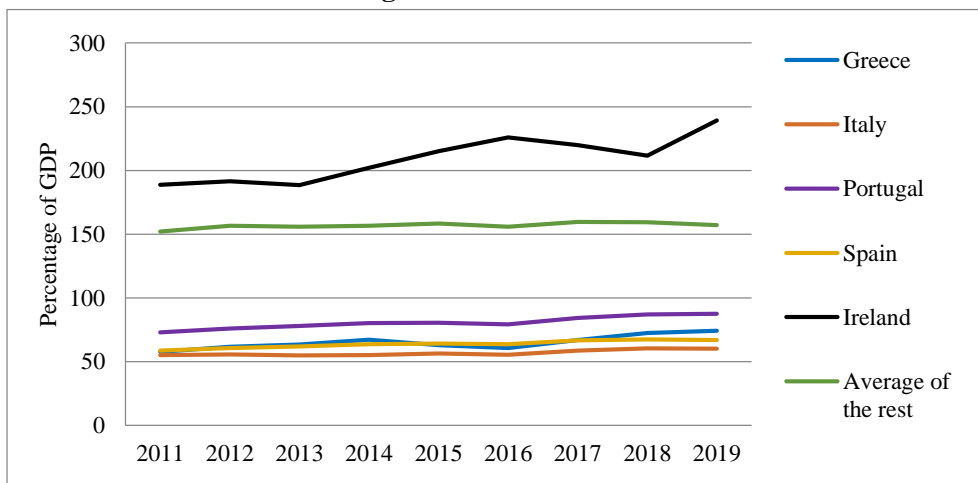
Additionally, concerns over the possibility of unfolding another debt crisis in the euro area have recently been mounting again. Particularly, Italy has attracted a lot of attention from the news media for its potential risk for bringing the next debt crisis (see, e.g., BBC News, 2019; Financial Times, 2020). Similar with other peripheral countries, Italy may be able to improve its economy and, therefore, to avoid the next debt crisis if there are larger inflation differentials than we are currently observing. In other words, larger inflation differentials are important in the present situation not only for the countries who already went through the debt crisis

– Greece, Ireland, Portugal, and Spain – but also for the country, such as Italy, who has potential risks for the next debt crisis.

In the following section, I examine the economic performance of the peripheral countries relative to the other EMU member states from 2010 to 2019 in order to investigate how much these countries have recovered from the past financial crisis. I also include the data for Italy as well in order to investigate its potential risks for unfolding the next euro crisis.

2-2-1. Trade Flows

Figure 11. Trade Flows



Source: Eurostat

Figure 11 provides the measurements for trade flows, which represent the sum of exports and imports each year as a percentage of GDP, for the peripheral countries and the average of the other EMU member states. Ireland has shown

stronger than the average export performance. Brazys and Regan (2016) point out that an excellent economic performance in Ireland after the crisis was feasible because of a concentrated effort done by Ireland's Industrial Development Authority (IDA) to attract FDI from US high-tech companies to Ireland. They also note that the success of attracting massive FDI led numerous foreign companies to install their EU headquarters in Ireland. This eventually caused 'cluster effects' in Ireland which improved its export performance, current account balance, and therefore helped the economy to quickly recover from crisis. Trade performances in other peripheral countries, however, are still much weaker than the average of the remaining EMU member states. Among the peripheral countries, Italy has had the weakest trade performance after the Global Financial Crisis.

2-2-2. Debt Levels

After the financial crises during the past decade, debt levels in the peripheral countries further increased due to expansionary fiscal policies, which were enacted in order to minimize economic loss from the crisis (Blueschke and Neck, 2011). Moreover, Artner and Rona (2012) point out that the biggest cause of these increased debt levels was the bailout of the banks. Greece received bailout packages in 2010 and 2011, Ireland in 2010, Portugal in 2011, and the ECB offered financial assistance to Spain and Italy by purchasing their bonds in order to lower their borrowing costs (Liu and Wang, 2013). Teica (2012) also finds that growing debts in these peripheral countries after the crisis brought a negative impact on market confidence which further complicated matters.

Table 3. General Government Debt (% of GDP)

	2011	2012	2013	2014	2015	2016	2017	2018	2019
Ireland	111.1	119.9	119.9	104.4	76.7	73.8	67.7	63.5	58.8
Greece	172.1	159.6	177.4	178.9	175.9	178.5	176.2	181.2	176.6
Spain	69.9	86.3	95.8	100.7	99.3	99.2	98.6	97.6	95.5
Italy	119.7	126.5	132.5	135.4	135.3	134.8	134.1	134.8	134.8
Portugal	114.4	129	131.4	132.9	131.2	131.5	126.1	122	117.7
EMU(19)	87.7	90.7	92.6	92.8	90.9	90	87.8	85.8	84.1

Source: Eurostat

As shown in **Table 8**, Greece has the highest level of debt to GDP at 176.6%, followed by Italy at 134.8%, Portugal at 117.7%, Spain 95.5%, and Ireland at 58.8% in 2019. Despite its large debt accumulation until 2013, Ireland improved its fiscal position shortly thereafter. Ireland now has lower than the average debt levels. On the other hand, Spain now has moderately higher than the average debts while debt levels in Greece, Italy, and Portugal are far above the average.

2-2-3. Global Competitiveness

Table 4. Global Competitiveness Index

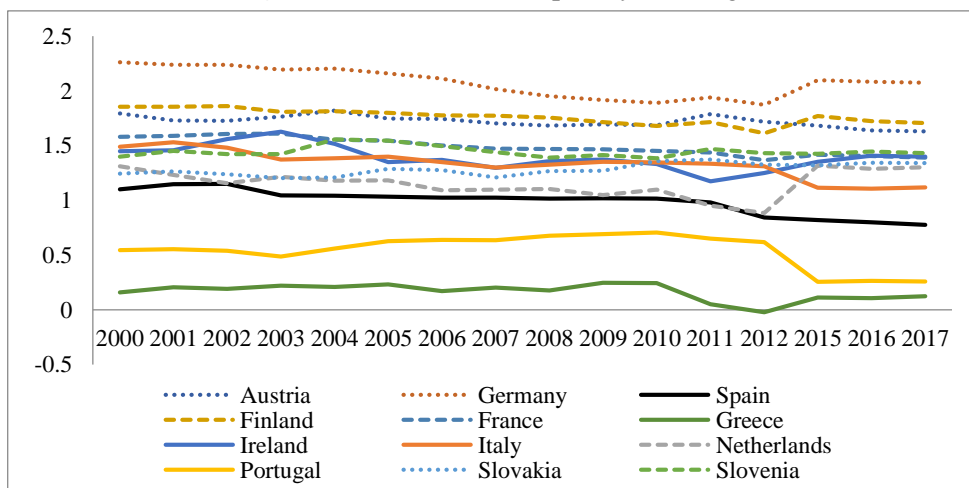
	2017	2018	2019
Greece	61.8	62.1	62.5
Ireland	76	75.7	75.1
Spain	73.8	74.2	75.3
Italy	70.5	70.8	71.5
Portugal	69.7	70.2	70.4
Average of the rest	72.9	73.4	73.7

Source: World Economic Forum

Economists have stressed that the improvement in international competitiveness is a necessary condition for the periphery countries to recover their economies. The strengthening of competitiveness will allow them to improve export performance and therefore to correct their excessive deficit. **Table 4** shows the global competitiveness index for five peripheral countries – Greece, Ireland, Spain, Italy, and Portugal – relative to other EMU member states during the past few years. Ireland and Spain now have more competitive economies than the average of the rest of the EMU member states while Greece, Italy, and Portugal have still underperformed in their competitiveness.

Sevdalis (2020) points out that a country can become more internationally competitive by either strengthening price competitiveness or by its technological (non-price) competencies. **Figure 12** shows economic complexity rankings which assess the relative knowledge intensity of an economy.

Figure 12. Economic Complexity Rankings



Source: OECD World

This index demonstrates technological competencies for individual member states by measuring their ability to utilize tacit knowledge in their production process. As shown in the figure above, Greece and Portugal are far behind the rest of the EMU member states in terms of economic complexity. Further, despite the fact that Italy's external competitiveness is lower than the average EMU member states, its economic complexity is similar to that of France. This suggests that weak competitiveness of Italy can be largely explained by its weak price/cost competitiveness indicators, rather than technological/non-price factors. To return to prosperity, therefore, Greece and Portugal need to either strengthen their price competitiveness or improve the quality of exports, while Italy's economic improvement appears to be allowed only through the strengthening of price competitiveness.

Literature is mixed on whether price competitiveness indicator plays a significant role in determining external competitiveness. For instance, Sevdalis (2020) finds that the external competitiveness of the EMU member states is mostly dependent on technological/non-price factors, rather than price factors. The ECB (2016), however, points out that the majority of existing studies have only focused on total trade flows in explaining the competitiveness in the EMU. The ECB therefore provides the study which disentangles between intra- and extra-EMU trade. They find that price competitiveness appears to have greater effects on extra-EMU exports than intra-EMU exports. They further find that price competitiveness significantly affects the EMU member states' export performances in the long run, while its effect seems to be less important in the short run. However, the general consensus in literature is that price competitiveness indicators are significantly

relevant in determining Italy's export performance (see, e.g., Cesaratto et al., 2011; Meloni, 2018)

In summary, divergence in economic performance of the peripheral countries were observed after the financial crises. Ireland has outperformed from the EMU average in terms of export performance, debt levels, and global competitiveness. Spain has much weaker export performance and slightly higher debt levels than the EMU average, whereas its global competitiveness is higher than the average. Greece and Portugal, on the other hand, have under-performed from the average in all respects. In this context, the peripheral countries, except Ireland, are still in the midst of economic recovery from the past financial crises. In addition to that, Italy, who has potential risk for the next debt crisis, has also under-performed from the EMU average. And more importantly, improvement in price competitiveness, rather than technological competency, is particularly important for Italy in order to enhance its global competitiveness.

3. Research Questions

Large inflation differentials across the member states during the first decade of the EMU triggered financial risk by causing several peripheral countries to experience boom-and-bust cycles. These economic imbalances eventually resulted in the European Sovereign Debt Crisis in 2010. However, the trend has reversed since then. The inflation differentials within the monetary union have substantially decreased since 2012. The European Parliament (2014), however,

reports that the EMU now needs larger inflation differentials in order to help the periphery to restore their economies from the past financial crisis and prevent further debt crisis in the euro area.

In this context, therefore, investigating the inflation differentials across the EMU member states will provide useful insights for understanding the economic stability of the euro area. The determinants of the inflation differentials in the EMU have been the subject of debate by scholars until the early 2010s in order to identify the root cause of the euro crisis. However, as the inflation differentials have significantly reduced since 2012, the interest in the subject from academia has greatly languished.

Therefore, this paper aims to fill this gap by including an update of the investigation. In this study, we will first discriminate between the past (1996 – 2012) and the present times (2013 – 2018) of the EMU, taking into account that there has been a trend reversal in fluctuation of the inflation differentials since 2012. After identifying the underlying factors that affect the inflation differentials for both periods, we will analyze how the determinants of the inflation differentials have changed over time. Based on our estimation results, we will further investigate which policy measures are needed for the peripheral countries in order to help them to strengthen their economies.

CHAPTER III. LITERATURE REVIEW: EXISTING THEORIES IN EXPLAINING THE INFLATION DIFFERENTIALS

Because the inflation differentials among the EMU member states have been extensively studied since the inception of the euro in 1999, several distinct theories have co-existed in explaining the driving factors of the inflation differentials.

First, the Balassa-Samuelson theory has often been used to rationalize the inflation divergence. The theory suggests that rapidly-growing economy with higher productivity level in tradable sector, compared to non-tradable sector, has a higher inflation rate. The productivity growth in tradable sector tends to be faster than in the non-tradable sector because technological factors are embedded in tradable sector, which is more capital-intensive, while non-tradable sector largely consists of service industry. This will result in an increased real wages for workers in tradable sector. However, with labor mobility, wages in both sectors will eventually rise and therefore the overall price level of the entire economy will also increase. Thus, the country with greater differences in productivity growth between tradable and non-tradable sectors tends to exhibit higher inflation rate, primarily due to high inflation in non-tradable sector (Lojschová, 2003). Due to a fixed exchange rate in the EMU, the Balassa Samuelson effect will be translated into real exchange rate appreciation (Mihaljek and Klau, 2003).

Nevertheless, the arguments concerning the relevance of the Balassa-Samuelson effect in explaining the inflation differentials are largely divided. The

earlier studies found that the Balassa-Samuelson effect was an important contributing factor in inflation divergence, whereas more recent studies argued that its effect was rather scant. For instance, while Halpern and Wyplosz (2001) find that the Balassa-Samuelson effect was significant, Mihaljek and Klau (2003) explain that the Balassa-Samuelson effects have diminished from the early 2000s.

Second possible explanation is related to price level convergence, which has been stressed by the ECB in explaining the inflation differentials. It suggests that the inflation differentials are the consequence of price convergence process across the member states since they had different initial price levels. According to the law of one price, the prices of tradable goods tend to become internationally equalized while those of non-tradable goods do not. Therefore, the country with lower initial price level will face higher inflation rates, compared with the country with higher initial price level (Pirovano and Poeck, 2011). Horvath and Koprnicka (2008) explain that a country with 20% lower price level than the euro area on average tends to experience around 1 percentage point higher inflation than the euro area. Nevertheless, Stavrev (2008) found that the role of price level convergence has declined in recent years.

Third possible explanation is related to the economic performance. Despite the fixed exchange rate, the differences in economic performance between the countries may lead to short-run inflation differentials because of disparities in countries' exposures to exogenous shocks. Even fully symmetric shocks, such as oil price shocks, may generate different impacts in the inflation rates across the countries, primarily due to the imbalances in economic structures and consumption patterns. However, it also can be the result of different domestic demand shocks,

caused by different fiscal stances or different effects of common demand shocks. These factors may lead to different levels of output growth and therefore give rise to inflation differentials in the monetary union (Hofmann and Remsperger, 2005). Honohan and Lane (2003) and European Central Bank (2002) have provided evidence that output gaps and inflation rates are statistically correlated, suggesting that differences in economic performance between the member states may be an important contributing factor to inflation differentials in the EMU.

Fourth explanation is related to different degrees of trade liberalization. Honohan and Lane (2003) argue that different exposures of the member states to trade with non-EMU countries may give them different degrees of sensitivity to currency movements. In other words, a country with higher reliance on the trade with non-EMU countries may face wider fluctuations in its inflation, depending on the strength of the euro. They further offer an example of Ireland who suffered the most from increased import prices because of the euro depreciation in the period of 1996 to 2000. Since Ireland was heavily relied on non-euro imports, compared with other EMU members, its nominal effective exchange rate was depreciated by around 17 percent, which was far larger than other member states.

Fifth explanation is related to the differences in fiscal stance. Pirovano and Poeck (2011) have found statistically significant correlation between fiscal balance and inflation, suggesting that the country with positive fiscal balance tends to exhibit lower inflation rate. Further, in consistent with their findings, Horvath and Koprnicka (2008) have also confirmed its statistical significance and found that the fiscal deficit of around 5-10% of GDP is related to 1 percentage point increase in inflation differential in the EMU.

Sixth explanation is related to the structural factors. The ECB (2003) finds that different degrees of oil dependency affect the inflation differentials in the EMU, with a notable exception of Netherlands. Moreover, the ECB (2011) points out that the product and labor rigidities can affect the inflation differentials. That is, a country with more regulated labor and product rigidities tend to exhibit higher inflation rates.

CHAPTER IV. METHODOLOGY

1. Determinants of the Inflation Differentials: Model and Variables

In order to investigate how the determinants of the inflation differentials have changed over time, I first discriminate between two periods of the EMU: the past (1996 – 2012) and the present (2013 – 2018). We therefore use two panel datasets, which includes annual observations for 19 member states, in identifying the determinants of the inflation differentials for each period. However, due to an endogeneity problem in my datasets, which occurs when a predictor variable (x) is highly correlated with the error term (ε) in the model, the estimated amount of OLS cannot be a matching estimate because various statistical assumptions are broken. Therefore, I use the Arellano-Bond (1991) GMM panel estimator and the estimating equation with GMM is specified as follows:

$$\Delta\pi_{it} = \gamma_1 \Delta\pi_{it-1} + x'_{it} \beta + u_{it}$$

To solve an endogeneity problem, the instrumental variable approach is necessary. An instrumental variable GMM estimator, proposed by Arellano and Bond (1991), includes a lagged dependent variable as instruments for $\Delta\pi_{it-1}$. By including the instrumental variable, which is not correlated with the error term, residual autocorrelation can be reduced.

The dependent variable ($\Delta\pi_{it}$) is the inflation differentials of a member state (i) compared to the EMU average. These measurements are obtained by subtracting the average inflation rate of the EMU from that of country i. $\Delta\pi_{it-1}$ is the lagged inflation differentials and x'_{it} includes the explanatory variables related to the determinants of the inflation differentials. Lastly, u_{it} is a composite error term.

First, the model includes the variables (unemp) and (outp_gap) in order to measure the differences in economic performance between the countries. The variable (unemp) represents the annual average unemployment rate, which is the number of unemployed persons as a percentage of total population of age class from 15 to 74. The observations are obtained from Eurostat. The variable (outp_gap) is the differences in output gap between the EMU average and country i. They are collected from OECD Economic Outlook 88. A country with stronger economic performance is expected to experience higher inflation rate. Hence, the coefficient of the variable (unemp) is expected to be negative while that of the variable (outp_gap) is expected to be positive.

Second, the variable (trade) is included in order to examine the effect of trade exposure of country i. This variable is obtained by multiplying the share of extra-EU imports in total imports by the exchange rate between euro (€) and US dollar (\$). This is collected from Eurostat and its coefficient is expected to be positive.

Third, the variables (labor_rig) and (pmar_reg) are included in order to analyze the effects of structural factors in explaining the inflation differentials. The variable (labor_rig) represents the indicators of employment protection legislation. Using the scale from 0 to 6, this index measures labor mobility rigidity. Higher the

value, the country is stricter in protecting employees from unfair dismissal. Also, the variable (*pmar_reg*) represents the indicators of product market regulation. This variable measures economic barriers to entry. Higher value means more difficult for new firms to enter the market. They are both collected from OECD Statistical Database. I expect countries with more strictly regulated labor and product market to exhibit higher inflation rates, suggesting positive coefficients for both. The variable (*ln_oildepen*) is also included, as a structural factor, in order to examine the role of oil dependency in explaining the inflation differentials. Data are collected from Eurostat, and the coefficient for this variable is expected to be positive because oil price increases are often associated with increase in inflation rates.

Fourth, the variable (*ln_in_fdi*) is included in order to assess how much inward FDI has affected the inflation differentials within the EMU, given the fact that the adoption of euro had promoted massive FDI to several peripheral countries. Data are collected from Eurostat, and the coefficient for this variable is expected to be positive.

Fifth, the variable (*gov_balance*) is included in order to analyze the effect of fiscal balances on inflation differentials. This variable represents general government balance as a percentage of GDP. Data are collected from Eurostat and the coefficient for this variable is expected to be negative, given the fact that high government revenue often relates to high inflation.

Lastly, I add a control variable (*imp_price*), which is the annual percentage change in the import price index. Data are collected from Eurostat. Since a large volume of literature points out that the roles of the Balassa-Samuelson effect and the

price level convergence have recently declined, I do not include these variables in my model.

CHAPTER V. EMPIRICAL RESULTS

1. Descriptive and Inferential Statistics (1996 to 2018)

Before identifying the key determinants of the inflation differentials for two separate time spans, I provide basic statistical analysis on the entire years of the EMU (1996 – 2018) in the following section. Despite the fact that the euro has officially adopted in 1999, the reason for including the datasets from 1996 to 1998 is to more accurately capture the effects of regional differences. Because the inflation differentials have more drastically reduced shortly before 1999, it is necessary to include these years in order to more precisely investigate the key determinants of the inflation differentials between the member states.

1-1. T-test

I conduct a t-test in order to analyze the economic differences between the core and peripheral countries. The core countries ($\text{country_dum}=0$) include Germany, Austria, Finland, Belgium, France and Netherlands, while the peripheral countries ($\text{country_dum}=1$) include Ireland, Greece, Spain, Italy and Portugal.

Table 5 reports that the periphery group has higher average inflation differentials than the core group from 1996 to 2018. Further, our results have shown that the core group has lower unemployment rates and higher output gap, implying that the core countries have shown stronger economic performance than the peripheral countries. Moreover, the core group has greater trade exposure, better

fiscal balances, and greater inward FDI, compared to the periphery group. On the other hand, the periphery group has more regulated labor and product market, and higher oil dependency than the core group.

Table 5. T-test

Variable	country_dum==0			country_dum==1			t-value	p-value
	Obs	Mean	Std.	Obs	Mean	Std. Dev.		
inf_diff	115	-0.420	1.089	138	-0.858	1.286	2.93***	0.003
unemp	115	7.122	3.553	131	4.547	1.395	7.28***	0.000
outp_gap	115	-1.420	5.091	137	-0.335	1.878	2.16***	0.003
trade	85	5.108	4.676	102	10.868	7.977	5.94***	0.000
labor_rig	75	2.681	0.976	90	2.420	0.321	2.21**	0.029
pmar_reg	80	1.669	0.347	96	1.447	0.239	4.83***	0.000
ln_in_fdi	65	9.251	1.472	76	10.114	1.046	3.94***	0.000
ln_oildepen	115	4.353	0.094	138	4.008	0.287	13.29***	0.000
gov_bal	115	-4.279	4.679	138	-1.672	2.363	5.42***	0.000
imp_price	44	20.593	59.7	83	12.898	53.530	0.71	0.476

***, **, * denote significance at the 1%, 5%, and 10% levels.

1-2. Correlation Test

I perform the correlation test between the variables included in the model and the results are shown in **Table 6**. Our results suggest that the correlation between the inflation differentials and output gaps are found to be positive and statistically significant at 5% level. Moreover, the correlations between the inflation differentials and trade exposure, inward FDI, and oil dependency are found to be negative and statistically significant at 1% level.

Table 6. Correlation Coefficients

	inf_diff	inf_diff t-1	unemp	outp_gap	trade	labor_rig	pmar_reg	ln_in_fdi	ln_oildepen	gov_bal	imp_price
inf_diff	1.000										
inf_diff t-1	0.689***	1.000									
unemp	0.033	0.132***	1.000								
outp_gap	0.109**	0.018	-0.639***	1.000							
trade	-0.200***	-0.210***	-0.108*	0.057	1.000						
labor_rig	-0.004	-0.004	-0.152**	0.106	0.123	1.000					
pmar_reg	0.039	0.086	0.174***	0.173***	-0.261***	0.273***	1.000				
ln_in_fdi	-0.251***	-0.265***	-0.138**	0.050	0.544***	-0.209**	-0.291***	1.000			
ln_oildepen	-0.153***	-0.149***	-0.047	0.021	-0.079	0.016	0.265***	0.293***	1.000		
gov_bal	-0.023	-0.105**	-0.416***	0.335***	0.022	-0.128*	-0.224***	-0.001	-0.120**	1.000	
imp_price	-0.022	0.070	-0.077	0.289***	0.009	0.054	0.212**	0.041	0.029	-0.030	1.000

***, **, * denote significance at the 1%, 5%, and 10% levels

2. Determinants of the Inflation Differentials during the Past (1996 – 2012) and the Present times (2013 – 2018)

In this section, we identify the key determinants of the inflation differentials in the EMU for two separate time periods.

2.1 Arellano-Bond GMM Estimation Results (1996 – 2012)

The results for the determinants of the inflation differentials in the EMU during 1996 – 2012 are shown in **Table 7**. Each column represents a different model specification. Additionally, I include the results for the Sargan test and the AR test at the bottom rows. The Sargan test is to examine whether my chosen instrumental variables are valid while the AR test is to detect residual autocorrelation.

First, the lagged dependent variable is positive and significant at 1% significance level at all columns, except the column 1 and 8. This suggests that the inflation differentials have been persistent since the beginning of the EMU. The import price change, which is the control variable, is negative and statistically significant in all specifications, except M1 and M8.

Based on the results, five explanatory variables are found to be statistically significant: unemployment rate, labor market rigidity, product market regulation, oil dependency, and government balance. The coefficients for unemployment rate are negative and statistically significant at 5% level at M1 and 10% level at M3. The coefficients for labor market rigidity are positive and statistically significant at 1% level at M6. The coefficients for product market regulation carry negative signs and statistically significant at 1% level at M7. The coefficients for oil dependency are

Table 7. Determinants of the Inflation Differentials in the EMU (1996 – 2012)

Variable	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	
_cons	3.819 (0.50)	-0.201* (-1.83)	0.438 (1.10)	-0.178 (-1.62)	-0.091 (-0.29)	-4.151*** (-2.68)	1.251** (2.12)	1.156 (0.97)	3.830* (1.67)	-0.374*** (-2.61)	
$\Delta inf_diff_{i,t}$	0.331 (1.28)	0.355*** (4.09)	0.309*** (3.30)	0.378*** (5.08)	0.311*** (2.73)	0.368*** (4.93)	0.334*** (2.99)	0.088 (0.73)	0.343*** (3.87)	0.350*** (4.65)	
imp_price	-0.003 (-1.14)	-0.003** (-2.14)	-0.003* (-1.65)	-0.005*** (-3.14)	-0.003* (-1.95)	-0.004*** (-2.98)	-0.004** (-2.49)	-0.002 (-1.01)	-0.003** (-2.10)	-0.003** (-1.98)	
unemp	-0.265** (-2.06)		-0.117* (-1.80)								
outp_gap	-0.084 (-1.44)			0.013 (0.53)							
trade	-0.057 (-0.68)				-0.008 (-0.29)						
labor_rig	1.320 (0.51)					1.565*** (2.58)					
pmar_reg	-0.215 (-0.18)						-0.850*** (-2.77)				
ln_in_fdi	-0.094 (-0.87)							-0.152 (-1.21)			
ln_oildepen	-1.086 (-0.75)								-1.004* (-1.83)		
gov_bal	-0.076* (-1.68)									-0.048* (-1.78)	
Wald chi2	202.47	23.86	22.42	68.49	17.14	114.89	10.56	2.95	23.70	43.71	
Sargan OR test	37.288 (0.716)	134.056 (0.007)	122.380 (0.022)	121.214 (0.036)	97.875 (0.063)	115.375 (0.031)	73.240 (0.372)	59.060 (0.233)	129.034 (0.013)	129.190 (0.013)	
AR test	1 st order	-2.338 (0.019)	-2.452 (0.014)	-2.407 (0.016)	-2.513 (0.011)	-2.276 (0.022)	-2.473 (0.013)	-2.616 (0.008)	-2.075 (0.038)	-2.467 (0.013)	-2.468 (0.013)
	2 nd order	-1.384 (0.166)	-1.116 (0.264)	-1.288 (0.197)	-1.193 (0.232)	-1.108 (0.267)	-1.073 (0.284)	-0.801 (0.422)	-1.239 (0.215)	-1.052 (0.292)	-0.942 (0.345)
N	59	95	92	93	81	88	73	62	95	95	

1) ***, **, * denote significance at the 1%, 5%, and 10% levels.

negative and statistically significant at 10% level at M9. Lastly, the coefficients for government balance are found to be negative and statistically significant at 10% level at M10. Output gap, trade exposure, and inward FDI are found to be statistically insignificant at any conventional levels.

Moreover, among the statistically significant explanatory variables included in the model, the coefficients of two variables carry an unexpected sign: product market regulation and oil dependency. Different from my initial expectation, more highly regulated product market significantly lowers the inflation differentials relative to the EMU average. Greater oil dependency significantly reduces the inflation differentials as well.

2-2. Arellano-Bond GMM Estimation Results (2013 – 2018)

Table 8 presents the results for the determinants of the inflation differentials in the EMU from 2013 to 2018. The results for M1 are unavailable because p-values of AR test are invalid at M1. Additionally, the results for M6 can be considered as unreliable because its sample size is too small.

The coefficients for lagged dependent variable are found to be positive and statistically significant at all specifications. This suggests that the inflation differentials have been persistently existed during 2013 – 2018. However, compared with the results from **Table 7**, which include the results for the previous period (1996 – 2012), the coefficients during 2013 – 2018 are smaller. This confirms our findings that the inflation differentials have currently become smaller than the past.

Based on the results, only two explanatory variables are found to be statistically significant: unemployment rate and oil dependency. The coefficient for

Table 8. Determinants of the Inflation Differentials in the EMU (2013 – 2018)

Variable	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10
_cons		0.047 (0.46)	0.558** (2.25)	0.156 (1.54)	0.099 (0.35)	-3.167 (-1.17)	-0.186 (-0.17)	0.155 (0.22)	1.139** (2.08)	0.068 (0.78)
Δ inf_diff _t		0.397*** (5.71)	0.379*** (6.20)	0.406*** (6.44)	0.398*** (5.79)	0.474** (2.17)	0.381*** (5.16)	0.341*** (4.08)	0.346*** (4.34)	0.397*** (5.83)
imp_price		0.002 (1.30)	0.001 (0.67)	0.000 (0.18)	0.002 (1.37)	-0.001 (-0.14)	0.002 (1.30)	0.003 (1.29)	0.002 (1.24)	0.002 (1.06)
unemp			-0.076* (-1.68)							
oup_gap				0.044 (1.19)						
trade					-0.008 (-0.26)					
labor_rig						1.420 (1.29)				
pmar_reg							0.159 (0.20)			
ln_in_fdi								-0.013 (-0.18)		
ln_oikdepen									-0.283** (-2.02)	
gov_bal										0.012 (0.28)
Wald chi2		78.78	75.04	43.85	79.85	4.84	75.33	80.62	61.95	80.23
Sargan OR test		87.396 (0.119)	82.626 (0.184)	74.351 (0.224)	85.866 (0.126)	11.833 (0.459)	85.884 (0.095)	67.415 (0.238)	85.924 (0.125)	85.354 (0.354)
AR test	1 st order	-2.350 (0.018)	-2.321 (0.020)	-2.336 (0.019)	-2.350 (0.018)	-0.525 (0.599)	-2.330 (0.019)	-2.237 (0.025)	-2.436 (0.014)	-2.413 (0.015)
	2 nd order	-0.059 (0.952)	-0.179 (0.857)	1.152 (0.249)	-0.061 (0.950)	-	0.076 (0.938)	-0.013 (0.988)	-0.220 (0.825)	-0.115 (0.908)
N		70	70	64	70	13	69	63	70	70

1) ***, **, * denote significance at the 1%, 5%, and 10% levels.

unemployment rate is negative and statistically significant at 10% level at M3. The coefficient for oil dependency carries a negative sign and is statistically significant at 5% level at M9. Consistent with our expectation, unemployment rate lowers the inflation differentials relative to the EMU average. On the other hand, the coefficient for oil dependency is found to carry an unexpected sign.

When comparing between the past and the present periods, the key determinants of the inflation differentials in the EMU have considerably changed over time. Only unemployment rate and oil dependency continue to influence the inflation differentials, whereas labor market rigidity, product market regulation, and government balance are no longer statistically significant in the present times. Further, magnitude of coefficients for unemployment rate and oil dependency have also changed from the past. The coefficients for unemployment rate in the past are -0.265 at M1 and -0.117 at M3, while it has been reduced to -0.076 in the present period. Also, the coefficient for oil dependency has been reduced from -1.004 to -0.283. This suggests that the effects of both variables in affecting the inflation differentials have lowered recently.

Based on our findings, therefore, the current trend of small inflation differentials in the EMU can be explained by reduced effects of unemployment rate, labor market rigidity, product market regulation, oil dependency and government balance in affecting the inflation differentials.

Chapter VI. Concluding Remarks

Large inflation differentials in the EMU had been the subject of debate when the euro area was hit by the Global Financial Crisis in 2008 and the European Sovereign Debt Crisis in 2010. However, as the inflation differentials have substantially reduced since 2012 due to the global phenomenon of inflation synchronization, attention from academia on this topic has also languished. Given that concerns over the likelihood of another debt crisis in the euro area have recently been raised again, it is important to re-focus on investigating the inflation differentials across the EMU member states in order to maintain its long-term stability.

Due to small inflation differentials in the EMU at present, Greece, Spain, and Portugal, who underwent severe debt crises in the past, are still having difficulties in recovering their economies. Further, Italy, who has recently received a lot of attention for its potential risks of unfolding the next debt crisis, has also confronted with difficulties in strengthening its economy. In order to overcome their economic slump, these peripheral countries need to have much lower inflation rates than other EMU member states, suggesting that the EMU now needs larger inflation differentials than we are currently observing.

Based on our estimation results, unemployment rate, labor market rigidity, product market regulation, oil dependency, and government balance had been the

key determinants in explaining large inflation differentials in the EMU during 1996 – 2012. These factors had, therefore, contributed to increasing the financial risk in the euro area in the past decade. Nevertheless, the effects of these factors have considerably changed from the past. The effects of labor market rigidity, product market regulation, and government balance have become no longer statistically significant since 2013. Only unemployment rate and oil dependency have continued to remain statistically significant in affecting the inflation differentials in the EMU. Our estimation results suggest that a country with higher unemployment rate and oil dependency will likely to have lower inflation relative to the EMU average.

In this context, the peripheral countries need to implement structural reforms and measures, particularly in respect of unemployment rate and oil dependency, to combat small inflation differentials relative to the other member states. In addition to that, the ECB needs to reorient its various policies and strategies towards the economic balance between the core and the periphery in order to stabilize the EMU in the long term.

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