COST CHANNEL AND LABOR MARKET OUTCOMES IN THE EA: A COMPARISON OF CORE AND SOUTH PERIPHERY RESPONSES TO MONETARY POLICY SHOCKS

By

Marta Bernardi

Submitted to

Central European University

Department of Economics and Business

In partial fulfillment of the requirements for the degree of Master of Arts in Economic Policy for Global Markets

Supervisor: Professor Attila Ratfai

Vienna, Austria

2023

Abstract

The study employs a Structural Vector Autoregression (SVAR) model to investigate the dynamic interaction between long-term interest rates and key economic variables within the European Monetary Union (EMU). Specifically, it examines the responses to shocks in labor market quantities, labor market prices, and employment levels between the European core (Germany, Finland, France, and Denmark) and Southern European countries (Greece, Spain, Portugal, and Italy). The findings reveal significant differences in the labor market responses to interest rate shocks. In the post-2010 period, the Southern European countries exhibit a substantial negative response in employment levels. This suggests a higher degree of responsiveness in employment rate. Conversely, the European core countries show no significant response, indicating a lack of adjustments. Similarly, the study uncovers similar patterns in the response of labor market prices, measured as the cost of labor. Both the Southern European countries and the European average demonstrate a negative and significant response, whereas the European core countries exhibit no significant response. These findings provide evidence of higher responsiveness in labor market quantities and prices in Southern European countries, indicating a potential lack of integration in the common European labor market. Furthermore, the study suggests that the observed differences in labor market responsiveness to changes in the cost of borrowing align with the presence of a Cost channel. This implies that fragmented economies with smaller and less capitalized firms, relying more on international external credit, may experience stronger effects from changes in the cost of borrowing. The study recommends long-term solutions like fiscal and banking unions to mitigate labor market disparities and enhance synchronization in the Euro Area. Additionally, targeted monetary policies and region-specific structural reforms are suggested for short-term measures to address observed labor market differences and promote economic diversification and intra-European investment.

Keywords: *Optimal Currency Area, Labor Market, South Europe, Cost Channel, Asymmetric shocks*

Contents

List of Figures

1 Introduction

When Mundell wrote about the advantages of creating a common currency area in 1961 (Mundell 1961), many began considering the possibility of a Central European Union with unified currencies as a natural application of his theory. However, the Euro Area that exists today bears little resemblance to the preconditions envisioned by Mundell in the early sixties. In fact, numerous contributions have attempted to assess whether Europe can be considered an Optimal Currency Area (OCA) at all, yet consensus has not been reached in the literature (De Grauwe et al. 1991; Kim et al. 2003; Corsetti 2008).

The most significant debate in the literature has emerged from the perspective of integrating post-Soviet economies into the Euro Area, particularly those that transitioned to market-based systems relatively recently. The discussion revolves around the costs of implementing a common currency policy, which would leave these newly joined countries without any monetary policy independence when faced with idiosyncratic disturbances and unsynchronized or uncorrelated shocks compared to the "core" countries of the Euro Area (Michael Frenkel et al. 1999; Horvath et al. 2004; M. Frenkel et al. 2005; Yoshimi 2014).

Among the many positive aspects of participating in a currency area, the literature emphasizes the potential welfare-enhancing distributive consequences of a stable, fixed, and common exchange rate, which promotes trade and encourages economic agreements across Europe. However, these very aspects also appear to be at risk of bearing the costs of monetary integration (Yoshimi 2016).

The presence of a highly stable exchange rate facilitates capital and labor mobility within the union, which Mundell and subsequent OCA literature have identified as crucial adjustment channels. Recognizing that a centralized monetary policy cannot cater to the diverse specific needs of member countries in a counter or pro-cyclical manner, the debate on this matter has gained significant political interest within the Euro Area, particularly following the revelation of the Union's fragility and deep heterogeneity during the 2010-2013 debt crisis. This has sparked a heated discussion on the appropriate approach to address the balance deficit, with notable contributions by Krugman [2013]. The author advocates for a holistic approach that goes beyond austerity and acknowledges the various challenges of being part of a currency union, which are not solely tied to the absence of a national monetary policy. For instance, a Euro Area member country lacks the ability to issue bonds directly tied to its national currency. While some steps have been taken, such as the potential issuance of Euro Bonds during the 2020 Coronavirus pandemic, there is no definitive consensus on whether this has effectively resolved the problems arising from the inability to issue national currency bonds.

Overall, the main issue stemming from the absence of a specific national monetary policy relates to the potential welfare costs it could impose on the citizens of nations whose circumstances are only marginally reflected in the central monetary policy. The research question addressed by this study is therefore which are the comparative labor market reactions of different geographical clusters of EA members to long-term interest rate shocks across two different historical periods (2000-2010 and 2010-2019) and along price and quantities dimensions.

The objective of this dissertation is to integrate three distinct strands of macroeconomic literature, aiming to shed light on a relatively unexplored aspect of the labor market consequences of intra-European asymmetries in structural responses to monetary policy. Specifically, the empirical macroeconomic contribution is focused on the different labor market equilibria created in different geographical areas of Europe, core-center, and south-periphery, as an effect of the different impacts of the central monetary policy on the diverse economic structures. The focus of the empirical approach is devoted to identifying the different structural effects of long-term interest rates, ten-years bond yields, on countries in the ”core” of the Euro Area and countries in the South periphery. Making reference to the literature analyzing the welfare cost of the debt crisis the two groups at the center of the analysis are designed as groups of four countries: Italy, Spain, Greece, and Portugal as representative of the common currency South-Periphery and Denmark, Germany, France and Finland as representative of the core currency area. Building on the methodologies pioneered in the late nineties from the American literature studying the heterogenous effect of FED-generated monetary policy in the USA the chosen empirical strategy is the identification of the causal effect of long-term interest rate on the GDP and labor market quantities, employment, and prices, wages. Starting from recognizing the significant difference in the synchronization of EA members' labor market and the synchronization of the business cycles.

The analysis reveals significant differences in the labor market responses to interest rate shocks, with the south-periphery countries exhibiting higher responsiveness in labor market quantities and prices compared to the core countries. These findings provide evidence of a still incompletely integrated common European labor market, suggesting the need for policy actions to address the asymmetries.

The remainder of the study is structured as follows: **Section I** reviews the contribution of the previous literature on the interaction of monetary and labor market policy in the EU in the framework of Optimal Currency Theory; **Section II** Gives a panoramic of the labor policy regimes in place in the countries of interest to identify their role in the implied mechanism**Section III** presents the Data and the shows the comparative evolution of the variables of interest in the setting; **Section IV** states the empirical model with its identification assumptions and the implied causal chain; **Section V** presents and discuss the findings; **Section VI** elaborate on the policy recommendations on which the findings are shedding light on and finally **Section VII** concludes.

2 Literature Review

The empirical and theoretical literature has extensively examined the potential significant costs associated with currency integration for member countries of an Optimal Currency Area (OCA) across various time periods. Notably, the focus has been on the labor market as the main adjustment mechanism to address asymmetry in shocks among countries within the Eurozone. The integration of parallel currencies and labor markets within the Eurozone has been a central theme in these studies. Of particular interest in the existing literature, including this paper, is the definition of shock asymmetry and its relationship with business cycle synchronization and labor market variables among different groups of Eurozone countries. This dissertation builds upon three main strands of literature in a structured manner.

2.1 Europe as an Optimal Currency Area

Firstly, there is an emphasis on analyzing the Euro Area as an Optimal Currency Area, which cannot be taken for granted (De Grauwe et al. 1991). Criteria outlined by a consistent strain of literature (Mundell 1961; McKinnon 1963; Kenen 1969) including nominal adjustment flexibility, factor mobility, and product diversification, have been used to assess the viability of the Euro Area as an OCA. However, even after more than twenty years since its establishment, the Euro Area falls short of meeting criteria such as fiscal integration. Nonetheless, another part of the OCA literature, building on Frankel (Frankel et al. 1998) seminal contribution, argues for the endogeneity of currency area criteria. According to this perspective, these criteria are more likely to be met once the currency area is created. Therefore, considering these criteria as prerequisites lacks reliability, and they should be viewed as objectives for establishing a functioning currency area in the short to medium term (Vieira et al. 2012).

Over time, the focus of research on determining the criteria for understanding the feasibility and optimal composition of the Euro currency area has shifted towards evaluating the costs of currency integration once the area is established, regardless of whether the criteria have been fully met. One of the main concerns raised about the feasibility of the common currency project relates to the economic structure and outlook disparities between countries in the "core" and "periphery" of Europe. This paper draws on one of the most recent contributions to this discussion by Kunovac et al. [2022], who builds upon the works of Kim et al.; Corsetti [2003; 2008] and Gulzar [2015]. Kunovac creates a new index that assesses the functionality of an OCA based on the symmetry of external shocks and their impact on the "core" countries (Germany, Belgium, Netherlands, Denmark, France) versus the "peripheral" countries (Italy, Spain, Greece, Portugal, Ireland, UK). The index also considers whether the shocks have similar effects on the respective economies. The author's definition of shock symmetry in the currency union aligns closely with the one adopted in the theoretical framework of this paper, encompassing both common shocks with different intensities across countries and external shocks that specifically affect a single country.

What differentiates this paper from previous research in this field and constitutes its contribution to the literature is its approach, which starts from the contemporary state of OCA theory in Europe (Kunovac et al. 2022) and the vulnerabilities revealed by the Euro debt crisis in the early 2010s (De Grauwe et al. 1991; Wolf 2011). The objective is to understand the consequences of asymmetric shock reactions in the labor market, taking into account the transmission channels of the common monetary policy implemented by the European Central Bank (ECB) and other factors that contribute to determining country-specific long-run interest rates. Thus, the aim is to determine whether it is appropriate to discuss a functional OCA in the absence of a fiscal or complete banking union, considering the country-specific heterogeneities present.

2.2 Core-Periphery Asymmetries and the Cost of Currency Integration

The reconstruction of the Optimal Currency Area (OCA) theory by Kunovac (2022) has led to a second phase of research that focuses on the effects of establishing a common currency without fulfilling all the theoretical prerequisites (Kunovac et al. 2022). This strand of literature aims to identify the costs incurred by countries within the union when asymmetric shocks occur and how these shocks should be classified in terms of their asymmetric impact. Specifically, it examines the potential challenges and risks associated with a currency union that lacks synchronization and investigates the areas at risk of synchronization failures within Europe. Furthermore, it investigates whether the lack of synchronization observed at the inception of the union, which may challenge the endogeneity of the OCA criteria (Frankel et al. 1998), has persisted over time.

In a well-functioning monetary union, economies involved are typically on similar cycles, primarily driven by common shocks. However, Bayoumi et al. [1993] demonstrated, on the eve of the currency union's creation, that underlying aggregate supply and demand disturbances are significantly more idiosyncratic in the 11 European countries analyzed compared to the United States, using a VAR decomposition. This finding signaled the need to frame the establishment of a currency union in Europe differently. Notably, Bayoumi et al. [1993] showed that if only the portion of the Euro Area neighboring Germany was considered, the shocks exhibited a greater similarity in terms of homogeneity to the shocks observed across U.S. states. Several years later, Michael Frenkel et al. [1999] replicated the empirical analysis using a larger and slightly different sample of EU countries and obtained similar results.

Interestingly, Campos et al. [2016] conducted a similar analysis 25 years later and identified the emergence of a new, smaller periphery comprising Spain, Greece, Portugal, and Ireland. They found systematic differences in the underlying aggregate demand and supply shocks within this periphery, and the over-identifying restrictions of the model valid for the rest of the Euro Area countries were rejected in most specifications (Campos et al. 2016). It is important to note that while this line of research primarily focuses on the correlation between shocks in different Euro Area member countries, Kunovac et al. [2022] emphasizes the overall importance of the shocks for the countries under analysis, suggesting that the emergence of a new smaller euro periphery as suggested by Campos et al. [2016]could be biased by not considering the relevance of the shocks for the countries´ economies.

Moreover, the entry of new members into the Euro Area has led to the emergence of new patterns, extensively explored in the literature assessing the fit of these countries into the union. Horvath et al. [2004] found a significant degree of business cycle synchronization among EMU countries, which has improved since the creation of the union compared to previous studies (Bayoumi et al. 1993). However, they also observed a high level of idiosyncrasy between supply and demand shocks in EMU countries and prospective accessory countries. Similarly, M. Frenkel et al. [2005] identified large differences between supply and demand shocks in the large Euro economies of Germany, France, and Italy, compared to those in the Central and Eastern European countries preparing to join the union. This finding suggests a significant cost of currency integration. M. Frenkel et al. [2005] also noted heterogeneity among prospective Central and Eastern European countries, with more advanced economies being closer to the core EMU economies.

More recently, Belke et al. [2017] found that the level of business cycle synchronization among core European countries increased since the last quarter of 2007, particularly after the onset of the 2008 crisis. In contrast, the degree of correlation among shocks within the periphery of the EMU decreased, allowing for more country-specific idiosyncrasies and potentially reducing the effectiveness of the common monetary policy. Klaus et al. [2015] examined the role of the consecutive recessions in 2008 and 2013 on economic integration measured as business cycle synchronization, focusing on France, Italy, Germany, and Spain. The study found that the first three countries achieved a significant level of economic integration that remained robust during the crisis, thus excluding the possibility that a common monetary policy would further destabilize them. Interestingly, Spain was decoupled from the synchronization of the other three countries even before the debt crisis, one year prior, contradicting the narrative that the gap between core and periphery countries was solely a consequence of the debt crisis.

While the aforementioned literature has not extensively covered the role of labor market variables in determining the cost of currency integration and the fitness of a country for entering an OCA, it is a crucial aspect that this paper aims to contribute to. Skorepa [2013] analyzed 31 advanced or late-stage transition economies within and neighboring the EMU over several years and found that the presence of a real income convergence process generally leads to higher values on the index of OCA fitness. These findings suggest that entering an OCA too early could slow down the convergence process, and it may be better to join after real incomes have become more correlated in their fluctuations. This is supported by the fact that Greece and Ireland were found to be less fitted for the OCA, before the debt crisis, compared to some advanced candidate countries from Central and Eastern Europe that were not in the EMU. Additionally, Yoshimi [2016] investigated the role of labor mobility and Pricing to Market firms' behavior and found that a welfare cost of currency integration arises when a country-specific Total Factor Productivity (TFP) shock occurs and when consumption basket weights differ across countries, even if the index for OCA fitness is high. In summary, the existing literature reveals a persistent lack of consensus in defining the core and periphery within EMU countries. The timing of entry into the EMU is recognized as a crucial factor, and the occurrence of the two crises has introduced potential turning points in currency integration dynamics. However, there remains no definitive seminal consensus on the precise timing of the emergence of a gap parallel to the debt crisis. This paper seeks to make a valuable contribution to this field of study by presenting empirical evidence on the synchronization of a geographically homogeneous core/periphery and conducting a comprehensive analysis of the contemporaneous synchronization, or lack thereof, between business cycles and labor market variables. Through this endeavor, I aim to enhance our understanding of the intricate dynamics of currency unions and monetary policy integration.

2.3 Adjustment Mechanisms in the Labor Market

A distinct line of literature focuses on the adjustment mechanisms that determine the costs of currency integration in terms of welfare and labor market outcomes. According to Mundell's theory, labor mobility was initially outlined as the primary adjustment mechanism to asymmetric shocks among members of an Optimal Currency Area (OCA). However, empirical studies (Arpaia et al. 2016; Landesmann et al. 2015; Farhi et al. 2014; Nchor 2020) find that labor mobility in Europe is significantly lower compared to the United States. The levels of labor mobility observed empirically cannot be considered sufficient compensation for the idiosyncrasies identified in the previous literature. Understanding the theoretical underpinnings and empirical evidence supporting the adjustment mechanism is crucial for the empirical design of this paper.

In theory, a country experiencing a significant shock, a productivity slowdown, and a unique downward phase of the business cycle, with limited access to macroeconomic stabilization instruments such as changes in nominal exchange rates, is expected to witness an outward movement of workers. As a result of the downward pressure on wages, the exit of workers from the labor market would increase the relative demand for labor, leading to a subsequent wage increase. However, the effectiveness of this mechanism is contingent upon country-specific wage bargaining regulations, which govern the flexibility of sectorial wages in response to downward productivity pressures and upward labor demand. Additionally, labor mobility is a time-consuming process fraught with numerous barriers.

Evidence suggests that labor mobility increases during periods of crisis (Jauer et al. 2014). However, the drivers of this mobility are primarily attributed to third-country nationals, including the immigration flow generated by the Arab Spring and the entry of newly joined countries. This finding supports the notion of a lack of a strong compensating mobility mechanism. Another piece of evidence on intra-European mobility, presented by Lafleur et al. [2017], explores the factors triggering South-North intra-European mobility. The volume and composition of this mobility are found to be determined by long-term structural, demographic, social, and economic transformations, rather than specific crisis-related short-term conditions. Additionally, Lafleur et al. [2017] comments on the relatively small migration flows compared to the magnitude of the damage inflicted on Southern European labor markets by the debt crisis. A similar level of wage disruption caused by the crisis is documented in the Schmidt et al. [2014] report on South-East European wage structures, which are known to be more institutionalized but less resilient to crisis due to less developed industrial relation mechanisms compared to other EU countries.

This paper relies on the causal chain, emphasizing the cost channel as one of the active transmission mechanisms of monetary policy to the real economy (Druant et al. 2012; Gaiotti et al. 2006). The cost channel posits that changes in interest rates influence the cost of credit for firms, affecting their ability to finance business operations, investments, and, importantly, payroll. Differences in how monetary policy is transmitted to the labor market are influenced by wage regulation characteristics and the levels of wage rigidity (Dellas et al. 2005; Erceg et al. 2000).

Furthermore, Guriev et al. [2016] document how the debt crisis led to a divergence between the adjustment dynamics of formal and informal wages, particularly affecting immigrant workers employed in unregulated sectors. Such discrepancies between formal and informal markets provide evidence of labor market reactions to the crisis beyond what is observed in formal markets. These findings contribute to understanding the welfare costs of integration, given that monetary policy cannot counterbalance specific national labor market disturbances. Dhéret et al. [2013], in their contribution to the European Political Economy project, highlight the importance of establishing a more homogeneous wage bargaining system and facilitating smooth labor mobility as a risk-sharing mechanism. This is seen as the only way to compensate for asymmetries among heterogeneous members of a currency union.

This paper contributes to the existing literature by identifying both labor market price and quantity effects in response to common monetary policies and their country-specific premia. The aim is to ascertain which aspect of the labor market reacts more strongly, and where, before and after the crisis. Additionally, this contribution references two other relevant strands of literature: the use of methodologies to causally identify heterogeneous reactions to monetary policy shocks and the evidence documenting the mechanisms underlying the credibility of the causal chain implied in the model (Lütkepohl 2005; Christiano et al. 1999). The paper also builds upon contributions exploring spatial aspects of labor market adjustment (Rijnks et al. 2018) and monetary policy transmission (Groot et al. 2011), which form the basis for the choice of the core-periphery structure adopted in the empirical strategy.

2.4 Data

The focus of this paper is to empirically identify the causal effects of monetary policy shocks on labor market prices and quantities across different geographical zones of Europe during the period 2000-2019. The empirical analysis utilizes data from four different sources. In the following subsection, I first present the definition of the core and periphery of the Euro Area adopted in the model. Next, I discuss the selection of the variables of interest, their sources, and how they are incorporated into the model. Finally, I provide a visual representation of the time series evolution of these variables for the core and the southern periphery of the Euro Area throughout the sample period.

2.5 Core-Periphery Definition

The core-periphery definition used in this paper builds upon previous studies Bayoumi et al.; Michael Frenkel et al. [1993; 1999] that considered the founders of the Euro Area as the core. However, the debt crisis brought attention to a new perspective, where the so-called PIIGS countries were considered part of the periphery. Nevertheless, this perspective was criticized by Campos et al. [2016], who argued for a smaller periphery based on the synchronization of various aspects of the countries economies. In the empirical design of this paper, I adopt the approach of Campos et al. [2016] and Kunovac et al. [2022], which categorizes the periphery as the geographical South periphery. This spatial homogeneity component is important for identifying labor market aspects related to worker mobility, as previous literature has shown the influence of historical, cultural, and amenity factors driven by proximity.

2.5.1 EMU Core

The core of the Euro Area is defined by four Central European countries. Firstly, Germany is known for its powerful influence on common monetary policy and has a national bank that closely resembles the structure and policy direction of the European Central Bank. Secondly, Belgium, with a historically close monetary policy tie to Germany but represents a smaller-scale economy with a distinct labor market structure characterized by non-sector-specific collective bargaining. It serves as an example of how the same monetary policy can yield different labor market outcomes. Thirdly, France, the second-largest economy in Europe, with a labor market regulated differently from Germany, is characterized by a more centralized system of industrial relations and wage bargaining, and a less flexible job market where wages are determined at the national level. Lastly, Denmark adopts a unique labor market regulation system known as "flexicurity," combining employment contract flexibility with a high level of social security provision. The collective bargaining system coexists with an independent individual wage agreement system between workers and employers. In summary, the Eurozone's core countries are distinguished by distinct approaches to labor market arrangements and industrial links, such as Germany's monetary policy influence, Belgium's unique labor market regulation, France's centralized industrial relations system, and Denmark's "flexicurity" model, which combines contract flexibility with social security guarantees.

2.5.2 EMU Periphery

The South periphery comprises four countries. Firstly, Spain, where the presence of a national minimum wage, along with initial increases in job market flexibility in the aftermath of the crisis, has been accompanied by recent efforts to introduce new forms of permanent employment. Secondly, Italy, where labor market relations are characterized by a dualism between collective bargaining and company- and sector-specific agreements, and the absence of a formal minimum wage at the national level. Thirdly, Greece, experienced significant changes in labor market regulations after the crisis, resulting in increased job precarity and enhanced flexibility in employment contracts. Lastly, Portugal, where recent labor market regulations have aimed to reduce wage segmentation historically fueled by sector-specific bargaining, coupled with a nationally updated annual minimum wage.

2.6 Variables and Sources

The data used in the model are measured quarterly and cover the period from the first quarter of 2000 to the fourth quarter of 2019. The choice of this sample period is motivated by the desire to study the effects of the Euro Area since its inception, encompassing the 2008 and 2013 crises, while excluding the noise caused by the structural break resulting from the COVID-19 pandemic, which is beyond the scope of this paper. The sample period is divided into two breaks to account for the change in the ECB's approach to crises during the Draghi presidency in 2010. The structural break test reported in Appendix A1 confirms that the Euro Area's economic structure is significantly different before and after the introduction of unconventional monetary policy tools in the ECB's toolbox. Therefore, it is appropriate to study the structural reaction of the Euro Area economy to shocks using both structures and referring to the two different sample periods.

The model used in the empirical design includes four variables, all of which are seasonally and calendar-adjusted and transformed into their first stationary form. The stationarity tests for all time series used in the model are reported in Appendix A2. The first variable is per capita Real Gross Domestic Product (RGDP), obtained from OECD data, measured as the first difference in the growth rate relative to the same period of the previous year (*OECD* 2023). The second variable, which plays a central role in the shock propagation model, is the long-term interest rate derived from OECD data, representing country-specific 10-year government bonds. The interest rates reflect the prices at which government bonds are traded in financial markets, with guaranteed repayment by the respective governments. The long-term interest rates are computed as the first differences of percentages (*OECD* 2023). The third variable is the Employment rate, measured using OECD data as the first difference in the number of employed individuals aged 25-54, regardless of the sector, divided by the registered population in thousands, multiplied by one hundred (*OECD* 2023). The fourth and final variable is the Labor cost index, obtained from Eurostat, measured as the first difference of the NACE 1 and NACE 2 indexes. The index represents wages in both industry and services, excluding activities carried out by foreigners, focusing on country-specific cross-sector labor market dynamics (*Labour cost index by NACE Rev. 1.1 activity - nominal value, quarterly data* 2023; *Labour cost index by NACE Rev. 2 activity - nominal value, quarterly data* 2023).

2.7 Time Series Evolution

This subsection presents the time series depicting the evolution of the four key variables in the model throughout the sample period for the Core and the South Periphery regions, as compared to the European average.

2.7.1 Employment Rate

Figure 1 below illustrates the employment rate. It is evident that Belgium exhibits higher volatility compared to the other three core countries, except for the post-2008 crisis period when Denmark's job market experienced severe downturns, reaching unprecedented lows among the group during both crises. The increased volatility in Belgium can be attributed to enhanced market flexibility in the post-crisis period. In terms of levels, Germany consistently maintains a higher employment rate throughout the entire sample period, while France closely aligns with the European average.

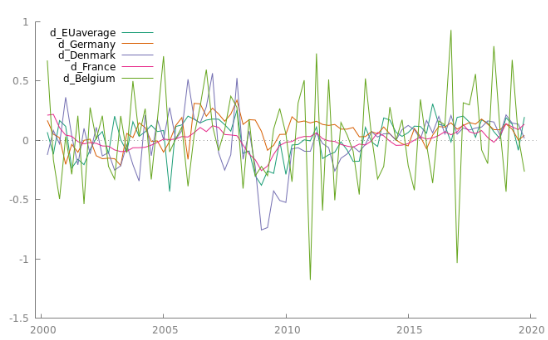

Figure 1: Employment Rate Core
Source: OECD data and author's calculations

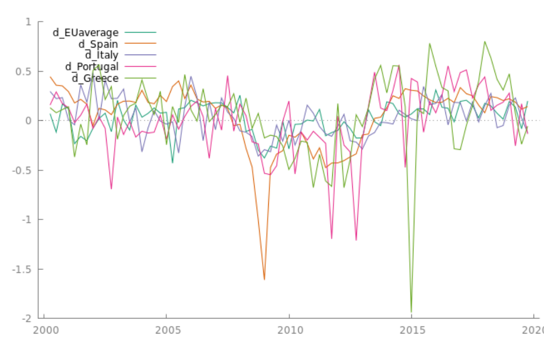

Figure 2: Employment Rate Periphery
Source: OECD data and author's calculations

On the other hand, Figure 2 above on the right showcases the dynamics of the employment rate in Southern European countries. Italy appears to exhibit greater synchronization with the European average. Interestingly, Spain faced the highest costs in terms of increased job market volatility during the crisis. Prior to the crisis, Spain had a higher employment level but experienced a significantly lower peak compared to the other three countries in the South Periphery. Greece, on the other hand, reached its lowest point following the debt crisis around 2015, driven by austerity measures imposed through common refinancing programs that limited the role of the state in the market and depressed the public employment sector. This resulted in historically high levels of unemployment. Portugal's trajectory is more similar to Italy and the European average, but it is notable that it reacted more sharply to the medium-term effects of the 2008 crisis and the short-term effects of the 2013 debt crisis, experiencing downward movements mostly between the two crises.

Overall, the literature suggests that all regions, particularly those affected by current account position crises in 2013, witnessed increased volatility in job markets starting in 2015 when the crisis itself was almost over but the labor market consequences had just started to be visible. This period was characterized by efforts to reduce public expenditure to comply with common public finance requirements and address decreased returns on government bonds caused by international investors' declining confidence in the governments´ solvency.

To provide a comprehensive overview, Figure 3 above presents the aggregate time series evolution of the two macro-regions in comparison with the European average.

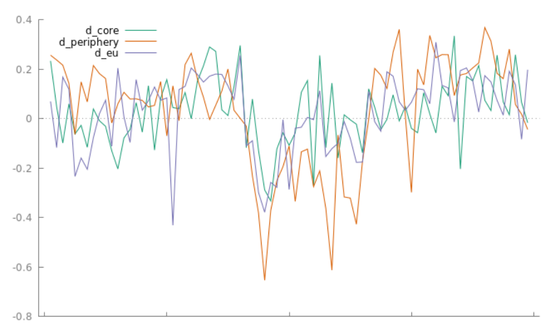

Figure 3: Employment Rate Aggregates
Source: OECD data and author's calculations

It is evident that the Core region experienced higher volatility between 2000 and 2005.

However, since the 2008 crisis, the South Periphery aggregate has witnessed unprecedented downward peaks, exceeding both the European average and the Core region. Nonetheless, there seems to be an improvement in synchronization between the two regions' job markets in terms of quantities after 2015, indicating that the lack of synchronization can be attributed to the different reactions of the regions to the crisis.

2.7.2 Labor Cost Index

Moving on to the evolution of prices in the labor market, Figures 4 and 5 below present the comparative time series of the Labor Cost Index. This index, developed by Eurostat, aims to harmonize hourly wages across different sectors in European member and candidate countries. It is primarily influenced by country-specific wage regulations that traverse various wage bargaining structures. Many regulatory aspects are related to the impact of job market-related policies within the diverse political scenarios of member states.

Examining Figure 4 on the right, it is observable that there have been comparative changes in the degree of volatility across the two depression periods. Belgium experienced higher peaks and deeper lows before the crisis but stabilized labor costs through crisis measures. During the post-crisis period, Belgium was replaced by Germany, which subsequently encountered increased volatility compared to the rest of the group. This substitution can be explained by the different crisis reaction approaches, with Germany moving towards flexibility while Belgium adopted a more protective approach towards workers' wages. In terms of labor market quantities, France appears to be closely aligned with Europe, while Denmark stands out with more extreme peaks and lows during the 2008 crisis, demonstrating a higher degree of reactivity.

In Figure 5 on the left, the core countries are depicted, exhibiting a larger range of variability in labor costs. Throughout the entire sample period, Greece consistently faced the highest level of volatility, resulting in workers experiencing significant fluctuations in the market value of their job performances and encountering reduced labor market stability.

Figure 4: Labor Cost Index Core
Source: Eurostat data and author's calculations

Figure 5: Labor Cost Index Periphery
Source: Eurostat data and author's calculations

Portugal also exhibits more movement compared to Italy and Spain, which are closer to the European average levels. However, Spain exhibited increased volatility between 2011 and 2013 during the initial phases of the debt crisis.

Figure 6: Labor Cost Index Aggregates
Source: Eurostat data and author's calculations

Figure 6 provides a comparative view, showing that before 2008, the Periphery, largely driven by Greece, was the only aggregate among the three that demonstrated volatility above plus or minus 0.5 at a quarterly frequency. However, since the 2008 crisis, the European average has started to react more markedly to shocks, and compared to the European average, the Core region has exhibited a higher degree of stability throughout the aftermath of both crises included in the sample period.

2.7.3 Long Term Interest Rate

Figure 7 on the right depicts, the evolution of the long-term interest rate in the Core of the EU revealing a higher level of synchronization compared to other labor market variables. Turning our attention to Figure 9, which depicts the Core and Periphery together, I observe a notable disparity in the scales of the two graphs. While from Figure 8 on the left is observable how the Periphery, with Greece being a prominent example, experienced peaks and lows during the period surrounding the 2013 crisis that was unparalleled by any other country in the sample. Conversely, Spain exhibited greater reactivity during the 2008 crisis.

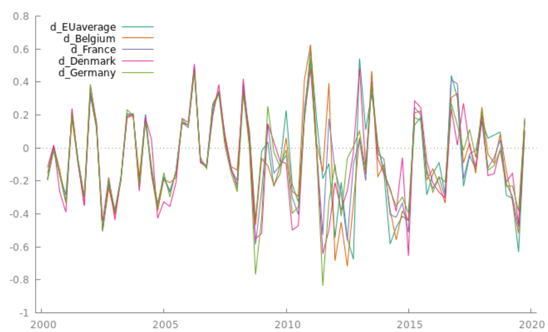

Figure 7: Long Term Interest Rate Core
Source: OECD data and author's calculations

Figure 8: Long Term Interest Rate Periphery
Source: OECD data and author's calculations

Examining the comparative aggregate picture before the 2008 crisis, it becomes evident that there was a high level of synchronization, as indicated by the scale displayed on the graph. However, the subsequent lack of synchronization persisted until 2018, when all three aggregates experienced a simultaneous cyclical downturn. Analyzing the duration and depth of these swings in both dimensions, it appears that the periphery exhibited a more pronounced and prolonged crisis response.

Looking at the comparative aggregate picture, in Figure 9 above, before the 2008 crisis the synchronization appears to be complete if looked at the scale appearing on the graph, while the subsequent lack of sync seems to be lasting until 2018 when all three aggregates

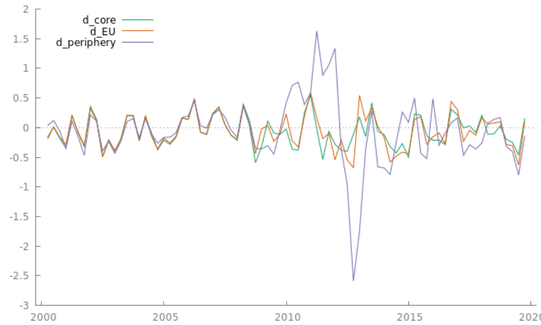

Figure 9: Long Term Interest Rate Aggregates
Source: OECD data and author's calculations

went through the same cyclical downswing. Looking at the time extension of the swings and their depth on both dimensions the periphery seems to have a more pronounced crisis response that lasted more in time.

2.7.4 Real Gross Domestic Product per Capita

Moving on to the variable of Real Gross Domestic Product per Capita (RGDP), which is widely recognized as an indicator of economic integration and closely monitored by common institutions, Figure 12 illustrates its time series evolution. Figures 10 and 11 depict the movement of country-specific variables, wherein it is observed that all variables tend to move in close alignment, except for Greece in the periphery. Greece experiences deeper and more frequent fluctuations compared to its Southern neighbors, consistent with previous literature. Another observation from Figure 11 is that Portugal and Italy closely follow the EU average, while Spain exhibits more fluctuations but still not to the extent of Greece.

On the right side in Figure 10, a notable trend emerges: for the first time in this comparative analysis, the Core region has a larger scale range compared to the periphery, indicating more significant upswings. Specifically, Germany leads this trend, experiencing the deepest fluctuations among the countries depicted in the graph, albeit consistently within the same cycle. Denmark appears to be the least synchronized among them, both before and after the two crises.

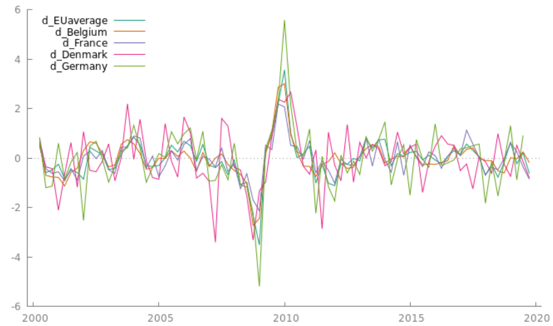

Figure 10: Real GDP per capita Core
Source: OECD data and author's calculations

Figure 11: Real GDP per capita Periphery
Source: OECD data and author's calculations

Commenting on the comparative aggregate evolution of Real Gross Domestic Product per Capita (RGDP), several observations can be made. Firstly, it is evident that the swings in the periphery during the debt crisis had higher frequency and shorter duration compared to other periods. Specifically, the downturn in 2011 was exclusive to the South Periphery and was not experienced by either the Core or the EU average. This indicates a distinct pattern of economic performance within the currency union during times of crisis.

Overall, it can be observed that the synchronization of business cycles before and after the crisis is relatively similar, suggesting that the cycles are in sync during regular economic conditions. However, during times of crisis, the shocks can be perceived differently in different parts of the currency union.

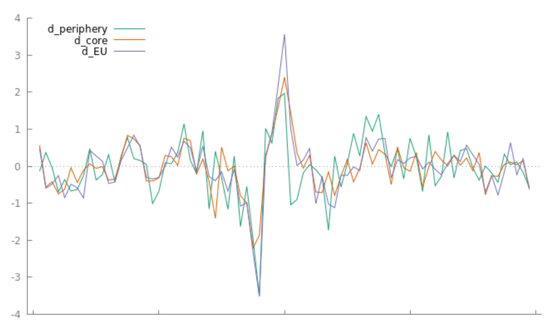

Figure 12: Real GDP per capita Aggregates
Source: OECD data and author's calculations

In conclusion, analyzing Figures 1 to 12, it is evident that the synchronization of labor market variables is lower compared to business cycles. Additionally, prices in the labor market exhibit greater asymmetry than quantities in the labor market.

3 Empirical Approach

To study the co-evolution and reciprocal influence of Real Gross Domestic Product, Short Term Real Interest Rate, Quantity, and Prices in the Southern European labor market with respect to the Euro Area Core a Structural Vector Autoregressive Model (SVAR) is applied. The aim of the empirical strategy is to try to identify in the more near to causal fashion possible the heterogeneity in the response to shock between the EA Core, which is the one which reports that the common monetary policy is most closely calibrated, and the Periphery of European countries. Specifically, the focus is on the South periphery: Italy, Portugal, Spain, and Greece and the mechanism that the model aims to isolate is the Cost channel. The goal is to identify which are the compensating forces in place in the job market to make up for the lack of a common fiscal policy in front of a common monetary policy that cannot accommodate potentially different shock responses.

The core of the model on which the identification strategy is relying is the causal chain imposed by the SVAR that has been chosen by the author to follow as close as possible both Neo-Keynesian economic theory and the intuitions on the economic reality in the last twenty years as reported by the literature and the policy briefs of the common European institutions. The rest of the section proceeds as follows: firstly the SVAR model is presented formally, then the identification strategy and the assumptions coming with it are explained, afterward the grounding of the causal chain behind the model is presented and the section concludes with the potential gaps of the strategy and the alternative mechanisms to the proposed one.

3.1 Cholesky SVAR

I start by defining W_t as a vector column of stochastic process representing the evolution over time of the four variables of interest as reported below in Equation 1.

$$W_t = \begin{pmatrix} U_{RGDP,t} \\ U_{INT,t} \\ U_{EMP,t} \\ U_{LCI,t} \end{pmatrix} \tag{1}$$

Then I specify a SVAR B-model as follows:

$$W_t = \mu + \beta_1 W_{t-1} + u_t \tag{2}$$

Where $\mu = 4X1$ is a constant, $\beta_j = 4X4$ are matrices of autoregressive parameters, $j = 1, ..., n$ is the VAR lag order determined using the Akaike Information Criteria, and $U_t = (u_{GDP,t}, u_{INT,t}, u_{EMP,t}, u_{LCI,t})$ is a vector of VAR disturbances, uncorrelated over time and forecast errors, that represents the part of W_t that cannot be explained by past information.

The vector of errors must satisfy the following three conditions: firstly $E(u_t) = 0$, secondly $E(u_t u_t') = \Sigma_u$ and lastly $E(u_t u_{t_k}') = MXM$ and is a positive definite for $k = 1, 2...$

If it satisfies the conditions above then the vector of disturbances can be decomposed into:

$$u_t = B \times \epsilon_t \tag{3}$$

Where: $\epsilon_t = 4X1$ is a vector of structural shocks, and $B = 4X4$ is a matrix containing the structural parameters that is the key for my identification strategy.

In this way by decomposing it is assumed that the VAR disturbances u_t are a linear combination of the structural shocks ϵ_t through the matrix B that is governing the channel through which the structural shocks are transmitted to the variables.

Now from the estimation of the first SVAR specified above the residuals of the model can be estimated as follows :

$$u_t = W_t + \mu + \beta_1 W_{t-1} \tag{4}$$

From the residual I obtain the VAR covariance matrix :

$$\Sigma_u = E(u_t u') \tag{5}$$

At this point, it is necessary to make some assumptions on the vector of structural shocks ϵ_t:

$$\epsilon_t = \begin{pmatrix} \epsilon_{RGDP,t} \\ \epsilon_{INT,t} \\ \epsilon_{EMP,t} \\ \epsilon_{LCI,t} \end{pmatrix} \tag{6}$$

Each shock must have unit variance and be orthogonal, uncorrelated, with the other shocks. Having in this way:

$$Var(\epsilon_t) = E(\epsilon_t \epsilon_t') \tag{7}$$

Proceeding with the Cholesky decomposition the order of the variables is going to determine the causal chain underlying the shock transmission between the variables, so the variables are going to be ordered in an ascending way on the basis of their level of endogeneity to the model. So the first variable is going to be the more exogenous and the last one is the less exogenous.

Given the relationship : $B = \widehat{B}$ I specify :

$$
\begin{pmatrix} U_{RGDP,t} \\ U_{INT,t} \\ U_{EMP,t} \\ U_{LCI,t} \end{pmatrix} = \begin{pmatrix} b_{RGDP,RGDP} & 0 & 0 & 0 \\ b_{INT,RGDP} & b_{INT,INT} & 0 & 0 \\ b_{EMP,RGDP} & b_{EMP,INT} & b_{EMP,EMP} & 0 \\ b_{LCI,RGDP} & b_{LCI,INT} & b_{LCI,EMP} & b_{LCI,LCI} \end{pmatrix} \cdot \begin{pmatrix} \epsilon_{RGDP,t} \\ \epsilon_{INT,t} \\ \epsilon_{EMP,t} \\ \epsilon_{LCI,t} \end{pmatrix} \quad (8)
$$

3.2 Causal Chain

The above-mentioned specified model implies the following causal chain:

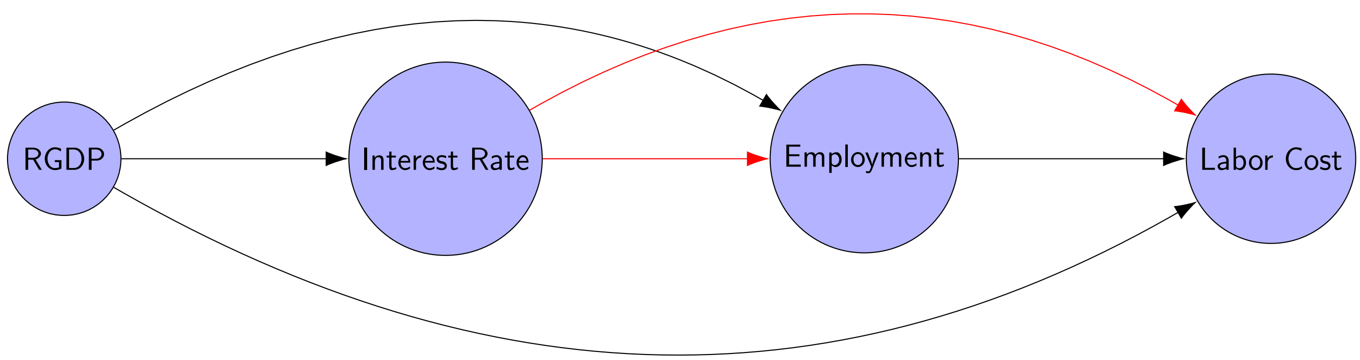

Figure 13: Implied Causal Chain for the SVAR model

- **Shocks to RGDP immediately affects Long-term Interest rate** : An increase in domestic output can prompt central banks to raise short-term interest rates to manage inflation. This association finds support in neoclassical models, particularly the New Keynesian model, which incorporates a central bank that follows Taylor's rule alongside country-specific premia. The impact of the short-term interest rate on the long-term interest rate can occur through various channels.

  Firstly, there is a mechanical effect where an increase in the cost of borrowing money raises interest rates across different maturity periods. Alternatively, it could be attributed to market demand, where investors shift their focus from short-term investments to longer-term maturities, resulting in changes in long-term interest rates. Another factor at play is the signaling effect of the central bank's setting of short-term interest rates, influencing investors' expectations regarding future monetary policy. Additionally, changes in the term premia, which reflect the further compensation that investors demand holding longer-term securities, can also contribute to the relationship between short-term and long-term interest rates. These factors collectively shape the relationship between short-term and long-term interest rates in empirical analysis.

- **Shocks in the Long-term Interest Rate immediately affects Employment rate** :

  A change in the interest rate, made with the intention to stabilize the economy, will cause a change in the cost of credit. Firms rely on credit for both business operations and payroll, therefore a change in the cost of credit will affect the budget allocated for the cost of labor. This relationship between the shocks can be framed in the so-called Cost Channel empirically documented by the literature.

- **Shocks in the number of Employed affects immediately the Cost of Labor** :

  This nexus is supported by the shreds of evidence on the effect of a change in the number of workers in the economy on the level of competition between workers and as a consequence their bargaining power in wage negotiations and therefore in the determination of the Labor Cost.

In all the steps mentioned above immediately is to be interpreted as from one quarter to the next one and all the connections that are not mentioned are not excluded absolutely but just ruled out in the short run. Specifically, the focus of the analysis is on the arrows depicted in red in Figure 17 above, indicating the connections between Long term Interest rates and Labor market prices and quantities.

More formally the causal chain in the model is realized as follows:

- RGDP shocks : $E_{GDP,t}$ is affecting contemporaneously

$$\begin{pmatrix} U_{RGDP,t} \\ U_{INT,t} \\ U_{EMP,t} \\ U_{LCI,t} \end{pmatrix} \tag{9}$$

through $b_{RGDP,RGDP}, b_{RGDP,INT}, b_{RGDP,EMP}, b_{RGDP,LCI}$

- Long term Interest Rate shocks: $E_{INT,t}$ is affecting contemporaneously

$$\begin{pmatrix} U_{INT,t} \\ U_{EMP,t} \\ U_{LCI,t} \end{pmatrix} \tag{10}$$

through $b_{INT,INT}, b_{INT,EMP}, b_{INT,LCI}$

- Employment level shocks : $E_{EMP,t}$ is affecting contemporaneously

$$\begin{pmatrix} U_{EMP,t} \\ U_{LCI,t} \end{pmatrix} \tag{11}$$

through $b_{EMP,EMP}, b_{EMP,LCI}$

- Labor Cost shocks: $E_{LCI,t}$ is affecting contemporaneously

$$\begin{pmatrix} U_{LCI,t} \end{pmatrix} \tag{12}$$

through $b_{LCI,LCI}$

In this way :

$$\widehat{B} = \begin{pmatrix} b_{RGDP,RGDP} & 0 & 0 & 0 \\ b_{INT,RGDP} & b_{INT,INT} & 0 & 0 \\ b_{EMP,RGDP} & b_{EMP,INT} & b_{EMP,EMP} & 0 \\ b_{LCI,RGDP} & b_{LCI,INT} & b_{LCI,EMP} & b_{LCI,LCI} \end{pmatrix} \tag{13}$$

And

$$u_t = \widehat{B}\epsilon_t \tag{14}$$

where $\widehat{B}$ is the Cholesky factor of the

$$\Sigma_u = \widehat{B}\widehat{B}'$$

covariance matrix.

Identification Assumptions

By using a Cholesky SVAR model I aim to identify the coefficients in the lower triangle of the coefficient matrix, this comes from the imposition of a series of **identification assumptions** that come from economic theory:

The RGDP shocks affects instantaneously all the other variables but are not contemporaneously affected by shocks in other variables:

This means that firstly $b_{LCI,RGDP} = 0$ and this assumption is relying on the fact that if there is a shock in the cost of labor this is going to affect aggregate expenditures in the next quarter and not those in the same one. This assumption could be contradicted only by the fact that the Wage change is expected and there is an anticipatory effect, although this scenario seems to be unrealistic in the framework I proposed due to the fact that the shocks are framed to be exogenous and unexpected, although it is true that the assumption is limiting the range of scenarios in which the model is fitted. It also means that secondly

$b_{EMP,RGDP} = 0$ I assume that a shock in the number of employed, either because of a movement from inactive to the active labor force or because of a share of workers moving to another country is not going to be the cause of a shock in GDP, but that instead, the opposite will happen, this is supported by extensive previous literature and is also intuitive how the labor market responds to changes in the output and is harder than a labor market change is exogenous to a previous RGDP change. Then lastly I am also assuming that $b_{INT,RGDP} = 0$, and this is consistent with almost any empirical results on monetary policy in the last 30 years reporting that there is a lagged effect of interest rate changes on the domestic product due to the time employed by the policy to have a tangible effect on the real economy.

Long-term Interest rate changes affect instantaneously Employment and Labor cost index shocks and are contemporaneously affected only by RGDP shocks:

So formally, $b_{EMP,INT} = 0$ and $b_{LCI,INT} = 0$. This means that I assume that if there is a Monetary shock it is not going to be contemporaneously affected by a shock in the labor market quantities and prices. This is supported by the past empirical evidence on the lag needed for monetary policy to affect labor market real economy variables, in addition to the proofs around the wage stickiness and the presence of a time span needed for workers to move from one country to another in the case that the quantity change is generated by a mobility mechanism.

The Employment level affects instantaneously the Labor Cost and is affected contemporaneously by RGDP and Long term Interest rate shocks:

This can be formally translated in the assumption that $b_{LCI,EMP} = 0$, that is relying on the fact that if a change in the Employment levels is representing a shortage or a surplus in the number of workers in the economy and this will drive the labor and demand to adjust on new equilibria of prices in the short run, especially for firms without large inventories, the opposite is harder due to the fact that more time is required for workers to move or exit the labor force.

The Labor Cost Shocks are therefore contemporaneously affected by all the

variables but are not affecting directly any of the variables in the short run

Out of all these assumptions those on which this study puts more emphasis are those related to the relationship between the Long term interest rate and the labor market variables and the ordering between labor market quantities and prices can be discussed and contradicted, while I argue that the ordering between the RGDP, the Interest rate, and the Labor market is as described above. In the identification of a Cholensky SVAR, the order of the variables is crucial because together with the reduced covariance matrix this is what is determining the uniqueness of the Cholensky factor of the B matrix of parameters. Therefore the above-mentioned order is sitting the causal identification of the mechanism that the study is aiming to isolate.

Necessary and Sufficient condition for Local Identification

The model is identified if it is possible to recover the structural shocks uniquely from the reduced form errors.

$$b = m = (1/2)M(M+1) \tag{15}$$

Which is equivalent to :

$$l = (1/2)M(M-1) \tag{16}$$

And means that the number of free elements in the B matrix (b) should be the same as the free elements of the variance-covariance matrix Σ_u. In other words, the number of independent shocks that can affect the system should be equal to the number of endogenous variables in the model.

3.3 Impulse Response Functions

Once the b coefficients are estimated from the data I can use them to compute the Impulse Response functions of one variable (j) to a one-unit shock to another variable (i) in a horizon h as :

$$IRF_j, i(h) = b_j, i(1), b_j, i(2), ..., b_j, i(h) \tag{17}$$

To compute the first a vector of given initial shocks is created for each of the possible IRFs that can be estimated as follows: $z_1 = (1, 0, 0, 0)$, $z_2 = (0, 1, 0, 0)$, $z_3 = (0, 0, 1, 0)$, $z_4 = (0, 0, 0, 1)$

Then these vectors are multiplied with the b coefficients to propagate the starting unit shocks forward in time so there will be the following: $z_t + 1 = (B)(z_t)$ given that the optimal lag is defined to be 1.

The necessary and sufficient conditions for identifications are supported by the seminal contribution of Christiano et al. [1999] that explains in detail how there is reasonable grounding to believe that there is no feedback from the bottom of the proposed causal chain to the top of it in the short run. Christiano et al. [1999] also reports how there is empirical consensus robust across a series of different identification strategies on the fact that the ordering of the three main categories in the analysis is realistic in terms of qualitative impact of monetary policy shocks: monetary policies then quantities in the labor market and then prices in the labor market.

The side on which the causal chain is weaker is one concerning the ordering of the first two variables, i.e. Long term interest rate and RGDP. In fact, if a reader would have enough reasons to believe that the RGDP is reported by the statistical offices with a delay then it could be true that it could incorporate a short-term impact of changes in the interest rate, although to especially mitigate this potential concern the long term interest rate has been chosen.

To estimate the aggregate Impulse Response Function for the three groups, the Euro Area, the Core, and the Periphery the Cholensky SVAR is transformed into a Triangular SVAR so that the standard deviation appearing in the diagonal of the Cholensky B Matrix is extracted and the diagonal of the B matrix is made of 0s: in this way, the Aggregate

Impulse Response Function is going to be interpretable in terms of responses to a one unit change instead of responses to a one standard deviation change. The SD measure would be a measure that depends on the variance in the data and using an aggregate would imply that the variance in each country is different and therefore the SD is not of intuitive interpretation. More formally this means that with the Triangular decomposition I start from the Cholensky factor:

$$\Sigma_u = \begin{pmatrix} b_{RGDP,RGDP} & 0 & 0 & 0 \\ b_{INT,RGDP} & b_{INT,INT} & 0 & 0 \\ b_{EMP,RGDP} & b_{EMP,INT} & b_{EMP,EMP} & 0 \\ b_{LCI,RGDP} & b_{LCI,INT} & b_{LCI,EMP} & b_{LCI,LCI} \end{pmatrix} \tag{18}$$

$$\times \begin{pmatrix} 0 & 0 & 0 & b_{RGDP,RGDP} \\ 0 & 0 & b_{INT,INT} & b_{INT,RGDP} \\ 0 & b_{EMP,EMP} & b_{EMP,INT} & b_{EMP,RGDP} \\ b_{LCI,LCI} & b_{LCI,EMP} & b_{LCI,INT} & b_{LCI,RGDP} \end{pmatrix} \tag{19}$$

And then to isolate the diagonal that is made by the standard deviation of the variables is the shock of a variable on itself:

$$\Sigma_u\& = \begin{pmatrix} 1 & 0 & 0 & 0 \\ b_{INT,RGDP} & 1 & 0 & 0 \\ b_{EMP,RGDP} & b_{EMP,INT} & 1 & 0 \\ b_{LCI,RGDP} & b_{LCI,INT} & b_{LCI,INT} & 1 \end{pmatrix} \tag{20}$$

$$\times \begin{pmatrix} b_{RGDP,RGDP} & 0 & 0 & 0 \\ 0 & b_{INT,INT} & 0 & 0 \\ 0 & 0 & b_{EMP,EMP} & 0 \\ 0 & 0 & 0 & b_{LCI,LCI} \end{pmatrix}$$

$$\times \begin{pmatrix} 0 & 0 & 0 & 1 \\ 0 & 0 & 1 & b_{INT,RGDP} \\ 0 & 1 & b_{EMP,INT} & b_{EMP,RGDP} \\ 1 & b_{LCI,EMP} & b_{LCI,INT} & b_{LCI,RGDP} \end{pmatrix}$$

In this way, the matrix in the diagonal matrix contains the standard deviation and the new $\widehat{B}$ can be used to derive aggregate IRFs interpretable in terms of unit changes.

3.4 The Cost channel Hypothesis

The primary objective of this study is to investigate and analyze potential asymmetries in the functioning of the Cost Channel between countries in the Core region of the Eurozone and those in the South Periphery. The Cost Channel refers to a specific mechanism through which alterations in borrowing costs translate into effects on the labor market. The hypothesis put forward by the author suggests that this mechanism operates differently in the two regions, as supported by existing literature (Gaiotti et al. 2006). By delving into the dynamics of borrowing costs and their impact on the labor market, this research seeks to provide valuable insights into the underlying mechanisms driving economic outcomes in the Core and South Periphery countries of the Eurozone.

4 Findings and Discussion

The impulse response functions (IRFs) of interest given the mechanism that the study aims to identify are those indicating the response of the Labor Cost Index and of the Employment Rate to a unit shock in the Long term Interest Rate. Therefore the rest of this section presenting and discussing the study's findings is organized as follows: the IRF of the Core, South Periphery, and EU average are reported in this order for the two structural breaks, before and after 2010, firstly for the response to a unit shock of Long Term Interest Rate on labor market quantities and then on labor market prices. Then to conclude the section the study's main limitations are discussed with a particular emphasis on the potential biases generated by the presence of confounding endogenous factors in the determination of Long term Interest Rates.

On a practical technical note, the impulse response functions reported below have been estimated on a 20-period forecast horizon with 67 percent, one standard deviation, and confidence interval reported in gray with intervals bootstrapped 1999 times, and they are estimated starting from SVAR models estimated with a constant and using HAC standard errors with one lag.

4.1 Response of Employment to Long-term Interest Rate Shocks

It can be observed in Figures 14 and 15 below how the response of the Employment rate in the Core for a one unit shock of Long term Interest Rate is non-significantly different from zero both before and after 2010 indicating a weak relationship between the labor market quantities and the long term interest rate constant across the crisis' period.

The only difference that can be noted is that the response goes to zero with complete certainty after 2010 two to three-quarters later. This could be a mild indicator of a better labor market integration that is absorbing the labor market quantity effect faster in the more integrated post-2010 European labor market.

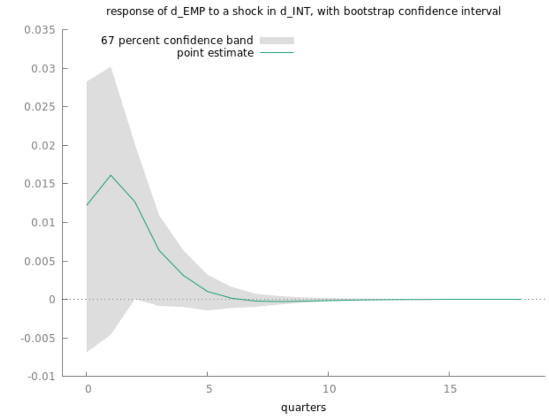

Figure 14: Core Aggregate IRF - Employment Rate to Long-term Interest Rate - Before 2010

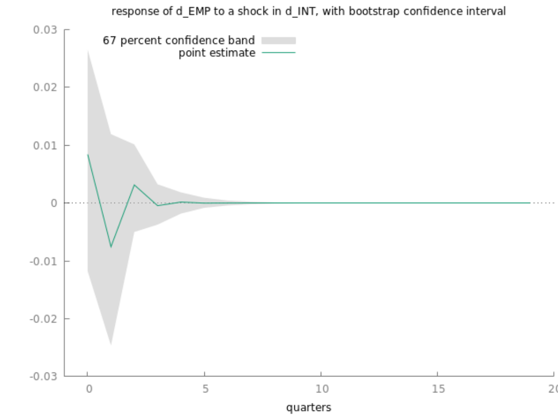

Figure 15: Core Aggregate IRF - Employment Rate to Long-term Interest Rate - After 2010

While in the South Periphery is observable in Figures 16 and 17 show before 2010 the confidence interval is very large indicating a lack of significance in the response of the Employment rate to a unit shock in Long term interest rate, or potentially a lack of fit in the model to explain the structure of the pre-2010 economy. But, in the aftermath of the crisis post-2010, there is a significant negative response of labor market quantities lasting one year and a half, approximately 10 quarters, before approaching zero.

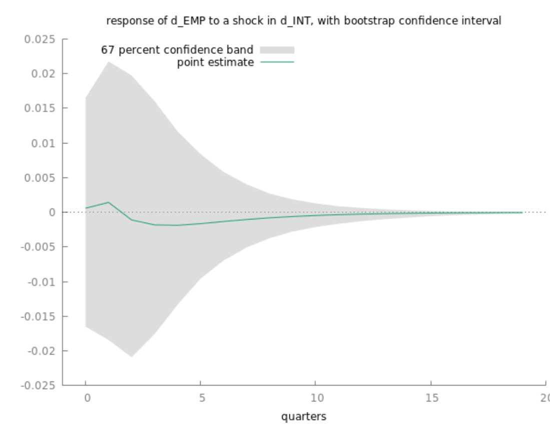

Figure 16: South Periphery Aggregate IRF - Employment Rate to Long-term Interest Rate - Before 2010

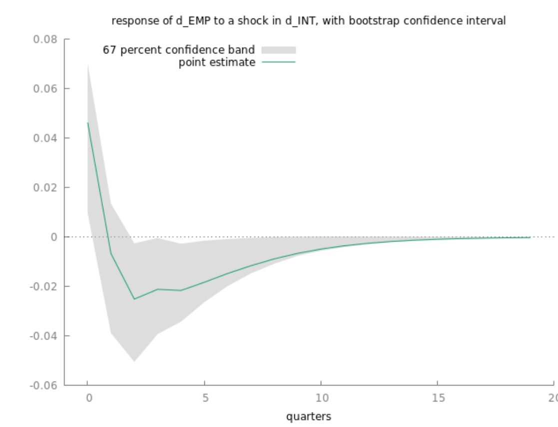

Figure 17: South Periphery Aggregate IRF - Employment Rate to Long-term Interest Rate - After 2010

What the change from before to after 2010 is indicating is that something in the structure of the economy has evolved across the crisis generating a greater deal of responsiveness in employment quantities for the South Periphery that is not found in a similar fashion in the core. It could be due to the presence of different monetary policy tools with more grounding to the real economy in the toolbox of the European Central Bank or it could be due to the presence of larger swings in correspondence to the debt crisis in the region that have fueled a larger deal of labor mobility which in turn had a negative impact of employment rates.

When turning to the effect of a unit shock in the Long term Interest Rate on the European average of Employment rate a different situation can be observed: where before 2010 the response seems to be negative in the very short run, for one quarter, and then positive for the subsequent year going to 0 then with absolute certainty after a time span that is comparable to the ones of the Core and the South Periphery analyzed above.

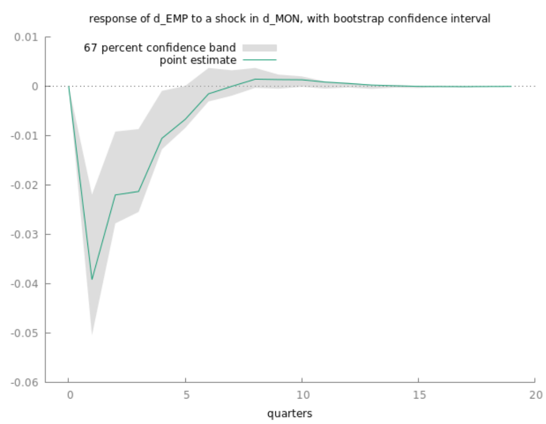

Figure 18: EA Aggregate IRF - Employment Rate to Long-term Interest Rate - Before 2010

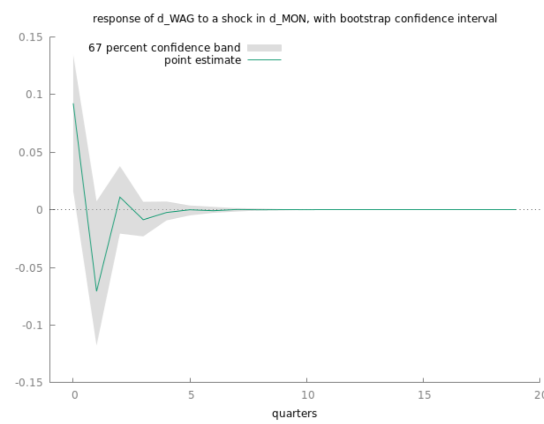

Figure 19: EA Aggregate IRF - Employment Rate to Long-term Interest Rate - After 2010

In the after-2010 period instead, the response appears to be comparable to the one of the South Periphery showing a negative correlation with the Interest rate shocks, but having a less long-lasting effect: it can be observed how the IRF is going to zero faster than in the South.

Summarizing the findings of the three aggregates it emerges how the Core has the less responsive market to Long term Interest Rate shocks in terms of quantities measured as employment rate. Following the Cost channel hypothesis this could be due to the presence of larger enterprises composing the structure of the economy that have larger inventories are less sensitive to volatility in the cost of borrowing and do not rely on payroll in the short run. Or it could also be that there are fewer established labor mobility channels to be activated in the quarters immediately following a shock in the interest rate. On the other hand, the findings highlights also that in the pre-2010 period, the EU average is the only one to have a significant, and positive, response to the unit shocks and this could be generated by the presence of newly entered just transitioned Central and Southern Eastern economies that experience a higher mobility rate and more general volatility in labor market quantities. Lastly, the finding that is more relevant to the study's research question is that an asymmetry emerges between the response of the Core and of the South Periphery in the post-2010 period, with the South experiencing an immediately negative correlation followed by a positive, less steep, response to shocks in the Long term Interest Rate. What could be argued starting from this is that there is more sensitivity to borrowing cost shocks in Southern Periphery indicating more dependency on external credit in the job market and potentially due to a market structure composed of smaller and less capital-intensive firms.

4.2 Response of Labor Cost to Long-Term Interest Rate Shocks

Stepping into the analysis of the response of the Cost of Labor to a unit shock in the Long term Interest Rate in Figure 21 below on the right is visible how the response for the Core before 2010 after being significantly negative for one quarter is positive for approximately three quarters to then go to zero.

After 2010 the Confidence Interval appears to be wider and the response is not significant at any point in the forecast horizon approaching zero at the same point, around one year and a half after the shock, as before 2010.

For the South Periphery as depicted below in Figure 22, the response of the Labor Cost before 2010 is significantly negative for one quarter to then become positive for two quarters in a similar way to the Core with the caveat of approaching zero with a concave shape faster.

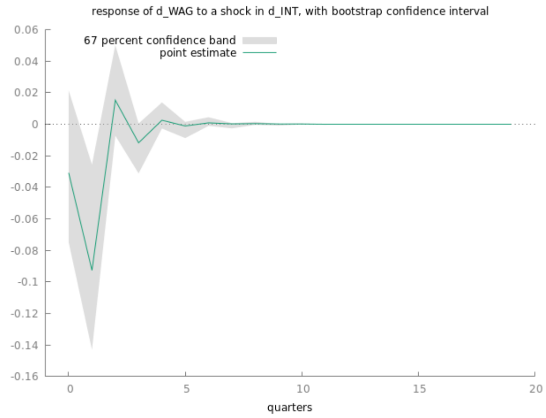

Figure 20: Core Aggregate IRF - Labor Cost to Long-term Interest Rate - Before 2010

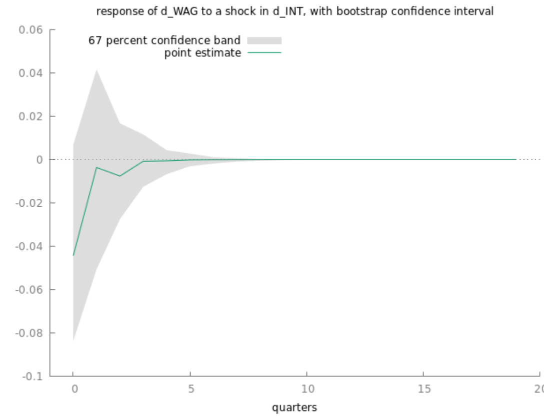

Figure 21: Core Aggregate IRF - Labor Cost to Long-term Interest Rate - After 2010

This is indicating that the monetary policy shock had a longer-lasting effect in the Core than in the Periphery.

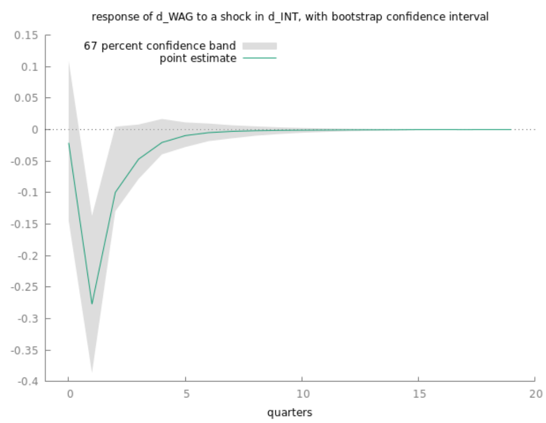

Figure 22: South Periphery Aggregate IRF - Labor Cost to Long-term Interest Rate - Before 2010

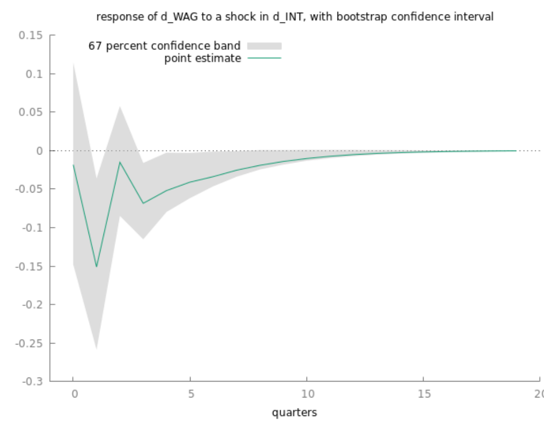

Figure 23: South Periphery Aggregate IRF - Labor Cost to Long-term Interest Rate - After 2010

While in Figure 23 reporting the response of the South Periphery after 2010 it is visible a more volatile evolution of the IRF showing a significant negative drop in both the second and the fourth quarter with a non-significant part in the middle. This could potentially show a form of seasonality in the cost of labor for countries with a strong service economy reacting during winter and summer quarters.

Lastly, on the right-hand side below in Figure 24, the EU response to the average Cost of Labor is showing a very different response evolution: having a strongly significant positive response in the first three quarters and then going down to approach zero around one year and a half after the shock.

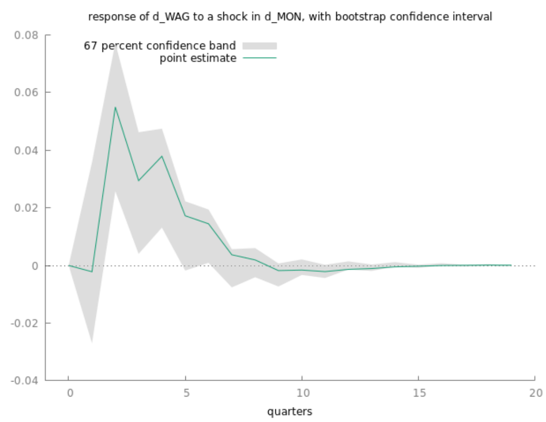

Figure 24: Euro Area Aggregate IRF - Labor Cost to Long-term Interest Rate - Before 2010

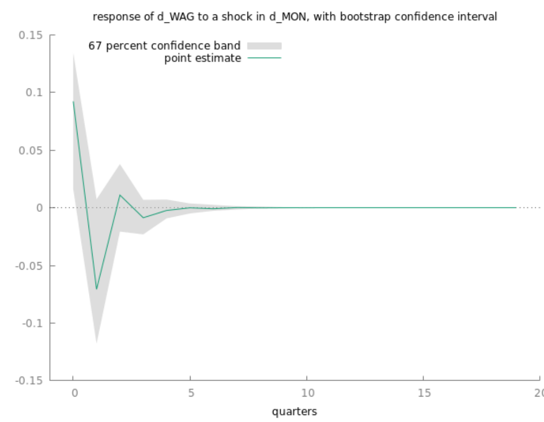

Figure 25: Euro Area Aggregate IRF - Labor Cost to Long-term Interest Rate - After 2010

On the right side, the after-2010 response in Figure 25 shows instead that the response is significantly different from zero only in the second quarter and is negative. It seems to overall indicate that the relationship between long-term interest rate and wage determination has weakened with time and across the two crises, potentially due to a more regulated common market, but this would be in contrast with the evidence reporting increased labor market flexibility in the after-crisis scenario.

Therefore on a comparative key, I observe that before 2010 Core and South Periphery had similar labor cost responses, being negative at first and then approaching c oncavely zero in the first year after the shock, while the EU average was driven by countries not in the two regions were reacting positively for the first year and a half before approaching zero. Then in the after-2010 structure, I observed that the response of the Core has weakened to the point of not being anymore significantly different from zero, while the response of the EU average is comparable to the one of the South periphery with the exception that the EU response is being exhausted with a negative response in the first quarter while the one of the South

Periphery is negative also in the fourth quarter.

4.3 Study's limitations and alternative mechanisms

The findings shown above are strongly dependent on the chosen causal chain that even if supported by many precedents in the literature could be reflecting better the mechanisms ongoing in one region with respect to those in another one and this is surely one of the main potential sources of bias in the results. Also, the measurement of the variables is largely depending on the use of indexes developed by Eurostat and OECD and the macro data are by definition prone to measurement error that could be additionally biasing the findings.

As an author, my foremost concern and the major limitation of this study is two-fold. Firstly, I am attempting to establish connections between multiple interconnected and complex phenomena, such as monetary policy and labor market outcomes, which are traditionally studied in isolation. This endeavor introduces inherent challenges and potential limitations in comprehensively capturing their interdependencies. Secondly, it is essential to recognize that within a currency union, despite the existence of a unified monetary policy, variations in interest rates across member countries can arise due to diverse factors. Therefore it is important to underline how there is an entire segment of literature dealing with the factors contributing to the determination of the long-term interest rate that is not the common central monetary policy and this should be clear when looking at the findings of this study. To underline this aspect and increase the transparency around the presence of country-specific differences in the Long term Interest Rate I reported the time series of the difference between each country in the Core and Periphery from the European Average.

In the figure is visible how the most different from the EU average in terms of the Long term Interest rate are Greece since the early 2000s and Spain since 2010 driving and how these two countries are most likely driving the results for the South periphery. It is also visible the reactivity of Denmark to the first part of the crisis in 2009 and how the difference between the EU average and the Italian interest rate increased in the late 2010s most likely

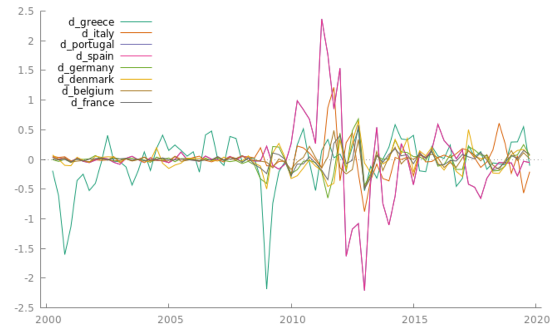

Figure 26: Country Premia in Long Term Interest Rate
Source: OECD data and author's calculations

due to the increased political instability and the medium-run consequences of the anti-crisis policies. Also between the other countries and the EU, there are differences, they are too small to be visualized on the same graph as the one reporting those of Greece and Spain.

5 Policy Perspectives

In terms of policy perspectives arising from the findings of this study, there are two main directions to address the lack of synchronicity in the evolution of labor market quantities and variables resulting from country-specific shocks to monetary policy and interest rates. Firstly, it appears that the Southern European labor market exhibits a higher level of responsiveness in both quantity and prices, which may indicate a stronger degree of labor market adjustment in these countries to compensate for the fluctuating country premia affecting long-term interest rates. To tackle this aspect of incomplete integration in the European Common labor market, the European Central Bank (ECB) could consider employing targeted monetary policy more frequently to offset the higher volatility in Southern European interest rates. By doing so, the ECB can mitigate the potential welfare and political costs associated with fluctuations in the labor market, which otherwise arise from movements in the EU average.

Another policy perspective stemming from the identified mechanism is to implement a series of Regional Development and Structural reforms aimed at reducing the significant differences in economic outlook and structure among EU member states. For instance, promoting economic diversification can enhance the resilience of labor markets to fluctuations in borrowing costs. Additionally, increased capitalization of medium-sized enterprises can generate revenue streams that are less dependent on international borrowing costs and more aligned with national financial equilibria. Another related policy approach involves fostering intra-European funding, which would decrease reliance on international borrowing costs and help compensate for asymmetries in country premia, without imposing significant social costs that could affect labor costs or labor quantities.

6 Conclusion

Concluding the study, I investigate the response of labor market quantities and prices to shocks in the long-term interest rate before and after 2010, focusing on two distinct macro-regions within the Euro Area. Employing a Structural Vector Autoregressive (SVAR) model with four variables, I analyze the period from the first quarter of 2000 to the fourth quarter of 2019. Our objective is to examine the presence of different labor market adjustment mechanisms in response to interest rate shocks in Southern European countries (Italy, Greece, Spain, and Portugal) and Core European countries (Germany, France, Belgium, and Denmark). I select these regions based on geographical proximity and similar economic outlook.

Regarding the response of employment levels to a unit shock in long-term interest rates in the post-2010 period, our main findings reveal an asymmetry. The South Periphery exhibits a significant negative response lasting six quarters, while the Core region shows no significant response, indicating a difference in labor market responsiveness between the two macro-regions. The employment reaction in the South Periphery aligns more closely with the European average, which likely drives the response.

Similarly, analyzing the response of labor market prices, measured as the cost of labor, to a unit shock in long-term interest rates in the post-2010 period, I find comparable patterns to those observed for labor market quantities. Both the Southern Periphery and the EU average display a negative and significant response, with the EU average exhibiting a shorter response time. In contrast, the Core region shows no significant response.

Overall, the study´s contribution is to provide novel evidence of the higher responsiveness in labor markets, in terms of both prices and quantities, for Southern European countries. This finding suggests an incomplete integration of the common European labor market. Additionally, these results indicate varying levels of sensitivity in labor markets to changes in borrowing costs, consistent with the presence of a cost channel that exerts a stronger effect in fragmented economies with smaller and less capitalized firms, relying more on international external credit.

Based on these findings, the study suggests potential policy actions aimed at enhancing labor market synchronization and mitigating asymmetries within the Euro Area. Long-term recommendations include the creation of a fiscal union or the completion of the banking union, as proposed in existing literature, which would help attenuate these asymmetries. In the short run, adopting a politically feasible perspective, targeted monetary policies and regionally-focused structural reforms that encourage economic diversification and promote intra-European investment are recommended. These measures aim to reduce the reliance on labor market quantities and prices as compensation mechanisms for asymmetries, which currently incur high social and welfare costs.

empty citation

References

Arpaia, A. et al. (2016). "Labour Mobility and Labour Market Adjustment in the EU". In: *IZA Journal of Migration* 5.1. URL: https://doi.org/10.1186/s40176-016-0069-8.

Bayoumi, T. and B. Eichengreen (1993). "Shocking aspects of European monetary integration". In: *Adjustment and Growth in the European Monetary Union*. Ed. by F. Torres and F. Giavazzi. Cambridge University Press.

Belke, Ansgar, Christian Dominick, and Daniel Gros (2017). "Business Cycle Synchronization in the EMU: Core vs. Periphery". In: *Open Economies Review* 28.5, pp. 863–892.

Campos, Nauro F. and Corrado Macchiarelli (2016). "Core and Periphery in the European Monetary Union: Bayoumi and Eichengreen 25 years later". In: *Economics Letters* 147.C, pp. 127–130.

Christiano, Lawrence J., Martin Eichenbaum, and Charles L. Evans (1999). "Monetary Policy Shocks: What Have We Learned and to What End?" In: *Handbook of Macroeconomics*. Ed. by John B. Taylor and Michael Woodford. 1st ed. Vol. 1. Elsevier. Chap. 2, pp. 65–148.

Corsetti, G. (2008). *A modern reconsideration of the theory of optimal currency areas*. Tech. rep. 6712. CEPR Discussion Papers.

De Grauwe, P. and W. Vanhaverbeke (1991). "Is Europe an Optimum Currency Area? Evidence from Regional Data". In: *Discussion paper* 555. URL: https://cepr.org/publications/dp555.

Dellas, H. and G. Tavlas (2005). "Wage rigidity and monetary union". In: *Economic Journal* 115, pp. 907–927. DOI: 10.1111/j.1468-0297.2005.01024.x.

Dhéret, C. et al. (2013). *Making progress towards the completion of the single European labour market (EPC Issue Paper 75)*. Tech. rep. European Policy Centre (EPC).

Druant, Martine et al. (2012). "Firms' Price and Wage Adjustment in Europe: Survey Evidence on Nominal Stickiness". In: *Labour Economics* 19.5, pp. 772–782.

Erceg, C. J., D. W. Henderson, and A. T. Levin (2000). "Optimal monetary policy with staggered wage and price contracts". In: *Journal of Monetary Economics* 46, pp. 281–313. DOI: 10.1016/S0304-3932(00)00028-3.

Farhi, E. and I. Werning (2014). *Labor Mobility Within Currency Unions*. Tech. rep. 20105. NBER Working Paper. DOI: 10.3386/w20105.

Frankel, Jeffrey A. and Andrew K. Rose (1998). "The Endogeneity of the Optimum Currency Area Criteria". In: *The Economic Journal* 108.449, pp. 1009–1025. DOI: 10.1111/1468-0297.00318.

Frenkel, M. and C. Nickel (2005). "New European Union members on their way to adopting the Euro: an analysis of macroeconomic disturbances". In: *Global Finance Journal* 15, pp. 303–320.

Frenkel, Michael, Christiane Nickel, and Gunter Schmidt (1999). *Some Shocking Aspects of Emu Enlargement*. Tech. rep. Research Note No. RN-99-4. URL: https://ssrn.com/abstract=164551.

Gaiotti, E. and A. Secchi (2006). "Is There a Cost Channel of Monetary Policy Transmission? An Investigation into the Pricing Behavior of 2,000 Firms". In: *Journal of Money, Credit, and Banking* 38.8, pp. 2013–2037. DOI: 10.1353/mcb.2007.0002.

Groot, Stefan P. T. et al. (Sept. 2011). "The crisis sensitivity of European countries and regions: stylized facts and spatial heterogeneity". In: *Cambridge Journal of Regions, Economy and Society* 4.3, pp. 437–456. ISSN: 1752-1378. DOI: 10.1093/cjres/rsr024. eprint: https://academic.oup.com/cjres/article-pdf/4/3/437/957136/rsr024.pdf. URL: https://doi.org/10.1093/cjres/rsr024.

Gulzar, Wasim Abbas (2015). "Enrichment in OCA Theory: Towards a Robust Model for Optimum Currency Area by Inclusion of Culture Criteria". In: *Life Science Journal* 12.8.

Guriev, Sergei, Biagio Speciale, and Michele Tuccio (2016). "How do Regulated and Unregulated Labor Markets Respond to Shocks? Evidence from Immigrants during the Great Recession". In: *CEPR Discussion Paper* 11403.

Horvath, J. and A. Ratfai (2004). "Supply and demand shocks in accession countries to the Economic and Monetary Union". In: *Journal of Comparative Economics* 32.2, pp. 202–211.

Jauer, Julia et al. (2014). "Migration as an Adjustment Mechanism in the Crisis? A Comparison of Europe and the United States". In: *OECD Social, Employment and Migration Working Papers* 155. URL: https://doi.org/10.1787/5jzb8p51gvhl-en.

Kenen, Peter B. (1969). "The Optimum Currency Area: An Eclectic View". In: *Monetary Problems of the International Economy*. Ed. by Robert A. Mundell and Alexander K. Swoboda.

Kim, Y. and H. K. Chow (2003). "Optimum currency area in Europe: an alternative assessment". In: *Economic Letters* 81, pp. 297–304.

Klaus, Benjamin and Filippo Ferroni (2015). *Euro area business cycles in turbulent times: convergence or decoupling?* Working Paper Series 1819. European Central Bank.

Krugman, P. (2013). "Revenge of the Optimum Currency Area". In: *NBER Macroeconomics Annual*. Vol. 27.

Kunovac, Davor, Diego Rodriguez Palenzuela, and Yiqiao Sun (Sept. 2022). *A New Optimum Currency Area Index for the Euro Area*. Working Paper 2022/2730. European Central Bank. URL: https://ssrn.com/abstract=4228407.

Labour cost index by NACE Rev. 1.1 activity - nominal value, quarterly data (2023). Online data code: LC_LCI_R1_Q. Eurostat. URL: https://ec.europa.eu/eurostat/data/database (visited on 05/21/2023).

Labour cost index by NACE Rev. 2 activity - nominal value, quarterly data (2023). Online data code: LC_LCI_R2_Q. Eurostat. URL: https://ec.europa.eu/eurostat/data/database (visited on 05/21/2023).

Lafleur, Jean-Michel and Mikolaj Stanek, eds. (2017). *South-North Migration of EU Citizens in Times of Crisis*. IMISCOE Research Series. Springer International Publishing. DOI: 10.1007/978-3-319-39763-4.

Landesmann, M., S. M. Leitner, and I. Mara (2015). *Intra-EU Mobility and Push and Pull Factors in EU Labour Markets: Estimating a Panel VAR Model*. Tech. rep. 120. wiiw Working Paper.

Lütkepohl, H. (2005). *New Introduction to Multiple Time Series Analysis*. Springer.

McKinnon, Ronald I. (1963). "Optimum Currency Areas". In: *The American Economic Review* 53.4, pp. 717–725. URL: http://www.jstor.org/stable/1811021.
Mundell, R. A. (1961). "A Theory of Optimum Currency Areas". In: *The American Economic Review* 51.4, pp. 657–665. URL: http://www.jstor.org/stable/1812792.
Nchor, Dennis (2020). "Labour Mobility as an Adjustment Mechanism to Asymmetric Shocks in Europe: Evidence from the Czech Republic, Hungary, Poland, and Slovakia". In: *Journal for Labour Market Research* 54.1. URL: https://doi.org/10.1186/s12651-020-00282-w.
OECD (2023). Quarterly GDP (indicator). DOI: 10.1787/b86d1fc8-en.
OECD (2023). Long-term interest rates (indicator). DOI: 10.1787/662d712c-en.
Rijnks, R. H., S. Koster, and P. McCann (2018). "Spatial Heterogeneity in Amenity and Labor Market Migration". In: *International Regional Science Review* 41.2, pp. 183–209. DOI: 10.1177/0160017616672516. URL: https://doi.org/10.1177/0160017616672516.
Schmidt, V. and D. Vaughan-Whitehead, eds. (2014). *The Impact of the Crisis on Wages in South-East Europe*. Geneva, Switzerland: International Labour Office.
Skorepa, Michal (2013). "Troubles in the Euro Area Periphery: The View Through the Lens of a Simple Convergence-Sensitive Optimum Currency Area Index". In: *Finance a Uver* 63.2, p. 129.
Vieira, Carlos and Isabel Vieira (2012). "Assessing the Endogeneity of OCA Conditions in EMU". In: *The Manchester School* 80, pp. 77–91.
Wolf, M. (May 2011). "Managing the Eurozone's Fragility". In: *The Financial Times*.
Yoshimi, T. (2014). "Currency Integration under Labor Mobility: when cost is incurred". In: *Journal of Economic Integration* 29.1, pp. 188–209.
— (2016). "Welfare Implications of Currency Integration: Labor Mobility and Pricing-to-Market". In: *Global Economic Review* 45.

APPENDIX

SVAR Model Results

Core - Before 2010

VAR system, lag order 1
OLS estimates, observations 2000:3–2010:4 ($T = 42$)

Log-likelihood = −34.5944
Determinant of covariance matrix = 6.10295e–05
AIC = 2.5997
BIC = 3.4272
HQC = 2.9030
Portmanteau test: LB(10) = 171.007, df = 144 [0.0617]

Equation 1: d_GDP
HAC standard errors, bandwidth 2 (Bartlett kernel)

	Coefficient	Std. Error	t-ratio	p-value
const	0.0399249	0.126367	0.3159	0.7538
d_GDP_1	0.645344	0.122532	5.267	0.0000
d_INT_1	0.561604	0.458914	1.224	0.2288
d_EMP_1	−2.55878	0.703739	−3.636	0.0008
d_WAG_1	−0.00429603	0.351384	−0.01223	0.9903

Mean dependent var	−0.026010	S.D. dependent var	1.088543
Sum squared resid	24.57265	S.E. of regression	0.814939
R^2	0.494202	Adjusted R^2	0.439521
$F(4, 37)$	9.388682	P-value(F)	0.000024
$\hat{\rho}$	0.051813	Durbin–Watson	1.885784

F-tests of zero restrictions

All lags of d_GDP	$F(1, 37) = 27.7387$	[0.0000]
All lags of d_INT	$F(1, 37) = 1.49761$	[0.2288]
All lags of d_EMP	$F(1, 37) = 13.2203$	[0.0008]
All lags of d_WAG	$F(1, 37) = 0.000149476$	[0.9903]
All vars, lag 1	$F(4, 37) = 9.38868$	[0.0000]

Equation 2: d_INT
HAC standard errors, bandwidth 2 (Bartlett kernel)

	Coefficient	Std. Error	t-ratio	p-value
const	−0.0574948	0.0342342	−1.679	0.1015
d_GDP_1	−0.0237865	0.0295362	−0.8053	0.4258
d_INT_1	0.0801535	0.106996	0.7491	0.4585
d_EMP_1	0.443932	0.240402	1.847	0.0728
d_WAG_1	−0.0201844	0.0848283	−0.2379	0.8132

Mean dependent var	−0.059634	S.D. dependent var	0.258723
Sum squared resid	2.535775	S.E. of regression	0.261791
R^2	0.076031	Adjusted R^2	-0.023857
$F(4, 37)$	1.346522	P-value(F)	0.271177
$\hat{\rho}$	0.029197	Durbin–Watson	1.906245

F-tests of zero restrictions

All lags of d_GDP	$F(1, 37) = 0.648562$	[0.4258]
All lags of d_INT	$F(1, 37) = 0.561188$	[0.4585]
All lags of d_EMP	$F(1, 37) = 3.41002$	[0.0728]
All lags of d_WAG	$F(1, 37) = 0.0566176$	[0.8132]
All vars, lag 1	$F(4, 37) = 1.34652$	[0.2712]

Equation 3: d_EMP
HAC standard errors, bandwidth 2 (Bartlett kernel)

	Coefficient	Std. Error	t-ratio	p-value
const	0.00725964	0.0158743	0.4573	0.6501
d_GDP_1	0.0251443	0.0163586	1.537	0.1328
d_INT_1	0.0435915	0.0702127	0.6208	0.5385
d_EMP_1	0.426832	0.150116	2.843	0.0072
d_WAG_1	−0.0235922	0.0336793	−0.7005	0.4880

Mean dependent var	0.007112	S.D. dependent var	0.141234
Sum squared resid	0.575490	S.E. of regression	0.124715
R^2	0.296323	Adjusted R^2	0.220250
$F(4, 37)$	2.917399	P-value(F)	0.034098
$\hat{\rho}$	−0.136040	Durbin–Watson	2.240764

F-tests of zero restrictions

All lags of d_GDP	$F(1, 37) = 2.3626$	[0.1328]
All lags of d_INT	$F(1, 37) = 0.385454$	[0.5385]
All lags of d_EMP	$F(1, 37) = 8.08464$	[0.0072]
All lags of d_WAG	$F(1, 37) = 0.490696$	[0.4880]
All vars, lag 1	$F(4, 37) = 2.9174$	[0.0341]

Equation 4: d_WAG
HAC standard errors, bandwidth 2 (Bartlett kernel)

	Coefficient	Std. Error	t-ratio	p-value
const	0.0258491	0.0618129	0.4182	0.6782
d_GDP_1	−0.0787494	0.0971397	−0.8107	0.4227
d_INT_1	−0.446822	0.320379	−1.395	0.1714
d_EMP_1	0.0389514	0.494254	0.07881	0.9376
d_WAG_1	−0.361715	0.113072	−3.199	0.0028

Mean dependent var	0.045238	S.D. dependent var	0.460356
Sum squared resid	7.349334	S.E. of regression	0.445680
R^2	0.154184	Adjusted R^2	0.062745
$F(4, 37)$	2.839599	P-value(F)	0.037755
$\hat{\rho}$	-0.049579	Durbin–Watson	2.098109

F-tests of zero restrictions

All lags of d_GDP	$F(1, 37) = 0.657205$	[0.4227]
All lags of d_INT	$F(1, 37) = 1.94509$	[0.1714]
All lags of d_EMP	$F(1, 37) = 0.00621076$	[0.9376]
All lags of d_WAG	$F(1, 37) = 10.2335$	[0.0028]
All vars, lag 1	$F(4, 37) = 2.8396$	[0.0378]

Core - After 2010

VAR system, lag order 1
OLS estimates, observations 2010:3–2018:4 ($T = 34$)

Log-likelihood = 6.63571
Determinant of covariance matrix = 7.95393e–06
AIC = 0.7861
BIC = 1.6840
HQC = 1.0923
Portmanteau test: LB(8) = 120.591, df = 112 [0.2728]

Equation 1: d_GDP
HAC standard errors, bandwidth 2 (Bartlett kernel)

	Coefficient	Std. Error	t-ratio	p-value
const	0.0289712	0.0830372	0.3489	0.7297
d_GDP_1	0.158599	0.148786	1.066	0.2952
d_INT_1	0.185565	0.336746	0.5511	0.5858
d_EMP_1	−0.962919	0.459468	−2.096	0.0449
d_WAG_1	−0.136211	0.220613	−0.6174	0.5418

Mean dependent var	−0.053558	S.D. dependent var	0.455472
Sum squared resid	6.094680	S.E. of regression	0.458434
R^2	0.109748	Adjusted R^2	-0.013045
$F(4, 29)$	1.214010	P-value(F)	0.326260
$\hat{\rho}$	−0.144745	Durbin–Watson	2.147611

F-tests of zero restrictions

All lags of d_GDP	$F(1, 29) = 1.13625$	[0.2952]
All lags of d_INT	$F(1, 29) = 0.303659$	[0.5858]
All lags of d_EMP	$F(1, 29) = 4.39207$	[0.0449]
All lags of d_WAG	$F(1, 29) = 0.381208$	[0.5418]
All vars, lag 1	$F(4, 29) = 1.21401$	[0.3263]

Equation 2: d_INT
HAC standard errors, bandwidth 2 (Bartlett kernel)

	Coefficient	Std. Error	t-ratio	p-value
const	−0.0818826	0.0353638	−2.315	0.0279
d_GDP_1	0.150767	0.0685814	2.198	0.0361
d_INT_1	0.156684	0.128363	1.221	0.2321
d_EMP_1	−0.0129062	0.305876	−0.04219	0.9666
d_WAG_1	0.0771370	0.122872	0.6278	0.5351

Mean dependent var	−0.109074	S.D. dependent var	0.244888
Sum squared resid	1.735396	S.E. of regression	0.244625
R^2	0.123103	Adjusted R^2	0.002151
$F(4, 29)$	2.940602	P-value(F)	0.037212
$\hat{\rho}$	0.043375	Durbin–Watson	1.802939

F-tests of zero restrictions

All lags of d_GDP	$F(1, 29) = 4.83282$	[0.0361]
All lags of d_INT	$F(1, 29) = 1.48995$	[0.2321]
All lags of d_EMP	$F(1, 29) = 0.00178035$	[0.9666]
All lags of d_WAG	$F(1, 29) = 0.394109$	[0.5351]
All vars, lag 1	$F(4, 29) = 2.9406$	[0.0372]

Equation 3: d_EMP
HAC standard errors, bandwidth 2 (Bartlett kernel)

	Coefficient	Std. Error	t-ratio	p-value
const	0.0608372	0.0191383	3.179	0.0035
d_GDP_1	0.0468809	0.0307558	1.524	0.1383
d_INT_1	−0.0116198	0.0713067	−0.1630	0.8717
d_EMP_1	−0.247040	0.142548	−1.733	0.0937
d_WAG_1	0.0644140	0.0634232	1.016	0.3182

Mean dependent var	0.046135	S.D. dependent var	0.120733
Sum squared resid	0.420253	S.E. of regression	0.120381
R^2	0.126330	Adjusted R^2	0.005824
$F(4, 29)$	2.819884	P-value(F)	0.043175
$\hat{\rho}$	0.086133	Durbin–Watson	1.802817

F-tests of zero restrictions

All lags of d_GDP	$F(1, 29) = 2.32348$	[0.1383]
All lags of d_INT	$F(1, 29) = 0.0265546$	[0.8717]
All lags of d_EMP	$F(1, 29) = 3.00338$	[0.0937]
All lags of d_WAG	$F(1, 29) = 1.03149$	[0.3182]
All vars, lag 1	$F(4, 29) = 2.81988$	[0.0432]

Equation 4: d_WAG
HAC standard errors, bandwidth 2 (Bartlett kernel)

	Coefficient	Std. Error	t-ratio	p-value
const	−0.0417940	0.0865940	−0.4826	0.6330
d_GDP_1	−0.143111	0.0820403	−1.744	0.0917
d_INT_1	−0.0963405	0.269440	−0.3576	0.7233
d_EMP_1	0.0329862	0.473309	0.06969	0.9449
d_WAG_1	−0.403798	0.205037	−1.969	0.0585

Mean dependent var	−0.021078	S.D. dependent var	0.331308
Sum squared resid	2.885334	S.E. of regression	0.315427
R^2	0.203443	Adjusted R^2	0.093573
$F(4, 29)$	2.897862	P-value(F)	0.039218
$\hat{\rho}$	0.116128	Durbin–Watson	1.638026

F-tests of zero restrictions

All lags of d_GDP	$F(1, 29) = 3.04293$	[0.0917]
All lags of d_INT	$F(1, 29) = 0.127848$	[0.7233]
All lags of d_EMP	$F(1, 29) = 0.00485708$	[0.9449]
All lags of d_WAG	$F(1, 29) = 3.87851$	[0.0585]
All vars, lag 1	$F(4, 29) = 2.89786$	[0.0392]

South Periphery - Before 2010

VAR system, lag order 1
OLS estimates, observations 2000:3–2010:4 ($T = 42$)

Log-likelihood = −76.0991
Determinant of covariance matrix = 0.000440438
AIC = 4.5761
BIC = 5.4036
HQC = 4.8794
Portmanteau test: LB(10) = 157.817, df = 144 [0.2037]

Equation 1: d_GDP
HAC standard errors, bandwidth 2 (Bartlett kernel)

	Coefficient	Std. Error	t-ratio	p-value
const	−0.115178	0.209462	−0.5499	0.5857
d_GDP_1	0.240014	0.175396	1.368	0.1794
d_INT_1	−0.330181	0.464548	−0.7108	0.4817
d_EMP_1	−0.0648085	1.03342	−0.06271	0.9503
d_WAG_1	−0.000667512	0.132015	−0.005056	0.9960

Mean dependent var	−0.152687	S.D. dependent var	0.971798
Sum squared resid	36.39450	S.E. of regression	0.991784
R^2	0.060061	Adjusted R^2	-0.041554
$F(4, 37)$	0.734438	P-value(F)	0.574380
$\hat{\rho}$	−0.042396	Durbin–Watson	2.071910

F-tests of zero restrictions

All lags of d_GDP	$F(1, 37) = 1.87255$	[0.1794]
All lags of d_INT	$F(1, 37) = 0.505177$	[0.4817]
All lags of d_EMP	$F(1, 37) = 0.00393289$	[0.9503]
All lags of d_WAG	$F(1, 37) = 2.55666e - 05$	[0.9960]
All vars, lag 1	$F(4, 37) = 0.734438$	[0.5744]

Equation 2: d_INT
HAC standard errors, bandwidth 2 (Bartlett kernel)

	Coefficient	Std. Error	t-ratio	p-value
const	0.0314634	0.0464679	0.6771	0.5026
d_GDP_1	0.0837122	0.0425030	1.970	0.0564
d_INT_1	0.509160	0.128188	3.972	0.0003
d_EMP_1	−0.153071	0.230962	−0.6628	0.5116
d_WAG_1	−0.0118844	0.0367621	−0.3233	0.7483

Mean dependent var	0.007281	S.D. dependent var	0.301921
Sum squared resid	2.467136	S.E. of regression	0.258223
R^2	0.339881	Adjusted R^2	0.268517
$F(4, 37)$	6.712212	P-value(F)	0.000363
$\hat{\rho}$	−0.057545	Durbin–Watson	2.107987

F-tests of zero restrictions

All lags of d_GDP	$F(1, 37) = 3.87917$	[0.0564]
All lags of d_INT	$F(1, 37) = 15.7766$	[0.0003]
All lags of d_EMP	$F(1, 37) = 0.439243$	[0.5116]
All lags of d_WAG	$F(1, 37) = 0.104509$	[0.7483]
All vars, lag 1	$F(4, 37) = 6.71221$	[0.0004]

Equation 3: d_EMP
HAC standard errors, bandwidth 2 (Bartlett kernel)

	Coefficient	Std. Error	t-ratio	p-value
const	−0.00852865	0.0197354	−0.4322	0.6681
d_GDP_1	0.00953622	0.0244240	0.3904	0.6984
d_INT_1	0.00473287	0.0531049	0.08912	0.9295
d_EMP_1	0.738380	0.0927729	7.959	0.0000
d_WAG_1	0.00714947	0.0154686	0.4622	0.6467

Mean dependent var	0.006792	S.D. dependent var	0.195703
Sum squared resid	0.633361	S.E. of regression	0.130835
R^2	0.596659	Adjusted R^2	0.553054
$F(4, 37)$	20.10567	P-value(F)	7.20e–09
$\hat{\rho}$	−0.143231	Durbin–Watson	2.282281

F-tests of zero restrictions

All lags of d_GDP	$F(1, 37) = 0.152447$	[0.6984]
All lags of d_INT	$F(1, 37) = 0.00794293$	[0.9295]
All lags of d_EMP	$F(1, 37) = 63.3456$	[0.0000]
All lags of d_WAG	$F(1, 37) = 0.213621$	[0.6467]
All vars, lag 1	$F(4, 37) = 20.1057$	[0.0000]

Equation 4: d_WAG
HAC standard errors, bandwidth 2 (Bartlett kernel)

	Coefficient	Std. Error	t-ratio	p-value
const	0.712784	0.166614	4.278	0.0001
d_GDP_1	−0.254972	0.128421	−1.985	0.0545
d_INT_1	−1.16198	0.500362	−2.322	0.0258
d_EMP_1	1.15453	0.723969	1.595	0.1193
d_WAG_1	−0.0748805	0.105955	−0.7067	0.4842

Mean dependent var	0.717857	S.D. dependent var	1.048406
Sum squared resid	36.93945	S.E. of regression	0.999181
R^2	0.180314	Adjusted R^2	0.091699
$F(4, 37)$	2.704567	P-value(F)	0.045084
$\hat{\rho}$	−0.083740	Durbin–Watson	2.130372

F-tests of zero restrictions

All lags of d_GDP	$F(1, 37) = 3.94197$	[0.0545]
All lags of d_INT	$F(1, 37) = 5.39302$	[0.0258]
All lags of d_EMP	$F(1, 37) = 2.54314$	[0.1193]
All lags of d_WAG	$F(1, 37) = 0.499453$	[0.4842]
All vars, lag 1	$F(4, 37) = 2.70457$	[0.0451]

South Periphery - After 2010

VAR system, lag order 1
OLS estimates, observations 2010:3–2018:4 ($T = 34$)

Log-likelihood = −76.8709
Determinant of covariance matrix = 0.00108120
AIC = 5.6983
BIC = 6.5962
HQC = 6.0045
Portmanteau test: LB(8) = 175.23, df = 112 [0.0001]

Equation 1: d_GDP
HAC standard errors, bandwidth 2 (Bartlett kernel)

	Coefficient	Std. Error	t-ratio	p-value
const	0.0739125	0.100962	0.7321	0.4700
d_GDP_1	−0.0123697	0.225565	−0.05484	0.9566
d_INT_1	−0.280590	0.111776	−2.510	0.0179
d_EMP_1	−0.288922	0.298471	−0.9680	0.3410
d_WAG_1	0.112717	0.124987	0.9018	0.3746

Mean dependent var	0.106794	S.D. dependent var	0.637980
Sum squared resid	11.29257	S.E. of regression	0.624018
R^2	0.159255	Adjusted R^2	0.043290
$F(4, 29)$	3.795253	P-value(F)	0.013357
$\hat{\rho}$	−0.046548	Durbin–Watson	2.007334

F-tests of zero restrictions

All lags of d_GDP	$F(1, 29) = 0.00300728$	[0.9566]
All lags of d_INT	$F(1, 29) = 6.30153$	[0.0179]
All lags of d_EMP	$F(1, 29) = 0.937041$	[0.3410]
All lags of d_WAG	$F(1, 29) = 0.813299$	[0.3746]
All vars, lag 1	$F(4, 29) = 3.79525$	[0.0134]

Equation 2: d_INT
HAC standard errors, bandwidth 2 (Bartlett kernel)

	Coefficient	Std. Error	t-ratio	p-value
const	−0.118986	0.117481	−1.013	0.3195
d_GDP_1	−0.0913562	0.153121	−0.5966	0.5554
d_INT_1	0.548539	0.108669	5.048	0.0000
d_EMP_1	−0.0264037	0.531555	−0.04967	0.9607
d_WAG_1	0.116262	0.0974643	1.193	0.2426

Mean dependent var	−0.214012	S.D. dependent var	0.725859
Sum squared resid	10.60324	S.E. of regression	0.604673
R^2	0.390154	Adjusted R^2	0.306038
$F(4, 29)$	7.026625	P-value(F)	0.000440
$\hat{\rho}$	0.079497	Durbin–Watson	1.831908

F-tests of zero restrictions

All lags of d_GDP	$F(1, 29) = 0.355965$	[0.5554]
All lags of d_INT	$F(1, 29) = 25.4804$	[0.0000]
All lags of d_EMP	$F(1, 29) = 0.00246735$	[0.9607]
All lags of d_WAG	$F(1, 29) = 1.42294$	[0.2426]
All vars, lag 1	$F(4, 29) = 7.02663$	[0.0004]

Equation 3: d_EMP
HAC standard errors, bandwidth 2 (Bartlett kernel)

	Coefficient	Std. Error	t-ratio	p-value
const	0.0211063	0.0288788	0.7309	0.4707
d_GDP_1	−0.0470098	0.0595589	−0.7893	0.4363
d_INT_1	−0.0598599	0.0380382	−1.574	0.1264
d_EMP_1	0.593449	0.161178	3.682	0.0009
d_WAG_1	0.0746304	0.0386445	1.931	0.0633

Mean dependent var	0.064677	S.D. dependent var	0.250370
Sum squared resid	0.846176	S.E. of regression	0.170817
R^2	0.590945	Adjusted R^2	0.534524
$F(4, 29)$	13.78933	P-value(F)	2.05e–06
$\hat{\rho}$	0.079681	Durbin–Watson	1.766261

F-tests of zero restrictions

All lags of d_GDP	$F(1, 29) = 0.622995$	[0.4363]
All lags of d_INT	$F(1, 29) = 2.47646$	[0.1264]
All lags of d_EMP	$F(1, 29) = 13.5567$	[0.0009]
All lags of d_WAG	$F(1, 29) = 3.72954$	[0.0633]
All vars, lag 1	$F(4, 29) = 13.7893$	[0.0000]

Equation 4: d_WAG
HAC standard errors, bandwidth 2 (Bartlett kernel)

	Coefficient	Std. Error	t-ratio	p-value
const	−0.0489836	0.122264	−0.4006	0.6916
d_GDP_1	−0.610969	0.277277	−2.203	0.0357
d_INT_1	−0.470974	0.163695	−2.877	0.0075
d_EMP_1	2.20727	0.385758	5.722	0.0000
d_WAG_1	−0.237888	0.122385	−1.944	0.0617

Mean dependent var	0.072059	S.D. dependent var	0.976306
Sum squared resid	19.40577	S.E. of regression	0.818025
R^2	0.383057	Adjusted R^2	0.297961
$F(4, 29)$	11.46564	P-value(F)	0.000011
$\hat{\rho}$	-0.032819	Durbin–Watson	2.039682

F-tests of zero restrictions

All lags of d_GDP	$F(1, 29) = 4.85525$	[0.0357]
All lags of d_INT	$F(1, 29) = 8.27797$	[0.0075]
All lags of d_EMP	$F(1, 29) = 32.7403$	[0.0000]
All lags of d_WAG	$F(1, 29) = 3.77822$	[0.0617]
All vars, lag 1	$F(4, 29) = 11.4656$	[0.0000]

EU Aggregate - Before 2010

VAR system, lag order 1
OLS estimates, observations 2000:3–2010:4 ($T = 42$)

Log-likelihood = −30.0950
Determinant of covariance matrix = 4.92593e–05
AIC = 2.3855
BIC = 3.2129
HQC = 2.6888
Portmanteau test: LB(10) = 221.879, df = 144 [0.0000]

Equation 1: d_WAG
HAC standard errors, bandwidth 2 (Bartlett kernel)

	Coefficient	Std. Error	t-ratio	p-value
const	−0.00459043	0.0355814	−0.1290	0.8980
d_WAG_1	−0.619423	0.280359	−2.209	0.0334
d_EMP_1	−0.604840	0.523163	−1.156	0.2550
d_GDP_1	−0.218120	0.108494	−2.010	0.0517
d_MON_1	−0.00882884	0.200365	−0.04406	0.9651

Mean dependent var	0.016667	S.D. dependent var	0.481824
Sum squared resid	6.233025	S.E. of regression	0.410439
R^2	0.345156	Adjusted R^2	0.274362
$F(4, 37)$	7.761381	P-value(F)	0.000120
$\hat{\rho}$	−0.140092	Durbin–Watson	2.261648

F-tests of zero restrictions

All lags of d_WAG	$F(1, 37) = 4.88143$	[0.0334]
All lags of d_EMP	$F(1, 37) = 1.33662$	[0.2550]
All lags of d_GDP	$F(1, 37) = 4.04186$	[0.0517]
All lags of d_MON	$F(1, 37) = 0.00194162$	[0.9651]
All vars, lag 1	$F(4, 37) = 7.76138$	[0.0001]

Equation 2: d_EMP
HAC standard errors, bandwidth 2 (Bartlett kernel)

	Coefficient	Std. Error	t-ratio	p-value
const	−0.0242884	0.0198997	−1.221	0.2300
d_WAG_1	−0.0856219	0.0726609	−1.178	0.2462
d_EMP_1	−0.252824	0.143673	−1.760	0.0867
d_GDP_1	0.0587502	0.0379441	1.548	0.1301
d_MON_1	−0.158079	0.0432919	−3.651	0.0008

Mean dependent var	−0.011905	S.D. dependent var	0.153341
Sum squared resid	0.759591	S.E. of regression	0.143281
R^2	0.212081	Adjusted R^2	0.126901
$F(4, 37)$	6.428385	P-value(F)	0.000495
$\hat{\rho}$	−0.020936	Durbin–Watson	2.016564

F-tests of zero restrictions

All lags of d_WAG	$F(1, 37) = 1.38857$	[0.2462]
All lags of d_EMP	$F(1, 37) = 3.0966$	[0.0867]
All lags of d_GDP	$F(1, 37) = 2.39734$	[0.1301]
All lags of d_MON	$F(1, 37) = 13.3333$	[0.0008]
All vars, lag 1	$F(4, 37) = 6.42839$	[0.0005]

Equation 3: d_GDP
HAC standard errors, bandwidth 2 (Bartlett kernel)

	Coefficient	Std. Error	t-ratio	p-value
const	−0.0335904	0.0914109	−0.3675	0.7154
d_WAG_1	0.212343	0.642965	0.3303	0.7431
d_EMP_1	1.34975	0.695922	1.940	0.0601
d_GDP_1	0.643610	0.219749	2.929	0.0058
d_MON_1	−0.579347	0.377932	−1.533	0.1338

Mean dependent var	−0.049581	S.D. dependent var	1.060813
Sum squared resid	24.91337	S.E. of regression	0.820569
R^2	0.460029	Adjusted R^2	0.401654
$F(4, 37)$	5.890415	P-value(F)	0.000901
$\hat{\rho}$	−0.105323	Durbin–Watson	2.205459

F-tests of zero restrictions

All lags of d_WAG	$F(1, 37) = 0.109069$	[0.7431]
All lags of d_EMP	$F(1, 37) = 3.7617$	[0.0601]
All lags of d_GDP	$F(1, 37) = 8.57807$	[0.0058]
All lags of d_MON	$F(1, 37) = 2.3499$	[0.1338]
All vars, lag 1	$F(4, 37) = 5.89041$	[0.0009]

Equation 4: d_MON
HAC standard errors, bandwidth 2 (Bartlett kernel)

	Coefficient	Std. Error	t-ratio	p-value
const	−0.0255152	0.0359231	−0.7103	0.4820
d_WAG_1	0.380145	0.233967	1.625	0.1127
d_EMP_1	0.371515	0.314833	1.180	0.2455
d_GDP_1	0.147983	0.108968	1.358	0.1827
d_MON_1	0.604425	0.112347	5.380	0.0000

Mean dependent var	-0.077203	S.D. dependent var	0.457904
Sum squared resid	4.459207	S.E. of regression	0.347159
R^2	0.481289	Adjusted R^2	0.425212
$F(4, 37)$	10.09620	P-value(F)	0.000013
$\hat{\rho}$	0.006684	Durbin–Watson	1.970825

F-tests of zero restrictions

All lags of d_WAG	$F(1, 37) = 2.6399$	[0.1127]
All lags of d_EMP	$F(1, 37) = 1.39249$	[0.2455]
All lags of d_GDP	$F(1, 37) = 1.84426$	[0.1827]
All lags of d_MON	$F(1, 37) = 28.9445$	[0.0000]
All vars, lag 1	$F(4, 37) = 10.0962$	[0.0000]

EU Aggregate - After 2010

VAR system, lag order 1
OLS estimates, observations 2011:3–2019:4 ($T = 34$)

Log-likelihood = 39.9985
Determinant of covariance matrix = 1.11756e–06
AIC = −1.1764
BIC = −0.2785
HQC = −0.8702
Portmanteau test: LB(8) = 129.173, df = 112 [0.1277]

Equation 1: d_WAG
HAC standard errors, bandwidth 2 (Bartlett kernel)

	Coefficient	Std. Error	t-ratio	p-value
const	0.000544885	0.0642365	0.008482	0.9933
d_WAG_1	−0.292408	0.139010	−2.104	0.0442
d_EMP_1	1.11348	0.381752	2.917	0.0068
d_GDP_1	−0.0449134	0.0829201	−0.5416	0.5922
d_MON_1	−0.292747	0.312980	−0.9354	0.3573

Mean dependent var	0.008824	S.D. dependent var	0.454851
Sum squared resid	4.935566	S.E. of regression	0.412543
R^2	0.277089	Adjusted R^2	0.177378
$F(4, 29)$	6.245396	P-value(F)	0.000942
$\hat{\rho}$	−0.146240	Durbin–Watson	2.280292

F-tests of zero restrictions

All lags of d_WAG	$F(1, 29) = 4.42476$	[0.0442]
All lags of d_EMP	$F(1, 29) = 8.50746$	[0.0068]
All lags of d_GDP	$F(1, 29) = 0.293381$	[0.5922]
All lags of d_MON	$F(1, 29) = 0.874887$	[0.3573]
All vars, lag 1	$F(4, 29) = 6.2454$	[0.0009]

Equation 2: d_EMP
HAC standard errors, bandwidth 2 (Bartlett kernel)

	Coefficient	Std. Error	t-ratio	p-value
const	0.00482385	0.0182524	0.2643	0.7934
d_WAG_1	−0.0235919	0.0596741	−0.3953	0.6955
d_EMP_1	−0.202984	0.0969006	−2.095	0.0450
d_GDP_1	0.0788678	0.0382084	2.064	0.0481
d_MON_1	−0.0270577	0.146026	−0.1853	0.8543

Mean dependent var	0.002941	S.D. dependent var	0.131392
Sum squared resid	0.510957	S.E. of regression	0.132737
R^2	0.103122	Adjusted R^2	-0.020585
$F(4, 29)$	5.282807	P-value(F)	0.002542
$\hat{\rho}$	−0.101651	Durbin–Watson	2.180748

F-tests of zero restrictions

All lags of d_WAG	$F(1, 29) = 0.156298$	[0.6955]
All lags of d_EMP	$F(1, 29) = 4.38806$	[0.0450]
All lags of d_GDP	$F(1, 29) = 4.2607$	[0.0481]
All lags of d_MON	$F(1, 29) = 0.0343335$	[0.8543]
All vars, lag 1	$F(4, 29) = 5.28281$	[0.0025]

Equation 3: d_GDP
HAC standard errors, bandwidth 2 (Bartlett kernel)

	Coefficient	Std. Error	t-ratio	p-value
const	−0.0241586	0.0703315	−0.3435	0.7337
d_WAG_1	0.238157	0.115165	2.068	0.0477
d_EMP_1	1.62115	0.618685	2.620	0.0138
d_GDP_1	0.357673	0.131928	2.711	0.0111
d_MON_1	−0.216525	0.270968	−0.7991	0.4307

Mean dependent var	−0.021480	S.D. dependent var	0.470522
Sum squared resid	4.754482	S.E. of regression	0.404904
R^2	0.349227	Adjusted R^2	0.259466
$F(4, 29)$	2.744969	P-value(F)	0.047369
$\hat{\rho}$	−0.041186	Durbin–Watson	2.069624

F-tests of zero restrictions

All lags of d_WAG	$F(1, 29) = 4.27651$	[0.0477]
All lags of d_EMP	$F(1, 29) = 6.86607$	[0.0138]
All lags of d_GDP	$F(1, 29) = 7.35015$	[0.0111]
All lags of d_MON	$F(1, 29) = 0.638527$	[0.4307]
All vars, lag 1	$F(4, 29) = 2.74497$	[0.0474]

Equation 4: d_MON
HAC standard errors, bandwidth 2 (Bartlett kernel)

	Coefficient	Std. Error	t-ratio	p-value
const	−0.0267423	0.0141373	−1.892	0.0686
d_WAG_1	0.00625897	0.0322843	0.1939	0.8476
d_EMP_1	0.0672558	0.127763	0.5264	0.6026
d_GDP_1	0.0830823	0.0385206	2.157	0.0394
d_MON_1	0.548534	0.0728596	7.529	0.0000

Mean dependent var	−0.053371	S.D. dependent var	0.117565
Sum squared resid	0.187021	S.E. of regression	0.080306
R^2	0.589966	Adjusted R^2	0.533410
$F(4, 29)$	31.84070	P-value(F)	3.14e–10
$\hat{\rho}$	0.215481	Durbin–Watson	1.519239

F-tests of zero restrictions

All lags of d_WAG	$F(1, 29) = 0.0375857$	[0.8476]
All lags of d_EMP	$F(1, 29) = 0.277106$	[0.6026]
All lags of d_GDP	$F(1, 29) = 4.65192$	[0.0394]
All lags of d_MON	$F(1, 29) = 56.6804$	[0.0000]
All vars, lag 1	$F(4, 29) = 31.8407$	[0.0000]