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Navigating Through Crisis: A Case Study of the Greek Sovereign Debt Crisis and Its Migratory Effects

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Abstract: This study explores the patterns of emigration from Greece and migration rates within Greece in the aftermath of the Greek Sovereign Debt Crisis. Employing the Synthetic Control Method (SCM), we construct a hypothetical, counterfactual to Greece, the Synthetic Greece. Our key findings include a marked increase in emigration with emigration rates 0.87% above those of Synthetic Greece between 2009 and 2021. These rates remain consistently high suggesting a lasting effect of the Greek sovereign debt crisis on Greek emigration. Further, our analysis identifies the key economic drivers behind this emigration trend, notably stagnant unemployment rates and GDP per capita. The study also delves into domestic migration and reveals a statistically significant increase in emigration from Greek metropolitan areas relative to its synthetic control unit. Similarly, emigration from rural areas increased, however, this effect was much lower in magnitude and statistically insignificant. Recent years have shown signs of a gradual recovery in these trends. Lastly, we identify negative correlations between the change in net migration rates and most economic variables, indicating that Greeks were more inclined to emigrate from financial centres. Overall, this research sheds light on demographic changes in post-crisis Greece, offering quantitative insight into the migration dynamics set off by one of the biggest economic challenges the Eurozone has faced to date.

Keywords: Greek Sovereign Debt Crisis, Migration, Emigration, Synthetic Control Method, Influencing Factors

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Abbreviations

DiD	Difference-in-Difference
EUROSTAT	European Statistical Office
FDI	Foreign Direct Investment
GDP	Gross Domestic Product
KNOMAD	Global Knowledge Partnership on Migration and Development
MG	Metropolitan Greece
MSPE	Mean Square Prediction Error
RG	Rural Greece
RMSPE	Root Mean Square Prediction Error
SCM	Synthetic Control Method
SMG	Synthetic Metropolitan Greece
SRG	Synthetic Rural Greece

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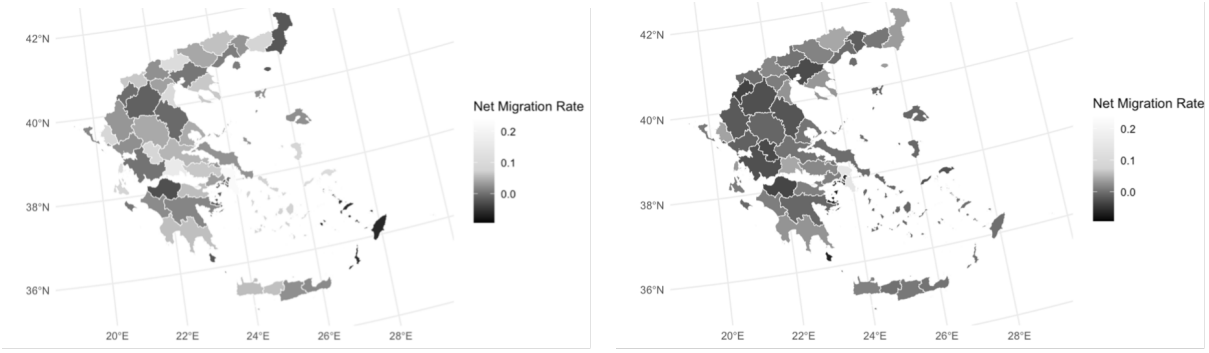
1 Introduction

Amidst economic instability, Greece was at the forefront of an unprecedented sovereign debt crisis which unfolded in 2009. The Greek sovereign debt crisis swiftly escalated into a full-blown economic emergency, sending shockwaves through the country and beyond. A country once steeped in cultural wealth and history was now grappling with a new reality marked by financial hardship, political upheaval, and a mass departure of its people in search of stability and opportunities elsewhere.

The crisis raises pressing questions: To what extent has the Greek sovereign debt crisis affected the Greek emigration rates? Moreover, how have the crisis and its influencing factors shaped regional migration trends within the country?

Figure 1: Net Migration Rates in Greece



(a) Net Migration Rate 2000-2009

(b) Net Migration Rate 2010-2020

Source: EUROSTAT (2023)

Figures 1a and 1b illustrate the regional migration trend in Greece before and after the onset of the Greek sovereign debt crisis in 2009. The data indicates an overall emigration effect, where Greeks predominantly migrated away from their regions. However, while these visualisations provide preliminary insight into the effects of the Greek sovereign debt crisis, they cannot be used to demonstrate causal inference.

To analyse potential causal inference and to address the questions raised above, this thesis employs the Synthetic Control Method (SCM). This statistical tool, specifically the method in comparative case studies outlined by Abadie and Gardeazabal (2003) and Abadie et al. (2010), allows us to compare Greece's actual migration rates to a hypothetical Greece without the crisis' effect. We use a panel dataset that includes various European countries to create a "Synthetic Greece". This composite, formed from countries unaffected by the Greek sovereign debt crisis, mirrors Greece's pre-crisis demographic and economic characteristics through a blend of qualitatively and quantitatively chosen predictors. This methodological approach isolates the specific effects of the Greek sovereign debt crisis on both emigration and internal migration patterns. By contrasting the actual migratory movements of Greece with its synthetic counterfactual, we aim to quantify the crisis's impact, domestically and internationally, after 2009. Analysing over a decade worth of data contributes to understanding Greece's national emigration and regional migration trends post-crisis[1]. In contrast to previous studies focused on qualitative interviews, our research explores the long-term impact on emigration, including the entire population beyond the typical "Brain Drain" narrative. Additionally, we address research gaps by quantifying and examining migration trends in metropolitan and rural Greek areas. Within this regional framework we also contribute to the discussion of factors influencing migration to and from

[1] Although the Greek sovereign debt crisis reached far into the 2010s, we will classify every year post-2009 as "post-crisis". For a further elaboration on the classification of pre-crisis and post-crisis years, see Section 6.3.

metropolitan and rural areas in Greece. We thus offer new insights into the socio-economic effects of the Greek sovereign debt crisis.

Our research into the Greek sovereign debt crisis reveals a substantial and enduring effect on emigration rates. As the crisis deepened, emigration rates surged dramatically, peaking in 2012. However, while emigration rates have been declining since 2012, they have not returned to pre-crisis levels, indicating a sustained demographic shift. The gap between actual and Synthetic Greece, constructed from countries unaffected by the Greek sovereign debt crisis, provides compelling evidence of the crisis' immediate and enduring impact on emigration patterns. When examining the consequences of the Greek sovereign debt crisis, we observe a pronounced decline in the total Greek population when compared to Synthetic Greece without the crisis. Additionally, we note higher unemployment rates in the long term, which reflect the depth of the economic disruption. Our findings also offer insight into the demography of the emigration, which primarily involved those impacted by unemployment and limited domestic opportunities following the Greek sovereign debt crisis. They also point to the human capital flight that threatens to alter the country's socio-economic fabric in the long term. Moreover, the persistent divergence in GDP per capita between real and Synthetic Greece underscores the severity of the crisis's impact. It marks a significant shift in the economy that has yet to revert to its pre-crisis trajectory.

This study further examines net migration rates within Greece, investigating the internal shifts that contribute to broader demographic trends. For the purpose of this analysis, we group all Greek metropolitan areas into one "Metropolitan Greece", and all Greek rural areas into one "Rural Greece". We then analyse net migration rates for both Metropolitan Greece and Rural Greece. We identify a reduction of the net migration rates[2] in both metropolitan and rural areas, however, the effects differ in magnitude and significance between these two areas. While net migration rates in metropolitan areas substantially decreased after 2009, in rural areas the effect was much weaker and statistically insignificant.

To analyse the causes of the different effects of the Greek sovereign debt crisis on regional net migration rates, we conduct a further study in all 52 regions of Greece. We explore the relationship between selected control variables and the percentage change in the average net migration rate between 2004 and 2009 as well as 2010 and 2014. Here, we identify a negative correlation between the change in net migration rates and most considered economic variables. This emphasises the overarching impact of the Greek sovereign debt crisis on migration and its nuanced variations between regions, shedding light on the complex interplay of economic and demographic factors during this critical period.

The paper is structured as follows: Chapter 2 provides background information about the debt crisis in Greece and the country's social and political developments. Chapter 3 reviews relevant literature, such as migration theory and the impact of other financial and economic crises on migration trends. In Chapter 4, we present the research question and hypotheses that are studied in this paper. In Chapter 5, we elaborate on the methodology and present the empirical model and assumptions for the analysis. In the following chapter, we outline the data used for the model used in our analysis and the limitations of this data. Chapters 7 and 8 present the results of the Synthetic Control Method. In Chapter 8, we analyse the net migration rates in Greece and study possible regional influencing factors using a correlation analysis. The final section of these chapters tests our empirical model for robustness and statistical significance. In Chapter 9, we discuss the results presented in the previous two chapters before concluding in Chapter 10.

[2]The Net Migration Rate measures the difference between the number of immigrants (people entering the country) and the number of emigrants (people leaving the country) divided by the population.

2 Background on the Greek Sovereign Debt Crisis

After Greece joined the Eurozone in 2001, it reported fast economic growth, with an average GDP growth rate of 4% between 2000 and 2008. This growth was driven by strong consumer demand fuelled by cheap credit supply available at the time. However, beneath the surface of this apparent prosperity, the economy lacked competitiveness and suffered from chronic fiscal and external deficits as well as a large public debt. These weaknesses surfaced in October 2009 (Matsaganis, 2011). After the general election on October 4th, 2009, the new socialist government announced that earlier fiscal data had been misreported. As a result, the reported budget deficit for 2008 was retrospectively corrected from 5.0% to 7.7% of Greece's GDP, while the deficit projections for 2009 were raised from 3.7% to 12.5% of GDP, and later adjusted again to 13.6%. The corresponding public debt estimate was also increased from 99.6% to 115.1% of Greece's GDP in 2009. The current account deficit reached 14.7% of GDP in 2008, reflecting the country's steady loss of international competitiveness (Bank of Greece, 2011).

The revelation of this corrected economic data sent shock waves through the Greek population and the international financial markets. The timing of this disclosure shortly after the onset of the global financial crisis highlighted Greece's overwhelming reliance on external financing, which had previously been underestimated. The reaction from financial markets was swift and harsh. Borrowing costs increased dramatically. Further, interest rate spreads between the Greek and German bonds soared and credit ratings plummeted (Featherstone, 2011). These events marked the beginning of Greece's most profound economic turmoil since the end of the military dictatorship in 1974 and is referred to as the "Greek Sovereign Debt Crisis". The Greek sovereign debt crisis remains one of the most serious crises faced by the European Monetary Union to date. The Greek sovereign debt crisis also highlighted some of the Eurozone's structural fragilities and its susceptibility to financial market turbulences.

In response to the outbreak of the Greek sovereign debt crisis, Eurozone leaders and the International Monetary Fund (IMF) opted for a strategy aimed at an "internal devaluation" of the Greek economy, demanding austerity measures such as cuts in wages and pensions, reductions in public sector size, and extensive privatisations (IMF, 2010). This approach was deemed less damaging than a potential Greek departure from the Eurozone, prompting a bailout plan to bolster competitiveness and attract investment (Tagaris, 2012).

The Greek population largely disapproved of the measures connected to the bailout strategy, as the economy and society were in distress. Consequences were far-reaching, with unemployment rates soaring, particularly among the youth, and real wages falling by up to 50%, alongside a decline in public service efficacy due to a shrinking public sector workforce (Matsaganis, 2011). However, at the 2010 World Economic Forum in Davos, Prime Minister George Papandreou defended the measures connected to the bailout strategy. Papandreou also described Greece as being plagued by systemic corruption and nepotism. He framed these issues as a rationale for the impending stringent fiscal policies. Despite the political risks, the Greek government pressed on with austerity measures from March 2010, targeting fiscal stability (Reuters, 2010). Eventually, a €110 billion financial aid agreement was secured with the European Commission, the European Central Bank, and the IMF, collectively known as the "Troika". This arrangement was subject to a set of extensive fiscal adjustments and tax hikes summarised in a "Memorandum of Economic and Financial Policies". This memorandum was ratified by the Greek Parliament in May 2010, with the goal of curtailing the national deficit to below 3% of GDP by 2014 (Matsaganis, 2011).

While this financial aid initially had a positive impact on international financial markets, it provoked vehement opposition in Greece, leading to a surge in political extremism. Despite rising poverty and job instability, successive Greek administrations from 2009 to 2012 endorsed the Troika's strict reform agenda. In hindsight, the stringent reform agenda that was implemented, however, led to suboptimal outcomes. The IMF admitted to "notable failures" in the first Greek

bailout, as it led to a deeper recession than expected, a run on the country's banking system, and exceptionally high unemployment (IMF, 2019). Between 2009 and 2012 the Greek GDP contracted by an unprecedented 27%, marking the steepest peacetime decline in modern Greek economic history. Employment opportunities dwindled significantly, with a marked reduction in hiring over a three-year span. Nonetheless, the government persisted with its austerity policies, with a second financial rescue plan implemented in 2012 that exacerbated the recession and imposed further slashing of wages and pensions. By 2013, unemployment in Greece had soared, with forecasts suggesting a continued negative trend (Yfantopoulos & Yfantopoulos, 2015).

In addition to the economic consequences, the debt crisis caused major political instability in Greece. This led to frequent government turnovers, including the resignation of Prime Minister George Papandreou in 2011. Over time, the political landscape also became increasingly fragmented, leading to coalition governments which struggled to reach consensus on policy measures amid recurring national elections and referendums that reinforced the societal divisions (Kazamias, 2018). The pervasive influence of the Troika on Greek policy was perceived by many as undermining national sovereignty, intensifying the political turmoil, and contributing to a loss in trust in the political establishment during the crisis (Cohen et al., 2015).

The Greek sovereign debt crisis, a combination of external pressures, such as the inherent instability in financial markets, and internal weaknesses, including persistent fiscal and trade deficits, represented a complex challenge that did not dissolve merely with the global economic recovery that followed the global financial crisis. By mid-2010, despite ongoing turbulence in the Euro area, economic growth had returned in other EU member states, yet Greece found itself sinking deeper into recession. The far-reaching impact of this crisis on Greece's economy, societal structure, and political landscape is complex, and it will require in-depth research and analysis to understand and address this fully.

3 Literature Review

This chapter reviews the background in migration trends to and from Greece, as well as within Greece since the end of the second World War. Subsequently, we summarise different push and pull factors affecting migration decisions before turning to more general migration theories. We then look at the migration responses to previous financial and economic crises, and how labour migration theory helps us understand the migration responses to such economic and financial crises. Finally, we summarise the Brain Drain phenomenon during the Greek sovereign debt crisis.

3.1 Migration to and from Greece

1945 – 1974: Post World War II and Military Junta

Migration to and from Greece after the Second World War was always influenced by political and economic conditions at home, which resulted in fluctuating numbers of migrants over the years. Since the late 19th century, Greece had been a significant source of emigration, a trend that intensified in the 30 years following World War II. During this period, Greece grappled with political turbulence and domestic issues, including the civil war from 1946 to 1949 and a military dictatorship from 1967 to 1974. Meanwhile, several European countries, such as Germany, Belgium, and Sweden, rebuilt their economies after World War II and restored their domestic labour markets. These countries became attractive destinations for international migrants. The challenging social and economic conditions at home prompted many Greeks to seek a better life and employment opportunities in these more industrialised European countries (Labrianidis & Pratsinakis, 2016).

This emigration wave (1945-1970) led to the establishment of many Greek communities in those European countries (Christopoulos et al., 2014). In the 1950s the emigration wave also extended to other continents, with approximately half a million Greeks emigrating to the United States, Canada, and later, Australia. Christopoulos et al. highlight that due to the inflated unemployment rates in Greece between 1950 and 1960, the levels of emigration during that period were particularly high. Another significant era in Greece's 20th-century migration history spanned from 1955 to 1976, during which approximately 1.22 million Greeks emigrated. This migration wave reached its peak between 1962 and 1966, when around 500,000 individuals left the country (Christopoulos et al., 2014).

1974-2000: Reversal of Migration Trends

The political transformation of Greece after 1974 was marked by significant changes, including the fall of the military junta, the abolition of the monarchy, and the establishment of the Third Hellenic Republic. Concurrently, more restrictive immigration policies in other European countries began to reverse the upward trend in Greek emigration. Between 1974 and 1985, nearly half of the post-war emigrants returned to Greece, attracted by the nation's political stabilisation and better economic prospects (Kasimis & Kassimi, 2004).

The 1980s then witnessed a significant shift in Greece's migration dynamics. The country transformed from a country with many emigrants to an immigrant-receiving country. This trend was accelerated by the collapse of central and eastern European regimes in 1989. Greece was, and has since been, a key gateway into the European Union for migrants from diverse backgrounds, including Albania, the Balkans, the former Soviet Union, and parts of Asia.

Greece joining the European Union in 1981 also played a pivotal role in its transformation to an immigrant-receiving country. It brought Greece economically and socially closer to the more developed European countries. Greece became an attractive destination for migrants due to its position as the geographical gateway to Europe and its relatively open borders. The implementation of the Maastricht Treaty in 1992, which allowed people to move freely within the European Union, further facilitated this migration influx.

2001-2009: Stability as Migrant Destination

According to the 2001 census, Greece's foreign population had increased to 797,000, including both documented and undocumented migrants, with about 47,000 being EU citizens (Kasimis, 2013). Immigrants significantly contributed to both the demography and economy of Greece. After 1991, immigration became the main driver of population growth, with 97% of the population increase attributed to migration, compared to only 3% from natural population growth. Immigrants played a complementary role in the economy, facilitating the shift of around 273,000 native primary sector workers to other sectors, primarily services. They also supported the integration of women into the labour market by freeing them from household chores. Many immigrants also took jobs in agriculture, construction, and tourism (Kasimis, 2013).

In the years before 2009, a significant number of Greeks returned to Greece due to the country's relative political and economic stability. Those who had previously migrated to Western Europe primarily originated from Northern Greece. In contrast, most who had settled in the United States, Canada, and Australia were from Southern Greece and the Greek islands (Christopoulos et al., 2014). The return of economically active residents in many regions combined with the relatively sound economy led to a short period of stabilisation before the sovereign debt crisis hit the country.

3.2 Migration in Regional Greece

During the 1980s, an increasing number of Greeks, particularly in rural areas, aspired to a higher standard of living driven in part by agricultural subsidisation reforms such as the Common Agricultural Policy (CAP). The resulting increase in wealth motivated many Greeks to move away from the physically demanding careers in agriculture and the population gravitated towards urban centres (Kasimis & Papadopoulos, 2003). This shift started a rural-to-metropolitan migration trend (Gkartzios, 2013). With the exodus of the Greek rural population, and as already described in Section 3.1, a labour void emerged, which was mainly filled by Eastern European migrants, such as Albanians (Kasimis & Papadopoulos, 2003). Hence, while there was an increase in the rural population during this period, it was largely attributed to the influx of migrants and not to a genuine counter-urbanisation trend (Gkartzios, 2013).

The 2008 global financial crisis and its subsequent socio-economic ramifications, such as increasing unemployment and crime, began to alter urban Greeks' perspectives on rural migration. According to a 2012 government-commissioned study, 68.2% of respondents considered relocating to provincial areas, while 19.3% had already made relocation plans (Gkartzios, 2013).This trend was labelled "crisis counter-urbanisation" by Gkartzios (2013), emphasising the crisis's role in reversing urbanisation trends in Greece. Yet, Anthopoulou et al. (2017) question whether the urban population's heightened interest in rural relocation was less about actual migration and more about idealising rural areas as a "locus for refuge and recovery". Despite the idea of this "rural idyll", the actual migration from urban to rural settings did not match the heightened aspirations of these people as found by Anthopoulou et al. (2017).

3.3 Migration Theory, Brain Drain, and Previous Financial Crises

The following section provides an overview of the different push and pull factors and different economic theories and frameworks that can explain migration decisions. We then turn to the impact previous financial and economic crises had on migration patterns and what we can expect for the Greek sovereign debt crisis based on this context. A focus on labour migration and a closer look at the Brain Drain phenomenon during the Greek sovereign debt crisis allows us to build an understanding of how general migration trends could have been shaped in Greece after 2009. This approach enables us to draw parallels and contrasts between specialised migration flows, like Brain Drain, and broader migration movements.

3.3.1 Push- and Pull Factors, and Regional Drivers of Migration

International and internal migration are complex phenomena influenced by economic, cultural, educational, demographic, and other factors (Thet, 2014). Within each factor category, there is a distinction between push and pull factors. Push factors generally originate in the migrant's home country and pull factors originate in the destination country. A factor for migration can have both push and pull aspects.

The primary factors driving migration, both push and pull, are economic. Studies indicate that challenges such as low income, unemployment, and underemployment in migrants' home countries compel people to move to more economically prosperous regions within and outside of their country (Thet, 2014). The Greek sovereign debt crisis intensified pre-existing push factors such as high unemployment rates, prompting particularly high-skilled labour to seek opportunities in other Greek regions and countries (Labrianidis & Pratsinakis, 2016).

Political dynamics also significantly affect migration (Thet, 2014). These dynamics include policies, public safety, stability, and trust in a country's political system. Amid the Greek sovereign debt crisis, the lack of trust in the Greek government, amplified by austerity and recession, caused Greeks to seek more stable prospects in industrialised Europe (Kousis &

Chatzidaki, 2022). Additionally, socio-cultural elements like networks in destination countries can strongly pull migrants. For some Greek migrants, existing Greek communities outside of Greece (see Section 3.1) facilitated their relocation decisions and influenced their choices to migrate to countries like Germany (Pratsinakis et al., 2019).

While economic, cultural, educational, and demographic factors are all pivotal in both international and internal migration, demographic characteristics are particularly influential in the latter (Thet, 2014). Factors like high population growth rates, marriage patterns, and family planning as well as job availability affect domestic migration flows.

3.3.2 Migration Theory

Despite the understanding of migration choices through push and pull factors, a unified framework to fully explain international migration has yet to be defined. However, authors from different academic disciplines emphasise diverse aspects of migration. Neoclassical economic models focus on wage disparities and migration costs, viewing migration as a strategy for income optimisation. In contrast, the "New Economics of Migration Theory" looks at the broader family or household context and how these groups make migration decisions (Massey et al., 1993).

Neoclassical Migration Models

Theories like the Dual Labour Market Theory and the World-Systems Theory analyse broader socio-economic forces. The former associates migration with the needs of advanced industrial societies, while the latter views it as an outcome of global economic interconnections. Moreover, early models by Lewis (1954), Ranis and Fei (1961), and Harris and Todaro (1970) suggest that labour migration is driven by spatial disparities in labour supply and demand. This leads to wage differentials that incentivise migration. This is complemented by the flow of investment capital, with skilled professionals migrating to places where their skills are in higher demand. As discussed by Sjaastad (1962) and Torado and Maruszko (1987), a microeconomic viewpoint explains migration as an individual's rational decision based on a cost-benefit analysis. Individuals consider relocating to maximise their productivity and earnings, weighing the costs and benefits of moving to various destinations.

The New Economics of Migration

The New Economics of Migration argues that groups like families or households often make migration decisions. These networks aim to diversify their geographic resource allocation, manage economic risks, and rely on migrants' earnings in times of local economic downturns. Moreover, migrant networks, with their family ties and common community backgrounds, reduce the costs and risks of migration and enhance its benefits. As these networks grow, they perpetuate a cycle of further migration and network expansion (Stark & Bloom, 1985). Finally, the examination of humanitarian crisis movements by S. F. Martin et al. (2014) underscores the aspects of causation, geographic distribution, duration, and vulnerability. Crises, like natural disasters, can be immediate or delayed, like droughts, and affect migration patterns. Migration dynamics in the face of crises may be determined by specific factors. Internal displacement of people plays a role as well as their behaviour in various stages from pre-crisis to adaptation. The affected population's resilience will also be crucial, especially when it comes to vulnerable groups.

In the following section we delve deeper into the specific impacts of financial crises on migration patterns. We examine historical financial upheavals, analyse how these events have shaped the flow and nature of migration, and how they reinforce the complex relationship between economic stability and migratory trends.

3.3.3 Impact of Historical Economic and Financial Crises on Migration

The Irish Famine as an Example of Migration Responses to an Economic Crisis

One of the earliest documented impacts of an economic crisis on migration was recorded in the 19th century, with the Irish Famine during the 1840s. In 1845, 1846, and 1848, a large number of potato crops in Ireland failed. While there is no quantifiable economic measure, it can be assumed that the loss of agricultural workers' staple food in agricultural land must have been substantial (O´Rourke, 1995). Combined with huge poverty in Ireland at the time, these losses were almost certainly threatening the existence of those living in Ireland. Thus, this is a good example for a significant economic crisis. Between 1840 and 1850, more than 1,5 million people emigrated from Ireland (Hatton & Williamson, 2005). Even if not all of this emigration can be attributed to the famine, it is reasonable to assume that a majority left because of the dire economic situation and that this economic crisis caused mass famine-driven emigration.

Historical Financial and Economic Crises and their Migration Responses

A report published by the International Organization for Migration (IOM) (Koser, 2009) analyses different financial crises in the 20th century, including the Great Depression (1930s), the Oil Crisis (1973), and the Russian financial crisis (1998). These crises significantly influenced migration patterns. The impacts on migration, however, vary greatly across the different financial crises.

The Great Depression accelerated the decline in international labour migration that began post-World War I, partly due to restrictive migration policies. In Canada for example, immigration numbers plummeted drastically between 1929 and 1935 (Struthers, 2021). The Great Depression also led to significant repatriations of individuals back to their home countries. For example, nearly half of the Mexican-origin population in the US left and returned to Mexico during the 1930s (USCIS, 2020). In France, there were large-scale departures and deportations of migrants in the early 1930s, driven by job shortages and social factors such as xenophobia. In the United States, net migration was negative (i.e., emigration was larger than immigration) between 1932 and 1935 (OECD, 2009).

The 1973 Oil Crisis caused substantial declines in inflows of migrants to Europe, as well as guest worker migration across Europe. Interestingly, large-scale returns to countries of origin were rare, as the crisis also hit these countries, and European host countries' social security nets were stronger than in the home countries of the migrants. Emigration out of Europe rose slightly, but quickly dropped back to pre-crisis levels. Return migration during this time was more likely among migrants from higher-income countries (Sirekci et al., 2012).

The Asian financial crisis in 1997 and 1998 had a relatively minor impact on migration in Asia. Although the number of migrants decreased in some countries, it increased during the crisis in others. Migration flows were primarily dominated by the dependency on migrant labour in many destinations, and the reluctance of natives to perform the tasks previously performed by those migrant workers (especially basic manufacturing) (Skeldon, 2004).

The Russian financial crisis in 1998 accelerated emigration from Russia, with notable increases in departures to Kazakhstan and Israel. Political and economic turmoil in Russia further affected migration decisions within former Soviet states. The South American financial crisis period (1998-2002) saw a marked increase in emigration from Argentina, with a significant number relocating to Spain. This crisis contributed to a brain drain as skilled and educated individuals, including many Argentine Jews, migrated to countries like the US.

Koser (2009) thus highlights the heterogeneous migration responses of the different financial and economic crisis, shaped by regional and country-specific factors. Specifically, the repercussions of such crises vary considerably across different geographies due to the interaction of labour market structures, the extent of structural dependency of economies on migrant labour, political dynamics, and public sentiment (Koser, 2009).

The authors presented in this section have not entirely been able to link the effects of long-term economic downturns to migration trends. However, they all mention that more prolonged economic downturns tend to cause some slowing of migration inflows and a slight increase in return migration (emigration from the country affected towards the migrants' home country).

In contrast, the effects of financial and economic crises appear to be less clear. While the IOM report (Koser, 2009) sees migration trends as largely robust and unaffected (Oil Crisis and Asian financial crisis), examples like the Irish Famine, the Great Depression, and the Russian financial crisis show crises that heavily impacted emigration choices.

3.3.4 Labour Migration Responses to Economic Downturns

Previous authors have primarily studied the migration effects of financial and economic crises through labour migration developments. In this section we present the Buffer Theory, a theory particularly relevant in both historical and contemporary contexts. It provides a framework to understand the patterns of labour migration influenced significantly by economic cycles. We also review how labour migration developed during previous financial and economic crises in contrast to the Buffer Theory.

The "Buffer Theory", a concept formulated in post-World War II Western Europe, suggests that the migrant labour stock in the host country behaves as a flexible buffer, which increases during labour shortages and decreases during economic downturns (Dobson et al., 2009). According to the report mentioned previously (Koser, 2009), the economic consequences for migrants' countries of origin are particularly pronounced during financial crises, as seen in altered employment levels and fluctuations in remittances.

However, a UK case study (Dobson et al., 2009) illustrates some limitations of the buffer theory. Historical analysis shows a decline in migrant inflows during recessions without a corresponding increase in outflows in the UK, challenging the buffer theory's predictions. This pattern emphasises the importance of considering a range of factors beyond labour market conditions.

A further paper on labour migration during economic downturns and financial crises (Beets & Willekens, 2009) confirms the discrepancy in magnitude in return migration between different financial crises. This is attributed to various social rather than economic factors. Meins (2009) notes that migration during economic downturns largely follows the principles of the buffer theory mentioned previously. However, migration towards the United States, for example, shows that the high cost and risk of migration mean that migration typically only happens when a job is available. Once settled, these migrants are more reluctant to return due to high costs, uncertainties in their home countries, and the high standard of living in the United States. At the same time, EU migration shows that especially migrants who invested significantly in their migration, earn higher wages, or have familial ties in the host country, are inclined to endure the crisis rather than return home. The assumption is that migrants may return home if employment opportunities in host countries diminish and prospects in their home countries appear relatively more favourable (Beets & Willekens, 2009).

The literature highlights the complexity and variability of migration trends following economic crises. However, most financial crises did impact migration numbers. The extent of this impact and the resulting migration patterns heavily depend on the nature of the crises and the conditions in potential host countries. Migration is influenced by regional labour market structures, economic dependency on migrant labour, political factors, and public sentiment. Thus, migration patterns appear to be largely robust against crises but can vary significantly across geographies.

3.3.5 Brain Drain Phenomenon during the Greek Sovereign Debt Crisis

Definition of Brain Drain

The OECD defines "Brain Drain" as synonymous with the movement of human capital and the net flow of expertise heavily in one direction (Salt, 1997). This phenomenon thus describes the departure of a country's most skilled and educated at a significant rate (Bushnell & KinChoy, 2001). The notion of a Brain Drain was first introduced by the British Royal Society in the early 1960s, primarily to describe the emigration of British scientists and technicians to the United States and Canada (Pablos & Tennyson, 2006). Brain Drain is commonly linked to economic disadvantages for countries which lose their highly skilled labour force. In economics, it is referred to as "human capital flight", i.e. the migration of capital that is not reinvested in its country of origin (Patrutiu-Baltes, 2014). Brain Drain is often viewed as a social loss, as it encompasses the departure of highly skilled professionals, including scientists, researchers, and academics from their countries (Christopoulos et al., 2014). The departure of highly qualified individuals can profoundly affect a country's economic growth and competitive potential. Equally, a country's inflow of talented and skilled workers can foster economic development and enhance its competitive edge (Triandafyllidou et al., 2013).

Both economic and non-economic factors are typically driving forces of Brain Drain. Economic factors include the pull of higher salaries in destination countries and the global concentration of human capital in areas where human capital is already abundantly available (due to economic opportunities, or network effects). Non-economic push factors that cause qualified people to leave their home countries range from employment structures and insufficient research funding, to nepotism, undervaluation of talent, and lack of professional competence of institutions and peers. In addition, a lack of prospects, social discrimination, the substandard quality of intellectual, professional, educational, and cultural life at home, and, in some instances, prevailing political conditions may motivate young professionals to emigrate (Labrianidis & Pratsinakis, 2016).

Labrianidis and Pratsinakis (2016) describe in their report that the departure of highly qualified individuals from less developed to more developed countries adversely impacts the countries they leave, due to the loss of a crucial workforce segment that is both sophisticated and integral to societal progress. Economically, the impact is even more pronounced because the government often funds its education through taxpayer money. The country of origin therefore faces a dual loss: the investment in financial and human capital and the diminished capacity for economic prosperity without these skilled individuals through, for example, losses in tax revenues. Consequently, this can increase inequality between developed and developing countries. Brain Drain can, however, also offer benefits to the country of origin. For instance, if migrants return with enhanced skills and specialisations acquired abroad, they can contribute positively to their home country. Educated migrants working abroad often send remittances home to support their families or invest in their native countries, making these remittances a valuable source of income. Additionally, educated migrants can positively impact their home countries through tourism, political influence, charitable activities, and cultural contributions (Labrianidis & Pratsinakis, 2016).

Brain Drain during the Greek Sovereign Debt Crisis

The post-war era in Greece was marked by a number of significant economic events, that reflected the ongoing tension between government policies and market dynamics (Christopoulos et al., 2014). Amanatides (2010) notes that, despite these economic events, emigration from Greece predominantly involved unskilled labour prior to the Greek sovereign debt crisis. However, the trend shifted towards a Brain Drain during the crisis. Since opportunities within Greece, particularly in the private sector, were extremely limited during this crisis, professionals from various fields sought employment and better living conditions abroad (Christopoulos et al., 2014). By 2015, an estimated 200,000 professionals and scientists had left Greece since the beginning of the Greek sovereign debt crisis (Smith, 2015; Varvara, 2013). Triandafyllidou et al. (2013) found that 90% of Greek emigrants held university degrees. Among them were

roughly 25% engineers, 20% IT specialists, and another 25% with a degree in mathematics or economics. Furthermore, 48% of the emigrants were under 30, and 49% were between 31 and 45 years old. Additionally, the authors found that over half of these highly educated emigrants were employed in Greece before leaving, but were dissatisfied with their career prospects and earnings. Remarkably, and in contrast to popular migration theory, 46% of these emigrants were living abroad for the first time, often without the support network of relatives or friends in their new country of residence. The researchers asked emigrants about their motivations and found out that key factors were the desire for meritocracy as opposed to corruption and nepotism; the availability of responsible positions for younger professionals based on skills and ambition; higher salary levels; improved quality of life; and a more open and diverse environment. Triandafyllidou et al. (2013) suggest that a sense of acute relative deprivation pushed the decision to migrate due to the crisis, coupled with a profound dissatisfaction with the conditions in Greece. The authors suggest that the crisis intensified Greece's existing push factors. Pablos and Tennyson (2006) note that due to the enduring nature of the crisis, which widened the gap between the supply and demand for a highly educated workforce, the return of these individuals to Greece is unlikely.

The case of Greece, particularly during the sovereign debt crisis, exemplifies the Brain Drain phenomenon. The crisis spawned a notable shift in migration patterns, with an increasing number of educated and skilled professionals leaving the country. It has also created a pernicious cycle where economic decline spurs further emigration. The departure of skilled and educated individuals has not only exacerbated the country's economic challenges. The uncertainty surrounding the return of these emigrants further aggravates the issue, suggesting that Greece may face long-term adverse effects on its demography and economy from this wave of Brain Drain. This topic is further explored in later sections of this thesis.

4 Research Design

The literature reviewed in Chapter 3 outlines the impacts of financial and economic crises on migration. Yet, significant gaps remain, particularly concerning the Greek sovereign debt crisis. Chapter 4 seeks to address these gaps, focusing explicitly on the effects of the Greek sovereign debt crisis on emigration rates and regional migration. This chapter presents our specific research question and hypotheses, aiming to provide a comprehensive and quantitative assessment of the crisis' impact on migration at both the national and regional levels in Greece.

4.1 Greece

As outlined in Chapter 3, research suggests that the impact of financial and economic crises on migration varies widely, with some crises heavily impacting migration trends and others having no such effect. Similarly, long-term effects of migration and the time to return to pre-crisis migration levels vary significantly between different crises. While there is a lot of literature on labour migration caused by different financial and economic crises, broader population migration has not been studied to the same extent. This thesis aims to contribute to that gap. Our research design allows us to identify a comprehensive trend across the entire Greek population by providing empirical evidence of the impact on emigration rates caused by the Greek sovereign debt crisis.

4.2 Regional Greece

As shown in Section 3.3, most studies indicate a predominant trend of migration from metropolitan to rural areas during the economically challenging period starting after 2008 (Anthopoulou

et al., 2017; Gkartzios, 2013). Most research has focused on the combined effect of the Greek sovereign debt crisis and the global financial crisis during this period. To our knowledge, the isolated effects of the Greek sovereign debt crisis on regional net migration rates remains inadequately explored. This is particularly true when considering the consequences of the isolated Greek sovereign debt crisis' effect on the net migration rate of distinct metropolitan and rural areas, as classified according to the "NUTS 3"[3] (Nomenclature of Territorial Units for Statistics 3) system. Our research is designed to address this existing gap in the literature by providing a comprehensive and quantitative examination of the regional migration effects caused by the Greek sovereign debt crisis.

It is important to note that this analysis does not consider the destination of the migrants. We are thus not able to study any migration flows between regions in Greece. We are also not able to tell whether migrants who leave a region migrate to another region in Greece or out of the country entirely. Hence, we only look at the migration rate in a specific region at one point in time.

4.2.1 Regional Influencing Factors

As discussed in Section 3.3.1, migration is influenced by many factors, including economic and political dimensions. Hence, as part of our regional analysis, our objective is to explore the factors influencing regional net migration rates of metropolitan and rural areas during the Greek sovereign debt crisis. The analysis is conducted on a regional level, rather than on a national level, because regional influencing factors of migration have been comparatively less explored. We aim to contribute to the literature concerning the consequences of the Greek sovereign debt crisis while at the same time enhancing the understanding of regional push and pull factors in a crisis context.

4.3 Research Question, Hypotheses, and Contribution

As detailed in Sections 4.1 and 4.2, our study contributes to research on national emigration and regional migration trends in Greece. Additionally, the analysis on a regional level allows us to better understand the trends and influencing factors of migration we observe in Greece in the years after the crisis started.

By quantifying emigration rates and economic hardship in Greece for a period of more than ten years post-crisis, we offer explanations for the persistence of long-run impacts on emigration rates. While other authors previously have mainly drawn on qualitative interviews with Greek emigrants in London and Amsterdam, we aim to contribute through a quantitative approach to further improve the understanding of the long-run effects of the Greek sovereign debt crisis on emigration (Triandafyllidou et al., 2013).

Furthermore, the analysis of regional migration trends caused by the Greek sovereign debt crisis has been neglected in existing literature. Our research adds to the research by quantifying and understanding migration trends in metropolitan and rural areas post-crisis. It also examines the influencing factors of these regional trends. The analysis of emigration rates and regional migration trends over a decade post-crisis provides a comprehensive understanding of the long-term socio-economic impacts of the Greek sovereign debt crisis. In contrast to previous studies, our quantitative approach sheds light on broader demographic trends. It goes beyond the frequently discussed Brain Drain to include a broader spectrum of the Greek population. This perspective allows us to draw a general conclusion on migration trends in Greece.

Based on these analyses, the research question of this paper can be formulated as follows:

[3]The NUTS 3 classification separates all European countries into smaller regions more suitable for analysis.

What is the effect of the Greek sovereign debt crisis on the Emigration Rate out of Greece, and what are the effects of the crisis and the influencing factors on regional migration trends?

Based on our review of existing literature on financial and economic crises, and assumptions about the development of migration due to the Greek sovereign debt crisis, we define three hypotheses that will be analysed:

H_1: The Greek sovereign debt crisis caused a significant increase in the Emigration Rate post-crisis.

H_2: The Greek sovereign debt crisis caused a significant decrease in the Net Migration Rate of Greek metropolitan areas.

H_3: The Greek sovereign debt crisis caused a significant increase in the Net Migration Rate of Greek rural areas.

The first hypothesis (H_1) stems from the expectation that severe economic downturns, such as the one experienced during the Greek sovereign debt crisis, should typically lead to increased emigration rates as individuals seek better opportunities abroad. We believe that this should be particularly relevant for Greece, where we expect the economic deterioration to impact migration decisions more profoundly than other migration factors. The second (H_2) and the third hypotheses (H_3) address the anticipated migration dynamics in different regions in Greece in response to economic hardship. As Greek urban centres suffered under the effects of the debt crisis, our hypothesis is that reduced job opportunities and prospects may have led people to leave these regions at an increased rate. At the same time these factors could have been responsible for decreased immigration to metropolitan areas (H_2). Rural areas' relative economic stability and independence could have led to more immigration than emigration in those regions, with family networks and support systems playing a pivotal role (H_3). These hypotheses are supposed to capture the multifaceted nature of migration trends triggered by the crisis, offering a comprehensive perspective on national and regional migration shifts in Greece.

5 Methodology

This chapter outlines the methodology to estimate the effect of the Greek sovereign debt crisis on emigration and regional migration in Greece. We first summarise the Synthetic Control Method before formalising the model itself, the causal inference tests, and the correlation analysis for the regional influencing factors. We will also deal with the externalities that challenge the assumptions required for the model.

We use the Synthetic Control Method (SCM), first brought forward in 2003 (Abadie & Gardeazabal, 2003), to identify a causal effect between the Greek sovereign debt crisis and emigration and regional migration in Greece. The SCM aims to estimate the effects of "aggregate interventions, that is, interventions that are implemented at an aggregate level affecting a small number of large units (such as cities, regions, or countries) on some aggregate outcome of interest" (Abadie, 2021).

The SCM expands the more established Difference-in-Difference (DiD) analysis approach and addresses some of its limitations. The DiD analysis measures the effect of an intervention by comparing changes in outcomes over time between a treatment group and a control group. Additionally, it allows to account for independent variables that could influence the outcome variable but are not of direct or statistical interest. However, the DiD analysis fundamentally relies on the "common trends assumption", which consists of two key assumptions. First, it assumes that in the absence of the treatment, the difference between the treatment and control groups would be constant over time. Second, transitory factors that may affect the outcome are assumed to have a similar effect across all units comprising the synthetic unit. If

the common trends assumption is met, then it can be assumed that the affected and control units (here: Greece and a group of other European countries) would have evolved similarly without the treatment (here: Greek sovereign debt crisis). However, verifying the common trends assumption is challenging, and any deviation can lead to biased results. In contrast, the SCM does not rely on this assumption of consistency in unobserved variables. Instead, SCM actively uses observed data to create a counterfactual scenario for the period before the treatment. This approach allows SCM to consider potential changes in underlying factors that might not be directly observed, which the DiD method might overlook. As a result, SCM is particularly effective for comparative studies where strict assumptions about common trends between treatment and control groups may not hold, as noted by Abadie et al. (2010).

In our specific case, we create a Synthetic Greece – a weighted combination of countries that, before the crisis, mirrored Greece's economic trends and key indicators. We follow the approach used by Abadie and Gardeazabal (2003) in our modelling. This counterfactual allows us to outline what would have happened to Greece had the Greek sovereign debt crisis never occurred. This approach is particularly useful in situations where finding a naturally comparable control group is challenging. The SCM ensures that the post-crisis analysis remains unaffected by unobserved and unmeasured variables' effects (Abadie et al., 2010). SCM also relies on a data-centric approach to select the countries from a donor pool, ensuring the best match for Greece based on the outcome variable *Emigration Rate* (Abadie & Gardeazabal, 2003).

5.1 Formalisation of Synthetic Control Method

The SCM used to estimate the effect of the Greek sovereign debt crisis on emigration is based on the concepts brought forward by Abadie et al. (Abadie & Gardeazabal, 2003; Abadie et al., 2015). Our model creates a Synthetic Greece by combining data from other European countries from a donor pool[4]. This synthetic version largely mirrors Greece's economic and social characteristics before the crisis started in 2009. The objective is to use Synthetic Greece as a hypothetical benchmark of the migration rates that Greece might have experienced, had the Greek sovereign debt crisis never occurred. We can distinguish the crisis's impact on emigration by comparing Greece to Synthetic Greece. A critical premise for using this model effectively is that Greece and Synthetic Greece should show parallel trends and consistent levels in the *Emigration Rate* variable every period before the crisis, starting in 2009. This guiding principle is called the "identification assumption". Moreover, the ideal approach involves selecting weights for the control countries in Synthetic Greece to ensure that it reflects Greece's pre-crisis predictors as closely as possible. If Synthetic Greece can closely match the outcome variable (*Emigration Rate*) and other critical indicators pre-crisis, it confirms the validity of the identification assumption.

Following Abadie and Gardeazabal (2003) and Abadie (2021), let $J+1$ represent the aggregate observed units, labelled as $j = 1, 2, 3, \ldots, J+1$, where $j = 1$ is the treated unit Greece, and the remaining units $j = 2, 3, \ldots, J+1$ are the potential countries in the donor pool. We assume the data spans for the period T, where the first T_0 years are the years pre-crisis, with $1 \leq T_0 \leq T$. For each unit and each time interval, an outcome Y_{jt} is recorded. We assume two potential outcomes for each unit at each time interval:

- Y_{jt}^N – The expected outcome without the crisis
- Y_{1t}^I – The expected outcome with the crisis (but we only consider this for the unit that experienced the crisis (Greece) and only for the time intervals post-crisis (after 2009))

The start of the Greek sovereign debt crisis was not anticipated and unpredictable beforehand[5]. Thus, the crisis does not affect the outcome prior to its occurrence. Therefore, during

[4]To create this Synthetic Greece, we use the R package "synth" as brought forward by Abadie et al. (2010).

[5]Recall the disclosure of misreported data in late 2009, as elaborated on in Chapter 2.

the first T_0 years $Y_{jt}^I = Y_{jt}^N$, where $t \in \{1, 2, \ldots, T_0\}$ and all $j \in \{1, 2, \ldots, J+1\}$. Post-crisis, the impact of the crisis at any given time interval t (after T_0) is thus the difference between these two potential outcomes:

$$\tau_{1t} = Y_{1t}^I - Y_{1t}^N$$

This equation allows the effect of the crisis to change over time, which is essential since the effect of the crisis could potentially dissipate over time.

The objective for the Synthetic Greece control group is to replicate Y_{1t}^N, where $t > T_0$, that is, the emigration rate of Greece ($j = 1$) that would have been observed had the crisis not occurred. Mathematically, the synthetic control is a weighted average of the countries from a donor pool. To replicate Y_{1t}^N, let $W = (w_2, w_3, \ldots, w_{J+1})$ be a $(J \times 1)$ vector of unit weights such that $\sum_{j=2}^{J+1} w_j = 1$ and $w_j \geq 0$ for $j = 2, 3, \ldots, J+1$. This ensures that the synthetic control genuinely represents a weighted average of the countries in the donor pool, where each vector W constitutes a different potential Synthetic Greece. Given a specific combination of weights W, the estimator $\hat{Y}_{1t}^N$ is:

$$\hat{Y}_{1t}^N = \sum_{j=2}^{J+1} w_j Y_{jt}$$

and thus:

$$\hat{\tau}_{1t} = Y_{1t}^I - \hat{Y}_{1t}^N$$

The synthetic control Synthetic Greece is constructed to closely match the affected unit Greece and its characteristics during the pre-crisis periods. For each unit j we observe a set of K predictor variables of the outcome $X_{1j}, \ldots, X_{kj}$, which may include the pre-crisis period. Importantly, these predictors should not be influenced by the Greek sovereign debt crisis. Let X_1 be a $(K \times 1)$ vector of pre-crisis values of K predictors. Let $X_0 = [X_2, \ldots, X_{J+1}]$ be a $(K \times J)$ matrix where each column is a vector of predictors for a country in the donor pool. When choosing the synthetic control, the goal is to determine $W^* = (w_2^*, w_3^*, \ldots, w_{J+1}^*)$ so that the distance between X_1 and X_0 is minimised:

$$\|X_1 - X_0 W\| = \left((X_1 - X_0 W)' V (X_1 - X_0 W)\right)^{\frac{1}{2}}$$

$$= \left(\sum_{m=1}^{K} v_m \left(X_{m1} - w_2 X_{m2} - \ldots - w_{(J+1)} X_{m(J+1)} \right)^2 \right)^{\frac{1}{2}}$$

In the equation above, V is a $(K \times K)$ positive, symmetric semi-definite matrix, where v_m is a weight that reflects the relative importance assigned to the mth predictor variable when measuring the difference between Greece and the synthetic control. The choice of V is essential because W^* depends on this choice. The synthetic control $W(V) = (w_2(V), \ldots, w_{J+1}(V))'$ is meant to reproduce the behaviour of the outcome variable, the *Emigration Rate*, for the treated unit, Greece, in the absence of the crisis. Therefore, the weights $v_1, \ldots, v_k$ should reflect the predictive value of the covariates.

Abadie et al. (2010) suggest different choices of V. However, in practice, most papers choose a V that minimises the Mean Square Prediction Error (MSPE) of the synthetic control with regards to Y_{1t}^N. The MSPE is a measure used to evaluate the accuracy of a predictive model. It quantifies the average squared difference between the observed actual outcomes and the outcomes predicted by the model:

$$\text{MSPE} = \sum_{t=1}^{T_0} \left(Y_{1t} - \sum_{j=2}^{J+1} w_j^*(V) Y_{jt} \right)^2$$

In any given period, the square root of the MSPE, denoted as RMSPE, gives an average measure of the deviations between Greece and Synthetic Greece's emigration rate. It encapsulates the overall magnitude of differences in the pre-crisis period. Considering all of this, the predictor for the effect of the Greek sovereign debt crisis is:

$$\hat{\tau}_{1t} = Y_{1t} - \sum_{j=2}^{J+1} w_j^* Y_{jt}$$

where $t \in \{T_0 + 1, T_0 + 2, \ldots, T\}$.

Should the identification assumption hold, the impact of the Greek sovereign debt crisis on the emigration rate for any year post-2009 can be measured by contrasting the rates of Greece with those of its synthetic counterpart. Consequently, the influence on the emigration rate for any year after 2009 can be understood as the shift in the rate from one period to the next.

5.1.1 Donor Selection

In addition to the previously mentioned identification assumption, there are further assumptions to be considered when conducting a synthetic control analysis. Countries in the dataset impacted by similar events to the Greek sovereign debt crisis would have to be removed from the donor pool of countries. They could potentially distort the results of the model as they might mirror Greece too closely and would then receive a significant weight in the model. This could inadvertently lead to an uneven representation of the outcome variable in the synthetic control. Further, any country in the donor pool that experienced a significant and unique shock to its emigration rate at any point in the research timeframe should be excluded, especially if that shock would have impacted Greece had the Greek sovereign debt crisis not occurred. It is also essential to reduce the donor pool to countries that resemble Greece to prevent interpolation discrepancies. Interpolation discrepancies occur when the model inaccurately estimates Synthetic Greece's emigration rate, due to significant differences in the predictors between Greece and the donor countries. Additionally, removing countries that resemble Greece too much helps to avoid overfitting, which happens when Synthetic Greece captures characteristics and patterns of the donor pool, which might not be relevant to Greece. This could potentially reduce the model's predictive accuracy for Greece. Abadie et al. (2015) explain that overfitting could arise if the affected country's (in our case: Greece) characteristics are synthetically recreated by capturing random fluctuations across a broad range of unaffected countries. This means that relying on an extensive sample with diverse attributes might result in a synthetic version of Greece that aligns too closely with Greece's emigration rates and trajectories pre-crisis. This could ultimately compromise Synthetic Greece's meaningfulness as a counterfactual, making post-crisis trajectories and levels more unreliable. Abadie et al. (2010) note that if the number of pre-intervention outcomes in the data is "large", then matching with pre-crisis outcomes allow us to control for the heterogeneous response to multiple unobserved factors. The intuition here is that only countries that are similar in terms of observed and unobserved factors will have a similar trajectory before the start of the crisis.

In our analysis, we draw the donor pool exclusively from European countries. All member countries of the Eurozone followed a common monetary policy throughout the years leading up to the crisis. The countries in Europe which are not part of the Eurozone can be assumed to also be impacted by this monetary policy due to their geographical location and trade dependencies. Furthermore, Europe uniquely relies on a common regulatory framework within the EU, or the Schengen and European Economic Areas (EEA). This shared affiliation ensures significant homogeneity across these countries regarding regulations, economic freedoms, and institutional frameworks. Given this context, it becomes dispensable to exclude any specific country due to concerns of interpolation bias. As Abadie et al. (2015) noted, when units share many intrinsic characteristics, they naturally exhibit similar trajectories and outcomes. Thus, by focusing on

countries within the Schengen and EEA spheres, we harness the inherent homogeneity of these countries, ensuring that our comparative analysis is rooted in genuine regional parallels and not merely superficial resemblances. Therefore, we do not exclude any of these countries for potential interpolation reasons.

In our study, we have chosen to use data from 1990 to 2021, with the point of intervention being the start of the Greek sovereign debt crisis in 2009. By incorporating nearly two decades of pre-treatment data, we ensure a robust foundation for matching and controlling for diverse responses to observed and unobserved factors. This extensive pre-crisis dataset facilitates the identification of countries that have followed parallel trajectories leading up to the 2009 intervention, implying similarities in their observable and unobservable attributes.

5.1.2 Externalities affecting Donor Assumptions

This section assesses the impact of the global financial crisis, the Eurozone crisis, the refugee crisis, and the COVID-19 Pandemic on the donor countries and how these external shocks could impact the analysis of the impact of the Greek sovereign debt crisis on emigration rates.

The Eurozone crisis in 2009/2010 had profound implications for many European countries. The crisis was not an isolated event affecting just a few countries. Instead, it unsettled the entire European continent. Every country (with or without the Euro as its currency) experienced its effects to some degree, whether directly or indirectly. Some countries experienced increased economic strains, while others were more resilient (ECB, 2023). It is also worth noting that already structurally weak regions were more susceptible to the crisis's effects. These vulnerabilities, however, are not limited to country borders, and thus, some regions within countries fared quite well while others suffered tremendously (OECD, 2020). The widespread impact supports the argument that the crisis acted as a "baseline" influence, affecting on average all European countries. Excluding individual countries that experienced the Eurozone crisis more than others, in essence, would mean excluding a significant portion of Europe, given the widespread nature of the event. We retain these countries in our model because we assume that the crisis had a pervasive effect across Europe. The Greek sovereign debt crisis, while occurring within the context of the broader Eurozone crisis, had unique characteristics and consequences specific to Greece. Focusing on the Greek sovereign debt crisis allows us to avoid potential redundancies in our analysis. As explained earlier, the Eurozone crisis is not viewed as a unique shock. Instead, it provides a backdrop against which the more distinct effects of the Greek crisis can be discerned.

Like the Eurozone crisis, the refugee crisis in the 2010s was a pan-European event, influencing countries both within and outside the European area. While intensity varied, no European country was completely spared from its ramifications. Due to either their geographic proximity to migration routes or their open-door policies, some countries experienced a more direct impact from the refugee crisis[6]. We consider the refugee crisis as a baseline effect that affected on average all European countries similarly. Hence, we do not exclude any country based on those effects. While the refugee crisis was primarily an immigration challenge, its implications for emigration rates are distinct albeit less direct. The emigration rates will have been influenced by the refugee crisis in more indirect ways such as economic strain, political and social challenges, or perceived quality of life. It is thus essential to distinguish between the general effects of the refugee crisis and specific shocks to a country's emigration rate.

It can be assumed that the global financial crisis of 2007 and 2008, as a covariant shock, affected all countries in the donor pool. Thus, there is no need to account for it in selecting control countries. Similarly, the COVID pandemic, which heavily influenced migration rates in 2020 and 2021, can be reasonably assumed to have affected all countries in the donor pool.

[6]Italy and Germany are two examples of countries with increased migration inflows due to the refugee crisis, despite their geographical differences.

Previous authors (Koser, 2009) have indicated that there is an inherent time lag in migration responses to economic downturns. Thus, especially the global financial crisis in 2008 could result in inflated migration rates in the immediate years after 2009. These are effects we cannot control for since all countries in the donor pool were affected by this crisis. The time lag must be considered when interpreting the migration rates immediately after 2009 as the observed effect in those years may not be exclusively attributable to the Greek sovereign debt crisis.

While we acknowledge the significance of the refugee and Eurozone crises, we ensure that our analysis isolates the migration effect attributable to the Greek sovereign debt crisis. We treat the broader impact of these crises as the baseline "noise" in our analysis. This approach allows us to focus on the specific migration effects directly attributable to the Greek sovereign debt crisis, set against the backdrop of these wider crises. Although we will not be able to fully account for all the external effects, we believe this approach captures the most significant externalities impacting migration across a variety of European countries. This variety is a key strength of our model, as it reflects the commonalities and challenges all European countries share. This approach also ensures that our synthetic control is a balanced representation of Greece without overly narrowing our comparative scope. By adopting this method, we establish a comprehensive and representative, while not exhaustive, basis for our model.

5.1.3 Predictor Selection

Choosing the K predictors for the model is crucial, as these predictors determine the weights assigned to the countries in the donor pool to ultimately recreate Synthetic Greece. Relevant authors highlight various push and pull factors impacting migration choices (Massey et al., 1993; Thet, 2014). Given the context of the financial crisis, our primary model prioritises predictors drawn from literature that specifically address the push and pull factors of economic migration (such as studies on the Brain Drain). This targeted approach allows us to concentrate on the most relevant determinants that influence migration decisions under economic distress without being side-tracked by other factors often associated with non-economic migration, such as wars or humanitarian crises. Such events, while critically important in the broader context of migration studies, fall outside the scope of our investigation which focuses on economic repercussions of the Greek sovereign debt crisis. By narrowing our focus in this manner, we aim to capture the nuances of economic migration patterns most pertinent to our research question.

Our methodology incorporates the use of a lagged dependent variable. This approach involves utilising the value of the dependent variable from a previous period as an independent variable in the model. By doing so, we can account for the influence of past values of the dependent variable on its current state, which is particularly relevant in the context of migration where past migration trends can significantly impact future movements. This aspect of our methodology is critical, especially given the complex and evolving nature of migration patterns, as it allows us to better understand and predict trends based on historical data. The specific details of using a lagged dependent variable in our analysis are further discussed and justified in Appendix 2.

Other papers have either not outlined clear criteria for selecting predictors, or relied on a quantitative approach by selecting the set of predictors that minimises the RMSPE of that predictor combination (Cerulli, 2019). Our objective in the predictor selection is to combine the qualitative approach previously suggested by Abadie and Gardeazabal (2003), and Abadie et al. (2010) with the quantitative approach by Bouttell et al. (2018). This method is further discussed in Appendix 2. Initially, we adopt a set of base predictors chosen from the push and pull-factors of migration described in literature. This set of predictors establishes a core group, to which we then add predictors from a set of a further 40 possible predictors. These additional predictors are then evaluated for both qualitative (a visual observation of the model) and quantitative evaluation of the RMSPE value. Due to the volatile economic and international migration situation highlighted in Section 5.1.2, this approach allows us to choose the predictors

so that the identification assumption of the Synthetic Control Method is best satisfied.

The predictor and donor selection highlighted in the previous two sections will be adapted for the regional analysis and elaborated on in subsequent sections of this thesis.

5.2 Causal Inference and Robustness Tests

To validate the results of the SCM model in Section 5.1, we formalise the causal inference and robustness tests in this section. We first formalise the Leave-One-Out Test (5.2.1) to verify the robustness of our model. Then, the In-Space Placebo Test (5.2.2) is described to ensure the specificity and relevance of our findings. Finally, the T-Test (5.2.3) is formalised which is used to statistically affirm the significance of the observed effects. These tests are essential to strengthen the credibility of our analysis and to address any potential biases in our model.

5.2.1 Leave-One-Out Test

The Leave-One-Out Robustness Test, as proposed by Abadie et al. (2015), is used to determine the sensitivity of synthetic control results to changes in the donor weights. This process systematically re-estimates synthetic Greece by omitting one of the donor countries in each iteration. This process allows us to analyse to what extent the fit of our synthetic control is dependent on one specific donor country. Ideally, the process yields results that are similar in both pre- and post-crisis fit (Abadie et al., 2015).

If the exclusion of one specific donor country significantly impacts the magnitude of the post-crisis results, while not affecting the pre-crisis period, it suggests that this excluded donor country was affected by a distinct idiosyncratic shock or treatment. This shock or treatment would then have affected its migration rate during the post-crisis period (Abadie et al., 2015). Consequently, the donor country in question might not be suitable for the creation of a synthetic counterfactual, as the idiosyncratic shock introduces bias in the post-crisis comparison of Greece with its synthetic counterpart.

5.2.2 In-Space Placebo Test

The placebo test used for causal inference, as proposed by Abadie et al. (2010), is based on permutation methods. In the context of synthetic controls the In-Space Placebo Test artificially reallocates the crisis to each country in the donor pool. We replicate this approach of reallocating for every country in the dataset, using the same methodology of constructing a synthetic counterfactual. Then the individual synthetic counterfactuals and the actual Synthetic Greece are combined into a permutation distribution. Through comparison of the impacts of the Greek sovereign debt crisis on the different control units, one may conduct visual inference of the significance of the crisis' effects on Greece compared to the other countries in the donor pool. These differences in the significance of the crisis' effect also allow for inference and calculation of a p-value, measuring the fraction of placebos with results equal to or larger than the one estimated for Greece's post-crisis state (Abadie et al., 2015).

Abadie et al. (2015) utilise the RMSPE of the synthetic control estimator for unit j during time periods $t_1, .., t_2$:

For $0 \leq t_1 \leq t_2 \leq T \quad \text{and} \quad j = \{1, \ldots, J + \lfloor 1 \rfloor\}$, let

$$R_j(t_1, t_2) = \left(\frac{1}{t_2 - t_1 + 1} \sum_{t=t_1}^{t_2} \left(Y_{jt} - (Y_{jt}^N) \right)^2 \right)^{\frac{1}{2}}$$

where $(Y_{jt} - \hat{Y}_{jt}^N)$ is the difference between the actual- and the synthetic control outcome of unit j at time t, and where j is considered the treated unit. Furthermore, all other J donor

units are used to construct the synthetic control. Further, the ratio of pre- and post-treatment RMSPEs is calculated as:

$$r_j = \frac{R_j(T_0+1, T)}{R_j(1, T_0)}$$

or more simply:

$$r_j = \frac{\text{Post-treatment RMSPE}_j}{\text{Pre-treatment RMSPE}_j}$$

Thus, the value of r_j is a relative measure of fit of the synthetic control unit j pre- and post-crisis. Utilising the permutation distribution r_j, a p-value may be calculated:

$$p = \frac{1}{J+1} \sum_{j=1}^{J+1} [I_+(r_1 - r_j)]$$

where $I_+()$ is an indicator function of value one for all $(r_1 - r_j) > 0$ and zero otherwise. Therefore, the p-value indicates whether the actual crisis effect on the treated unit is extreme relative to the placebo ratios of the donor pool. It is important to note that Abadie (2021) suggests the possibility, given a heterogeneous donor pool, to remove placebos with an extremely poor pre-crisis fit to prevent outliers from distorting the p-value calculation.

5.2.3 T-Test

The robust T-Test proposed by Chernozhukov et al. (2022) is utilised to make inference on the average treatment effects on the treated unit (ATT) in a synthetic control framework. This test is implemented to complement the results from the In-Space Placebo Test. However, it must be noted that these two tests are not the same. While the Placebo Test determines whether the post-crisis effect was significant relative to the distribution of post-crisis effects in non-treated placebos, the T-Test assesses whether the average post-crisis effect in the treated unit is significantly different from zero. Chernozhukov et al. (2022) first consider a basic synthetic control framework with a pre-crisis period T_0, a post-crisis period T_1, and N untreated donor countries, where $Y_{0t}(1)$ and $Y_{0t}(0)$ respectively denote the outcomes of the treated country with and without the crisis. Thus, the ATT is calculated as:

$$\tau = \frac{1}{T_1} \sum_{t=T_0+1}^{T_0+T_1} (Y_{0t}(1) - Y_{0t}(0))$$

However, as $Y_{0t}(0)$ is not observed during the post-crisis period it is exchanged with the synthetic control outcomes $\sum_{i=1}^{N} w_i Y_{it}$ where

$$\hat{w}_i = \hat{w}_1, \ldots, \hat{w}_N$$

$$\sum_{i=1}^{N} \hat{w}_i = 1$$

$$\tilde{\tau} = \frac{1}{T_1} \sum_{t=T_0+1}^{T_0+T_1} \left(Y_{0t}(1) - \sum_{i=1}^{N} \hat{w}_i Y_{it} \right)$$

Thus, in this basic framework the estimated average treatment effect of the treated country is the average of the sum of the difference between the treated country and its synthetic control in the post-crisis period. However, Chernozhukov et al. (2022) identify two major constraints of

this basic approach in a synthetic control environment, that may be characterized by a T_0 that is smaller or comparable to N and where data is characterised by persistence and dynamics.

Firstly, in such an environment $\tilde{\tau}$ is biased, irrespective of correct specification, due to the error introduced by estimating a high number of weights from a small pre-crisis period. Secondly, the estimation of standard errors is challenging due to their dependence on the Long-Run Variance (LRV) and the fact that LRV estimators rely on very large samples for reliable inference (Chernozhukov et al., 2022; Newey & West, 1987). To address the latter two issues Chernozhukov et al. (2022) developed a method that removes this bias through a K-fold cross-fitting procedure and avoids LRV estimation through "a self-normalised T-Statistic with an asymptotically pivotal T-Distribution with K-1 degrees of freedom". Furthermore, this method is applicable to stationary and non-stationary data and does not require assumptions about the nature of the non-stationarity. Rather, it requires similarity between the control units and the treated unit, which is a fundamental part of any synthetic control analysis. Chernozhukov et al. (2022) create a setup with *N+1* units and $T = T_0 + T_1$ time periods. The treated unit is defined by *i=0* and the donor units are defined by *i=1,...,N*. $Y_{it}(1)$ and $Y_{it}(0)$ are the potential outcomes with and without treatment. The observed effects are $Y_{it} = Y_{it}(0) - \alpha_t D_{it}$ where $D_{it} = 1t > T_{0,i} = 0$ and $\alpha_t = Y_{1t}(1) - Y_{0t}(0)$. Thus, the hypothesis tested about the ATT, $\tau = \frac{1}{T_1} \sum_{t=T_0+1}^{T} \alpha_t$, is:

$$H_0 : \tau = \tau_0$$

To test this hypothesis, Chernozhukov et al. (2022) first remove the bias from the synthetic control through a K-fold cross-fitting procedure. K, which is fixed, represents consecutive blocks from the pre-crisis period, represented by:

$$H_1 \cup H_2 \cup \ldots \cup H_K \subseteq \{1, \ldots, T_0\},$$

where

$$r = \min \left\{ \frac{T_0}{K}, T_1 \right\}$$

and for $1 \leq k \leq K$

$$H_k = \{(k-1)r + 1, \ldots, kr\}$$

For *k=1,...,K*, compute

$$\hat{\tau}_k = \frac{1}{T_1} \sum_{t=T_0+1}^{T} \left(Y_{0t} - \sum_{i=1}^{N} \hat{w}_{i,(k)} Y_{it} \right) - \frac{1}{|H_k|} \sum_{t \in H_k} \left(Y_{0t} - \sum_{i=1}^{N} \hat{w}_{i,(k)} Y_{it} \right)$$

where $\hat{w}_{(k)} = \left(\hat{w}_{1,(k)}, \ldots, \hat{w}_{N,(k)} \right)$ are calculated by applying the synthetic control method to the data in $H_{(k)}$. The first part of the formula above represents the biased ATT and the second part represents the estimation of the bias in the estimation of the ATT in the pre-treatment period. Chernozhukov et al. (2022) assume equality of pre- and post-crisis bias which allows them to remove the bias from the ATT estimator via subtraction.

Thus, the final ATT estimator may be calculated by:

$$\hat{\tau} = \frac{1}{K} \sum_{k=1}^{K} \hat{\tau}_k$$

with the scale-free t-statistic being calculated by:

$$T_K = \frac{\sqrt{K}(\hat{\tau} - \tau_0)}{\hat{\sigma}_{\hat{T}}}$$

where

$$\hat{\sigma}_{\hat{T}} = \sqrt{1 + \frac{Kr}{T_1}} \sqrt{\frac{1}{K-1} \sum_{k=1}^{K} (\hat{\tau}_k - \hat{\tau})^2}$$

Thus, a confidence interval can be constructed:

$$CI_K(1-\alpha) = \left[\hat{\tau} - t_{K-1}(1 - \frac{\alpha}{2}) \frac{\hat{\sigma}_{\hat{T}}}{\sqrt{K}}, \hat{\tau} + t_{K-1}(1 - \frac{\alpha}{2}) \frac{\hat{\sigma}_{\hat{T}}}{\sqrt{K}} \right]$$

where α is the significance level, most commonly 0.05.

When conducting this analysis, the choice of K is imperative. However, before determining K, two aspects need to be considered. Increasing K leads to a shorter confidence interval but decreases the sample coverage accuracy. Sample coverage accuracy refers to the proportion of times the true parameter falls within the constructed Confidence Interval (CI) from repeated samples. It is a measure of the practical accuracy of the CI. Thus, if the sample accuracy of a 95% CI is less than 95%, this indicates that in practice the method used to construct the CI is not performing as expected. Chernozhukov et al. (2022) suggest a *K=3* for analysis with a small T_0 to get a good balance between sample coverage accuracy and CI length. Consequently, the subsequent T-Tests employed in this study use $K = 3$.

5.3 Correlation Analysis

The correlation analysis aims to identify underlying factors that drive the impact of the Greek sovereign debt crisis on net migration in all Greek regions. The data does not allow for a basic linear regression model or calculation of Pearson's Correlation Coefficient, therefore a visual analysis in the form of scatter plots is employed. This method plots the dependent variable, *Percentage Change in Net Migration*, on the Y-axis and the individual independent variables on the X-axis. The visual representation identifies the fundamental characteristics of the relationship between the two variables, i.e. a positive or negative correlation. It allows us to infer how each specific factor may have influenced migration movements on a regional level. Importantly, even if two variables show a strong relationship in the scatter plots, we cannot determine that one variable causes a change in the other. We are therefore unable to draw a conclusion on causal inference from this analysis. Moreover, the effects of the Greek sovereign debt crisis may be unique on a regional level, some Greek regions were more profoundly affected than others. Similar to the Placebo Tests, extreme outliers significantly affecting the robustness and reliability of the correlation analysis are omitted.

6 Data

Chapter 6 presents the data used to analyse the effects of the Greek sovereign debt crisis on emigration and regional migration within Greece. We present the various data sources utilised for both national and regional levels, covering metropolitan and rural areas, and the creation of the donor pools for Greece as a whole and its regions. The chapter also discusses the inherent data limitations at both the national and regional levels, acknowledging the challenges these may pose to our analysis.

6.1 Data Sources Greece and Donor Pool

For the empirical analysis in this research, we use panel data on the outcome variable, *Emigration Rate*, and for the different predictor variables. Where necessary, the variables in the dataset are re-scaled to per-capita values to account for differences in country and population size[7]. The data and data sources are summarised in Appendix 1. The data covers the years 1990 to 2021, with the pre-crisis period spanning from 1990-2009 and the post-crisis period from 2010-2021[8], with 2021 being the final year in the sample.

The primary outcome variable is the *Emigration Rate*, which is calculated using EUROSTAT's absolute emigration numbers from 1990 through 2021 for 37 European countries[9] divided by annual total population numbers from the United Nations Population Division[10] each year.

Following the predictor selection approach described in Section 5.1.3, the core group of predictors includes the lagged dependent variable *Emigration Rate*[11], and also *Unemployment Rate*, the *Consumer Price Index* (with the base year 2015), and the *GDP per Capita* (2023 US$). As a lagged outcome variable, we use the lags of the *Emigration Rate* as described in Appendix 2. Where necessary, predictor variables are, in the same way as the outcome variable, divided by total population numbers obtained from the UN Population Division. The *Consumer Price Index* is obtained from yearly EUROSTAT data. Since this data does not consider population size as a factor, it does not need to be expressed as a per capita value. The data for the other two predictors (*Unemployment Rate* and *GDP per Capita*) are obtained from the World Bank World Development Indicators and thus provide a coherent dataset.

The additional predictors selected following the quantitative method highlighted in Section 5.1.2 are also –where necessary– divided by total population numbers from the UN Population Division. We thereby use per capita values and account for different population sizes. This set of predictors includes *Current Account Balance per Capita*, *Outflow of Remittances per Capita*, *Foreign Direct Investment per Capita* and *GDP per Person Employed* (in 2017 US$)[12]. The *Outflow of Remittances* is obtained from KNOMAD, the "Global Knowledge Partnership on Migration and Development" database. KNOMAD is an initiative of the World Bank and therefore uses World Bank data. The *Foreign Direct Investment* data is obtained from the World Bank Open Databank. There, the FDI data is collected for 266 different countries over more than 60 years, thus providing a comprehensive dataset for the countries relevant to our research. The remaining predictors, *Current Account Balance per Capita* (2023 US$), and *GDP per Person Employed* (2017 US$) are sourced from the World Bank World Development Indicators database.

6.2 Construction of Donor Pool Synthetic Greece

We must exclude some European countries from the donor pool because we rely on reporting data from different national statistical authorities. The dataset compiled from EUROSTAT includes 37 European countries. From this dataset, we exclude the countries that either do

[7]Relevant literature (Abadie, 2021) suggests that using a synthetic control with weights is only warranted if data for the variables is rescaled to control for differences in country and population size, through e.g., per capita values. Thus, in this model, we provide each variable as per capita value.

[8]The Debt crisis started in late 2009, thus the treatment of the model is set to 2009 and 2009 remains a pre-crisis year. We elaborate on this Data Limitation in 6.3.

[9]Due to limited Data Availability, we ultimately exclude the countries that have not sufficiently and consistently reported migration numbers.

[10]Total Population as of July 1st of each year.

[11]Reasoning of lagged dependent variable is elaborated on in Section 5.1.3 and Appendix 2.

[12]This is not a per Capita value and instead is an exception. This is not a problem since the division by the total number of people employed accounts for population size like the per capita calculations.

not start reporting their emigration data until after 1995 or have considerable gaps in the data reported. Furthermore, we also consider potential spillover effects of the debt crisis in Greece's neighbouring countries. Albania and Turkey are not part of the EUROSTAT dataset so do not need to be excluded. The other neighbours, Bulgaria, Cyprus, and North Macedonia will likely have experienced the effects of the crisis due to their geographical proximity and financial links with Greece. All five countries have close economic and social ties, with many Greeks living in one of those neighbouring countries and vice versa (Maroukis & Gemi, 2011). We therefore exclude those countries from the donor pool.

The donor pool consequently consists of 19 European countries that are used for the empirical analysis of the effects of the Greek sovereign debt crisis on emigration rates in Greece.

6.3 Data Limitations Greece and Donor Pool

As we are using real-world data, there are limitations to consider when conducting the empirical analysis. Firstly, we use data on a country level. This prevents the consideration of possible differences between regions in Greece and where people tend to emigrate from. We aim to mitigate this by separately analysing regional migration rates in Greece in Chapter 8 to better understand what influenced net migration rates in Greece.

Furthermore, the data for Greece and the donor countries is reported on an annual basis. We are therefore not able to discern seasonal trends or other temporary effects. This temporal restriction in the data leaves us with the decision of whether to include 2009 as a post-crisis year or classify it as pre-crisis. When the Greek sovereign debt crisis started in October 2009 through the disclosure of Greece's budget deficit by George Papaconstantinou, the finance minister in Greece at the time (Kyriakidou, 2009), almost 4/5 of the year had passed. We, therefore, consider 2009 to be the final pre-crisis year. Consequently, 2010 is classified as the first post-crisis year. Moreover, classifying 2009 as a post-crisis year would have required an analysis of Greece's emigration rates within that year, which is not ideal given the inherent time lag in emigration responses (see Section 5.1.2). This delay in response reinforces our decision to treat 2009 as a pre-crisis year and makes us interpret the numbers from 2010 with increased caution, as those numbers might not reflect the full effect yet.

Using data from different countries implies that reporting standards and standardisations will vary. The definition of who is considered an emigrant, for example, may be different between countries. This limitation speaks for the use of the EUROSTAT dataset, which provides the most reliable and coherent data for European countries.

A fourth limitation is that irregular and undocumented migration will not be reflected in the data available. Undocumented migration is estimated and reported according to different standards in the individual countries. Hence, we decide to view undocumented migration as a limitation similar to the Eurozone and refugee crises mentioned earlier, as on average it affects all countries in the donor pool (see Section 5.1.2).

Finally, while we have made efforts to control for spillover effects by eliminating immediate neighbouring countries, we are analysing a donor pool consisting of interconnected economies or at least heavily influenced through a shared monetary policy and economic area. Thus, it will not be possible to fully control for all spillover effects between the set of countries in the analysis.

6.4 Data Sources Regional Greece

To analyse the effect of the Greek sovereign debt crisis on a regional level in Greece, panel data for the outcome variable and predictors are collected. All variables were collected in standardised formats such as indices, rates, or per capita metrics. Furthermore, the regional

classification follows the Nomenclature of Territorial Units for Statistics 3 (NUTS 3) system, which is used in the European Union.

While the OECD defines metropolitan areas as "areas encompassing commuting zones and cities with at least 50,000 residents and a density of more than 1,500 individuals per square kilometre" (OECD, 2009), this criterion does not align with our research objective. Since there are 40 cities in Greece with a population above 50,000 inhabitants, their characteristics are varied and often different from major European metropolitan areas (Review, 2023). Hence, to ensure comparability between the metropolitan donor areas and the Greek metropolitan areas we focus specifically on the largest, non-island, metropolitan areas of Greece. Consequently, we raise the metropolitan classification threshold to 100,000 residents. To account for similarity in population density, we integrate it as a predictor in our synthetic control model. However, we do not set a fixed cut-off point because the majority of Greek metropolitan areas with a population above 100,000 inhabitants do not have a population density above 1,500 individuals per square kilometre. All regions with a population below the 100,000 population threshold are classified as "rural".

On the regional level the pre-crisis period is defined as the period from 2001 to 2009, and the post-crisis period as 2010 to 2019. The regional pre and post crisis periods thus differ from the national level due to the limited data availability for many regional variables prior to 2001 and post 2019. When comparing national emigration drivers to regional migration drivers, we believe the latter is more multi-faceted and may be comparatively less influenced by economic factors alone. Therefore, the choice of predictors on the regional level is more diversified to capture economic, environmental, and population dimensions.

6.4.1 Data Sources Metropolitan Greece

The outcome variable, *Crude Rate of Net Migration* (Including Statistical Adjustments), was obtained from the EUROSTAT dataset "Population change – Demographic balance and crude rates at regional level (NUTS 3)". *Crude Rate of Net Migration* (Including Statistical Adjustments) is calculated as the ratio of net migration, including statistical adjustments during the year, and the average population during that year.

The two predictors chosen to analyse potential environmental drivers of net migration are *Heating Degree Days* (HDD) and *Cooling Degree Days* (CDD). They were obtained from the EUROSTAT dataset "Cooling and heating degree days by NUTS 3 regions – annual data". HDD and CDD are indices that capture the need for heating/cooling energy requirements of buildings. Including HDD and CDD as predictors provides insights into evolving climate patterns, which affects migration decisions (Hunter et al., 2015). Additionally, we believe they indirectly highlight the implications on quality of life and individual economic challenges, particularly in terms of energy expenses.

The two predictors used to represent population-centred drivers of net migration are *Crude Birth Rate* and *Crude Death Rate*. They were obtained from the EUROSTAT dataset "Population change – Demographic balance and crude rates at regional level (NUTS 3)". Both predictors are calculated as the ratio of live births/deaths during the year divided by the average population size during that year. These predictors were included as they provide insights into natural population change, which affects underlying migration motivations influenced by, for example, age (Plane, 1993).

Another population-centred driver of net migration is *Population Density* and it was obtained from the EUROSTAT dataset "Population density by NUTS 3 region". It is calculated by dividing the total population by area of land. We include this predictor as it adds another spatial factor to the analysis in addition to the classification of regional units into metropolitan and rural.

The main economic predictor, *GDP per Capita*, was obtained from the EUROSTAT dataset "Gross domestic product (GDP) at current market prices by NUTS 3 regions". *GDP per Capita*

is calculated using the output method, which sums up the gross value of output (in 2015 EUR) produced in an economy divided by the average population size during that year. We include this predictor as it represents the economic health and prosperity of the region, and thus the economic satisfaction of individuals which influences migration decisions (Parkins, 2010).

6.4.2 Data Sources Rural Greece

All variables mentioned in the previous section are also part of the rural analysis. However, to improve the qualitative fit of the model *Labour Productivity* is added as a predictor. Data for this predictor is obtained from the EUROSTAT dataset "Nominal Labour productivity by NUTS 3 regions". *Labour Productivity* is calculated as the annual ratio of labour output and labour input.

6.4.3 Regional Influencing Factors

In the correlation analysis, the dependent variable is defined as the *Percentage Change in Net Migration*. It is calculated as the percentage change in the average annual net migration rate between 2004 and 2009 and the average annual net migration rate between 2010 and 2014, both measured on a regional level. The reason for the adjusted timeframe, starting in 2004 and ending in 2014, is the ability to incorporate multiple variables which lack documentation prior to 2004 and post 2014. All independent variables documented in absolute values have been normalised using the natural logarithm.

6.5 Donor Pool for Synthetic Regional Greece

To allow for a regional analysis the regions are classified into metropolitan and rural areas. Hence, donor units for each type of region are chosen according to the classification criteria stated in Section 6.4. In Sections 6.5.1 and 6.5.2 we discuss the donor pool used for the SCM analysis of metropolitan and rural areas. In Section 6.5.3 we discuss a separate donor pool used in the correlation analysis of the regional influencing factors.

6.5.1 Donor Pool for Synthetic Metropolitan Greece

Metropolitan Greece is made up of an average of eleven individual Greek NUTS 3 metropolitan areas. These individual metropolitan areas all have a population above 100,000 inhabitants, as explained in Section 6.4. For Synthetic Metropolitan Greece, 20 NUTS 3 regions from across Europe are selected to ensure a comprehensive analysis of migration trends. This selection is shown in Appendix 5. Given the extensive number of NUTS 3 regional units available (1166 in total), a focus on economically comparable and demographically significant areas was necessary for manageable and comprehensive analysis. The chosen units represent cities in countries like Germany, Spain, Italy, and Sweden. These choices reflect a broad geographic diversity and capture a broad scope of migration dynamics across Europe. Key metropolitan areas such as Brussels, Madrid, Barcelona, and Milan are included as they have a high economic significance to their countries and urban characteristics similar to the Greek metropolitan areas. Besides those financial centres, the donor pool also consists of smaller urban centres. These emerging economic centres are important as they provide a more diverse mix in the donor pool and thus offer valuable insights into migration patterns within different economic contexts. This selection ensures that the main assumptions stated in Section 5.1.1[13] are fulfilled.

[13]These are the Identification assumption, that there are no significant and unique shocks, and that no country was impacted by similar events pre-crisis.

6.5.2 Donor Pool for Synthetic Rural Greece

Rural Greece is made up of an average of 41 individual Greek NUTS 3 rural areas. Thus, combined with the eleven NUTS 3 metropolitan areas selected in 6.5.1, we cover all 52 Greek NUTS 3 regions in this regional SCM analysis. Similar to the donor selection for Metropolitan Greece, the extensive amount of NUTS 3 regions requires a focused approach for selecting rural areas. For this purpose, we chose 17 rural regions from Belgium, Bulgaria, and Germany, as shown in Appendix 5. This selection represents a diverse cross-section of rural Europe, encompassing regions with varied agricultural, economic, and demographic profiles. The choice was guided by the aim to include regions with populations below 100,000 inhabitants, ensuring that they are genuinely representative of rural characteristics and not influenced by urban spillover effects. These regions were also selected for their data availability and compatibility with the main assumptions of our study, as outlined in Section 5.1.1. By focusing on these specific rural areas, we ensure a balanced comparison with Rural Greece, capturing the characteristics of rural migration patterns across different European contexts. This methodical selection allows for a comprehensive yet manageable analysis.

6.5.3 Regional Influencing Factors

Irrespective of the previous classification of the Greek regions into metropolitan and rural areas for the SCM analysis, the study of regional influencing factors considers all the 52 Greek NUTS 3 regions. The reason for this is to understand the underlying migration effect of the Greek sovereign debt crisis in all of Greece. Extreme outliers[14] can significantly skew the results, allowing for misleading interpretations. Consequently, regions with a significantly atypical datapoint (percentage change in net migration of more than 400%) not representative of the general trends across the Greek NUTS 3 regions are excluded. This ensures robustness and reliability in the analysis.

6.6 Data Limitations Regional Greece and Regional Donor Pool

Similar to the limitations on country level, there are several restrictions associated with the regional analysis.

Firstly, the data limitations outlined in Section 6.3, regarding annual data, varying reporting standards, irregular and undocumented migration, and spillover effects equally apply on the regional level.

Secondly, our decision to classify metropolitan areas based on a population threshold of 100,000 is arbitrary to a certain degree. The rationale behind our metropolitan classification is discussed in Section 6.4.

Thirdly, the large number of NUTS 3 regional units across Europe preclude a detailed analysis of the individual regions in terms of their principal cities, distinctive regional characteristics, and similarities to Greek regions. The detailed donor selection criteria are stated in Sections 6.5.1 and 6.5.2.

Fourthly, the data on net migration provides insight into the migration patterns within regional units, however, it precludes a directional analysis of inter-regional migration trends. Therefore, it remains ambiguous whether the Greek sovereign debt crisis caused a migration flow from metropolitan to rural areas or vice versa (see Section 4.2).

Lastly, the limited data availability on a NUTS 3 level prevents a more nuanced predictor selection tailored to each predictor category. This leads to the limited accuracy of the pretreatment fit of the synthetic control. It may consequently affect whether the identification assumption can be considered fulfilled.

[14] The only outliers with a percentage change in net migration of more than 400% are: Dytikos Tomeas Athinon (EL302), Peiraias, Nisoi (EL307), Kastoria (EL532), Larisa (EL612), and Aitoloakarnania (EL631).

7 Results: Greece

In the following chapter, we present the results from the synthetic control model specified in Section 5 using the data described in Chapter 6.

7.1 Synthetic Greece

7.1.1 Predictors

As discussed in Section 5.1.2, we rely on a set of core predictors based on literature and qualitative analysis of factors potentially impacting the Greek sovereign debt crisis. These base predictors are the lagged dependent variable *Emigration Rate*, *Unemployment Rate*, *Consumer Price Index* (with the base year 2015), and *GDP per Capita* (2023 US$). We then add a set of further possible predictors and evaluate the RMSPE as well as the visual fit of the model after adding new predictors to the model. The base predictors are thus complemented with the additional predictors *Current Account per Capita*, *Outflow of Remittances per Capita*, *Foreign Direct Investment per Capita* and *GDP per Person Employed* (2017 US$). Based on this method, the RMSPE of the final predictor combination is 0.005251252. Thus, on average, the deviation in outcomes between Greece and Synthetic Greece in the pre-crisis period, considering both magnitude and direction, is captured by an RMSPE of 0.0525%. The detailed reasoning behind the qualitative and quantitative predictor selection is discussed in Appendix 2.

Table 1 provides an overview of the final predictor set used and compares the values of those predictors for the treated unit Greece, Synthetic Greece, and the sample mean across the 19 donor countries used in the model. For almost all predictors used, the Synthetic Greece unit is closer to the sample mean compared to the treated unit Greece. The closer Synthetic Greece's characteristics are to the sample mean of the donor countries, the more reliable the synthetic control becomes in estimating what would have happened in Greece in the absence of the Greek sovereign debt crisis. This is a fundamental concept for the validity of the conclusions drawn from the SCM analysis. The table also shows the ratio of Synthetic/Treated and, therefore, which predictors provide a good fit between the synthetic control group and Greece.

Table 1: Emigration Rate Predictor Means

Predictors	Greece	Synthetic Greece	Sample mean	Synthetic/ Treated
Lagged Emigration per Capita	0.004	0.004	0.006	1.00
Outflow of Remittances per Capita	0.000	0.000	0.001	1.00
Current Account per Capita	-1120.193	98.545	531.192	-0.088
Foreign Direct Investment per Capita	126.085	590.637	1686.631	4.684
Unemployment Rate	0.097	0.081	0.077	0.835
GDP per Capita (2023 US$)	18583.650	26846.605	34574.993	1.445
Consumer Price Index	0.945	0.944	0.925	0.999
GDP per Person Employed (2017 US$)	74547.271	72135.764	81888.092	0.968

Source: See Appendix 1

Most of the predictors chosen show a ratio of close to 1. This is desirable, as it indicates that the synthetic control closely matches the treated unit in terms of that predictor. It suggests that the synthetic control is a good counterfactual for the treated unit with respect to the specific predictor. Despite the comparatively weak fit of the *Current Account per Capita* and *FDI per Capita* predictors, they are included in the model as they provide a better fit between Greece and Synthetic Greece and decrease the RMSPE of the model. Therefore, they are included as they also allow a more holistic view of the economic situation in Greece and can provide complementary information.

From the V matrix provided as output of the model (see Appendix 4), the different predictors are weighted: *Emigration per Capita* lag (55.2%), *Consumer Price Index* (24.8%), *GDP per Person Employed* (10.2%), *Outflow of Remittances* (5.7%), *GDP per Capita* (1.8%), *FDI per Capita* (1.3%), *Unemployment Rate* (0.6%) and *Current Account per Capita* (0.3%). The weighting of the lagged dependent variable is a good sign, as relevant authors (Abadie, 2021) see it as the best predictor because it captures the inherent time-series momentum and historical trends in the data. According to Abadie, a lagged dependent variable effectively reflects the persistence and continuity of the crisis. This is particularly important in dynamic systems where past values have a significant influence on current and future states, as is the case with migration patterns.

At the same time, some authors have advised caution when high weights are attributed to lagged dependent variables, especially if this results in other covariates or predictors becoming irrelevant (Kaul et al., 2017). The concern is that over-reliance on one predictor or lagged variable might lead to suboptimal results or skewed interpretations (Kaul et al., 2017). The 55.2% weight attributed to the *Emigration per Capita* lag reflects its significance in migration patterns, aligning closely with expectations that emphasise historical trends and networks as key determinants in forecasting future emigration (Pratsinakis et al., 2019). This emphasis on historical data is also supported by established theories such as "The New Economics of Migration". Thus, we believe that the weight of 55.2% attributed to the lagged variable does not lead to suboptimal results or skewed interpretations of our analysis. To assess potential structural breaks, we divide the lagged dependent variable into four separate lags from 1991-2009. However, this approach resulted in these lags cumulatively accounting for over 90% of the model's weight, overshadowing other predictors. Consequently, we reverted to using a single lag, which appropriately balances the model with a more reasonable weight of 55.2%, as further elaborated in Appendix 2.

7.1.2 Donor Countries

In addition to the weight and characteristics of the predictors used in the model, the weighting of each donor unit shows which countries were used in the model to replicate Greece. Table 2 lists the nine countries with weights ≥ 0.001. Portugal, Germany, Poland and Switzerland comprise approximately 97% of the weights, with the remaining 3% allocated to Italy, Croatia, Ireland, Finland and Belgium.

Portugal has the greatest weight (45.6%), which can be explained by Portugal showing the smallest differences to Greece in the dataset for five of the nine predictors. The three heavily weighted economic predictors, *Consumer Price Index* and *GDP per Person Employed*, and *GDP per Capita* show similar levels and trends between Portugal and Greece from 1990-2009. These economic factors reflect the similarities between the two southern European countries. The countries joined the Eurozone in 1999 and 2001, respectively. This membership in the years leading up to the Greek financial crisis means that both countries were subject to the same monetary policy set by the European Central Bank, which impacted their economies. The most important economic sectors of both countries are wholesale and retail trade, transport, accommodation, and food services. These sectors together make up more than 20% of the GDP. With tourism also playing a significant role, these service-oriented sectors probably result in

similar trends in indicators like *GDP per Person Employed*, *Consumer Price Index* and *GDP per Capita*. These similarities in economics further help to explain why the most notable predictor, the *Emigration Rate*, is, on average, closest between Portugal and Greece, with a gap of 0.307% pre-crisis.

Germany receives a higher weight as it resembles Greece in the *Outflow of Remittances per Capita* predictor. As discussed in more detail in Section 3.1, after the collapse and disintegration of the former Eastern Bloc, the 1990s saw a considerable influx of immigrants into Greece (Labrianidis & Pratsinakis, 2016). In the 1990s, it received the highest percentage of immigrants relative to its labour force in the EU (Kasimis & Kassimi, 2004). After the collapse of the Eastern Bloc, Greece's geographic location in the Mediterranean and its status as the gateway to mainland Europe caused constantly high migration numbers through the 1990s and early 2000s. In Germany, the fall of the Iron Curtain and the subsequent return of approximately three million ethnic Germans between 1988 and 2003 contributed massively to Germany's high immigration rates (Oezcan, 2004). Combined with Germany's long-standing interest in recruiting foreign labour which had been raising the immigration rates, this indicates that both Germany and Greece have experienced – albeit for different reasons – somewhat similar immigration per capita numbers. Thus, the immigrants' origins and intentions in Greece and Germany explains the similarity found in the *Outflow of Remittances* in both countries.

Based on these findings, we deem the selection of countries in the donor unit reasonable for constructing the Synthetic Greece control group.

Table 2: Country Weights for Synthetic Greece

Country	Weight
Portugal	0.456
Germany	0.220
Poland	0.159
Switzerland	0.134
Italy	0.024
Croatia	0.002
Ireland	0.001
Finland	0.001
Belgium	0.001

Note: Only countries with positive weights are shown. The full weight allocation table can be found in Appendix 3.

Source: Compiled by Authors with Data listed in Appendix 1

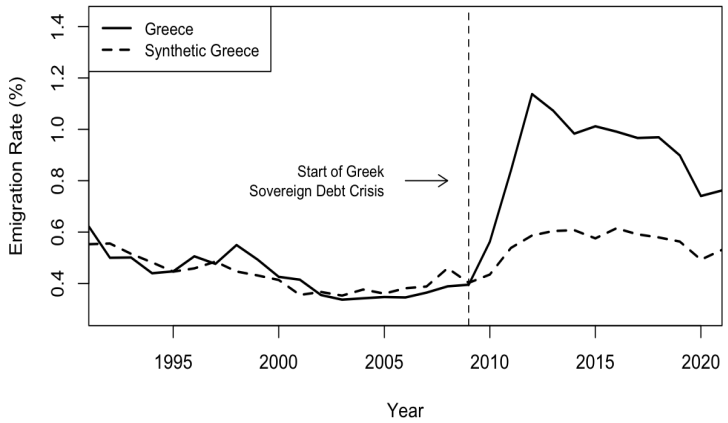
The model fit between Greece and the synthetic control group, both for the dependent variable *Emigration Rate* and the predictors selected previously, shows the identification assumption as fulfilled and thus we proceed with presenting the results on the effect of the Greek sovereign debt crisis on emigration out of Greece.

7.2 Comparison Greece and Synthetic Greece

When constructing Synthetic Greece, we target its emigration rate to align closely with the actual Greek emigration rate during the pre-crisis years. It should ideally reflect the factors that influence emigration, rather than directly mirroring the emigration rate. This confirms that the constructed synthetic control reflects the hypothetical trajectory of the emigration rate from 2010-2021, had the Greek sovereign debt crisis not occurred. Figure 2 shows that before the start of the crisis, the emigration rates of Greece and Synthetic Greece follow each other quite closely. When examining the actual differences in emigration rates between Greece

and Synthetic Greece, the average from 1990-2009 was 0.001037%. There are some divergences, especially between 1995 and 2000. During this period, the difference between Greece and Synthetic Greece was 0.0360% on average. From 2006 to 2008, we see another diversion, which is 0.0435%. Both these values are higher than the average presented earlier. The divergence between 2006 to 2008 is not ideal, as we aim for an especially close fit in the immediate years leading up to the crisis to ensure that the observed effect post-crisis is realistic. The very close fit in 2009 just before the crisis starts is therefore encouraging. Combined with the similarity between Greece and Synthetic Greece in the other years pre-2009, it can be concluded that Synthetic Greece follows actual Greece both in pre-crisis trend and level.

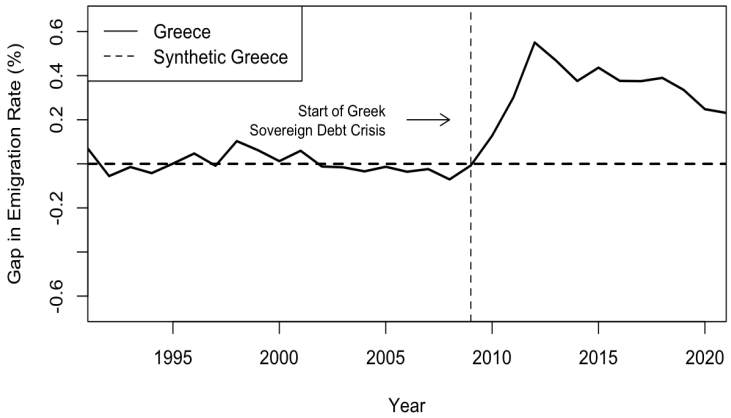
Figure 2: Path Plot of Emigration Rate 1990-2021



Source: Compiled by Authors with Data from EUROSTAT (2023)

7.3 Effects on Emigration Rates

Figure 3: Gap Plot of Emigration Rate 1990-2021



Source: Compiled by Authors with Data listed in Appendix 1

Table 3: Emigration Rate Predictor Means

Year	Emigration Rate Greece	Emigration Rate Synthetic Greece	Difference Greece and Synthetic Greece
2009	0.395%	0.402%	-0.007%
2010	0.562%	0.435%	0.127%
2011	0.840%	0.538%	0.301%
2012	1.137%	0.587%	0.551%
2013	1.073%	0.604%	0.469%
2014	0.983%	0.607%	0.376%
2015	1.012%	0.576%	0.436%
2016	0.991%	0.615%	0.376%
2017	0.966%	0.591%	0.375%
2018	0.969%	0.579%	0.390%
2019	0.899%	0.563%	0.336%
2020	0.740%	0.493%	0.248%
2021	0.762%	0.531%	0.231%

Source: Compiled by Authors with Data listed in Appendix 1

Figure 3 visualises the gap in emigration rates between Greece and the synthetically constructed Greece over time. The results of the model presented in Figures 2 and 3 show that immediately after the crisis began in 2009, the emigration rate in Greece started to grow rapidly. Emigration rates peaked in 2012 before slowly going back, although emigration rates have not recovered to pre-crisis levels. Thus, from visual inspection and without making assumptions yet on whether these results are significant, we observe a substantial change in the immediate aftermath of the crisis and in the long-term.

The three years after 2009 were marked by an unprecedented increase in the emigration rates in Greece. While the real gap in emigration between Greece and Synthetic Greece was, on average, 0.001037% before 2009, it rose to 0.55% in 2012. The emigration rate almost tripled from an average of 0.373% from 2006 to 2009 to an average of 0.9% between 2010 and 2013. Over the following years, a clear trend is observable in the graphs and data of the model. In 2012, 2013 and 2015, more than 1% of the entire population left the country. While the six years after the crisis saw the highest emigration rates, these rates have steadily declined since 2016, even though they remain almost twice as high in 2021 when compared to 2008 (Table 3).

The consistent trend observed in the difference between Greece and Synthetic Greece highlights a clear change in emigration rates after 2009. Moreover, if we look at the more recent years in the dataset, this trend remains steady, which suggests that it is permanent. This persistent pattern challenges the notion of a transient effect of the Greek sovereign debt crisis on emigration rates, indicating possible prolonged economic distress in Greece and only a slow recovery from the crisis. The following section will examine these possible factors causing the constantly high emigration rate.

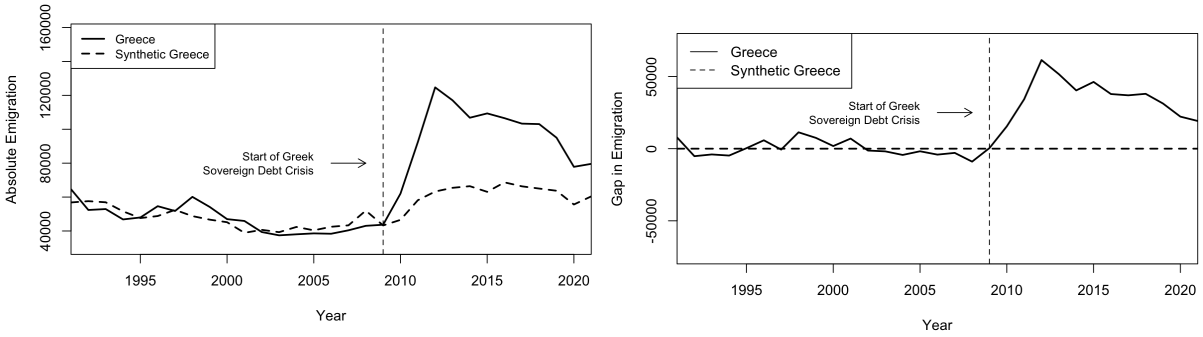
7.4 Influencing Factors

7.4.1 Absolute Emigration and Population Size

In the six years immediately after the crisis started, approximately 600,000 Greeks left the country. Figure 4 shows the path- and gap plot of emigration in Greece and Synthetic Greece. The graphs are very similar to the graphs for the emigration rate values. Since Synthetic Greece follows Greece both in trend and magnitude pre-crisis, the identification assumption can

be regarded as fulfilled. The gap before the crisis started in 2009 was 110.79 on average, while it rose to 15,479.33 in 2010. The gap then is on average 41,574.53 or 68.73% above Synthetic Greece from 2010 to 2015. Like the emigration rate, the absolute numbers show a sustained effect until 2021. The gap in 2021 is at 19,196.87, or 31.78% higher than it would have been in the hypothetical non-crisis state.

Figure 4: Path and Gap Plot of Absolute Emigration 1990-2021

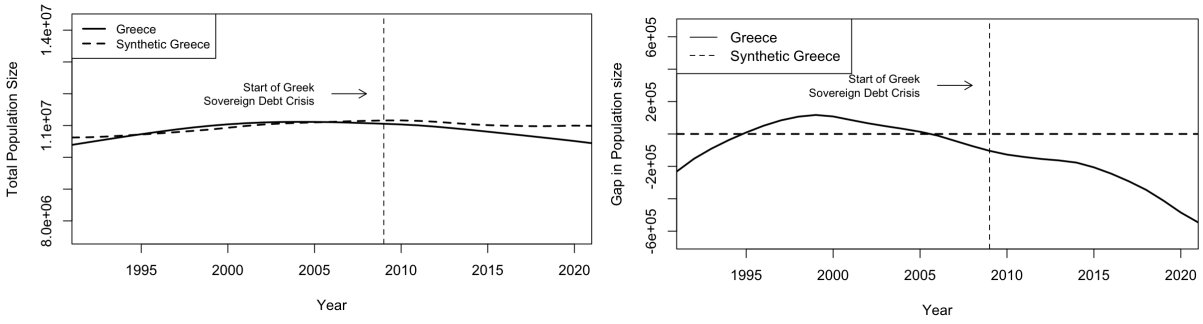


(a) Path Plot (b) Gap Plot

Source: Compiled by Authors with Data listed in Appendix 1

The evolution of the population size in the past 30 years shows that Greece's population has been declining since 2005. Figure 5 confirms this trend and further shows that the population decline rate increased after the start of the financial crisis in 2009. The path plot (Figure 7) shows that Greece and synthetic Greece largely follow the same trend, while the gap plot (Figure 8) shows that the gaps between the two units pre-crisis do not exceed the gaps post-treatment in magnitude. Thus, the identification assumption is fulfilled. The average gap between Greece and Synthetic Greece pre-crisis is 472.11. This gap increased to 127,451 in 2010. In 2015, the population in Greece was 1.89% below Synthetic Greece in absence of the Greek sovereign debt crisis. This trend continues into 2021, with the gap between synthetic Greece and Greece widening to 549,784 in 2021, which equals to a 5% lower population size in Greece compared to Synthetic Greece with no sovereign debt crisis.

Figure 5: Path and Gap Plot of Total Population Size 1990-2021



(a) Path Plot (b) Gap Plot

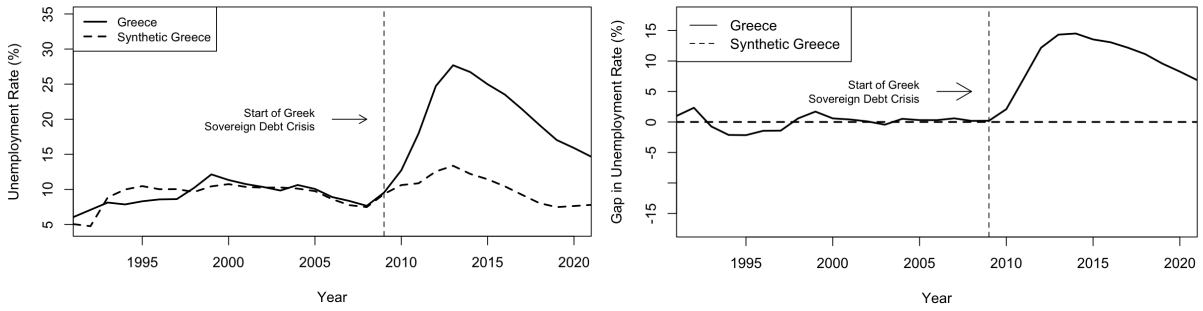
Source: Compiled by Authors with Data listed in Appendix 1

We now present the Greek sovereign debt crisis' effect on *Unemployment Rate* and *GDP per Capita* to further understand why Greece has experienced sustained high emigration rates ever since the Greek sovereign debt crisis first impacted the country in 2009.

7.4.2 Unemployment Rate

The path and gap plots of the unemployment rate in Greece show that the Synthetic Greece unit closely follows Greece both in trend and magnitude in the pre-crisis period, thus fulfilling the identification assumption. The average gap pre-crisis between Greece and Synthetic Greece is 0.0251%. In 2008, just before the crisis, this gap was 0.177%, which increases to a 2.10% gap in unemployment rate in 2010. The average gap in unemployment rate in between 2010 to 2020 was 10.72%, an extremely high value which reflects the difficulties of Greeks to find employment during the height of the debt crisis. At its peak in 2013, the unemployment rate in Greece was 27.69% and thus 107.15% higher than it would have been in the hypothetical non-crisis scenario. Like the emigration rate, the unemployment rate only slowly recovered, with the 2021 rate at 14.66% and, therefore, still 88.02% higher compared to the no-crisis scenario.

Figure 6: Path and Gap Plot of Unemployment Rate 1990-2021



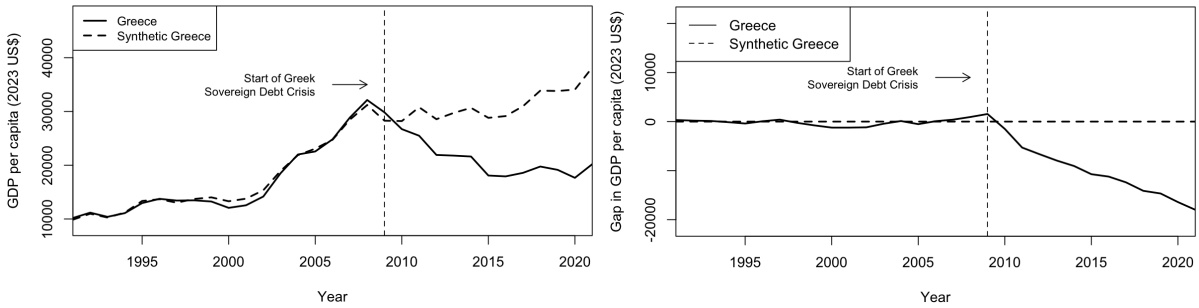
(a) Path Plot (b) Gap Plot

Source: Compiled by Authors with Data listed in Appendix 1

7.4.3 GDP per Capita

The path and gap plots for GDP per capita show that Synthetic Greece closely follows Greece, especially in the immediate years leading up to the crisis. Therefore, we are confident that the identification assumption holds for GDP per capita as the dependent variable. The path plot shows that, on average, the gap pre-crisis between Greece and Synthetic Greece was -100.99$. Notably, the GDP per capita value started decreasing significantly in 2008, one year prior to the onset of the crisis and then continued its negative trend. In 2008, the GDP per capita value for Greece was 32,127.98$. In 2010, Greece reached a GDP per capita value of 26,716.65$. The period from 2010 to 2016 shows an average gap between the two units of -7,481.88$. Similar to the economic trends shown before, GDP per capita also fails to recuperate in the years after the onset of the crisis. In 2020 and 2021, the gaps were -16,410.31$ and -17,977.35$, respectively (48.12% below Synthetic Greece in 2020 and 47.10% lower in 2021), and thus, the economic performance in Greece has not been able to recover to pre-crisis levels.

Figure 7: Path and Gap Plot of GDP per Capita 1990-2021



(a) Path Plot (b) Gap Plot

Source: Compiled by Authors with Data listed in Appendix 1

In summary, Greece's economy suffered significantly from the effects of the sovereign debt crisis for an extended period, as shown by the declining GDP per capita and increased unemployment rates. Therefore, it is not surprising that the emigration rate has remained at a high level post-crisis. These findings also confirm that the high emigration rates are caused by lasting effects, not transient ones. It can also be inferred that Greece is constantly losing a high number of people, which in turn raises the question which population groups predominantly leave Greece, and how this could impact Greeks' economic and social state. This will be discussed further later on in Chapter 9.

7.5 Causal Inference and Robustness Tests

To assess the validity of the results in Section 7.2, we conduct placebo studies and robustness tests following the approach proposed by Abadie et al. (2015). This alternative inference model is based on the premise that the confidence in the estimates would be weakened if we obtained similar effects in cases where the Greek sovereign debt crisis did not occur. The set of tests includes a T-Test of the hypothesis that the Greek sovereign debt crisis had no significant effect on emigration rates in Greece. Furthermore, we conduct an In-Space Placebo Test and a Leave-One-Out Robustness Test.

7.5.1 T-Test

When conducting the T-Test for our model, we test the hypothesis "H_0: The Greek sovereign debt crisis had no significant effect on the emigration rate in Greece" against the alternative hypothesis "H_a: The Greek sovereign debt crisis had no significant effect on the emigration rate in Greece". The T-Test follows the methodology described in Section 5.2.3. Table 4 shows the Average Treatment Effect, Standard Error, Upper and Lower Bound of the model specified when performing a robust T-Test with a K-Value = 3 and significance level of 0.05%.

Table 4: T-Test Results for the SCM Model

Average Treatment Effect (ATT)	Standard Error	Lower Bound	Upper Bound
0.0028852	0.0003669739	0.001306239	0.004464162

Source: Compiled by Authors with Data listed in Appendix 1

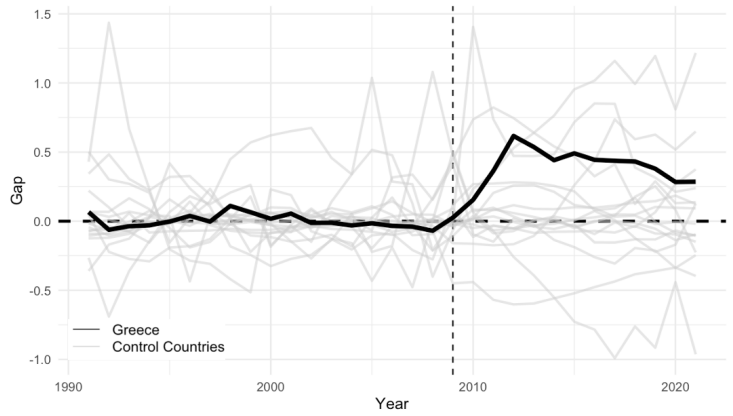
As shown in Table 4, we find a significant ATT, with a confidence level of 95%. The data suggests that, on average, the crisis led to the emigration rate in Greece being 0.289% higher

post-crisis compared to Synthetic Greece. This result comes with a standard error of 0.0367%. Additionally, the confidence interval spans from 0.131% to 0.446%. The fact that this confidence interval excludes zero affirms that the effect of the crisis is not merely a random occurrence.

7.5.2 In-Space Placebo Tests

The In-Space Placebo Test allocates the crisis to another country in the donor pool. We replicate this for every country in the dataset, using the same methodology of constructing a synthetic counterfactual and estimating the difference in the dependent variable. Comparing the result from Greece with the placebo result from each country also allows for inference and calculation of a p-value. This measures the proportion of placebo results (from other countries in the donor pool) that are equal to or more significant than the effect size estimated for Greece from the onset of the crisis period, as discussed in Section 5.2.2 (Abadie et al., 2015).

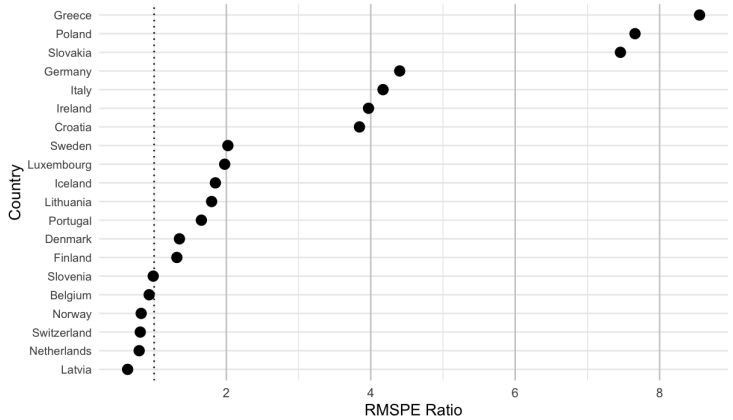
Figure 8: In-Space Placebo Test



Source: Compiled by Authors with Data listed in Appendix 1

Figure 8 shows the results of the placebo test. The gaps in the pre-crisis period are much less volatile than in the post-crisis period, where the gaps increase substantially. The ratio between the gaps in the pre-crisis period and post-crisis period is thus significant, which decreases the p-value.

Figure 9: Post/Pre MSPE Ratio: Greece and Donor Countries



Source: Compiled by Authors with Data listed in Appendix 1

Figure 9 shows the dataset's Post/Pre MSPE ratio for Greece and all other countries. The p-value can be calculated as the proportion of placebo RMSPEs larger than the treated unit's

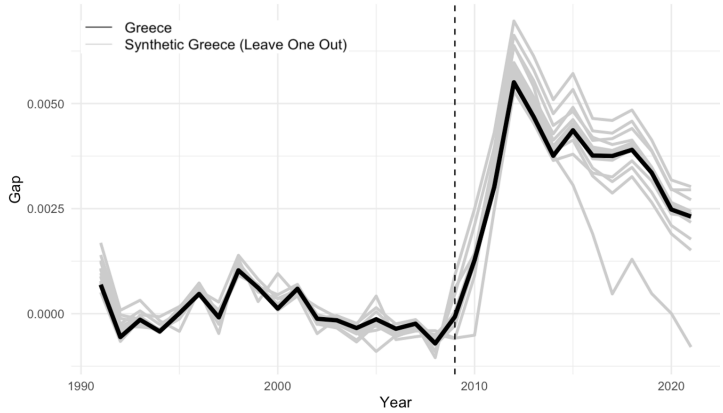
RMSPE. Greece's post-MSPE / pre-MSPE ratio is the highest, leading to a p-value of < 0.01[15]. This result confirms the previous tests and indicates a significant crisis effect on the emigration rate in Greece.

In addition, to validate these results, we conducted an In-Time Placebo Test. The results of the test are presented in Appendix 4. The results show that the effects of a placebo crisis with an onset in 1995, 2000 and 2005 do not cause any significant divergence between Synthetic Greece and Greece. Based on these Placebo Tests, we can therefore conclude that the conclusions from our results are valid and confirm the results from the In-Space Placebo Test conducted earlier.

7.5.3 Leave-One-Out Robustness Test

Finally, a Leave-One-out Robustness Test is used to determine whether one or more influential donor countries mainly drive the results in the model. By eliminating one country in the dataset at a time, the overall robustness of the results can be assessed (Abadie et al., 2015).

Figure 10: Leave-One-Out Robustness Test



Source: Compiled by Authors with Data listed in Appendix 1

Figure 10 shows that when leaving out one country at a time, the overall results remain robust to eliminating one state in the donor pool at a time. The effect of the crisis remains nearly identical compared to the results of our original analysis.

Overall, the T-Test and the Placebo Test show that the model's results are statistically significant and that the Greek crisis profoundly affected the emigration rate in Greece. The Leave-One-Out Test shows that the result is neither driven by a specific country in the donor pool nor significantly impacted by excluding any country from the donor pool.

The crisis has had a sustained, significant impact on Greek emigration rates with more than one million Greeks leaving the country since the start of the crisis in 2009. We now turn to a more nuanced analysis of net migration rates within Greece to understand which parts of the country were especially affected and what possible reasons for regional migration trends could be.

8 Results: Regional Greece

In this chapter we present the results of the SCM analysis on the regional level. We use the metropolitan and rural areas as classified in Chapter 6 and the SCM model formalised in Chapter 5. We also present the results of the correlation analysis on the regional influencing factors in Section 8.4 using the method described in Section 5.3 with the data from Section 6.4.3.

[15]The p-value is calculated as elaborated in Section 5.2.3: $0/19 = 0$ and thus p-value < 0.01.

8.1 Synthetic Metropolitan Greece

8.1.1 Predictors

The positively weighted predictors used to determine the donor weights (W) for the analysis of Metropolitan Greece are, as shown in Table 5, *Birth Rate*, *Death Rate*, *Heating Degree Days*, *GDP per Capita*, *Population Density*, and *Migration Rate*. The respective weights are 66% for *Population Density*, 32.3% for *Net Migration Rate*, 0.6% for *Death Rate*, 0.5% for *Birth Rate*, 0.5% for *GDP per Capita*, and 0.1% for *Heating Degree Days*. *Population density* as the most significant predictor is unsurprising due to the nature of the regional analysis with a donor pool consisting of larger and more densely populated areas. Furthermore, this predictor is very valuable in modelling migration rates due to its strong correlation with economic activity, cultural diversity, and urban development, which may act as push as well as pull factors for migrants. Similarly, it is unsurprising that the average lagged Net Migration Rate between 2001 and 2009 is one of the most significant predictors. This is because past migration trends may provide valuable insights into future trends and behaviours by reflecting historical attractiveness and challenges of the region.

Table 5: Predictor Weights for Synthetic Metropolitan Greece (SMG)

Predictor	Weight
Population Density	0.660
Lagged Net Migration Rate	0.323
Death Rate	0.006
Birth Rate	0.005
GDP per capita (2023 US$)	0.005
Heating Degree Days	0.001

Source: See Appendix 1

8.1.2 Donor Regions

The donor units used to create Synthetic Metropolitan Greece (SMG), as shown in Table 6, are the NUTS-3 regional units of Vienna (Austria), Milan (Italy), Brussels (Belgium), Riga (Latvia), Augsburg (Germany), and Madrid (Spain). The positive weights associated with each unit are 21.5% for Vienna, 19.9% for Milan, 19.6% for Brussels, 19% for Riga, 14.1% for Augsburg, and 6.0% for Madrid. One reason for the weighting could be that between 2001 and 2009, all the mentioned regions, except Milan, experienced an average yearly change in net migration of approximately zero. This may be explained with these regions' stable population numbers with an average yearly population change of 1.4%, through balanced migration flows. Furthermore, population density is stable, with changes between 2% and -0.5% in the different regions. However, while the donors show trend-similarity, they do not share absolute levels of population density. Nevertheless, the overall trend stability in net migration and population density makes them good donor units as they provide predictable absolute population and population density baselines.

Except for Madrid, the donor regions are relatively equally weighted. This indicates a high average similarity between the donor regions and Metropolitan Greece. Vienna, for example, aligns closely in four of the six predictor variables, and ranks third in best fit for the lagged dependent variable, the second most heavily weighted predictor. Similarly, Milan is highly similar to Metropolitan Greece, with four out of six predictor values being the second most similar to Metropolitan Greece. The slightly lesser weight attributed to Milan despite its higher average similarity in those four predictors may be attributed to its comparatively larger disparities in the remaining two predictors. This to some degree reduces its overall similarity to Metropolitan

Greece. Madrid's lowest weighting in the model may be attributed to its comparatively large difference in the lagged dependent variable, which is the most influential predictor in the model. Although Madrid shows notable similarities in *Heating Degree Days* and *GDP per Capita*, these predictors carry the least weight. Thus, its low weighting is justifiable and consistent with the data. We therefore consider the selected donor regions and weights suitable for creating a synthetic control unit of Metropolitan Greece.

Table 6: Donor Weights for Synthetic Metropolitan Greece (SMG)

Donor Units	Weights (w)
Vienna	0.215
Milan	0.199
Brussels	0.196
Riga	0.190
Augsburg	0.141
Madrid	0.060

Source: Compiled by Authors with Data listed in Appendix 1

8.2 Synthetic Rural Greece

8.2.1 Predictors

The positively weighted predictors used to determine the donor weights are, as shown in Table 7, the *Migration Rate* (2001-2009), the *Population Density* (2001-2009), *Cooling Degree Days*, *Heating Degree Days*, *Birth Rate*, and *Death Rate*. The respective weights are 62.2% for *Migration Rate*, 35.6% for *Population Density*, 0.6% for *Cooling Degree Days*, 0.5% for *Heating Degree Days*, 0.4% for *Death Rate*, and 0.1% for *Birth Rate*. Similar to SMG, *Migration Rate* and *Population Density* are the two largest predictors with a combined weight of 97.8

Table 7: Predictor Weights for Synthetic Rural Greece (SRG)

Predictor	Weight
Lagged Net Migration Rate	0.622
Population Density	0.356
Cooling Degree Days	0.006
Heating Degree Days	0.005
Birth Rate	0.004
Death Rate	0.001

Source: See Appendix 1

8.2.2 Donor Regions

The weighted donor units used to create the Synthetic Rural Greece (SRG), as shown in Table 8, are the NUTS-3 regional units of Pontevedra, Pleven, Arr. Waremme, and Arr. Dinant. The positive weights associated with each unit are 39.2% for Pontevedra, 22.8% for Pleven, 25% for Arr. Waremme, and 13% for Arr. Dinant.

The distribution of weights across the four donor regions is remarkably balanced. This is likely attributable to the fact that three out of the four donor regions are most similar to Rural Greece's predictors in at least one out of the six predictors each.

Pleven's most similar predictors are *Death Rate*, *Population Density*, and *Cooling Degree Days*. The predictor values for Waremme are very much like the values for those of Rural

Greece. Hence it has a good average similarity across most predictors.

Pontevedra is the donor unit with the largest weight of 39.2%. This high weight may be assigned because the region's predictor *Birth Rate* is most like Rural Greece and its *Death Rate* is also similar with a difference of only 1.8%. The similarity in these two variables indicates a similar population structure, particularly with respect to the younger and older demographics. Furthermore, this region shows the closest similarity in *Heating Degree Days* and the second-best fit in *Cooling Degree Days*. This indicates a close resemblance in climate conditions between the two regions.

Notably, Dinant has the closest similarity to Rural Greece's *Net Migration Rate*, yet the lowest weighting of all the regions in the donor pool. However, this may be explained by the relatively high discrepancy in most other predictor variables such as *Cooling Degree Days* (46% more cooling days in Dinant than in Rural Greece) and *Heating Degree Days*. Furthermore, Dinant's *Population Density* is approximately 20% higher than that of Rural Greece, which indicates a significant difference in the second most weighted predictor. Despite the good fit in the lagged dependent variable, the overall similarity between Dinant and Rural Greece therefore appears to be relatively low in comparison to the other three donor units. Consequently, a comparably lower weighting for Dinant appears reasonable.

The understanding of the donor weights allows us to consider the overall selection of donor regions suitable for recreating a synthetic control unit of Rural Greece.

Table 8: Donor Weights for Synthetic Rural Greece (SRG)

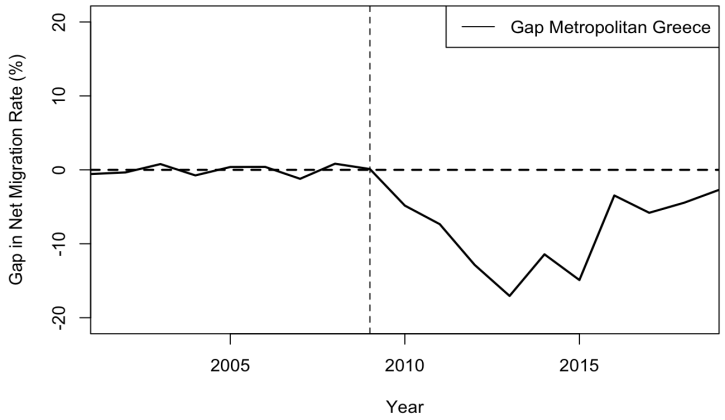
Donor Units	Weights (w)
Pontevedra	0.392
Pleven	0.228
Arr. Waremme	0.250
Arr. Dinant	0.130

Source: Compiled by Authors with Data listed in Appendix 1

8.3 Comparison Regional Greece and Synthetic Regional Greece and Effects of Sovereign Debt Crisis on Net Migration Rates

As outlined in Chapter 5, a good pre-crisis fit is essential for the post-crisis comparison of the synthetic control and the treated unit. For Synthetic Metropolitan Greece (SMG) the period from 2001 to 2006 provides a relatively good fit with minor deviations from Metropolitan Greece. On average, the gap in the *Net Migration Rate* during this period is -0.016%. As shown in Figure 16, between 2006 and 2007 net migration in SMG increases as opposed to a stable downward trend in Metropolitan Greece (MG). However, this disparity significantly diminishes up until the treatment year 2009. Therefore, given an adequate pre-crisis fit, SMG and MG can be compared post-crisis. Due to the close pre-treatment fit and the assumptions stated in Section 5.1.2, the identification assumption holds.

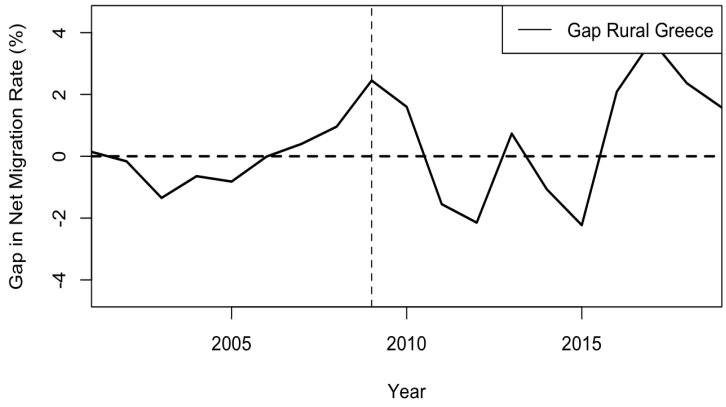
Figure 11: Gap Plot of Net Migration Rate 2001-2019 (MG)



Source: Compiled by Authors with Data listed in Appendix 1

When creating the Synthetic Rural Greece ((Figure 12)) there are some gaps in pre-crisis fit, particularly between 2002 to 2004 with an average gap in the Net Migration Rate of -0.718%, and 2006 to 2009 with an average gap in the *Net Migration Rate* of 0.950%. Notably, there is a larger disparity between 2008 and 2009, very close to the onset of the crisis. However, in our analysis this disparity remained when including more donor units. Consequently, when interpreting the post-crisis results, this deviant fit must be considered.

Figure 12: Gap Plot of Net Migration Rate 2001-2019 (RG)



Source: Compiled by Authors with Data listed in Appendix 1

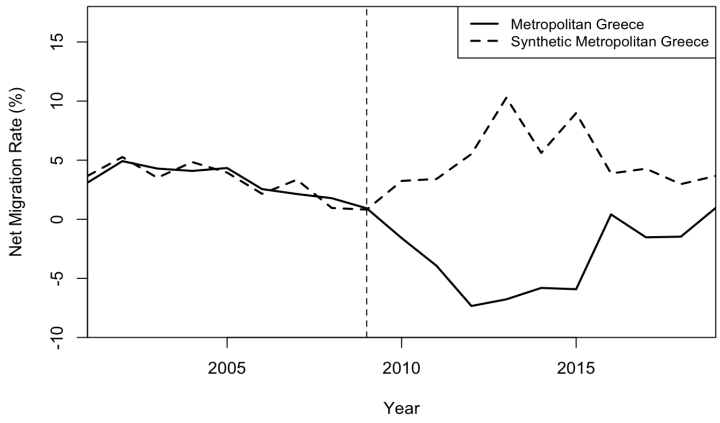
8.3.1 Effects on Metropolitan Greece

Metropolitan Greece (MG), as illustrated in Figure 13, experiences an immediate decrease in its net migration rate following the crisis in 2009. This negative trend reaches its bottom during 2012 with a net migration rate of -7.34%. Net migration rates remain low until 2015, from which point there is a rapid increase in net migration until 2016, when immigration and emigration balances again at a rate of 0.409%. Following 2016, net migration remains at an average of -0.679% until 2019. Contrary to Metropolitan Greece, SMG experiences a continuous yearly increase in its net migration rate until 2013 when it reaches 10.28%. Post 2015 the synthetic control unit's migration rate significantly decreases back to its pre-crisis level of 3.70% and MG and SMG appear to converge. Consequently, the disparity in the net migration rate between MG and SMG is largest between 2010 and 2015, with a maximum difference of 17.05% in 2012.

The extreme difference in the net migration rate of MG and SMG in the short run highlights

an immediate and pronounced effect of the crisis on metropolitan areas in Greece. Furthermore, the rapid reduction in the difference between the two, starting in 2015, indicates a quick recovery of net migration rates in metropolitan areas. Additionally, the post-2015 trend of convergence between MG and SMG suggests that, in contrast to the Greek sovereign debt crisis' effect on Greece's national emigration rate, the metropolitan net migration effect was transitory. This implies that metropolitan areas recovered more quickly from the Greek sovereign debt crisis' effects on migration than Greece's emigration as a whole did.

Figure 13: Path Plot of Net Migration Rate 2001-2019 (MG)

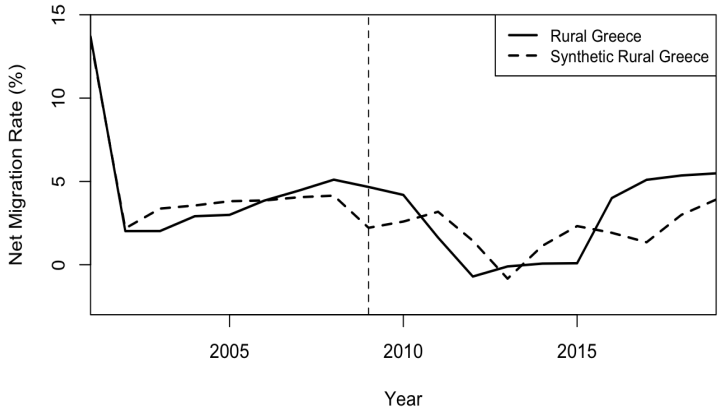


Source: Compiled by Authors with Data listed in Appendix 1

8.3.2 Effects on Rural Greece

Rural Greece's net migration rate (Figure 14) starts to decrease already in 2008 with a significant drop in 2011. Similar yet delayed when compared to its metropolitan counterpart, Rural Greece experiences an increase in its net migration rate in 2015 to above pre-crisis levels of 4.00%. It is notable that the net migration rate only becomes negative during 2012, with a value of -0.707%. The Synthetic Rural Greece shows a similar pattern to Rural Greece (RG), with a negative effect of the debt crisis on its migration rate. However, its recovery starts already in 2013 with a return to its pre-crisis level in 2019. Hence, the disparity between SRG and RG is largest during 2017 with a difference of 3.75%. The average post-crisis gap between SRG and RG is only 0.512%, which is neglectable. However, when interpreting the differences between the two units the deviant pre-crisis fit must be taken into consideration. From our analysis, there therefore appears to be no significant difference between the two units post crisis. Nevertheless, from the decline in the net migration rates, we see that in the rural areas the crisis was also an emigration crisis. While there are disparities in the pre-crisis fit, SRG and RG are similar in overall trends, with notable differences only in 2003 and 2009. This similarity in trends, in combination with the low average pre-crisis gap of 0.1077% in net migration, indicates that the identification assumption is fulfilled on a rural level. The neglectable differences in the net migration rate of RG and SRG, both in the short and long run, indicate that there was no drastic migration effect of the Greek sovereign debt crisis on a rural level. This implies that in the context of the crisis, Greek rural regions were more resilient to migration shocks than metropolitan regions and the country as a whole.

Figure 14: Path Plot of Net Migration Rate 2001-2019 (RG)



Source: Compiled by Authors with Data listed in Appendix 1

8.4 Regional Influencing Factors

As outlined in Section 5.3, we perform a descriptive correlation analysis of the *Percentage Change in Net Migration* and the influencing factors listed in Tables 9 and 10. Using scatter plots we look at how these factors indicate effects of the Greek sovereign debt crisis on the change in net migration rate in all the 52 NUTS 3 regions of Greece. The inclusion of all 52 regions is important to consider, as the results from the correlation analysis reflect correlations irrespective of the previous metropolitan and rural classification.

It is important to remember that this analysis only indicates the relationship between the two variables of interest, and causality cannot be determined.

Tables 9 and 10 display the correlation results from the analysis. The individual scatter plots are shown in Appendix 7.

Table 9: Predictors with a Positive Correlation

Predictor	Correlation Sign
Death Rate	+
Employment Rate	+
Gross Value Added AFF	+
Employees AFF	+
Heating DD	+

Source: EUROSTAT (2023)

Table 10: Predictors with a Negative Correlation

Predictor	Correlation Sign
Birth Rate	-
Population Under 15	-
Population Between 15 and 64	-
Population above 64	-
Population Density	-
Marriages	-
Number of Universities	-
Heating Degree Days	-
Cooling Degree Days	-
Employment Rate	-
GDP per capita	-
Gross Value Added Industry	-
GVA Manufacturing	-
GVA Construction	-
GVA Wholesale and retail trade, etc.	-
GVA Information and Communication	-
GVA Financial and Insurance Activities	-
GVA Real Estate Activities	-
GVA Professional, etc.	-
GVA Public administration and Defence; etc.	-
Employees Manufacturing	-
Employees Construction	-
Employees Wholesale and retail trade, etc.	-
Employees Information and Communication	-
Employees Financial and Insurance Activities	-
Employees Real Estate Activities	-
Employees Professional, etc.	-
Employees Public administration and Defence; etc.	-
Employees Industry (except construction)	-
Labour Productivity	-

Source: EUROSTAT (2023)

As illustrated in Table 9, most variables are negatively correlated with the *Percentage Change in Net Migration Rate*. This includes most economic and employment variables such as Gross Value Added (GVA) and industry employment shares. The negative correlation indicates the tendency for Greeks to emigrate from economic centres. Additionally, the only GVA variable positively correlated with *Percentage Change in Net Migration Rate* is *GVA from Agriculture, Forestry, and Fishing* (AFF), industries centred in rural regions of Greece. It provides an indication of why metropolitan areas might have experienced a more extreme emigration effect than rural regions.

Similarly, the majority of population variables are negatively correlated with the *Percentage Change in Net Migration Rate*. Particularly, the population distribution variables, *Population Under 15*, *Population Between 15 And 64*, and *Population Above 64*, demonstrate consistent negative correlations. The negative correlation with the *Population Above 64* variable appears paradoxical. Particularly when contrasted with the positive correlation between regions with a higher death rate and the *Percentage Change in Net Migration Rate*, this seems remarkable. Possible reasons for this are discussed in Section 9.3.3. Furthermore, *Birth Rate*, *Marriage Rate*, and the *Number Of Universities* are also negatively correlated with the *Net Migration*

Rate, indicating that younger demographics are more likely to emigrate from their region of residence.

8.5 Causal Inference and Robustness Tests for Regional SCM Analysis

Causal inference and robustness tests for the regional SCM analysis were performed as well. Given the iterative nature of these tests, this section offers a concise overview of the results, while a more comprehensive and detailed account can be found in Appendix 6.

T-Test
On a regional level, the T-Test for the SMG is significant at the 10% level, while SRG is not. These results indicate that only metropolitan areas experienced a statistically significant migration effect due to the crisis.

In-Space Placebo-Tests
Similarly, the results for the Placebo Tests are only significant for SMG, with a p-value < 0.01. The p-value for SRG is 0.1765 and thus not statistically significant. Therefore, it can only be concluded that the crisis effect is not attributable to random variation on a metropolitan level.

Leave-One-Out Test
Furthermore, the Leave-One-Out Test identifies that the trajectory of all units closely follows that of the SMG. Consequently, the post-treatment fit may be considered as robust. For the SRG, the post-crisis trajectory appears to rely to some degree on one donor unit. This questions the robustness of the SRG and must be kept in mind when interpreting the results.

9 Discussion

To discuss the outcomes of our research we first examine our findings on emigration from Greece. We offer interpretations and outline the implications, focusing on long-term consequences and the factors that affect emigration from Greece. We then turn to the results from the regional migration analysis and the related analysis of factors that influence net migration.

9.1 Greece

Our study demonstrates that the Greek sovereign debt crisis acted as a catalyst for increased emigration. It confirms our initial hypothesis H_1 that the Greek sovereign debt crisis caused a significant increase in emigration rates post-crisis. Our result is both robust and statistically significant at a p-value < 0.01. The high emigration rate from Greece since the onset of the sovereign debt crisis deviates from pre-crisis migration patterns. While emigration rates have recently decreased as the years post-crisis have passed, they remain notably higher than before the crisis, causing a persistent demographic shift. These sustained high emigration rates support the crisis-induced migration model by S. Martin et al. (2013), which stipulates that humanitarian and financial crises intensify push factors and compel individuals to seek better prospects elsewhere. Furthermore, the significant increase in emigration rates, persistent over a decade, indicate that it is not a transient phenomenon but a lasting change of the Greek migration patterns.

Based on the results of this study, we believe that it is likely that the crisis may have irrevocably shifted the standard level of emigration in Greece. Reinforcing mechanisms such as established migrant networks and the enduring nature of the migration routes were created during the crisis. The lack of job opportunities, dissatisfaction with career prospects, and the

quest for a better quality of life are consistent with the push factors that according to literature have historically influenced migration decisions (Labrianidis, 2014; Triandafyllidou et al., 2013). This is particularly relevant in the context of Brain Drain, where the loss of human capital can have profound implications on the home country's future economic prospects and societal development. The literature also implies that such demographic shifts can lead to a reinforcing loop where reduced domestic prospects and diminished economic activity perpetuate the drive for emigration (Docquier & Rapoport, 2012).

Institutional quality plays a pivotal role in shaping migration trends, particularly in the aftermath of a crisis. The Greek institutional response involved austerity measures and structural reforms, which most likely exacerbated the outflow of emigrants[16]. While the austerity measures accelerated emigration, the subsequent institutional reforms failed to significantly reduce the emigration rates, suggesting their limited effectiveness in reversing the demographic outflow.

The persistent high emigration rates substantially affect Greece's demographic and economic potential. As many people of working age in Greece leave the country, the strain on the social security systems grows, and the prospects for robust economic growth diminish. This corresponds with the concerns raised by Borjas (1989), who discusses the potential adverse effects of emigration on the origin country's labour market and economic prospects. Greece's demographic profile will likely be skewed towards an older population with potential long-term consequences for the labour market and economic recovery.

The sustained high emigration rates from Greece contrast with other financial crises where migration trends demonstrated greater resilience, such as the Great Depression and the Russian financial crisis, which both led to temporary periods of negative net migration (OECD, 2009) but quickly recovered following the crisis. The case of Greece, however, appears to present a scenario in which the crisis has led to a persistent, rather than transient, emigration trend. This enduring pattern suggests a significant shift in the country's demographic profile, possibly altering its socio-economic structure in the long-term.

9.2 Influencing Factors

The sovereign debt crisis in Greece has had a profound impact on the country's emigration patterns, population dynamics, unemployment rates, and GDP per capita, as shown in this study. These findings not only highlight the severity of the crisis but also confirm the complex interplay between economic downturns and migration flows that have been examined by previous authors.

The observed emigration from Greece post-crisis is consistent with historical patterns of financial crises influencing migration, such as during the Irish Famine of the 1840s, as discussed by O´Rourke (1995) and Hatton and Williamson (2005). Like Ireland, where significant parts of the population emigrated due to the famine, Greece has seen a considerable departure in the wake of its economic turmoil. Furthermore, similar to the famine-driven migration, the factors influencing migration during these crises are not solely economic but are also rooted in institutional and social dynamics, as other authors indicated previously (Sirekci et al., 2012).

The results of this study reveal a more pronounced population decline in Greece compared to Synthetic Greece post-crisis, which provides evidence of the lasting demographic impact of the debt crisis. This is consistent with the general findings in relevant literature that economic crises can lead to significant demographic shifts, for example noted in the IOM report (Koser, 2009) that analysed various financial crises and their impact on migration patterns. The unemployment rates in Greece, which peaked in 2013 and slowly recovered after that, correspond to the labour market disruptions documented in past financial crises. The Great Depression, for instance, caused a sharp decline in labour migration and significant returns to home countries,

[16]See Chapter 2 for a description of the austerity measures and bailout programmes and their implications for the Greek population.

as stated by the OECD (2009). While our analysis shows some recovery, Greece still grapples with unemployment rates substantially higher than the hypothetical no-crisis scenario. The decline in GDP per capita before and during the crisis is a tangible measure of the economic hardship faced by Greece. Relevant literature suggests lower GDP growth does not necessarily result in higher emigration (Sirekci et al., 2012). Yet, the extreme drop in Greece's GDP per capita seems to have been accompanied by a sustained increase in emigration, signalling a more complex relationship influenced by the severity and duration of economic downturns.

9.3 Regional Greece

9.3.1 Metropolitan Greece

As stated in Section 4.4, our hypothesis, based on prior research, sets forth that the Greek sovereign debt crisis should cause a significant decline in the net migration rate of Greek metropolitan areas. The empirical evidence substantiates this hypothesis, as it reveals a significant decrease in the short-term net migration rate of metropolitan areas in response to the debt crisis. This outcome is statistically significant at the 10%[17] level. It aligns with earlier research findings, which argue that economically turbulent environments in Greece tend to stimulate emigration from metropolitan areas (Gkartzios, 2013). However, it is essential to highlight that this effect appears to be transitory, contrary to national emigration rates, as metropolitan areas exhibit a rapid recovery and convergence in net migration rates post-2012. Yet, when analysing the long-term effects of the crisis, it must be noted that the significant increase in net migration starting in 2015 is possibly predominantly attributable to the Syrian refugee crisis, as discussed in Section 6.3. The crisis had a significant impact on immigration to Greece, while metropolitan donor units used to construct the SMG were less strongly affected. Consequently, the Syrian refugee crisis positively biases the long-run net migration rate of Metropolitan Greece, leading to an underestimation of the crisis' long-term effects. Therefore, drawing conclusions about long-term effects of the debt crisis on metropolitan areas is complex and may yield results with an underestimated magnitude of the crisis' impact on net migration rates. The analysis may, however, provide a valuable starting point for future research on the long run effect of the Greek sovereign debt crisis on regional net migration. Separating the regional migration effects of the Syrian refugee crisis from those of the debt crisis would offer a more reliable and unbiased understanding of the true long-term effects of the debt crisis. This type of research would be valuable and practical for policymakers seeking strategies that sustain regional population growth and development during economic crises.

9.3.2 Rural Greece

Regarding the effect of the Greek sovereign debt crisis on rural net migration rates, our initial hypothesis assumes a significant increase in net migration rates. However, this hypothesis is not substantiated and must be rejected. Contrary to our expectations, the influence of the debt crisis on Rural Greece closely parallels its impact on metropolitan areas in terms of its overall trend, albeit not in magnitude. Moreover, the statistical insignificance of this result indicates that the observed effect of the crisis is likely due to random variation. This outcome challenges Gkartzios (2013) assertion of a significant increase in counter-urbanisation during economically difficult periods and aligns with Anthopoulou et al. (2017) findings that rural immigration rates remained lower than initially anticipated during the crisis. This nuanced finding prompts us to speculate on the dynamics of migration during the Greek sovereign debt crisis. While some urban residents must have certainly relocated to rural regions, it appears as though the majority decided to emigrate out of Greece entirely. This phenomenon aligns with the notion

[17]Refer to the T-Test with a 10% significance level.

that the crisis was economically affecting all regions of Greece. Thus, it appears as though the Greek population in general was more prone towards emigrating out of the country rather than to another region within Greece. This assumption is further supported by our main analysis, which reveals a significant increase in emigration from Greece following the start of the crisis.

However, it is evident that the impact of the debt crisis on migration patterns was much less significant in rural regions than in metropolitan areas. One possible explanation for this discrepancy could be established support systems within closely-knit rural communities. These may have served as a source of reassurance during times of crisis and thereby reduced the imperative for individuals to emigrate as a coping strategy. These networks and support structures may have played a pivotal role in reducing the crisis's effects on rural migration.

9.3.3 Regional Influencing Factors

Since the NUTS 3 dataset only provides data on net migration for each regional unit without specifying the migrants' origins or destinations, it is not possible to determine the exact movements of regional migrants. However, the results from the correlation analysis allow the identification of distinct characteristics of the NUTS 3 regional units and their correlation with the *Percentage Change in Net Migration Rate*. For this reason, inference can be made regarding potential drivers and influencing factors of regional migration.

As illustrated in Table 9 most variables are negatively correlated with the *Percentage Change in Net Migration Rate*. Importantly, this includes most economic and employment variables, such as Gross Value Added (GVA) and industry employment shares. The negative correlation indicates the tendency for Greeks to emigrate from financial centres, generally in metropolitan areas, which provided many employment opportunities prior to the crisis, particularly for high-skilled labour as identified by Bacolod et al. (2009). By combining the insights from the emigration shock shown in Figure 13 (MG) with the known concentration of high-skilled labour in these areas, we can infer that a portion of this labour pool almost certainly emigrated from these regions. Thus, irrespective of destinations this exodus of human capital from these financial centres may have contributed to a slow economic recovery (Labrianidis, 2014).

Additionally, the only GVA and industry employment share variables positively correlated with *Percentage Change in Net Migration Rate* are *GVA from Agriculture, Forestry, and Fishing* (AFF) and *Employees AFF*. These industries are mainly located in rural regions of Greece. The observed migratory shifts from financial centres to rural regions, where Agriculture, Forestry, and Fishing (AFF) industries dominate, appear to support Gkartzios (2013) theory of an urban-to-rural migration pattern. One plausible explanation for this could be the comparatively low-skill requirements for employment in these industries. Consequently, rural areas may have emerged as more appealing employment destinations for labour previously based in metropolitan areas. Conversely, those already employed in rural regions had a lower incentive to emigrate, especially domestically. This disparity in migration incentives could partly explain why metropolitan areas were disproportionately more affected by emigration than their rural counterparts. However, this interpretation assumes that individuals from metropolitan areas did indeed relocate to rural areas and that the observed trend is not solely attributable to international labour immigration.

Furthermore, the analysis reveals a notable negative correlation between several population variables and the *Percentage Change in Net Migration Rate*, particularly the age distribution variables: *Population Under 15*, *Population Between 15 And 64*, and *Population Above 64*. This correlation aligns with expectations for the first two age groups. Adverse economic shocks, such as the Greek sovereign debt crisis, often drive the younger population to emigrate, seeking employment opportunities and better prospects elsewhere (Labrianidis & Pratsinakis, 2016). In the context of the Greek sovereign debt crisis, this migration tendency among younger demographics is further supported by the negative correlation observed in the *Birth Rate*, *Marriage Rate*, and the *Number Of Universities*. These variables indicate a younger demographic, suggesting

that the crisis may have particularly spurred emigration among these population groups. Moreover, the larger proportion of the 15- to 64-year-old population in metropolitan areas compared to rural areas, (11% more on average) could be a contributing factor in the more pronounced emigration wave observed in metropolitan areas. This demographic distribution suggests that metropolitan areas were more vulnerable to the emigration pressures induced by the crisis. Consequently, the correlation results provide further evidence that Greece did indeed experience a Brain Drain phenomenon.

The observed negative correlation of the *Percentage Change in Net Migration Rate* with the first two population distribution variables (*Population Under 15* and *Population Between 15 And 64*) appears plausible. However, the negative correlation with the *Population Above 64* variable is less straightforward and warrants further examination. This aspect becomes particularly intriguing when contrasted with the positive correlation between regions' higher death rates and their *Percentage Change in Net Migration Rate*. This seeming contradiction may point to a complex dynamic within age-related migration trends. One possible explanation for this phenomenon could be that the younger segment within the *Population Above 64* demographic is more inclined to emigrate, potentially driven by concerns about their imminent retirement prospects and the stability of the social security system in a financially unstable Greece. In particular, the austerity measures introduced by the government, including cuts in wages and pensions (IMF, 2010), might have contributed to this effect. In contrast, the older segment, particularly those already retired and less physically mobile, may be less inclined to relocate. Thus, the divergence in migration tendencies among these two groups could be attributed to differing perceptions and realities of financial security, social welfare and health in the context of the sovereign debt crisis.

9.4 External Validity and Scope

The concept of external validity is of particular interest when interpreting our findings. While our results show the link between the crisis and subsequent migration patterns, we must be cautious when generalising these outcomes in other contexts. Case studies, such as ours, inherently face challenges in external validity due to their specificity in time, geography, and socio-political circumstances. The unique influence of factors such as Greece's economic structure, its position within the Eurozone, and the specific nature of its austerity measures may limit the applicability of our findings to other crises or countries. Furthermore, the possibility that our findings are influenced by externalities such as the Eurozone crisis or the refugee crisis or by the methodological approach of the Synthetic Control Method cannot be entirely dismissed. Therefore, while our study provides valuable insights into the Greek phenomenon, its external validity and the extent to which our results can be extrapolated to predict or understand emigration trends in different settings should be considered cautiously.

Research into migration and the Greek sovereign debt crisis presents a vast and complex field of study with many dimensions, each with further potential for research. The scope of this study was intentionally focused on emigration and regional net migration in the wake of the Greek sovereign debt crisis. Therefore, there are aspects of migration that were not included in this study. For example, internal migration trends within Greece remain unexamined, though they undoubtedly would contribute to a more nuanced understanding of the crisis' demographic impact. Similarly, the dynamics of return migration, which can significantly influence both the immediate and long-term effects of the initial emigration wave, were not within the scope of this analysis. The potential reverse flow of migrants could result in adaptive responses to the evolving economic profile, which would be an area for subsequent research.

Lastly, the consequences of migration patterns on Greece's socio-economic profile, important for a holistic picture of the crisis' aftermath, are beyond the scope of this study. Such research could highlight the transformative effects on communities and human capital in origin and

destination regions, yet it falls outside the boundaries of our research. We acknowledge the different implications of migration while concentrating on the specific quantitative impacts of the Greek sovereign debt crisis on outward migration patterns from Greece.

10 Conclusion

The Greek sovereign debt crisis marked a turning point in Greece's history. It permanently changed the country's demographic and economic landscapes, particularly regarding emigration and regional migration patterns.

This thesis aimed to explore the consequences of the crisis for Greece's emigration rate and to identify influencing factors on regional migration movements. Employing a Synthetic Control Method, we developed a comprehensive model drawing from data up to 2009 to create a blend of qualitatively and quantitatively chosen predictors for similar European countries. The model enabled us to simulate a Greece unaffected by the crisis (Synthetic Greece).

Concerning our research question, our study shows that post-2009, Greece experienced a dramatic and sustained increase in emigration rates, which, despite a gradual decline, have not reverted to pre-crisis levels. The visual and statistical evidence presented indicates a clear, persistent shift in the migration patterns, with the corresponding T-Test results confirming the significance of these findings at a 5% level. At the same time, the placebo p-value is significant, with a p-value < 0.01. These outcomes challenge the notion of a transient emigratory responses to economic crises, suggesting a more profound and prolonged socioeconomic upheaval within Greece.

Moreover, our study reveals that in addition to increased emigration, Greece has faced a notable population decline and a steep rise in unemployment rates, surpassing those of its synthetic counterpart. The population size in Greece was consistently lower than in Synthetic Greece, with a divergence increasing to 5% by 2021. Similarly, unemployment rates skyrocketed, reflecting the severe challenges faced by Greeks when seeking employment, a situation only exacerbated by the crisis. The consistently high unemployment and lower population size highlight the severity of the crisis's impact. The GDP per capita trajectory further substantiates the prolonged economic distress, with Greece exhibiting a GDP per capita drastically lower than the synthetic control, indicating an economic performance that has yet to show signs of recovery to pre-crisis vitality.

On a regional level, both metropolitan and rural areas experienced a decrease in their net migration rates post-2009. However, the dimension and significance of the actual impact of the Greek sovereign debt crisis on the net migration rates differed distinctly between the areas. While metropolitan areas experienced a substantial and statistically significant decrease in their net migration rate, the effect in rural areas was smaller and statistically insignificant. Notably, on a regional level, as opposed to the national level, we find that the emigration effects appear to be transitory, with rapid recovery towards pre-crisis levels starting in 2012.

Moreover, through a correlation analysis between selected control variables and the percentage change in the average net migration rate between 2004 - 2009 and 2010 - 2014, we identify a negative correlation between the percentage change in the regional net migration rates with most economic variables such as *Gross Value Added by industry* and *GDP per Capita*. We therefore infer a tendency for Greeks to leave financial centres, as for example metropolitan areas like Athens, which provided significant employment opportunities pre-2009. Additionally, we identified population distribution as a potential driver of migration, where younger individuals are more likely to migrate from Greek regions.

While the findings provide a comprehensive picture of the emigration dynamics and regional migration trends post-crisis, the study acknowledges its low external validity, a common limitation in case studies of such specific economic events. The unique circumstances of the Greek crisis may not apply to other contexts, hence the results cannot be generalised.

In conclusion, this study opens up various possibilities for future research. Firstly, the methodology employed in this analysis could be applied to other economic and financial crises, either in a European context or to economies with characteristics similar to Greece. This would help to determine if our findings could be generalised. Such comparative studies would provide valuable insights into the external validity of our observed migration trends post-crisis.

There is merit in using more granular data, such as quarterly or monthly statistics, to gain a more detailed understanding of the migration dynamics immediately following the onset of the crisis in late October 2009. This could accurately depict the immediate demographic responses to economic shocks, which annual data may obscure.

Further research is also needed to examine the mechanisms through which economic downturns influence migration patterns. While this study has examined the correlation between the factors influencing migration decisions and migration rates, an in-depth exploration of how deteriorating economic conditions influence migration decisions would provide a more comprehensive understanding of the underlying mechanisms.

Further research could provide valuable insights by tracing the migration trajectories and examining the consequent regional transformations. Such an analysis would shed light on the demographic changes within Greece and the broader implications for urban and rural development, labour markets, and community dynamics in both origin and destination areas. Understanding these patterns is crucial for crafting policies that effectively address the challenges and opportunities of such significant population shifts. Lastly, as previously mentioned, future research could also focus on examining the enduring impact of the crisis on regional net migration rates. Such an investigation would hold significant value and practicality for policymakers attempting to formulate strategies that promote sustained regional population growth and development amid economic crises.

This thesis not only sheds light on the profound and long-lasting effects of the Greek sovereign debt crisis on national and regional migration patterns, but also highlights the critical need for future research in understanding and addressing the complexities of migration in response to economic turmoil.

As we move forward, it will be worthwhile to delve deeper into the details of such crises. This effort aims to enhance our theoretical understanding and inform more effective policy responses, which can mitigate the adverse effects of similar events in the future.

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A Appendix

A.1 Data Source

Table 11: Yearly Data on Country Level

Variable	Description	Period	Source
Emigration	Demographic Emigration Statistics	1990-2021	EUROSTAT
Outflow of Remittances	Remittance Outflows (2023 million US$)	2000-2021	World Bank
Consumer Price Index	Harmonised Index of Consumer Prices	1996-2021	EUROSTAT
Foreign Direct Investment	Foreign Direct Investment, net inflows (2023 US$)	1990-2021	World Bank
Total Population	Total Population as of July 1	1990-2021	United Nations
Current Account Balance	Current Account Balance (2023 US$)	1990-2021	World Bank
Unemployment Rate	Unemployment, total (% of total labour force)	1990-2021	World Bank
GDP per Capita	GDP per Capita (2023 US$)	1990-2021	World Bank
GDP per Person Employed	GDP per Person Employed (constant 2017 PPP $)	1990-2021	World Bank

Source: Compiled by Authors with Data from various Sources listed above

Table 12: Yearly Data on Regional Level

Variable	Description	Period	Source
Net Migration Rate	Crude rate of net migration, including statistical adjustment	2000-2022	EUROSTAT
GDP per Capita	GDP per Capita (2023 US$)	2000-2022	EUROSTAT
Labour Productivity	Nominal Labour Productivity	2000-2022	EUROSTAT
Heating Degree Days	Climate-indexed building energy metric	2000-2022	EUROSTAT
Cooling Degree Days	Climate-indexed building energy metric	2000-2022	EUROSTAT
Crude Birth Rate	Annual birth rate	2000-2022	EUROSTAT
Crude Death Rate	Annual death rate	2000-2022	EUROSTAT
Population Density	Population per km^2	2000-2022	EUROSTAT

Source: Compiled by Authors with Data from EUROSTAT

A.2 Predictor Selection

This appendix elaborates on the method used for selecting the predictors in our Synthetic Control Method as motivated in Section 5.1.3. We underscore the shortcomings of a purely quantitative approach to selecting predictors, as noted by Cerulli (2019). We describe our integrated method that combines qualitative insights, following Abadie and Gardeazabal (2003) and Abadie et al. (2010), with the more quantitative approach as suggested by Bouttell et al. (2018). This hybrid approach is essential in forming a well-rounded and context-sensitive empirical model.

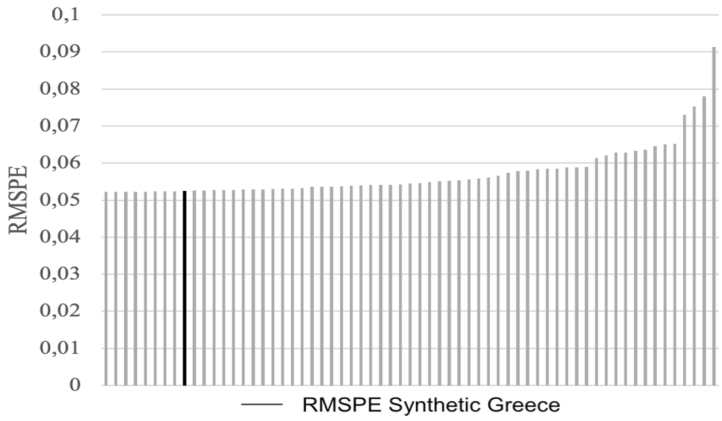
The first step involves selecting a foundational set of predictors guided by existing literature on economic measures and migration theory, as highlighted in Section 3.3.1. These foundational predictors are the *Emigration Rate* (lagged variable) to understand the emigration trends over time, the *Unemployment Rate*, the *Consumer Price Index* (with the base year 2015), and the *GDP per Capita* (2023 US$). All these predictors were chosen to capture the potential push factors of economic hardship on an individual level and the potential pull factors associated with network effects of previous emigration trends.

With the core predictors in place, we consider 40 potential predictors to enrich our model—this extension aimed at covering a more comprehensive array of economic indicators that capture the overall distress in Greece. The additional predictors were scrutinised for their qualitative coherence (via visual analysis of the model fit and thus the fulfilment of the identification assumption) and quantitatively through their impact on the Root Mean Square Prediction Error (RMSPE). Out of the virtually endless unique predictor combinations[18] from the dataset, we decide to test 70 possible combinations for their RMSPE value and then take the one that provides the best model fit to fulfil the identification assumption and the lowest RMSPE. Since this is a visual exercise we are bound to a limited number of tested predictor combinations and can thus not exclude the possibility that other combinations provide a better fit or different

[18] 40 possible predictors: 40! = 8.16E+47 possible unique combinations.

results.

Figure 15: RMSPE Distribution



Source: Compiled by Authors with Data listed in Appendix 1

Figure 15 displays the RSMPE Distribution for the pre-crisis period of 70 different predictor combinations[19]. When using the entire period the RMSPE of the final set of predictors as used in the model is 0.005251252. Notably, this value, while being the ninth-best RMSPE obtained, also provided the most coherent visual fit among the predictor combinations that were visually tested. This alignment of quantitative accuracy and qualitative coherence was critical in our decision making. Consequently, we arrive at the final set of predictors. This final set consists of the foundational predictors together with the additional predictors *Current Account per Capita*, the *Outflow of Remittances per Capita*, *Foreign Direct Investment per Capita* and *GDP per Person Employed* (2017 US$). This hybrid approach allows us to best fulfill the identification assumption of the model and ensure that our model is not only statistically sound but also contextually relevant and empirically robust.

Besides the qualitative and quantitative predictor selection, we examine whether possible structural breaks in the data affect the predictor weights and the reliance on the lagged dependent variable. In our SCM model, treating the lagged dependent variable is a pivotal aspect of our methodology. We have decided to utilise a single lagged dependent variable rather than splitting it into separate lags. This decision was informed by two primary considerations: weight allocation and the issue of structural breaks. When the lagged dependent variable was divided into four separate lags, each lag was assigned an equal weight of 20-25%, cumulatively constituting 91.8% of the model's weight. This disproportionate allocation to the lagged variables raised concerns about potentially overshadowing other essential predictors in the model.

On the other hand, using a single lagged variable, the model assigns a weight of about 55%, which is significantly more balanced and prevents the overrepresentation of historical data in the model's predictive framework. The equal weighting of the four separate lags also led us to reassess the concern over structural breaks within the data. The equal distribution of weights across all four lags suggests that the model does not distinctly recognise historical periods as having varying impacts on the dependent variable. This observation undermines the argument for using multiple lags to capture potential structural breaks, as the model does not differentiate between these periods regarding their predictive importance. As Kaul et al. (2017) describe, excessively weighing the lagged dependent variable could result in over-reliance and skewed results. Our single-lag approach ensures a more balanced representation of both historical and other covariate influences in the model, preventing the excessive dominance of historical emigration rates, especially since the years in our model pre-crisis are considerably

[19]These combinations were randomly selected through reiterations of the SCM model in the synth package in R.

different from migration trends post-2009, as elaborated on in Section 3.1.

Table 13: Emigration Lags Weight Distribution

Lags of dependent variables	Predictor weights (v)
Emigration Lag 1991-1996	0.243
Emigration Lag 1996-2001	0.230
Emigration Lag 2001-2006	0.234
Emigration Lag 2006-2009	0.211

Source: See Appendix 1

A.3 Donor Units

Table 14: Full Weight Allocation Synthetic Greece Donor Countries

Country	Weight
Portugal	0.456
Germany	0.220
Poland	0.159
Switzerland	0.134
Italy	0.024
Croatia	0.002
Ireland	0.001
Finland	0.001
Belgium	0.001
Netherlands	0.000
Luxembourg	0.000
Slovenia	0.000
Denmark	0.000
Latvia	0.000
Lithuania	0.000
Slovakia	0.000
Sweden	0.000
Iceland	0.000
Norway	0.000

Source: Compiled by Authors with Data listed in Appendix 1

A.4 Greece Results

A.4.1 Predictor Weighting

Table 15: Predictor weights

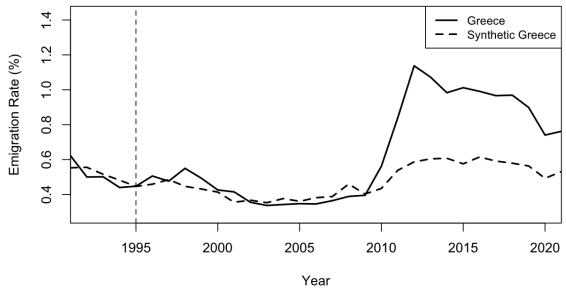
Predictor	Weight
Lagged Emigration per Capita	0.552
Consumer Price Index	0.248
GDP per Person Employed (2017 US$)	0.102
Outflow of Remittances per Capita	0.057
GDP per Capita (2023 US$)	0.018
FDI per Capita	0.013
Unemployment Rate	0.006
Current Account per Capita	0.003

Source: See Appendix 1

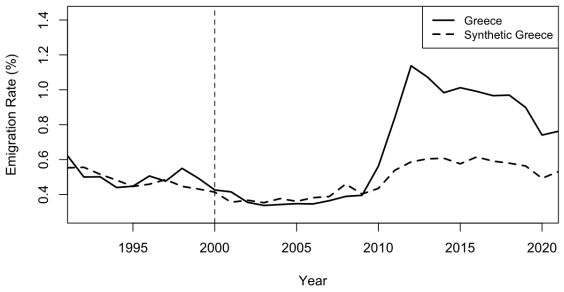
A.4.2 In-Time Placebo Tests

The In-Time Placebo Test is done by performing a rerun of the model and then setting the crisis point at an earlier date than it was. For this test, we shift the year of the onset of the crisis consecutively to 1995, 2000, and 2005. The process of backdating is used to determine whether any factors already impacted the predictors during the pre-crisis period. If this is the case, then the synthetic control estimators will be biased. Therefore, the crisis year may be adjusted to account for such forward looking agents or anticipation effects (Abadie, 2021). However, given that no such anticipation effects are present backdating may be utilised to determine the variability in the synthetic control if the treatment year is backdated. This process is known as in-time placebo testing and was first introduced to the synthetic control method by Abadie et al. (2015). Given a robust synthetic control it should closely mirror the trajectory of the actual treated unit in-between the backdated- and the actual treatment year. Similarly, despite backdating, there should still emerge a gap between the synthetic control and the actual treated unit in the true post-crises period. If this is the case, then this supports that Synthetic Greece is a credible counterfactual of Greece (Abadie, 2021).

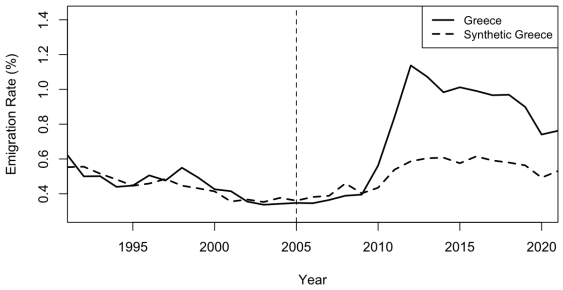
Figure 16: In-Time-Placebo Tests



(a) Placebo Crisis 1995



(b) Placebo Crisis 2000



(c) Placebo Crisis 2005

Source: Compiled by Authors with Data listed in Appendix 1

The In-Time Placebo Tests show that the effects of a crisis onset in 1995, 2000 and 2005 do not cause any significant divergence. Based on these placebo tests, we can thus conclude that we need not doubt the causality of our main results.

A.5 Regional Donor Regions

Table 16: Donor Regions Metropolitan

NUTS 3 ID	Regional Unit	Country
BE100	Arr. de Bruxelles-Capitale/Arr. Brussel-Hoofdstad	Belgium
DE126	Mannheim, Stadtkreis	Germany
DE131	Freiburg im Breisgau, Stadtkreis	Germany
DE276	Augsburg, Landkreis	Germany
DED51	Leipzig, Kreisfreie Stadt	Germany
ES300	Madrid	Spain
ES511	Barcelona	Spain
ITC11	Torino	Italy
ITC33	Genova	Italy
ITC4C	Milano	Italy
ITI12	Lucca	Italy
ITI43	Roma	Italy
LV006	Riga	Latvia
LU000	Luxembourg	Luxembourg
HU110	Budapest	Hungary
AT126	Wiener Umland/Nordteil	Austria
AT127	Wiener Umland/Sudteil	Austria
AT130	Wien	Austria
RO316	Prahova	Romania
SE110	Stockholms län	Sweden

Source: Compiled by Authors with Data listed in Appendix 1

Table 17: Donor Regions Rural

NUTS 3 ID	Regional Unit	Country
BE252	Arr. Diksmuide	Belgium
BE255	Arr. Oostende	Belgium
BE258	Arr. Veurne	Belgium
BE331	Arr. Huy	Belgium
BE334	Arr. Waregem	Belgium
BE351	Arr. Dinant	Belgium
BG314	Pleven	Bulgaria
DE115	Ludwigsburg	Germany
DE116	Rems-Murr-Kreis	Germany
DE117	Heilbronn, Stadtkreis	Germany
DE118	Heilbronn, Landkreis	Germany
DE11A	Schwäbisch Hall	Germany
DE121	Baden-Baden, Stadtkreis	Germany
DE123	Karlsruhe, Landkreis	Germany
DE125	Heidelberg, Stadtkreis	Germany
DE936	Osterholz	Germany
ES114	Pontevedra	Spain

Source: Compiled by Authors with Data listed in Appendix 1

A.6 Regional Causal Inference and Robustness Tests

T-Test

As highlighted in Table 18, using a robust T-Test with a K-value of 3, we find a significant ATT on the metropolitan level, with a confidence level of 90%. The data suggests that, on average, the debt crisis led to a 7.27% reduction in net migration to metropolitan areas. This conclusion has a standard error of 1.99%. Additionally, the confidence interval spans from -1.47 to -13.07. As this CI excludes zero, it suggests that this effect is most likely not a random occurrence. Hence, we can argue that the impact of the debt crisis on metropolitan migration is statistically significant and not due to random fluctuations.

Table 18: T-Test Results for SMG

Average Treatment Effect (ATT)	Standard Error	Lower Bound	Upper Bound
-0.0727272	0.01986231	-0.1307249	-0.01472954

Source: Compiled by Authors with Data listed in Appendix 1

Consistent with the inconclusive results of the placebo test, the ATT for SRG is also not statistically significant. On average, the debt crisis caused a marginal decrease of 1.55% in net migration to rural areas, with a standard error of 1.12%. Notably, the confidence interval spans from -4.82 to 1.72, encompassing zero. This suggests that we cannot confidently argue that the observed effect is not caused by random variation. Consequently, it is possible that the impact could be attributed to chance rather than the debt crisis.

Table 19: T-Test Results for SRG

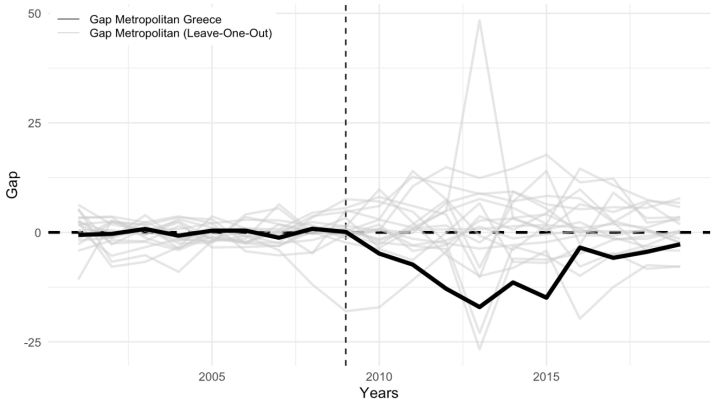
Average Treatment Effect (ATT)	Standard Error	Lower Bound	Upper Bound
-0.01548318	0.01120579	-0.04820393	0.01723756

Source: Compiled by Authors with Data listed in Appendix 1

Placebo Tests

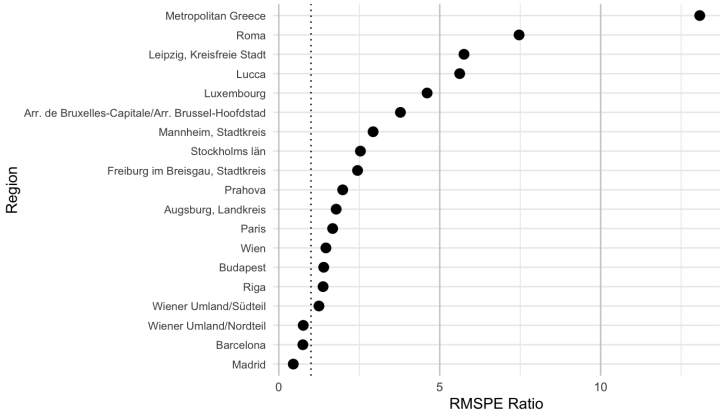
The gaps between Metropolitan Greece and Synthetic Metropolitan Greece (Figure 17) deteriorate post-crisis with a negative trajectory. Furthermore, the pre-crisis gaps are very small, particularly in comparison to its pre-crisis gaps. Moreover, this ratio is extreme compared to the other placebos, indicating that this treatment effect is not due to chance. This is supported by the p-value of zero, which means that none of the placebo RMSPE ratios are more significant than the RMSPE ratio of the treated unit and its synthetic control (Figure 18). This result is highly significant.

Figure 17: In-Space Placebo Test SMG



Source: Compiled by Authors with Data listed in Appendix 1

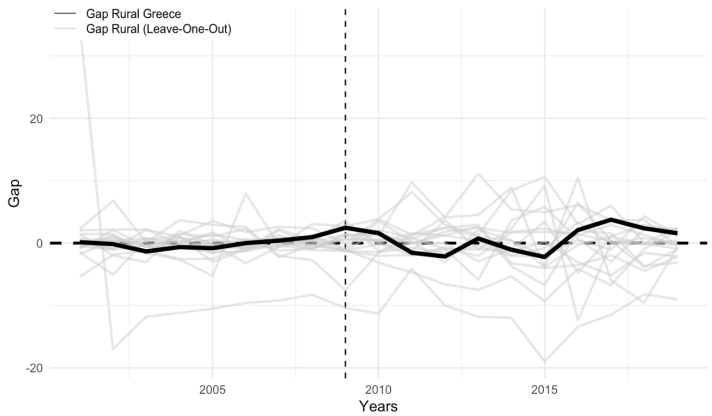
Figure 18: RMSPE Ratio SMG



Source: Compiled by Authors with Data listed in Appendix 1

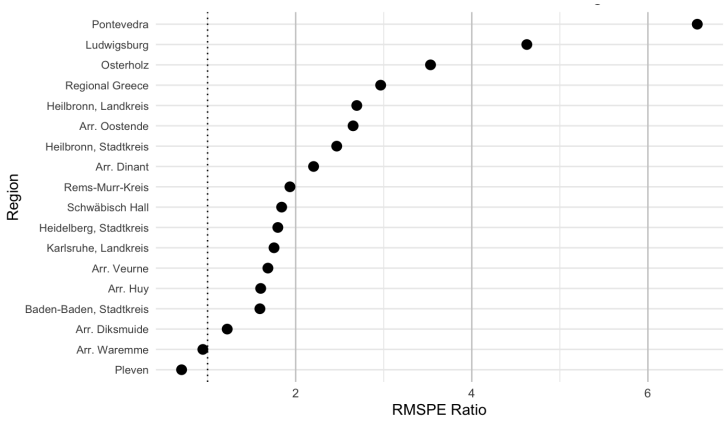
As we can see in Figure 19, the gaps between Rural Greece and Synthetic Rural Greece do not significantly deteriorate post-crisis. Furthermore, the small pre-crisis gaps continue post-treatment with only a slight deterioration. Therefore, the rural ratio of pre- and post-crisis RMSPEs of 2.965177 is only slightly larger than the average placebo RMSPE ratio of 2.343176. Therefore, the resulting p-value of 0.1765 is insignificant even at the 10% level.

Figure 19: In-Space Placebo Test SRG



Source: Compiled by Authors with Data listed in Appendix 1

Figure 20: RMSPE Ratio SRG

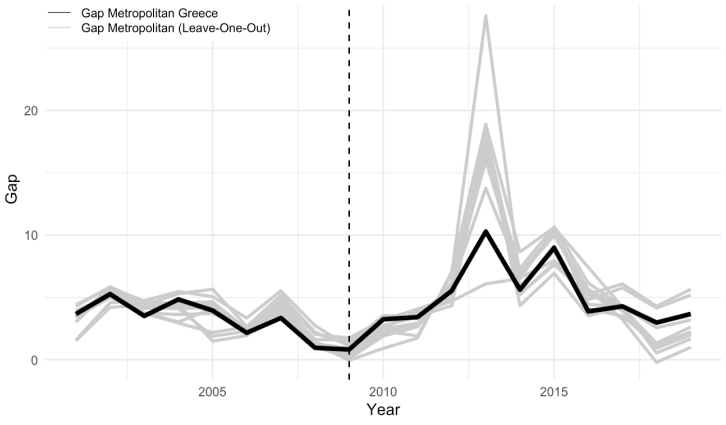


Source: Compiled by Authors with Data listed in Appendix 1

Leave-One-Out Robustness Test

The Leave-One-Out Test for the Synthetic Metropolitan Greece, as presented below, has a good pre-crisis fit. The only divergence emerges between 2003 and 2006, where five Leave-One-Out synthetic control units follow a slightly lower or higher trajectory. This indicates that the Synthetic Metropolitan Greece relies on a few donor regions for its fit during this period. Nevertheless, as most synthetic control units follow the same pre-crisis trajectory, the pre-crisis SMG may be considered as robust. As anticipated, there are also some discrepancies between SMG and Leave-One-Out synthetic control units post-crisis. Here, some units experience a higher spike in 2013, indicating that the relatively lower trajectory of our SMG in 2013 relies on individual donor units. However, since the rest of the trajectory of all units is like the synthetic control ending in between the others, we consider the post-crisis fit robust.

Figure 21: Leave-One-Out Result SMG

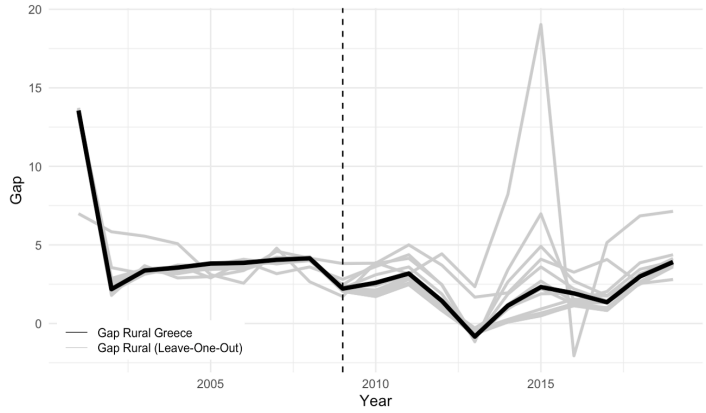


Source: Compiled by Authors with Data listed in Appendix 1

As illustrated in Figure 22, the Leave-One-Out Test for Synthetic Rural Greece demonstrates a commendable pre-crisis alignment, with most synthetic control units closely mirroring its trajectory. Post-crisis, however, there is a larger deviation from the SRG trajectory, highlighted by a pronounced spike in 2015. This suggests that the SRG significantly relies on specific donor units, which doubts its robustness. However, efforts to address this by incorporating additional donor units generally worsened the results. Hence, the composition of donor units plays a pivotal role in shaping the Leave-One-Out Test's outcome, particularly its variability. Given a more stable donor pool with less variability, potentially caused by idiosyncratic shocks, the

individual synthetic control units (here: the grey lines in Figure 21) would be more similar. Consequently, when interpreting the results of the SCM analysis for the SRG, it is crucial to factor in this dynamic.

Figure 22: Leave-One-Out Result SRG



Source: Compiled by Authors with Data listed in Appendix 1

A.7 Correlation Analysis Scatter Plots

Figure 23: Correlation Birth Rate

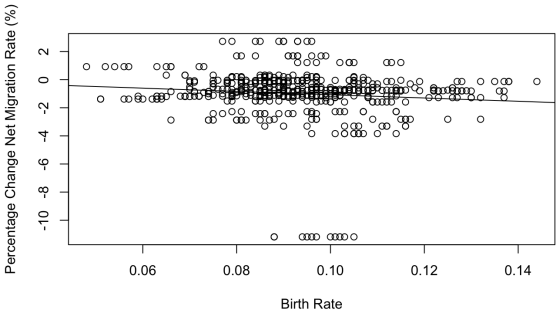
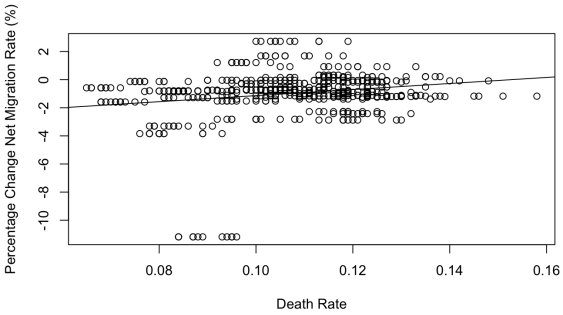


Figure 24: Correlation Death Rate



Source: EUROSTAT (2023)

Figure 25: Correlation Population Density

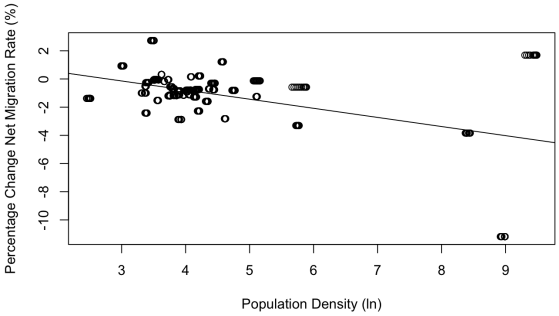
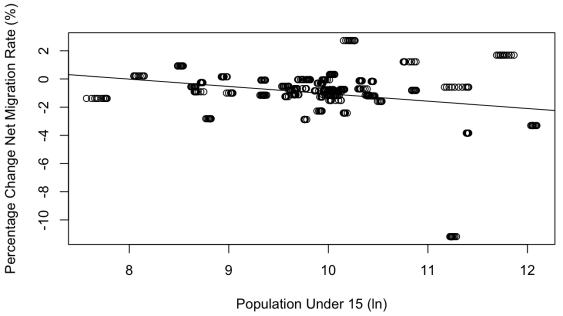


Figure 26: Population Under 15



Source: EUROSTAT (2023)

Figure 27: Population Between 15 and 64

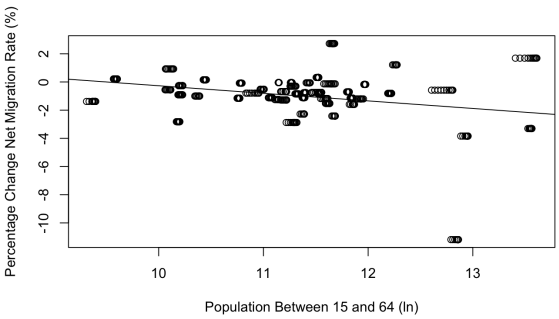
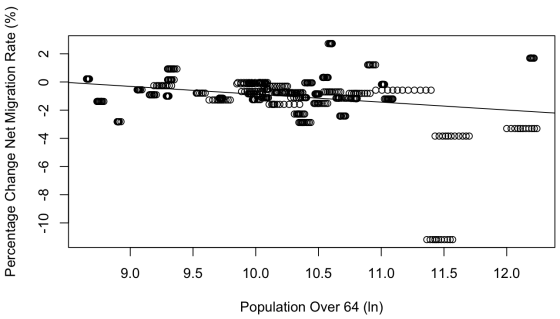


Figure 28: Correlation Population Over 64



Source: EUROSTAT (2023)

Figure 29: Number of Universities

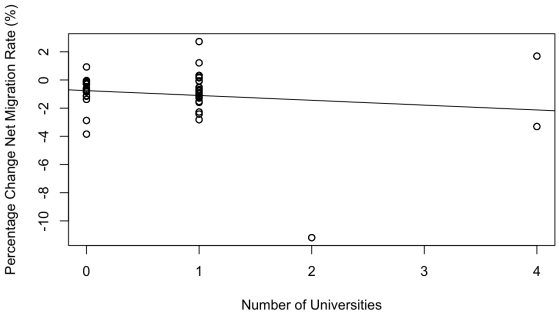
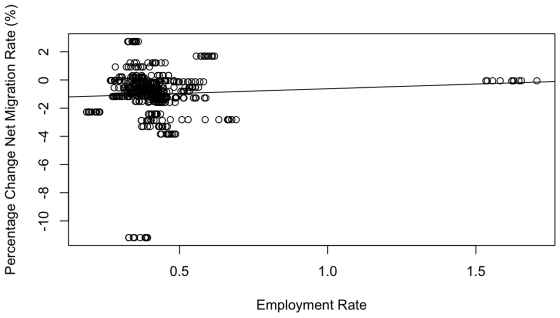


Figure 30: Correlation Employment Rate



Source: EUROSTAT (2023)

Figure 31: Correlation GDP per Capita

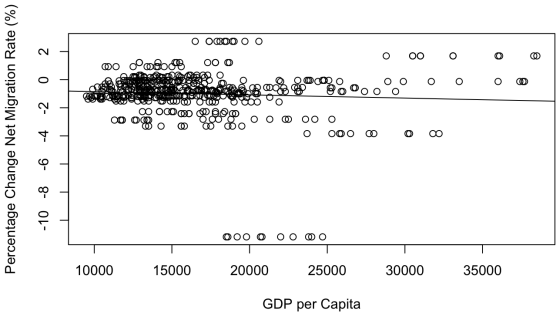
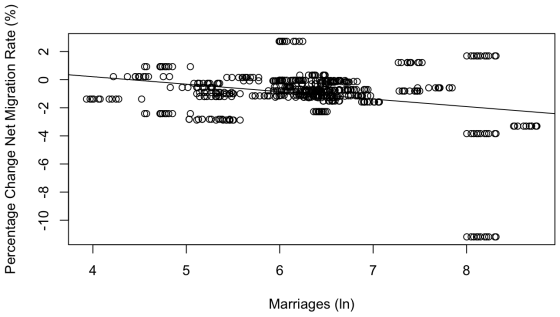


Figure 32: Marriages



Source: EUROSTAT (2023)

Figure 33: Correlation Employees AFF

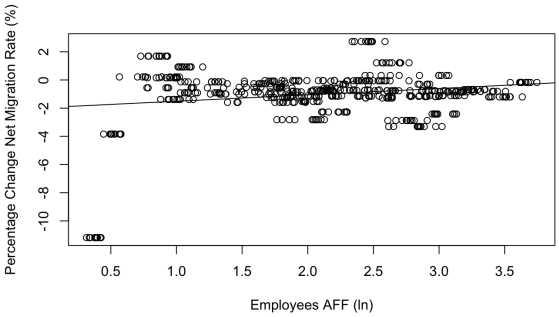
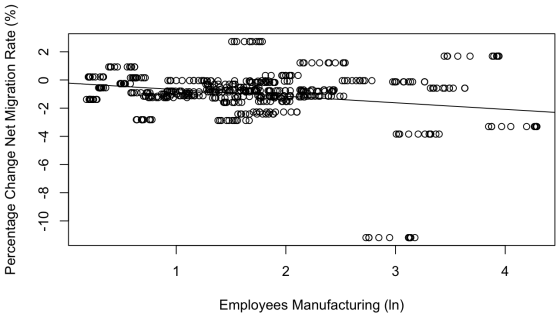


Figure 34: Correlation Employees Manufacturing



Source: EUROSTAT (2023)

Figure 35: Correlation Employees Construction

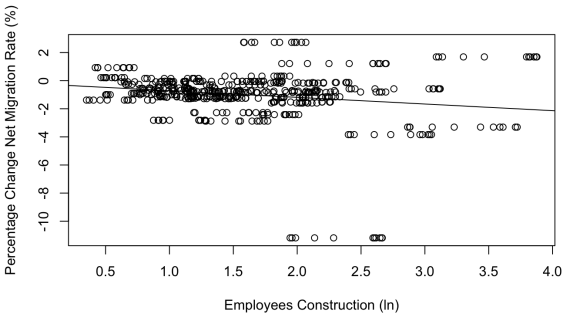
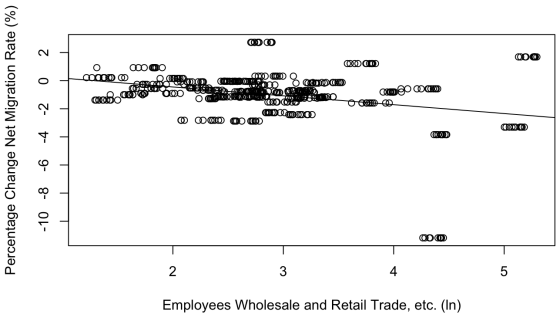


Figure 36: Correlation Employees Wholesale and Retail Trade, etc.



Source: EUROSTAT (2023)

Figure 37: Correlation Employees Information, etc.

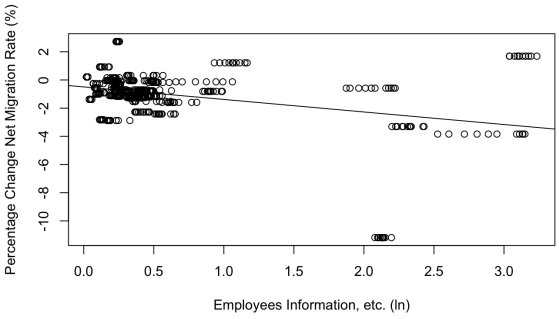
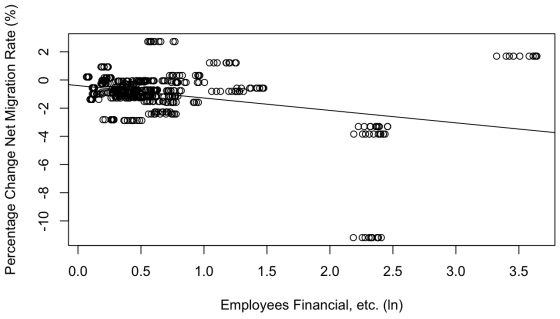


Figure 38: Correlation Employees Financial, etc.



Source: EUROSTAT (2023)

Figure 39: Correlation Employees Real Estate Activities

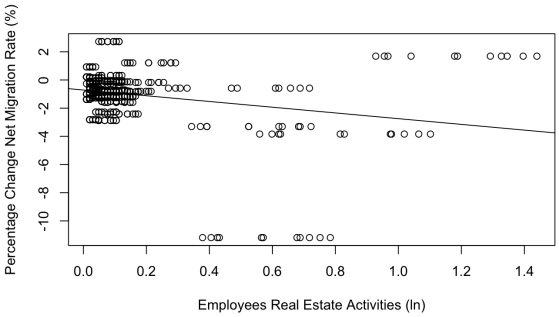
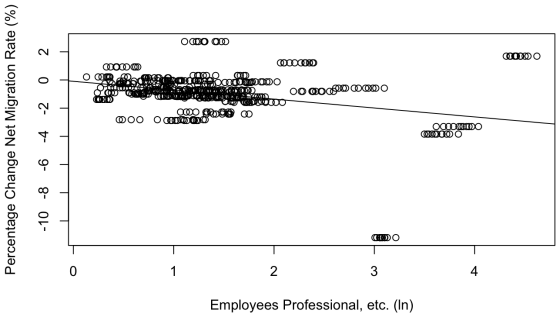


Figure 40: Correlation Employees Professional, etc.



Source: EUROSTAT (2023)

Figure 41: Correlation Employees Public Administration, etc.

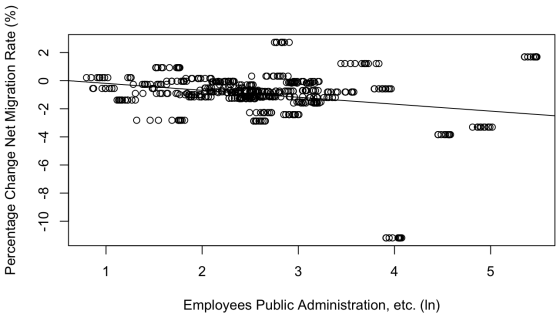
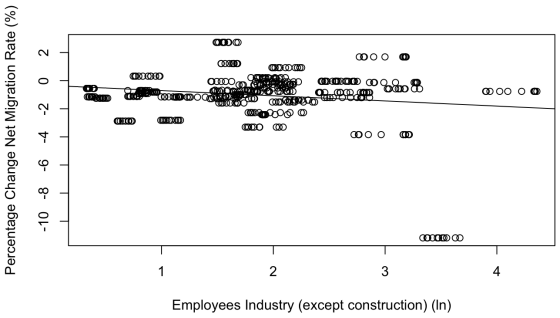


Figure 42: Correlation Employees Industry (except construction)



Source: EUROSTAT (2023)

Figure 43: Correlation GVA Wholesale and Retail Trade, etc.

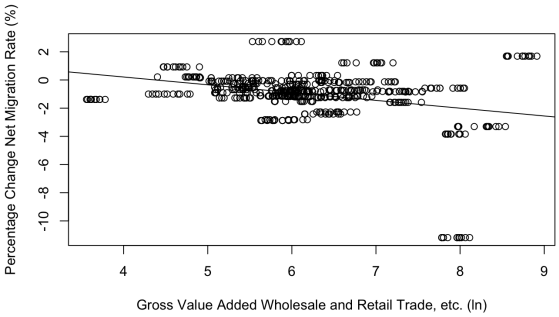
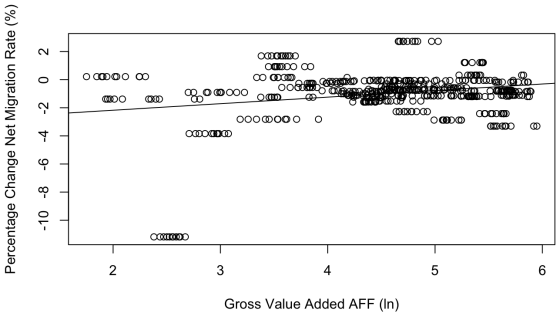


Figure 44: Correlation GVA AFF



Source: EUROSTAT (2023)

Figure 45: Correlation Labour Productivity

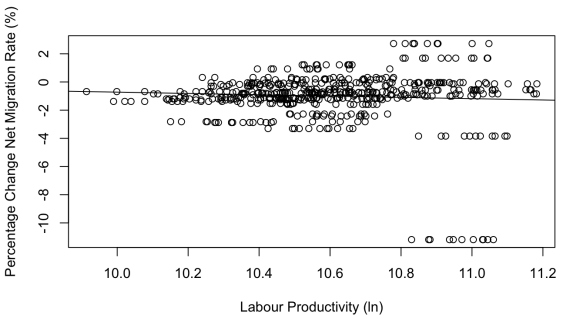
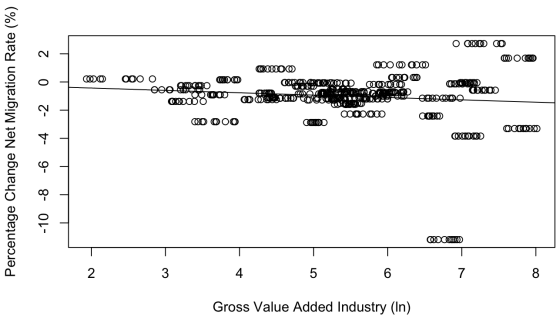


Figure 46: Correlation GVA Industry



Source: EUROSTAT (2023)

Figure 47: Correlation GVA Manufacturing

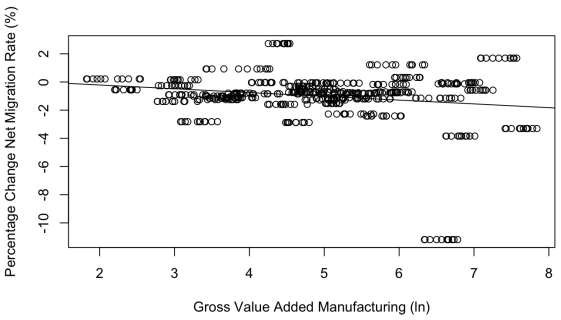
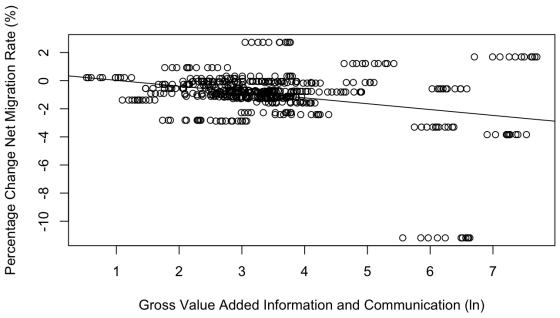


Figure 48: Correlation GVA Information and Communication



Source: EUROSTAT (2023)

Figure 49: Correlation GVA Financial Activities, etc.

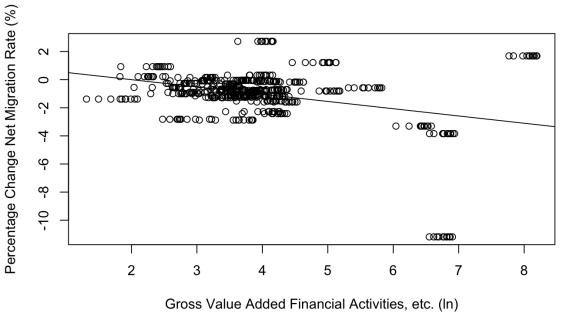
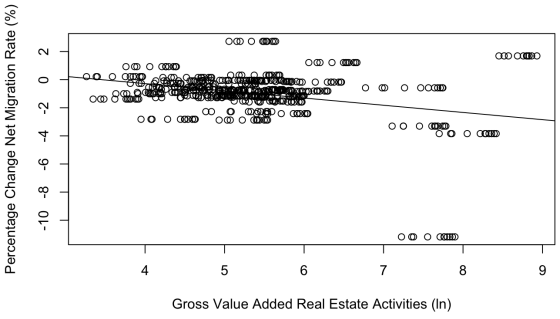


Figure 50: Correlation GVA Real Estate Activities



Source: EUROSTAT (2023)

Figure 51: Correlation GVA Professional Activities, etc.

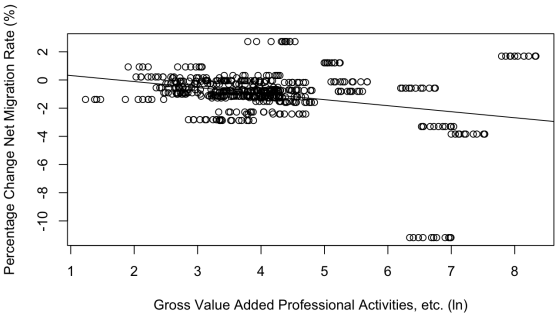
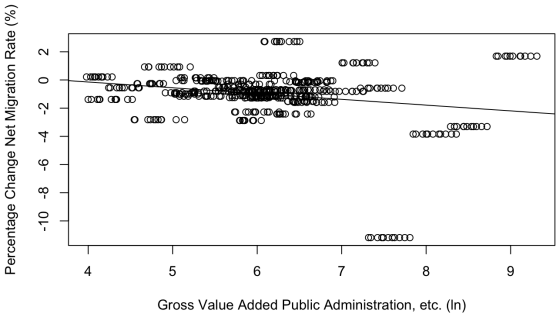


Figure 52: Correlation GVA Public Administration, etc.



Source: EUROSTAT (2023)