Cosimo Bianchi

S4114566

c.bianchi@student.rug.nl

CFB063A10: Capstone

Dr. Marianna Papakonstantinou

University College Fryslân

"What are the immigration effects on economic growth and income inequality among Southern European countries?"

A regional level regression analysis of Portugal, Spain, Greece, and Italy

Abstract

Given that immigration has been identified as a labor mobility mechanism that can help maintain a stable capital-labor ratio, thereby increasing labor productivity and regional income per capita, as well as contribute to recipient country performance and foster innovation, the goal of this research is to investigate the effects of immigration on regional economic growth and income inequality, with a focus on the economies of Southern Europe. This research has the main purpose to conduct a quantitative study to examine respectively the immigration effects on regional economic growth and income disparity, including a more in-depth analysis of the diverse impacts on the foreign-born's skill composition in relation to the two dependent variables in analysis. Particularly, the study examined the effects of the share of foreign-born population on regional economic growth over an eight-year period (2011-2019) and the Gini Index per capita. The findings of this study revealed that the proportion of foreign-born people is linked to higher GDP growth per capita, but no evidence of a link between immigration and income disparity per capita has been found. The findings also supported a favorable relationship between high- and medium-skilled migration and economic development; however, the skill mix of immigrants did not show any correlation with regional income disparity. The findings of this study provide significant insights on economic migration consequences on a regional scale by investigating Southern Europe, a geographical area where immigration effects on regional economic growth and income distribution have gotten insufficient attention.

Keywords: economic growth, income inequality, regional level regression, immigration, skill composition, Southern Europe

This research was conducted as part of a bachelor's thesis for the BSc in Global Responsibility and Leadership program at Campus Fryslân, University of Groningen. I would like to thank my supervisor, Dr. Marianna Papakonstantinou, for all of the support, direction, insights, and productive meetings that helped me complete my research. I would also like to express my gratitude to my family, friends, and colleagues for their support throughout my time at Fryslân.

Cosimo Bianchi

INTRODUCTION

Immigrants bring a broad mix of perspectives and expertise to the table, and they play an important role in technological advancement. Their diversity, more than their total amount, appears to be a key component in enhancing the destination country's pace of technology advancement (Șerban et al., 2020). There is evidence that net outbound migration from low-income nations and inward migration into high-income countries promote growth in both countries in the long run (Newbold, 2019). Simultaneously, it is vital to note that migrant flows' ethnic makeup, as well as their age, anticipated stay time, and professional skills, all have a substantial influence on economic growth (Brunow, Nijkamp & Poot, 2015). Evidence has revealed that the skill mix of immigrants is an essential indication to consider when assessing the impact of immigration on a country's economy.

Immigration is an adaptive capacity mechanism that allows for labor mobility and can help to maintain a balanced capital-labor ratio, thereby increasing labor productivity and regional income per capita (Fratesi et al., 2007), as well as contributing to the recipient country's performance and having a positive impact on innovation and economic growth (Fassio et al., 2019). However, it is crucial to note that different studies have produced different conclusions and sparked diverse disputes about the consequences of immigration on economic growth and income disparity. Extensive research has generally found more agreement on the positive effects of immigration on national economic growth (Brunow, Nijkamp & Poot, 2015); however, research tailoring on the effects on regional economic growth has been more contrasting, but overall, a positive or neutral effect of migration effects has been reported across OECD countries (e.g. Boubtane et al., 2016). When research examined the immigration effects on income inequality in a host country, results were even greater and more contradictory. As it has been

argued by Kalleberg (2011), the impacts of immigration on native employees are complex and depend in part on whether foreign-born persons are replacements or complements for native labor. In an analysis of data from a number of OECD countries, Blau and Kahn (2012) found that, while some studies revealed significant immigration effects on reducing income inequality on a regional scale (e.g. Borjas, 1990; Borjas and Katz, 2005), the majority of studies found no significant impacts of immigration on native income distribution.

Considering the unpredictability of empirical evidence in regards to the impact of the share of foreign-born population on both economic growth and income inequality, particularly on a regional level, this study aimed to further examine these associations by conducting a quantitative study on the immigrarion impacts on regional economic growth and economic growth, by examining Southern European regions, considering that this geographical area has not been widely researched. Particularly, this research paper aims to answer the following research question: "What are the immigration effects on economic growth and income inequality among Southern European countries?".

To investigate the research question in analysis, the Section 1 of this study firstly conducted a literature review to have a more in-depth understanding of the immigration effects on economic growth and income inequality on a regional level. Furthermore, a large body of literature on the various effects of foreign-born skill mix on GDP per capita and regional income distribution will be reviewed. Because findings showed that when the immigrant flow is made up of high-skill people, immigration has a stronger beneficial influence on growth, the immigration skill composition has been further investigated (Borjas, 2019). Furthermore, empirical research has indicated that the skill mix of immigrants is an important factor to consider when studying a country's regional income disparity patterns (DiPasquale, 2021).

Following that, Section 2 of this research will look at the methodological technique that was used to perform this study. The methodology section will also give a more in-depth knowledge of the indicators used in this study, including summary statistics and justifications for confounders chosen. However, the two particular regression equations that were utilized to investigate the study's dependent variables, regional GDP growth per capita and Gini Index per capita, have been displayed to offer a deeper understanding of the relationships in the analysis. Before analyzing the results obtained in the regression analysis, this study performed regression diagnostics by investigating the presence of Multicollinearity (i.e.,when detected indicates a high correlation between at least two independent variables in the OLS regression model) and heteroskedasticity (i.e., the assumption of non-constant error variance), which are two conditions that must be considered in order for the findings produced from this technique to be legitimate (Rovny, 2014).

Following the regression diagnostic, Section 3 aims to display the results obtained in the 16 regression models which have been performed to examine the association between regional economic growth and income inequality. The quantitative investigation was carried out with the use of RStudio and OECD. Stat Database to look at the effects of the share of foreign-born population on regional economic growth over an eight-year period (2011-2019) using multiple regression analyses, as well as the Gini Index per capita, which is a summary statistic that determines how evenly a resource is distributed throughout a population. Furthermore, a more comprehensive analysis of the effects of immigration on both regional economic growth and income inequality has been presented by examining the consequences of foreign-born skills mix on economic growth and income disparity. This means that the effects of high-, medium-, and low-skilled migration on GDP growth per capita and Gini index per capita have also been

examines, and the diverse migration skill composition level is classified based on the educational attainments pursued by the foreign-born population (respectively tertiary, secondary, and primary school education).

In addition, in Section 4, a closer look at the findings of this study will be provided with the goal of comparing the Capstone project's findings to earlier findings. The discussion analysis will be followed by a more in-depth reflection on the study's limitations, including a more in-depth reflection on the study's novelty and contribution to delineating policy recommendations to improve the economic impacts of immigration in a host country, as well as increase immigrants' opportunities to integrate into the European, or even more specifically, Southern European workforce.

This study adds to the body of information on the effects of immigration on economic development and income inequality in Southern European areas. The findings of this study make a significant contribution, given that there is little research that examines economic growth and income inequality in the same study, and it contributes to providing more insights on the economic migration impacts on a regional scale, by examining Southern Europe, which is a geographical location where immigration effects on regional economic growth and income distribution have received little attention.

LITERATURE REVIEW

International migration in Europe

Attitudes about immigration in Europe have changed throughout time. International migration in Europe has a long history of varying in response to changes in political and

economic power in Europe (Șerban et al., 2020). The most drastic developments in terms of migration happened after the fall of socialism in 1990. The wealth of southern European countries has attracted immigrants, while countries in the European Union's core have begun to consider recruiting immigrants with either a high level of education or the necessary skills for the changing economic climate (Popescu et al., 2017). The form and direction of migratory movements in the EU have been shaped by the economic transition of ex-communist nations, ethnic conflicts, and the inclusion of numerous additional countries into the European Union (Dustmann & Frattini, 2011). The expanding immigration flows in the EU were driven by the free movement of persons as part of the EU single market, which generated issues about the costs and advantages of immigration, notably after 2004–2007. Migration is a movement of labor across borders in response to market signals, altering labor supply and demographic characteristics in both the sending and the receiving nation (Chiswick & Hatton, 2003; Bratsberg et al., 2014). Economic immigrants benefit from self-selection in the labor market more than other individuals who relocate since they have the means to relocate . The more favorable the migrants' selections, the more effective their integration, and hence the higher the positive influence on the host nation (Chiswick, 2000). Central European countries such as Germany, Austria, Switzerland, France, and the Benelux countries have traditionally served as key immigration destinations and entry sites for many European labor migrants. Since the 1980s, southern European countries such as Greece, Italy, Portugal, and Spain have become immigration hotspots, receiving migrants from Northern Africa, the Eastern Mediterranean, and the Balkans, often through uncontrolled immigration, owing to geographical features (e.g. mountainous territories, coastlines) that allow for entry, as well as the fact that these locations are frequently targeted as transit points (Stalker, 2002; Zimmermann, 2005). While Germany, the

United Kingdom, and France were the main immigration nations in the 1990s, this image had altered by the end of the decade, first with a dramatic increase in migrant flows to Italy, and then in the 2000s to Spain, according to OECD and Eurostat statistics (Baycan-Levent & Nijkamp, 2009). Europe is a location wherein migration is especially advantageous from a socio-economic standpoint, considering a population aging and an increasing need for specialized skills (Baycan-Levent & Nijkamp, 2009). Because economic progress and the creation of new jobs are inextricably related to labor mobility, and because regional labor mobility in the EU is rather low, immigration from outside the EU might play a significant influence in Europe's aging population (Zimmermann, 2005).

The immigration impacts on economic advancement

Immigrants bring a diverse set of opinions and skills to the table, and they are a significant contributor to technological growth. Their diversity, more than their absolute quantity, appears to be a critical factor in accelerating the rate of technical growth in the destination country. Employees from varied backgrounds add their unique skills, knowledge, and competencies to the day-to-day interaction, which may enhance a team's effectiveness (Șerban et al., 2020). Hong and Page (2001) examine how heterogeneity promotes problem-solving and demonstrate that heterogeneous groups of persons with restricted talents can outperform homogenous groups of problem-solvers. According to empirical research, heterogeneity, including the degree of ethnic differences of teams of employees in multicultural backgrounds, boosts labor productivity while maintaining average performance (e.g. Hamilton et al., 2003; Trax et al., 2015). Immigration has been an important issue for economic advancement because

of the effects on unemployment and income levels, as well as economic growth. Immigration allows individuals to better respond to job opportunities and skill shortages in the short and long term (Newbold, 2019). When it comes to skills and educational competency, several empirical research claim that migration has an impact on economic advancement (Șerban et al., 2020). According to much research (e.g. Kanbur & Rapoport, 2005; Rappaport, 2005), skill-selective mobility has a major influence on both the origin and destination nations. In this regard, migration has an impact on the ratio of skilled to unskilled labor (Andersen & Dalgaard, 2011). Furthermore, the influx of skilled labor might result in an increase in the recipient country's performance (Etzo, 2008) and can have a favorable impact on innovation (Fassio et al., 2019). Similarly, labor force mobility implies that employees would want to maximize their individual utility by moving to nations and locations with more possibilities. This will result in greater differences between nations and regions, with receiving countries benefiting from skilled migrant inflows (Fratesi & Riggi, 2007). It might be claimed that cross-national migration, particularly from lower-income to higher-income countries, has a substantial impact on a variety of fronts. First, it affects immigrants by allowing them to earn more money in the receiving nation as a result of their enhanced output. It also increases the expected earnings of their children. Second, it has an impact on the recipient country's labor markets, competitiveness, innovation, population distribution, budgeting, and crime. This may result in a loss of human resources, but it also creates remittances and strengthens international relations through trade, foreign direct investment, and technological transfers (Koczan et al., 2021). The purpose of this research is to better understand the consequences of immigration on economic growth and income inequality in the destination country by first reviewing previous findings on the link between immigration, economic growth, and income inequality in the destination country.

The relationship between regional economic growth and migration

The research typically highlights that the causal relationship between migration and growth is bidirectional: growth causes inward migration, while newcomers can also impact economic growth. While polls reveal that individuals move for a variety of reasons, most immigrants are of productive age and would only relocate if it would significantly improve their situation, particularly if their actual income would increase. Sjaastad (1962) was the first one to officially explain that migration is an investment, in which the migrants pay a price in exchange for a higher gain on their human capital in the long term. As a result of economic expansion, inbound migration occurs. But what impact does migration have on future growth? Unless immigrants stay jobless or replace employees in the destination economy, the presence of more workers boosts GDP by increasing production (Boubtane et al., 2016). Because there is comprehensive empirical proof that migrants do not enhance unemployment rates (e.g., Longhi et al., 2008) or entirely displace native-born employees (e.g., Cattaneo et al., 2013), net inward mobility enhances the efficiency of the host economy. Furthermore, economic immigrants pay a price in order to gain the future advantage of a higher return on their human capital through relocation. Under these premises, a shift in the demand curve to labor supply by immigration simply results in a capital influx which restores the previous capital–labor ratio. The income per person is then equal to what it was previously. Alternatively, if we look at things from a regional standpoint and report the presence of immigrants in a region, capital inflow and labor outflow are simultaneously projected, resulting in equilibrium of capital–labor ratio values on a regional level (McCann, 2013).

Another point to consider is the geographical level, where the link between migration and economic expansion should be looked at a regional level. Focusing solely on the national scale

might lead to erroneous conclusions, particularly in nations where the production system is characterized by the coexistence of relatively backward and contemporary and dynamic sectors (Di Berardino et al., 2021). The variability of a country's production process raises issues about what lies below the national averages and if the link involving international immigration and development dynamics might take different forms at the local level. For instance, Italy is a particularly fascinating illustration of an importing developed country because of the significant territorial contrasts between the regions of the Center-North and the regions of the South (Di Berardino et al., 2021). The fact that regions in the South and the Center-North are at two different phases of development suggests that they have different absorptive capacities for world knowledge, which might influence how economic growth is affected in the long term (Castellacci & Natera, 2013). As a result of the significant variability of socio-economic and infrastructural properties among regions within the same country, which is in most cases much greater than across nations (Charron et al., 2014; Rodríguez-Pose, 2013), empirical assessments at the national scale may produce inaccurate results. Despite the fact that the national scale is the best level for regulating international migration, a smaller scale is highly crucial because it reflects the level at which many of the major infrastructures are formed and determine the link between economic growth and international immigration (Williams & Baláž, 2014).

The relationship between regional income inequality and migration

There are primarily two ways that immigration might impact income disparity. Firstly, if immigrants have a distinct income distribution than natives, their income might have an impact on inequality (Slettebak, 2021). According to Card (2009), income inequality among all employees in the industry is larger than it would be if immigrants had greater disparity than

natives. For instance, Telle et al. (2017) show that the foreign-born population in Norway has a greater degree of income disparity than the rest of the population, which, given the immigration net's growth, might underlie some of the recent increases in income discrepancy. The second, and more contentious, way in which immigration might increase income disparity is through affecting the amount or distribution of natives' wages (Blau & Kahn, 2012). Particularly, the theoretical premise is that immigrants increase labor supply too quickly, reducing competition amongst subgroups in the labor market and hence lowering wages (Slettebak, 2021).. According to Kalleberg (2011), the effects of immigration on native employees is multifaceted, and it relies in part around whether foreign-born people are replacements or supplements for native labor. Particularly, research has demonstrated contrasting findings in regards to the immigration impacts on income inequality in a host country. For instance, Card (2009) claimed that immigration has had little impact on native wage disparities in the US. Others believe that an inflow of low-skilled immigrants diminishes low-educated locals' incomes while raising college students' earnings (Borjas, 1990; Borjas and Katz, 2005).On the other hand, Dustmann et al. (2013) show that immigration in the UK lowers earnings in the bottom twentieth percentile while increasing salaries in the higher half of the distribution. However, Blau and Kahn (2012) indicated in an analysis of the data from numerous OECD nations that, although some research reported significant effects, the majority of studies did not find significant impacts of immigration on native income distribution.

Furthermore, when it comes to analyzing the interconnection between the share of foreign-born population and income inequality, **r**egional differences in income per capita are a key component of the economic landscape, particularly in Europe. Although most writers detect convergence at the country level, income per capita disparities are thought to be more persistent

at the regional scale. These analyses are based on the theoretical premise that immigration is an adaptation mechanism that permits labor mobility (viewed as a production component) and, as a result, can contribute to an equilibrium of the capital to labor ratio and, consequently enhancing labor productivity and regional income per capita (Fratesi at al., 2007).

Relevance of high-skilled migration

In today's globalized environment, international migration is continuously rising. In 2019, there were almost 272 million migrants, according to the International Organization for Migration (IOM, 2020). At the same time, highly skilled migrants with a higher level account for 35% of the total population (Oliinyk et al., 2021). According to experts, the annual influx of highly skilled persons will continue to increase (Acostamadiedo et al., 2020). According to analysts, roughly three times as many highly skilled people will move to the EU-28 in 2030 as they did on average between 2009 and 2018. Particularly, highly skilled labor migration is predicted to grow by 134 percent (Oliinyk et al., 2021). It is also relevant to acknowledge that the knowledge and skills that modern professionals must carry change dramatically. As a result, according to projections, demand for individuals with technological abilities would rise by 39% by 2030 (Oliinyk et al., 2021). Emotional and social skills, such as the intersection of personal talents and empathy, as well as teaching and learning from others, will grow in popularity. Higher cognitive skills will also be characterized by a minor rise (e.g. project management, quantitative and statistical skills). On the other hand, fundamental cognitive and physical abilities are projected to see a major drop in demand. The presence of highly skilled migrants not only increases the recipient country's human resources, but also provides a suitable competitive

environment for residents, encourages training and the acquisition of new information and expertise (Oliinyk et al., 2021).

The implication of foreign born's skilled-composition on economic growth

Immigration has been an important issue for economic advancement because of the effects on unemployment and income levels, as well as economic growth. Immigration allows individuals to better respond to job opportunities and skill shortages in the short and long term (Newbold, 2019). Despite the fact that immigrant characteristics and integration opportunities vary greatly by country, the operation has raised concerns about immigrants' economic outcomes and host countries' successful strategies for ensuring immigrants' economic assimilation, including the financial implications of immigration for host economies. When it comes to skills and educational competency, several empirical research claim that migration has an impact on economic advancement (Șerban et al., 2020). According to much research (e.g. Kanbur & Rapoport, 2005; Rappaport, 2005), skill-selective mobility has a major influence on both the origin and destination nations. In this regard, migration has an impact on the ratio of skilled to unskilled labor. Furthermore, the influx of skilled labor might result in an increase in the recipient country's performance and can have a favorable impact on innovation (Fassio et al., 2019).

According to Boubtane et al. (2016)'s findings, boosting continuous migration of foreign-born employees by one percentage point would enhance "productivity growth by between one- and six-tenths of a percentage-point per year" in most OECD nations, taking into consideration of foreign-born employees who pursued tertiary education (Column 4, Table 3, Boubtane et al., 2016, p.p. 17-18). With the exception of nations, we find that the shift in

increased productivity is favorable when we examine a 50% rise in the net migration percentage of the foreign-born population (Column 5, Table 3, Boubtane et al., 2016, p.p. 17-18). Nonetheless, except for Iceland, Luxembourg, and Ireland, in which productivity growth has been more than six tenths of a basis point annually, the migratory growth effect is minor. As a result, steady migration flows from outside boost GDP per capita across all OECD nations . These outcomes are consistent with prior empirical research based on immigration stock data, however the beneficial effect of foreign-born immigration appears to be less in scale (Boubtane et al., 2016). According to the findings of Felbermayr et al. (2010), a 10% rise in the migratory stock correlates to a 2.2 percent rise in GDP per capita. Furthermore, Ortega and Peri (2014) discover a qualitatively big effect: a ten-percentage-point variation in the proportion of foreign-born people in the population is related with disparities in GDP per capita by a ratio of close to two.

The implication of foreign born's skilled-composition on income inequality

Examining the effects of skilled migration on economic and income inequality in the host nation is another aspect that this research will further investigate. Considering that labor force mobility implies that employees would want to maximize their individual utility by moving to nations and locations with more possibilities, this will result in greater differences between nations and regions, with receiving countries benefiting from skilled migrant inflows (Fratesi & Riggi, 2007). Skilled worker immigration is a movement of human resources between nations and regions, implying that human capital earned in their home country is portable. This is a drawback for sending nations, as they spend on education for their own citizens and do not get a return on investment. These factors are evident in economic disparities between natives and

foreign-born population, as well as immigrants' heightened risk of impoverishment or marginalization (Șerban et al., 2020). However, this study particularly aims to investigate the immigration impacts on income inequality across Southern European countries. Therefore, a more comprehensive understanding of the findings delineated by previous research is required.

Borjas (1987) analyses the migration decision as a function of the differential rate of return on talent when it comes to the relationship among income disparity and skilled migration. He claimed that a receiving country with a better interest rate on skill than a source country is more likely to recruit skilled employees. He comes to the conclusion that economic inequality in a host country must be positively associated with a greater percentage of skilled migrants, whereas wealth inequality in a source country ought to be inversely associated with the skill composition of immigrants, using income disparity as a proxy variable relative to the high rate of return for skill. On the other hand, Zimmerman (2008) obtained different results as he argued that the degree of immigration to OECD nations is adversely connected to income disparity in the recipient economy. The proportion of competent to unskilled migrants as well as the Gini indexes of both sending and destination nations, on the other hand, are positively associated in Brucker & Defoort (2007)'s study. The inconsistency of the data may be explained in response to the fact that prior studies considered economic inequality as an exogenous variable. Therefore, Ehrlich & Kim (2015) concluded that it would be more useful to look at the relationship between foreign-born skill composition and income disparities as an association rather than a causation, because both variables are generated simultaneously.

The significance of examining the economic impacts of immigration in Southern Europe

The findings on the impact of immigration on both economic growth and income inequality were highlighted in the preceding parts of the literature review. However, as the literature analysis shows, much of the study has concentrated on the consequences of immigration on Northern European nations (e.g. Card, 2009) or the US (e.g. Borjas, 1990). As a result, the goal of this study was to look at the impacts of immigration on economic growth and income disparity in Southern European regions. Given that international migration has switched from a source to a destination country (González-Enríquez & Triandafyllidou, 2009), more in-depth study on immigration consequences is required to analyze policy suggestions in Southern European nations and regions' workplaces. Particularly, immigrants began to come in Southern European countries after the closing of immigration control channels in Northern and Central Europe in the mid-1970s, seeing these nations as immigration targets, as well as "stepping stones" to their wealthier neighbors. Particularly, Southern Europe's economic prosperity in the 1980s, Greece's (1981) and then Spain's and Portugal's (1986) admission to the European Communities, young people's rising educational levels and consequent flight from low-wage jobs, and the comparative boom of the informal economy across these nations have all opened up job opportunities for immigrants (González-Enríquez & Triandafyllidou, 2009). Providing a more in-depth analysis on the immigration effects on the economic advance of Southern Europe is important considering that the four selected countries which will be investigated in this study have a number of characteristics in common. Apart from their somewhat abrupt transition from emigration to immigration society, these four nations comprise the EU's southern border, with three of them bordering the Mediterranean and geographical areas with considerable emigration possibilities. All four nations have labor markets that are divided.

Southern European countries, apart from northern Italy and several Spanish provinces, have weak and inherently uneven economies. Thousands of migrant workers are employed (officially or irregularly) in low-paying and low-status areas of the labor market, resulting in local unemployment. Particularly, immigrants are absorbed in sectors such as construction, agriculture, trade, catering, tourism, and private care facilities, notably all labor-intensive sectors in which informal employment is widespread (again, excluding northern Italy as well as some Spanish territories) (González-Enríquez & Triandafyllidou, 2009). Given the possible similarities between the labor markets of the four countries, conducting research on the effects of immigration on economic growth and income inequality across Southern European regions can help develop policy recommendations that will benefit both the incoming migrants and the economies and labor markets of the Southern destination countries.

METHODOLOGY

In terms of the methodology that will be used for the Capstone thesis, this study used quantitative methods to gain a better understanding of the impacts of immigration on economic growth and income disparity. The quantitative study was carried out using RStudio and data from the OECD.Stat Database. To prevent confounding, this study looked at the dependent variables (DVs) economic growth and income inequality independently, first with a crude relationship and then with multiple regression analyses. Furthermore, by evaluating the impacts of foreign-born skills composition on economic growth and income inequality, a more extensive examination of the immigration effects on both DVs has been outlined. Based on the data supplied by the OECD() database, the migrants' skilled composition has been categorized as high-, middle-, and low-skilled.

It is also relevant to have a more in-depth understanding of the regression equations which have been adopted in this study. The image below respectively displays the two equations which have been delineated to analyze respectively the DV1 Regional Economic Growth and DV2 Regional Income Inequality.

$$economic\ growth_i = \alpha_0 + \alpha_1 immigration_i + \varepsilon_i$$
$$inequality_i = \beta_0 + \beta_1 immigration_i + \varepsilon_i$$

Regression analysis has been a useful statistical technique for determining the association between two or more variables. Regression analysis has been useful to examine the causal influence of one variable on another, such as, in this case, the effect of migration on respectively economic growth and income inequality. By examining the aforementioned regression notations, it can be argued that α0 and ß0 both display the regression model's constant (or intercept), which displays what your DV would be if the IV was zero. In both the equations, the main IV is the share of foreign-born population, which ranges from 15 to 64 years old, whereas α1 and ß1 indicate the regression coefficient, which denotes the slope of the line. An upward sloping linear regression has a positive regression coefficient, whereas a downward sloping regression line has a negative coefficient. Another parameter to take into account is the standard error, which is a measure of the extent of uncertainty associated with this α1 and ß1 number. The difference between every observation and the best-fitting line is the error. However, the equation error or residual term is denoted by the final element of the formula, the “e”. Both the regression equations which are shown in the image above refer to the main crude associations which are examined in this study. However, the aim of this research is to also adjust for confounding.

Therefore, multiple regression analyses have been conducted to further examine the relationship between the share of foreign-born population and the DVs.

Hypotheses

By analyzing research on the immigration effects to economic growth and income inequality, I had the possibility to reflect upon previous literature review to delineate two main research hypotheses. Considering that extensive research highlighted increasing national economic growth due to immigration effects (e.g. Bove & Elia, 2017; Brunow, Nijkamp & Poot, 2015), the first hypothesis examined in this study is the following:

- H1: The share of foreign-born population is associated with an increase of economic growth in Southern European countries

On the other hand, regarding income inequality, research has demonstrated opposing views about the immigration impacts on income inequality (DiPasquale, 2021). However, considering that research argued in favor of limited or relative Card (2009) immigration impacts on income disparities (e.g. Card, 2009), the second hypothesis examined in this study is the following:

- H2: The share of foreign-born population is associated with a decrease income inequality in Southern European countries

Despite the two main hypotheses that have delineated in this research, the aim of this paper is to also provide more in-depth information on the two premises by also examining the different effects of foreign-born's skill composition on the two DVs.

Indicators

The analysis of previously collected empirical data which is highlighted in the literature review has been useful to delineate which possible confounding factors have an impact on both economic growth and income inequality aside from immigration. Particularly, this thesis will focus on conducting Multiple Linear Regression in RStudio analysis between relevant socio-economic variables (predictors or IVs and the DVs (economic growth and income inequality, which will be examined separately). More specifically, the empirical data and the quantitative study will focus on the Southern European area, taking into consideration four countries: Portugal, Spain, Greece, and Italy. Therefore, Multiple Linear Regression will be conducted to examine the impacts of socio-economic indicators regarding immigration on economic growth and income inequality among the four selected countries on a regional level. To have a more comprehensive understanding of the indicators which will be analyzed in conducting this research, Table 1 below shows the different indicators which are taken into account.

Table 1 - Description of variables

Conceptual variable	Type of variable	OECD databases	OECD indicators	Indicators description	Coverage	References
Foreign-born population	IV	Database on Migrants in OECD Regions	Share of 15-64 year olds population by origin, in % of total (native plus foreign), 15-64 age population, all individuals	"The foreign-born population covers all people who have ever migrated from their country of birth to their current country of residence.This indicator is measured as a percentage of population. This specific OECD indicator takes into account the foreign-born population which ranges from 15 to 64 years old (OECD, 2022a)".	2011	OECD (2022a), Foreign-born population (indicator). doi: 10.1787/5a368e1b-en (Accessed on 17 March 2022) OECD. (2022). Database on Migrants in OECD Regions. OECD. (2022b) Retrieved March 17, 2022, from https://stats.oecd.org/Index.aspx?DataSetCode=REGION_MIGRANTS#
GDP growth per capita	DV1	Regional Economy	Regional GDP	"Regional GDP is measured according to the definitions of the 1993 System of National Accounts. GDP per capita is calculated by dividing the GDP of a country or region by the population (number of inhabitants) living there (OECD, 2016a)".	2011-2019	OECD. (2016a). Regional Well-Being : Regional income distribution and poverty. Retrieved March 17, 2022, from https://stats.oecd.org/index.aspx?queryid=58616
Gini Index	DV2	Regional income distribution and poverty	Gini index (at disposable income after taxes, and transfers)	"The Gini index for disposable income is based on the comparison of cumulative proportions of the population against cumulative proportions of disposable income they receive, and it ranges between 0 in the case of perfect equality and 1 in the case of perfect inequality (OECD, 2016b)".	2013	OECD. (2016b). Regional Well-Being : Regional income distribution and poverty. Retrieved March 17, 2022, from https://stats.oecd.org/index.aspx?queryid=58616
Unemployment rate	CV	Regional Labour	Unemployed Rate (% unemployed over labour force 15-64)	"The unemployed are people of working age who are without work, are available for work, and have taken specific steps to find work. This indicator is measured in numbers of unemployed people as a percentage of the labour force and it is seasonally adjusted. Data are based on labour force surveys (LFS)",	2011	OECD (2013), "GDP by region", in OECD Factbook 2013: Economic, Environmental and Social Statistics, OECD Publishing, Paris, https://doi.org/10.1787/factbook-2013-12-en. OECD. (2020). Regional Economy. Retrieved March 17, 2022, from https://stats.oecd.org/Index.aspx?DataSetCode=REGION_ECONOM

Tertiary education	CV	Regional Innovation	Share of Labour Force with Tertiary Education (ISCED 5-8)	"Educational attainment of the active population aged 15 years old or more: Number of persons with tertiary education". Educational attainments are internationally standardised through the ISCED 2011. Particularly, ISCED5-8 refers to "; 5 - medium-cycle higher education; 6 - bachelor; 7 - phd-degree (OECD "	2011	OECD. (2020, March). *Regional Innovation*. OECD.Stat. Retrieved May 22, 2022, from https://stats.oecd.org/Index.aspx?DataSetCode=REGION_INNOVATION
Life expectancy	CV	Regional Demography	Life expectancy at birth	"Life expectancy at birth is defined as how long, on average, a newborn can expect to live, if current death rates do not change. Gains in life expectancy at birth can be attributed to a number of factors, including rising living standards, improved lifestyle and better education, as well as greater access to quality health services (OECD, 2022c)".	2011	OECD. (2022c, June). *Regional Demography*. OECD.Stat. Retrieved May 22, 2022, from https://stats.oecd.org/Index.aspx?DataSetCode=REGION_DEMOGR
High-skilled migration	IV	Database on Migrants in OECD Regions : *Migrants - Education*	Share of 25-64 years old population with low education (ISCED 5-8), in % of 25-64 age population of the same origin	Tertiary education (ISCED 5-8) 5 - medium-cycle higher education; 6 - bachelor; 7 - phd-degree	2011	OECD. (2022d, March 10). *Database on Migrants in OECD Regions : Migrants - Education*. OECD.Stat. Retrieved May 23, 2022, from https://stats.oecd.org/index.aspx?queryid=111430
Medium-skilled migration	IV	Database on Migrants in OECD Regions : *Migrants - Education*	Share of 25-64 years old population with medium education (ISCED 3-4), in % of 25-64 age population of the same origin	Secondary Level (ISCED 3-4) 3 - vocational upper secondary school; 4 - short-cycle higher education;	2011	OECD. (2022d, March 10). *Database on Migrants in OECD Regions : Migrants - Education*. OECD.Stat. Retrieved May 23, 2022, from https://stats.oecd.org/index.aspx?queryid=111430
Low-skilled migration	IV	Database on Migrants in OECD Regions : *Migrants - Education*	Share of 25-64 years old population with high education (ISCED 0-2), in % of 25-64 age population of the same origin	Elementary Level (ISCED 0-2) 1 - basic school 8-10 grade; 2 - general upper secondary school	2011	OECD. (2022d, March 10). *Database on Migrants in OECD Regions : Migrants - Education*. OECD.Stat. Retrieved May 23, 2022, from https://stats.oecd.org/index.aspx?queryid=111430

As it can be observed in Table 1, the first dependent variable (DV1) examined in this study is GDP growth per capita, which was calculated by subtracting the logarithm of GDP per capita in 2019 from the logarithm of GDP per capita in 2011 in light of the study's goal of examining the effects of immigration on regional economic growth over an eight-year period (2011-2019). The second dependent variable (DV2) in analysis is the Gini index (at disposable income after taxes, and transfers) which has been retrieved in the OECD(2016b) dataset. The Gini index has been a useful indicator to examine income inequality since it is a summary statistic that determines how evenly a resource is distributed throughout a population. Particularly, The Gini index for disposable income is calculated by comparing the cumulative proportion of the population to the cumulative proportions of disposable income they get, and it goes from 0 to 1 in the event of perfect equality and perfect inequality, respectively (OECD, 2016b). On the other hand, the main Independent variable (IV) in this study is the share of foreign-born population (15-64 years old population) which has been retrieved in OECD (2022a) database. Other IVs are examined in this study to investigate the effects of immigrants' skill composition on regional economic growth and income inequality. Therefore, the share of 25-64 years old population with low (ISCED 0-2), medium (ISCED 3-4) and high (ISCED 5-8) education have been retrieved by OECD(2022d) dataset in order to show the effects of immigrants' varying educational attainment on both the DVs.

As it can be observed in Table 1, the regression models are also adjusted for confounders in the regression analyses by including control variables (CVs) in the multiple regression models. Particularly, Unemployed Rate (% unemployed over labour force 15-64) has retrieved by OECD(2020) database considering that the association between unemployment rate, the share of foreign-born population and economic growth has been examined in previous studies (e.g.

Bencivenga & Smith, 1997), as well as the association between economic growth, unemployment rate and income inequality (e.g. Pal et al., 2022). The CV "Share of Labour Force with Tertiary Education (ISCED 5-8)" has also been been integrated in the analysis to prevent confounding, given that research has shown that improvements in education first raise and then decrease growth as well as income disparity, when assessed by the Gini coefficient (e.g. Rehme, 2007). Another CV in analysis is life expectancy at birth considering that previous empirical studies examined the causal effects of life expectancy on economic growth (e.g. Cervellati & Sunde, 2011), as well as a more in-depth association between income inequality, poverty and life expectancy (e.g. Regidor et al., 2003). However, it is also important to notice that some of the regression models have been computed by also integrating the logarithm of GDP per capita in 2011 to examine the convergence hypothesis. Particularly, the convergence hypothesis states that, given enough time, all countries' inflation-adjusted per-capita incomes will reach equality. This is theorized based on the finding that low-income countries' per-capita incomes rise faster than high-income countries', because a developing country's acquisition of industrialization allows it to take advantage of labor cost imbalances, increasing demand for labor as the country grows wealth through exports. However, when that country's sectors evolve, the pace of pay growth slows to a near steady-state, reducing the comparative benefit of that nation's wage disparity with other industrialized nations (Cady, 2007).

Data description

There are 58 observations in the sample utilized in the regression analysis between the proportion of foreign-born population and regional economic development. These findings come from four different countries: Portugal, Greece, Spain, and Italy. When control variables are included in the analysis, the number of observations drops to 51. The sample utilized in the

regression study between foreign-born skill composition and regional economic growth consists of 47 observations, with 9 NA values in each of the three regression studies done on the varied skill composition of migrants. The regression study of the percentage of foreign-born population and regional income inequality, on the other hand, employed a sample of 37 observations for the crude association and 35 for the adjusted for confounders regression models. However, 35 observations were also found in the sample utilized in the regression analysis between the proportion of foreign-born skill composition and regional income disparity across the three regression models that were run.

Table 2 provides a summary of the descriptive statistics of the IVs, DVs and CVs variables implemented in the regression models.

Table 2: Descriptive Statistics of all Variables

Variables	N	Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
Foreign-born population	58	3.11	6.11	10.86	11.39	14.67	26.99
GDP growth per capita	58	-0.19	-0.02	-0.01	0.026	0.091	0.23
Gini Index	36	0.25	0.29	0.31	0.31	0.33	0.37
Unemployment rate	52	9.13	11.82	16.47	21.39	32.61	37.89
Tertiary education	58	7770.00	57600.00	138600.00	267553.00	310200.00	1549300.0
Life expectancy	58	80.60	82.10	82.40	82.45	82.90	84.20
High-skilled migration	49	6.60	11.50	14.30	16.62	22.52	32.73
Medium-skilled migration	49	24.30	33.10	36.90	37.24	39.80	53.15
Low-skilled	49	31.43	38.54	45.60	46.14	52.40	61.80

migration							
Log GDP per capita	58	9.94	10.25	10.36	10.44	10.66	10.97

Regarding the DV1, GDP growth per capita displays a moderate deviation considering that the minimum is -0.19 and maximum is 0.23, while for DV2, the Gini Index the deviation is rather relative given a minimum equal to 0.25 and a maximum of 0.37. When looking at the main IVs, the share of foreign-born population and the three different migration skilled compositions show a high deviation by examining the gap between the minimum and maximum across these indicators.However, the only variable which barely displayed deviation is "Log GDP per capita".

Detect Multicollinearity in OLS regression models

In a regression analysis, collinearity refers to the non-independence of IVs. It is a frequent component of every descriptive data collection, and it can make parameter estimation difficult since it expands the variance of regression coefficients, potentially leading to incorrect identification of key predictors in a regression model. Multicollinearity is discovered when the pairwise correlation coefficient (r) reaches a threshold above 0.7. However a moderate multicollinearity can also be identified within a threshold between 0.5-0.7 (absolute values) (Dormann et al., 2013). To investigate multicollinearity, four correlation matrices (Appendix 1) were used to explore the probability of multicollinearity among the IVs in each of the 16 regression models studied in this work. Therefore, the four correlation matrices respectively investigated multicollinearity among the IVs of the results displayed in Table 11, Table 12, Table 13, and Table 14. Considering that none of the pairwise correlation coefficients are over 0.7, it is important to note that significant multicollinearity has not been observed. However, the four

shown correlation matrices, on the other hand, show moderate multicollinearity amongst some of the IVs in analysis.

Detect heteroskedasticity in OLS regression models

Heteroscedasticity in regression analysis refers to the uneven spread of residuals terms. It refers to the situation when the distribution of the error terms changes in a systematic way throughout the range of observed values. Heteroskedasticity is a breach of the criteria for OLS regression analysis, and as a result, it can affect the validity of econometric research (Astivia & Zumbo, 2019). Particularly, this study performed the Breusch–Pagan test to detect the presence of heteroskedasticity across the OLS regression models. The Breusch–Pagan test (Breusch & Pagan, 1979) is the earliest and arguably most well-known test, which examines whether model errors are linked to any of the model predictors. Given the findings of the Breush-Pagan tests (Appendix) about the 16 regression models in analysis, it can be concluded that heteroskedasticity was present in Model 1, Model 6, and Model 8 given that the p-value is lower than 0.05 across the aforementioned Models. Therefore, heteroskedasticity has not been detected among Table 13 and Table 14 in the study.

Robust standard errors to fix heteroskedasticity

If the results obtained in Tables 11 and Table 12 are reviewed without adjusting for heteroskedasticity, the estimates would not be the most accurate linear estimates in this scenario since their variances are not necessarily the lowest. In addition, the standard errors would be biased and untrustworthy (Astivia & Zumbo, 2019). An approach to fix heteroskedasticity in Table 11 and Table 12 is heteroskedastic-consistent standard errors (Eicker, 1967; White, 1980),

also known as robust standard errors, which acknowledge the presence of non-constant variance and provide an alternative method for estimating the variability of sample linear regression. Therefore, the linear regression Model 1, and multiple linear regression Model 6, and Model 8 have been performed using robust standard errors, which are more "resistant" to the issue of heteroscedasticity and offer a more accurate estimation of a predictor coefficient's real standard error (Astivia & Zumbo, 2019).

RESULTS

The influence of the proportion of foreign-born population and their skilled-composition level on regional economic growth and income disparities in Southern European nations is examined in further detail in the four tables below. Tables 11 and 13 show the relationship between the proportion of foreign-born population and economic growth, and the relationship between the proportion of foreign-born population and the Gini Index (calculated after taxes and transfers) respectively. Tables 12 and 14, on the other hand, indicate respectively the relationship between the skill composition of the foreign-born population and regional economic growth, and the association between foreign-born skilled composition and the Gini Index (measured after taxes and transfers). Tables 12 and 14 provide three regression models in which the share of high-, medium, and low-skilled foreign-born population to a region’s total foreign-born population are studied in relation to the DVs. It is vital to note that the four tables are intended to show multiple regression analyses by evaluating the function of confounders in these regression models in greater depth. As a result, among the supplied data, the effect of IVs (unemployment rate, tertiary education, life expectancy, and the log of GDP per capita) in regression models is displayed to further explore the two hypotheses.

Linear regression: regional economic growth and the share of foreign-born population

Based on the findings in Table 11, it is reasonable to conclude that the foreign-born population is connected with regional economic growth in four regression models since Model 4 does not show significance in this relationship. However, it can be argued that Model 1, Model 2, Model 3, and Model 5 display a positive and significant relationship between the main IV and the DV. It can also be observed that the IV remains positive and significant at the 5% level when unemployment is introduced as a control (as can be seen in Model 2 of Table 11). In Model 3, however, the proportion of foreign-born persons in a region's population appears to be linked to regional economic growth, although only with a significance at the 10% level. Given these findings, when life expectancy is included in the regression analysis, it is important to evaluate the results obtained in Model 4. Particularly, the share of foreign-born population is no longer associated with the DV, while the unemployment rate is shown to be significantly and positively associated with economic growth with a significance at the 10% level. When the control variable "Log GDP per capita" is included in the regression analysis, the link between the DV and IV values is significant and positive again in Model 5. As a consequence, Table 11 provides considerable evidence in support of the study's first hypothesis, demonstrating that the proportion of foreign-born people has a positive and significant influence in four regression models. It is crucial to note, however, that Model 4 lacks significance, which is an important feature to consider as a limitation to the findings of this study.

Table 11. *(DV1: Economic growth per capita from 2011 to 2019) Focusing on Southern Europe*

	Model 1	*Model 2*	*Model 3*	*Model 4*	*Model 5*
Foreign-born population	0.005119900 **	0.005109000 **	0.004261000 *	0.004368000	0.005645000 *
	(0.001717400)	(0.001821000)	(0,001992000)	(0.002275000)	(0.002625000)
Unemployment rate		0.002107000	0.002042000	0.002123000	0.001452000
		(0.001056000)	(0,001068000)	(0.001130000)	(0.001323000)
Tertiary education			0.000000020	0.000000020	0.000000026
			(0,000000030)	(0.000000033)	(0.000000033)
Life expectancy				0.002652000	0.009083000
				(0.011110000)	(0.012920000)
Log GDP percapita (2011)					-0.061140000
					(0.062650000)
Intercept	-0.032254600	-0.077802000	-0.076290000	-0.292400000	-0.188400000
	(0.025803800)	(0.030447000)	(0.030740000)	(0.906200000)	(0.913000000)
R^2	0.123	0.233	0.240	0.241	0.257
R^2-adjusted	0.107	0.201	0.191	0.174	0.173
N. observations	58	51	51	51	51

Notes : Statistical significance is represented by one, two, and three asterisks at the 10%, 5%, and 1% levels, respectively. Standard errors are shown in parentheses below the regression coefficients. Robust standard errors are performed in Model 1. The data is retrieved by OECD (2020a), OECD (2020b), OECD (2022a), OECD (2022b), and OECD (2022c).

Linear regression: regional economic growth and foreign-born's skill composition

The findings of Table 12 display the relationship between regional economic growth and the different levels of migrants' skills. Particularly, Model 5 includes high-skilled migration, whereas Model 6 and Model 7 include medium- and low-skilled migration respectively. It is relevant to observe that high-skilled migration appears positive and significant at the 1% level with regional economic growth, whereas medium-skilled migration displays a significant at the 5% level with the DV. Additionally, it is relevant to observe that no variable that enters the model is found to have a significant effect on GDP per capita growth in Model 7. Therefore, low educational attainment does not seem to contribute to economic growth based on the results. It is

also relevant to observe that regional unemployment rate is the sole variable which appears to display positive significance in Model 8 considering that unemployment rate appears positive and significant at the 5% level with regional economic growth. As a conclusion, Table 12 shows that high-skilled and medium-skilled migration, in contrast to low-skilled migration, tend to be positively and significantly associated with regional economic growth.

Table 12. *(DV1: Economic growth per capita from 2011 to 2019) Focusing on Southern Europe*

	Model 6	*Model 7*	*Model 8*
High-skilled migration	0.006989500 ***		
	(0.001633400)		
Medium-skilled migration		-0.005032000 **	
		(0.001608000)	
Low-skilled migration			-0.000633150
			(0.001605100)
Unemployment rate	0.001060700	0.002277000	0.003589300 **
	(0.001152200)	(0.001159000)	(0.001092200)
Tertiary education	-0.000000030	0.000000005	0.000000016
	(0.000000002)	(0.000000030)	(0.000000022)
Life expectancy	0.010299000	0.010500000	0.007941100
	(0.013107000)	(0.011780000)	(0.016241000)
Log GDP percapita (2011)	-0.014066000	0.057780000	0.007969800
	(0.040204000)	(0.052310000)	(0.0534320000)
Intercept	-0.796080000	-1.290000000	-0.749860000
	(0.825880000)	(0.728800000)	(1.251900000)
R^2	0.499	0.397	0.255
R^2-adjusted	0.437	0.323	0.162
N. observations	47	47	47

Notes : Statistical significance is represented by one, two, and three asterisks at the 10%, 5%, and 1% levels, respectively. Standard errors are shown in parentheses below the regression coefficients. Robust standard errors are performed in Model 6 and 8. The data is retrieved by OECD (2020a), OECD (2020b), OECD (2022a), OECD (2022b), and OECD (2022c), OECD (2022d).

Linear regression: regional Gini Index and the share of foreign-born population

According to the findings in Table 13, the proportion of foreign-born people in Southern Europe does not appear to be correlated to the regional Gini Index (measured after taxes and transfers) in any of the five models studied. On the other hand, It can also be observed that the control variable regional tertiary education remains positive and significant at the 10% in Model 11 and Model 12. However, in Model 13, when the control variable "Log GDP per capita" is added in the analysis, tertiary education displays a positive significance at 5% level with the DV. Therefore, it can be argued an increase in tertiary education is associated with an increase in regional income inequality. However, life expectancy is another confounding variable that is significant in Model 12, as it displays a negative significance at the 1% level in connection to the Gini Index in the analysis. However, in Model13, it can be observed that life expectancy is negatively significantly associated with the DV. Therefore, it can be argued that an increase in life expectancy is associated with a decrease in regional income inequality. As a result, Table 8 does not provide significance to examine the second hypothesis of the study, which claims that the proportion of foreign-born people in the population is linked to a reduction in regional income disparity in Southern European nations.

Table 13. *(DV2: Gini Index after taxes in 2013) Focusing on Southern Europe*

	Model 1	*Model 2*	*Model 3*	*Model 4*
Foreign-born population	0.000251700	-0.000458100	-0.000902000	0.000972800
	(0.000828700)	(0.000790900)	(0.00077950)	(0.000800200)
Unemployment rate		0.000752400	0.000591800	-0.000215400
		(0.000422800)	(0.000408500)	(0.000421400)
Tertiary education			0.000000025 *	0.000000027 **
			(0.000000012)	(0.000000009)
Life expectancy				-0.011200000 *
				(0.005136000)
Log GDP percapita (2011)				-0.040170000
				(0.021250000)
Intercept	0.306	0.302	0.303	1.638
	(0.011)	(0.012)	(0.011)	(0.352)
R^2	0.003	0.090	0.205	0.526
R^2-adjusted	-0.027	0.0332	0.129	0.442
N. observations	37	35	35	35

Notes : Statistical significance is represented by one, two, and three asterisks at the 10%, 5%, and 1% levels, respectively. Standard errors are shown in parentheses below the regression coefficients.
The data is retrieved by OECD (2016), OECD (2020a), OECD (2020c), OECD (2022a), and OECD (2022d)

Linear regression: regional Gini Index and foreign-born's skill composition

Based on the findings in Table 14, all the different levels of skilled migrations compositions appear to not be statistically significant with the Gini Index (measured after taxes and transfers), except for low-skilled migration which is negatively associated with DV2 at the 10% . It can also be observed that the control variable regional life expectancy remains positive and significant at the 10% level in the three regression models reported. Additionally, tertiary education also remains positively and significantly associated at the 5% level with the DV in Model 15 and Model16. Another control variable which shows a positive significance with the Gini Index in Model 16 is "Log GDP per capita", which displays positive significance at the

10% level. As a result, Table 9 does not provide any evidence to examine the relationship between foreign-born's skill composition and income inequality within the context of Southern Europe.

Table 14. *(DV2: Gini Index after taxes in 2013) Focusing on Southern Europe*

	Model 14	*Model 15*	*Model 16*
High-skilled migration	0.001361000		
	(0.000894700)		
Medium-skilled migration		0.000979800	
		(0.000564100)	
Low-skilled migration			-0.001091000 *
			(0.000456300)
Unemployment rate	-0.000558500	0.000392100	-0.000058770
	(0.000535400)	(0.000401200)	(0.000033920)
Tertiary education	0.000000021	0.000000031 **	0.000000025 **
	(0.000000011)	(0.000000009)	(0.000000009)
Life expectancy	-0.0124100000 *	-0.010480000 *	-0.0121000000 *
	(0.005194000)	(0.004966000)	(0.004816000)
Log GDP percapita (2011)	-0.035620000	-0.039370000	-0.045420000 *
	(0.019500000)	(0.019700000)	(0.019280000)
Intercept	1.690000000	1.533000000	1.828000000
	(0.350000000)	(0.316000000)	(0.368000000)
R^2	0.539	0.550	0.586
R^2-adjusted	0.457	0.469	0.512
N.observations	35	35	35

Notes : Statistical significance is represented by one, two, and three asterisks at the 10%, 5%, and 1% levels, respectively. Standard errors are shown in parentheses below the regression coefficients. The data is retrieved by OECD (2016), OECD (2020a), OECD (2020b), OECD (2022a), OECD (2022c), and OECD (2022d)

DISCUSSION

The major goal of this research paper was to undertake a quantitative investigation on the impacts of immigration on regional economic growth and income inequality in Southern European nations. Given the substantial studies on the impacts of immigration on the economies of the US (e.g. Borjas, 1990) and Northern European nations (e.g. Card, 2009), this study chose to examine this relationship by concentrating on a geographical location that has received less attention. Extensive research discussed in literature review demonstrated the positive immigration impacts on the host countries' economy. For instance, research has demonstrated that the presence of more workers enhances GDP by increasing output, unless immigrants remain jobless or replace employees in the destination sector (Boubtane et al., 2016). Net inward mobility improves the efficiency of the host economy since there is extensive empirical evidence that migrants do not increase unemployment rates (e.g., Longhi et al., 2008) or completely displace native-born individuals (e.g., Cattaneo et al., 2013).

Considering that much research has been done on a national scale, this quantitative research examined a regional level regression of Portugal, Spain, Greece, and Italy by conducting OLS multiple regression analyses to look at the effects of the share of foreign-born population on GDP growth per capita to examine regional economic growth, and the immigration effects on the Gini Index (calculated after taxes and transfers) to investigate regional income inequality in Southern Europe. However, the literature study revealed a different perspective on the effects of immigration on both of the DVs under consideration. More findings supported a link between the share of foreign-born people in a population and regional economic growth (e.g. Brunow, Nijkamp & Poot, 2015; Boubtane et al., 2016). As a result, this study hypothesized that a larger proportion of foreign-born people in Southern Europe is linked to

higher GDP per capita. On the other hand, laying out the study's second hypothesis, which examines the influence of immigration on regional income disparities, has proven more difficult due to the large discrepancies in past empirical works (e.g. Brucker & Defoort, 2007; Zimmerman, 2008). However, the secondary hypothesis offered in this study is consistent with Zimmerman's findings, which explicitly analyze data from OECD nations and claim that the degree of immigration has a negative association with income inequality.

Given the findings of the Capstone project, it can be argued that more reflection on previous empirical papers can be tailored on regional economic growth considering that this research found more observations and significance on the immigration effects on GDP growth per capita rather than on the Gini Index in analysis. Given that several studies have connected a rise in national economic growth, and in some cases, regional economic growth (e.g. Ortega & Peri, 2014; Felbermayr et al., 2010) to the proportion of foreign-born people, the first hypothesis proposed in our study argued in favor of this relationship. Particularly, research focusing on OECD countries, revealed that a 50% rise in net migration of foreign-born people results in a "three-tenths of a percentage-point" rise in annual productivity growth (Boubtane et al., 2016). It might be claimed that there is some evidence in support of this premise based on the findings in Table 11. Model 1, Model 2, Model 3, and Model 4 provide substantial evidence in support of the study's first hypothesis, demonstrating that the proportion of foreign-born people is positively and significantly associated with regional economic growth, despite the fact that no positive and significant regression analysis was found for the regression Model 4 in Table 11. As a result, the findings of Table 11 do not fully support the hypothesis that an increase in the share of foreign-born population is associated with an increase in GDP per capita across Southern

European countries; however, the majority of regression models in Table 11 still show evidence of this association.

Considering the findings obtained in Table 12, the association between immigrants' skill composition and regional economic growth is supported by the empirical evidence. According to the empirical findings discussed in the literature review, a one-percentage-point increasing share of high-skilled immigrants increases the regional economic growth rate by 0.03 percentage points (Huber et al., 2010). Similar findings have been delineated by Boubtane et al. (2016), who argued that increasing continuous migration of foreign-born employees by one percentage point would boost "productivity growth by one to six tenths of a percentage point per year" in most OECD countries, when foreign-born employees who pursued tertiary education were taken into account (Boubtane et al., 2016, p.p. 17-18). Reflecting upon the findings of this study, Table 12 shows that both high- and medium-skilled migrants contribute to regional economic growth, with high-skilled and medium-skilled compositions being positively and substantially linked with regional economic growth at the 1% and 5% levels, respectively. As predicted, high-skilled migrants appear to be more significantly associated with an increase in GDP per capita than medium-skilled migrants. The difference in significance between high- and medium-skilled migrants is in line with previous research considering that migrants with a medium skill set can also promote economic growth by innovating. However, it has been suggested that this type of immigrants will make a smaller contribution than highly qualified immigrants (Huber et al., 2010).

On the other hand, Table 12 did not display any direct effects of low-skilled migration on regional economic growth. Considering that low-skilled workers are frequently seen to be the ones who have a detrimental impact on the host country's economy since they need to be

supported, taught, and absorbed into a new labor market (Șerban et al., 2020), it was expected that low-skilled migration could be significantly and negatively associated with the dependent variable. However, no evidence has been supported in this study in regards to the negative association between GDP growth per capita and low-skilled migration in Southern Europe. The findings might also not display a significant and negative association with the dependent variable considering that low-skilled migration might have a different impact between Northern and Southern European countries. In contrast to Northern and Central European nations, which strive to recruit highly competent immigrants while avoiding or reducing non-qualified migration, Southern European nations have implicitly banked on low skilled migrants to keep down productive sectors of the economy (González-Enríquez & Triandafyllidou, 2009). Thousands of businesses, whether in agriculture, catering, or trade that were initially based on rigorous domestic duties or the looking to hire low-skilled laborers, would have vanished as the rate of education and labor possibilities for local new generations improved, leading them out of these industries, whereas employers encountered immigration to be the sole source of working population (González-Enríquez & Triandafyllidou, 2009). Based on the findings in Table 12, the various demands that low-skilled migrants meet across Southern European countries may explain why low-skilled migration has not been found to be significantly and negatively connected with regional economic growth.

Reflecting upon the findings of Table 13, the relationship between the share of floreign-born population and regional income inequality has been outlined. As it can be observed in the literature review of this study, there are opposing findings which have been reported in regards to this association. Some empirical evidence is founded on the theoretical assumption that immigration is an adaptation mechanism that allows for labor mobility and, as a

consequence, can help to achieve a capital-labor ratio equilibrium, hence increasing labor productivity and regional income per capita (Fratesi et al., 2007). Borjas (1987), on the other hand, suggested that a receiving nation with a higher skill interest rate than an origin country is more likely to recruit talented workers, suggesting that economic disparity in a destination country must be positively related with a larger ratio of skilled migrants. However, the findings of this study are not in line with empirical evidence due to the fact that no association has been found between the share of foreign'born population and regional income inequality. On the other hand, Table 14 displayed a negative association between low-skilled migrants and income inequality.. Therefore, the outcomes are similar to Zimmerman (2008)'s findings, which suggested that migration has an influence on economic inequality because it changes the quality of the labor force. Inflows of foreign-born persons with a higher average skill set than the recipient country diminish inequality, but low-skilled immigration has the opposite impact (Zimmerman, 2008).

Policy recommendations

As it has been argued by OECD(2022) report, migrants made up 14 percent of essential employees on average across European regions, and approximately 20% in capital cities. Regions can profit from migration not just as an essential supply of labor, particularly in important areas where there are substantial shortages, but also in a variety of other ways. A 10% increase in migrant share is connected with a 0.15 percent rise in regional GDP per capita. Overall, the beneficial impact of immigration on per capita income levels is more than twice as strong for the lowest 25% of a country's regions (OECD, 2022). While migration can bring significant economic advantages to an area, such gains are not always distributed evenly over

geography and among different skilled workers. In comparison to regions with lesser levels of education, countries with more highly educated migrants see higher growth in international trading. In the labor market, an increase in labor supply owing to migration might have a short-term impact on natives' employment. Between 2010 and 2019, native employment ratios in European areas declined due to increased labor force due to immigration, particularly for low-educated individuals in lower-income regions (OECD, 2022). This impact, however, fades over time as provincial labor markets adjust. Regions characterized by higher GDP per capita integrate new employees more quickly, leading to limited or no impact on the native workforce, particularly those with higher education. Targeted policies might assist to fully realize migration's potential. To guarantee that all regions and groups benefit from migration, authorities should attempt to reduce any short-term negative labor market impacts on non-university educated people and economically disadvantaged areas. Policies that provide fair compensation and adequate working conditions can help areas recruit migrants, which is especially important in diminishing regions where crucial services are needed. Migrant integration in labor markets would likewise benefit from such measures, as would their protection against economic and health hurdles (OECD, 2022).

CONCLUSION

Immigration is an adaptive capacity system that allows for labor mobility and therefore can achieve a steady capital-labor ratio, rising labor productivity and regional average income (Fratesi et al., 2007), as well as making a contribution to destination country performance and having a major effect on economic growth (Fratesi et al., 2007). It is important to note, however, that different research has come to different results and prompted different debates on the impact

of immigration on economic growth and income gaps. Extensive study has demonstrated a greater consensus on the benefits of immigration to national economic growth (Brunow, Nijkamp & Poot, 2015). Although most authors report convergence at the national level, differences in income per capita are assumed to remain at the regional level (Boubtane et al., 2016). For this reason, this study looked at the impact of the percentage of foreign-born population on both economic growth and income disparity on a regional scale in Southern European to analyze a geographical area which has not been widely researched on this topic. The study used RStudio and the OECD.Stat Database to examine the impacts of the percentage of foreign-born population on regional economic growth over an eight-year period (2011-2019) using multiple regression analyses and the Gini Index per capita, which is a summary statistic that helps determine how equally a resource is dispersed throughout a population. Furthermore, by studying the impacts of the foreign-born skills mix on economic growth and income disparity, a more thorough examination of the effects of immigration on both regional economic growth and income inequality has been presented. Particularly, this research aimed to answer the following research question: "What are the immigration effects on economic growth and income inequality among Southern European countries?". Considering that more research has argued in favor of the positive and significant association between the share of foreign-born population and regional economic growth, the first hypothesis of this research supported this premise. The results obtained in the regression analyses displayed some evidence in regard to the association, but the first hypothesis has not been proven across all the regression models in Table 11. The positive and significant association has also been reported considering that a rise in the proportion of foreign-born people in a country's population is linked to an increase in GDP per capita; the same association has also been observed across the ratio of high- and medium-skilled migrants in

relation to regional economic growth. On the other hand, the findings of this paper did not report any significant association between the share of foreign-born population, including across different skilled migrants, and regional income disparities in Southern Europe. Therefore, the findings of this research contrast previous empirical research which either stated the immigration is positively or negatively associated with regional income inequality.

Considering some limitations to this study, it can be argued that there is still a general lack of evidence on the effects of high-skilled immigration on receiving countries, and that the available literature is impacted by data and methodological issues that make it difficult to identify these effects. This absence of research is considerably more pronounced in the EU than in the United States. Therefore, most of the literature is highly debatable (OECD, 2008).

Furthermore, due to the small size of the predicted income effect, the possibility for employing development cooperation as a migration policy instrument is restricted. Particularly, considering that the regression models which have been conducted in Table 13 and Table 14 are not extensive (the sample size is between 37 and 35 observations depending on the regression model investigated). Furthermore, the findings outlined to examine the effects of immigration on regional income inequality cannot provide a reliable source of information for Southern Europe due to missing data on the Gini Index in regards to Portugal and a limited amount of observation tailored to Greece on the same Indicator. The findings are more customized to Italy and Spain since, unlike Portugal and Greece, the majority of these two nations' regions were reportedly in the OECD(2016) database.

An expansion of our empirical model in this approach would allow for a more detailed understanding of the regional mechanisms that cause GDP growth effects. The identification of the factors that cause the share of foreign-born population to have a beneficial impact on the

GDP per capita in Southern European regions might have important policy implications for strategic regional strategies (Di Berardino et al., 2021). Additionally, future research should also aim to investigate the economic impacts on the source country, despite only focusing on the immigration effects on the host country in order to effectively improve the working conditions of both immigrants and natives.

REFERENCES

Acostamadiedo, E., Sohst, R. R., Tjaden, J. D., Groenewold, G., & de Valk, H. (2020). *Assessing Immigration Scenarios for the European Union in 2030: Relevant, Realistic and Reliable?*. International Organization for Migration.

Andersen, T. B., & Dalgaard, C. J. (2011). Flows of people, flows of ideas, and the inequality of nations. *Journal of Economic Growth*, *16*(1), 1-32.

Astivia, O. L. O., & Zumbo, B. D. (2019). Heteroskedasticity in Multiple Regression Analysis: What it is, How to Detect it and How to Solve it with Applications in R and SPSS. *Practical Assessment, Research, and Evaluation*, *24*(1), 1.

Baycan-Levent, T., & Nijkamp, P. (2009). Characteristics of migrant entrepreneurship in Europe. Entrepreneurship and regional development, 21(4), 375-397.

Bencivenga, V. R., & Smith, B. D. (1997). Unemployment, migration, and growth. *Journal of political Economy*, *105*(3), 582-608.

Blau, F. D., & Kahn, L. M. (2012, November). Female labor supply: Why is the US falling behind. In *AEA meetings, November*.

Borjas, G. J. (1987). *Self-selection and the earnings of immigrants* (No. w2248). National Bureau of Economic Research.

Borjas, G. J. (1990). *Friends or strangers: The impact of immigrants on the US economy*. Basic Books.

Borjas, G. J., & Katz, L. F. (2005). The evolution of the Mexican-born workforce in the United States (Working Paper No. 11281). *Recuperado de http://www.nber.org/papers/w11281*.

Boubtane, E., Dumont, J. C., & Rault, C. (2016). Immigration and economic growth in the OECD countries 1986–2006. Oxford Economic Papers, 68(2), 340-360.

Breusch, T. S., & Pagan, A. R. (1979). A simple test for heteroscedasticity and random coefficient variation. *Econometrica: Journal of the econometric society*, 1287-1294.

Brunow, S., Nijkamp, P., & Poot, J. (2015). The impact of international migration on economic growth in the global economy. In Handbook of the economics of international migration (Vol. 1, pp. 1027-1075). North-Holland.

Brücker, H., & Defoort, C. (2009). Inequality and the self‐selection of international migrants: theory and new evidence. *International journal of manpower*.

Cady, R. K. (2007). The convergence hypothesis. *Headache: The Journal of Head and Face Pain*, *47*, S44-S51.

Card, D. (2009). Immigration and inequality. *American Economic Review*, *99*(2), 1-21.

Castellacci, F., & Natera, J. M. (2013). The dynamics of national innovation systems: A panel cointegration analysis of the coevolution between innovative capability and absorptive capacity. *Research Policy*, *42*(3), 579-594.

Cattaneo, O., Gereffi, G., Miroudot, S., & Taglioni, D. (2013). Joining, upgrading and being competitive in global value chains: a strategic framework. *World Bank Policy Research Working Paper*, (6406).

Cervellati, M., & Sunde, U. (2011). Life expectancy and economic growth: the role of the demographic transition. *Journal of economic growth*, *16*(2), 99-133.

Charron, N., Lapuente, V., & Dijkstra, L. (2012). Regional governance matters: A study on regional variation in quality of government within the EU. *Regional Studies*, *48*(1), 68-90.

Chiswick, B., & Hatton, T. J. (2003). International migration and the integration of labor markets. In *Globalization in historical perspective* (pp. 65-120). University of Chicago Press.

Di Berardino, C., D'Ingiullo, D., Furia, D., & Cartone, A. (2021). Immigration diversity and regional economic growth. Economia Politica, 38(3), 863-886.

Dormann, C. F., Elith, J., Bacher, S., Buchmann, C., Carl, G., Carré, G., ... & Lautenbach, S. (2013). Collinearity: a review of methods to deal with it and a simulation study evaluating their performance. *Ecography*, *36*(1), 27-46.

Dustmann, C., Frattini, T., & Preston, I. P. (2013). The effect of immigration along the distribution of wages. *Review of Economic Studies*, *80*(1), 145-173.

Dustmann, C., & Frattini, T. (2011). Immigration: the European experience. *Centro Studi Luca d'Agliano Development Studies Working Paper*, (326).

Ehrlich, I., & Kim, J. (2015). Immigration, human capital formation, and endogenous economic growth. *Journal of Human Capital*, *9*(4), 518-563.

Fassio, C., Montobbio, F., & Venturini, A. (2019). Skilled migration and innovation in European industries. *Research Policy*, *48*(3), 706-718.

Felbermayr, G. J., Hiller, S., & Sala, D. (2010). Does immigration boost per capita income?. *Economics Letters*, *107*(2), 177-179.

Fratesi, U., & Riggi, M. R. (2007, March). Does migration reduce regional disparities? The role of skill‐selective flows. In *Review of Urban & Regional Development Studies: Journal of the Applied Regional Science Conference* (Vol. 19, No. 1, pp. 78-102). Melbourne, Australia: Blackwell Publishing Asia.

González-Enríquez, C., & Triandafyllidou, A. (2009). Introduction: Comparing the new hosts of Southern Europe. Eur. J. Migration & L., 11, 109.

Huber, P., Landesmann, M., Robinson, C., Stehrer, R., Hierländer, R., Iara, A., ... & Peng, F. (2010). *Migration, skills and productivity*. Verein" Wiener Inst. für Internat. Wirtschaftsvergleiche"(WIIW).

Eicker, F. (1967). Limit theorems for regressions with unequal and dependent errors.

Etzo, I. (2008). Internal migration: a review of the literature.

Godfrey, L. G. (2006). Tests for regression models with heteroskedasticity of unknown form. *Computational Statistics & Data Analysis*, *50*(10), 2715-2733.

Hamilton, B. H., Nickerson, J. A., & Owan, H. (2003). Team incentives and worker heterogeneity: An empirical analysis of the impact of teams on productivity and participation. *Journal of political Economy*, *111*(3), 465-497.

IOM. (2020). *World Migration Report 2020*. IOM, UN Migration. Retrieved May 24, 2022, from https://worldmigrationreport.iom.int/2020

Kalleberg, A. L. (2011). *Good jobs, bad jobs: The rise of polarized and precarious employment systems in the United States, 1970s-2000s*. Russell Sage Foundation.

Kanbur, R., & Rapoport, H. (2005). Migration selectivity and the evolution of spatial inequality. *Journal of economic geography*, *5*(1), 43-57.

Koczan, Z., Peri, G., Pinat, M., & Rozhkov, D. L. (2021). The impact of international migration on inclusive growth: A review. *IMF Working Papers*, *2021*(088).

Longhi, S., P. Nijkamp, and J. Poot. (2005). A meta-analytic assessment of the effect of immigration on wages. In Meta-regression analysis: Issues of publication bias in

economics, ed. C.J. Roberts and T.D. Stanley, 157–82. London: Blackwell.n migrants more assimilated than native ones?. *Available at SSRN 1526069*.

McCann, P. (2013). *Modern urban and regional economics*. Oxford University Press.

Newbold, K. B. (2019). Short‐term relocation versus long‐term migration: Implications for economic growth and human capital change. *Population, Space and Place*, *25*(4), e2211.

OECD (2008), "The Global Competition for Talent: Mobility of the Highly Skilled", Organisation for Economic Cooperation and Development, Paris: OECD.

OECD. (2016). Regional Well-Being : Regional income distribution and poverty. Retrieved March 17, 2022, from https://stats.oecd.org/index.aspx?queryid=58616

OECD. (2020a). Regional Economy. Retrieved March 17, 2022, from https://stats.oecd.org/Index.aspx?DataSetCode=REGION_ECONOM

OECD. (2020b, March). *Regional Innovation*. OECD.Stat. Retrieved May 22, 2022, from https://stats.oecd.org/Index.aspx?DataSetCode=REGION_INNOVATIO

OECD. (2020c). Regional Economy. Retrieved March 17, 2022, from https://stats.oecd.org/Index.aspx?DataSetCode=REGION_ECONOM

OECD. (2022a, June). *Regional Demography*. OECD.Stat. Retrieved May 22, 2022, from https://stats.oecd.org/Index.aspx?DataSetCode=REGION_DEMOGR

OECD. (2022b, March 10). *Database on Migrants in OECD Regions : Migrants - Education*. OECD.Stat. Retrieved May 23, 2022, from https://stats.oecd.org/index.aspx?queryid=111430

OECD. (2022c, June). *Regional Demography*. OECD.Stat. Retrieved May 22, 2022, from https://stats.oecd.org/Index.aspx?DataSetCode=REGION_DEMOGR

Oliinyk, O., Bilan, Y., Mishchuk, H., Akimov, O., & Vasa, L. (2021). The impact of migration of highly skilled workers on the country's competitiveness and economic growth. *Montenegrin Journal of Economics*.

Pal, S., Villanthenkodath, M. A., Patel, G., & Mahalik, M. K. (2022). The impact of remittance inflows on economic growth, unemployment and income inequality: an international evidence. *International Journal of Economic Policy Studies*, *16*(1), 211-235.

Popescu, C. R. G., Popescu, G. N., & Popescu, V. A. A. (2017). Creating Comprehensive Human Resources Management Policies and Instruments by Using Strategic Personnel Planning-A Case Study on Romania's Situation: a Quantitative and Qualitative Analysis. *Manager*, (25), 133-146.

Rappaport, J. (2005). How does labor mobility affect income convergence?. *Journal of Economic Dynamics and Control*, *29*(3), 567-581.

Regidor, E., Calle, M. E., Navarro, P., & Domínguez, V. (2003). Trends in the association between average income, poverty and income inequality and life expectancy in Spain. *Social science & medicine*, *56*(5), 961-971.

Rodríguez-Pose, A. (2013). Do institutions matter for regional development?. *Regional studies*, *47*(7), 1034-1047.

Rovny, J. (2014). Multicollinearity and Heteroscedasticity.

Șerban, A. C., Aceleanu, M. I., Dospinescu, A. S., Țirca, D. M., & Novo-Corti, I. (2020). The impact of EU immigration on economic growth through the skill composition channel. *Technological and Economic Development of Economy*, *26*(2), 479-503.

Slettebak, M. H. (2021). Labour migration and increasing inequality in Norway. Acta Sociologica, 64(3), 314-330.

Sjaastad, L. A. (1962). The costs and returns of human migration. *Journal of political Economy*, *70*(5, Part 2), 80-93.

Stalker, P. (2002). Migration trends and migration policy in Europe. *International migration*, *40*(5), 151-179.

Telle K, Eika T, Halvorsen E, et al. (2017) Husholdningene. Økonomiske analyser 36(1): 86–99.

Trax, M., Brunow, S., & Suedekum, J. (2015). Cultural diversity and plant-level productivity. *Regional Science and Urban Economics*, *53*, 85-96.

White, H. (1980). A heteroskedasticity-consistent covariance matrix estimator and a direct test for heteroskedasticity. Econometrica: journal of the Econometric Society, 817-838.

Williams, A., & Baláž, V. (2014). *International migration and knowledge*. Routledge.

Zimmermann, K. F. (2005). European labour mobility: challenges and potentials. *De economist*, *153*(4), 425-450.

Appendix 1

Table 3: Correlation Matrix of Table 11

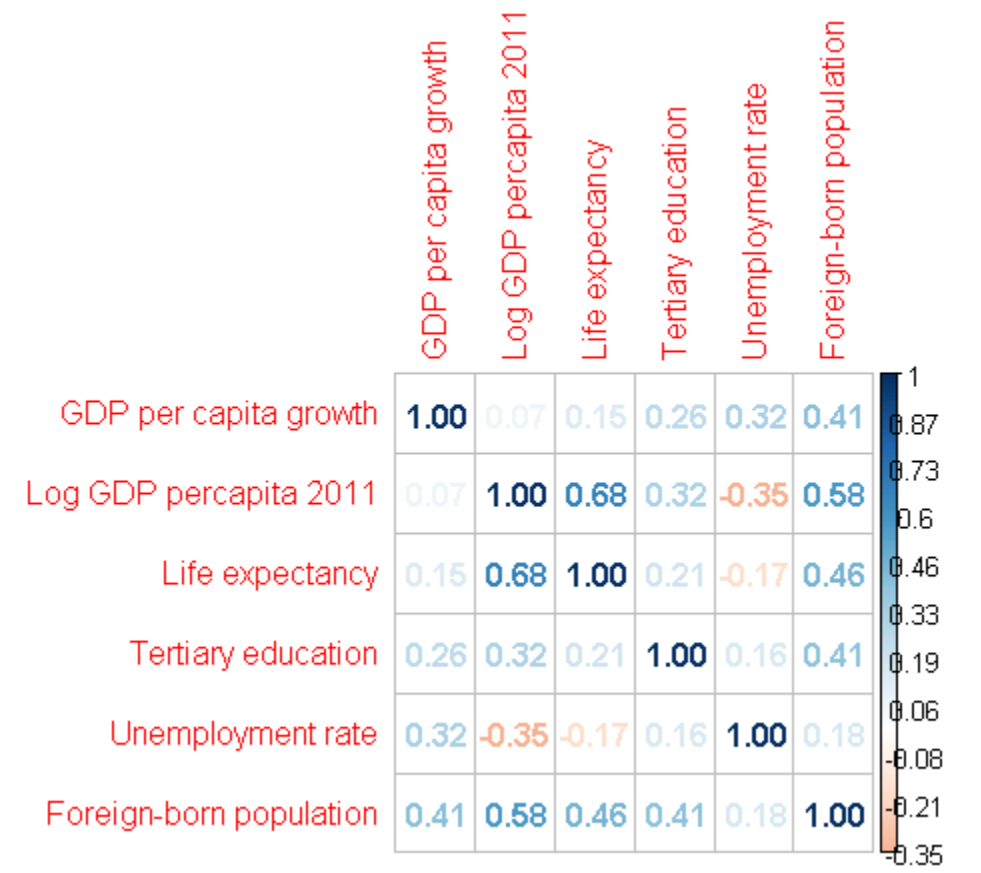

Table 4: Correlation Matrix of Table 12

Table 5: Correlation Matrix of Table 13

Table 6: Correlation Matrix of Table 14

Table 7: Breush-Pagan test of Table 10

```
        studentized Breusch-Pagan test

data:  Model_1
BP = 5.9809, df = 1, p-value = 0.01446


        studentized Breusch-Pagan test

data:  Model_2
BP = 3.8229, df = 2, p-value = 0.1479


        studentized Breusch-Pagan test

data:  Model_3
BP = 3.5637, df = 3, p-value = 0.3126


        studentized Breusch-Pagan test

data:  Model_4
BP = 7.3955, df = 4, p-value = 0.1164


        studentized Breusch-Pagan test

data:  Model_5
BP = 6.9666, df = 5, p-value = 0.2231
```

Table 8: Breush-Pagan test of Table 12

```
        studentized Breusch-Pagan test

data:  Model_6
BP = 13.354, df = 5, p-value = 0.02028


        studentized Breusch-Pagan test

data:  Model_7
BP = 9.594, df = 5, p-value = 0.08759


        studentized Breusch-Pagan test

data:  Model_8
BP = 18.752, df = 5, p-value = 0.002138
```

Table 9: Breush-Pagan test of Table 13

```
        studentized Breusch-Pagan test

data:  Model_9
BP = 0.39858, df = 1, p-value = 0.5278


        studentized Breusch-Pagan test

data:  Model_10
BP = 5.5683, df = 2, p-value = 0.06178


        studentized Breusch-Pagan test

data:  Model_11
BP = 4.9922, df = 3, p-value = 0.1724


        studentized Breusch-Pagan test

data:  Model_12
BP = 4.6734, df = 4, p-value = 0.3225


        studentized Breusch-Pagan test

data:  Model_13
BP = 7.8169, df = 5, p-value = 0.1666
```

Table 10: Breush-Pagan test of Table 14

```
        studentized Breusch-Pagan test

data:  Model_14
BP = 2.85, df = 5, p-value = 0.7231


        studentized Breusch-Pagan test

data:  Model_15
BP = 7.6179, df = 5, p-value = 0.1786


        studentized Breusch-Pagan test

data:  Model_16
BP = 6.2701, df = 5, p-value = 0.2808
```