universität wien

MAGISTERARBEIT

Titel der Magisterarbeit

„THE RELATIONSHIP BETWEEN IMMIGRATION AND UNEMPLOYMENT: THE CASE OF AUSTRIA"

Verfasst von

CIHAN YAYLALI, Bakk.rer.soc.oec

angestrebter akademischer Grad

Magister der Sozial- und Wirtschaftswissenschaften

(Mag.rer.soc.oec.)

Wien, 2014

Studienkennzahl lt. Studienblatt:	A 066 913
Studienrichtung lt. Studienblatt:	Magisterstudium Volkswirtschaftslehre
Betreuer:	Univ.-Prof. Dr. Robert M. Kunst

CONTENTS

I. LIST OF FIGURES

II. LIST OF TABLES

The Relationship Between Immigration and Unemployment: The Case of Austria.

Abstract

This paper examines empirically the relationship between immigration and the Austrian labor market variables, such as unemployment, real wage and per capita GDP by using the Johansen co-integration procedure, a vector error correction model (VECM), and Impulse Response Functions (IRFs), respectively. The estimation results reveal that there exist a statistical connection between immigration and unemployment in Austria using yearly data for the period 1975-2012. The findings of the Johansen procedure show that immigration has a significant and positive effect on unemployment in the long-run. The vector error correction model indicates that immigration influence positively unemployment in the short-run. Furthermore, the finding of impulse response functions shows that the impact of unemployment on immigration, and vice versa, is insignificant, whereas the impact of real wages on per capita GDP only seems to be positive and significant, but, this effect dies off shortly.

Key words: immigration; labor market dynamics; co-integration.

Kurzfassung

Die vorliegende Arbeit untersucht die Beziehung zwischen Migrationsströmen und Arbeitsmarktvariablen, wie Arbeitslosigkeit, Reallohn und Pro-Kopf-Einkommen unter Verwendung vom Johansen-Kointegration-Verfahren, eines Fehlerkorrekturmodells sowie von Impulse-Antwort-Funktionen (IRFs). Die Ergebnisse der ökonometrischen Schätzung zeigen, dass es eine statische Relation zwischen Migration und Arbeitslosigkeit für Österreich zwischen 1975-2012 gibt. Das Kointegrationsverfahren zeigt, dass Migration langfristig einen signifikanten und positiven Effekt auf die Arbeitslosigkeit hat. Das Fehlerkorrekturmodell indiziert, dass Migration kurzfristig spürbare und positive Effekte auf die Arbeitslosigkeit hat. Nach den Ergebnissen der Impulse-Antwort-Funktion, führt Arbeitslosigkeit zu steigender Migration. Dieser Effekt ist jedoch insignifikant. Die Auswirkungen der Reallöhne auf Pro-Kopf-Einkommen sind lediglich positiv und signifikant. Der Effekt ist jedoch kurzfristiger Natur und scheint langfristig zu verschwinden.

Schlagwörter: Migration; Arbeitsmarktdynamik; Kointegration.

"Human migration is a complex and comprehensive issue which has to be understood as a consequence of political, ideological, social and economic process (Mückler, 2004; p.42)".

1. INTRODUCTION

Migration has become in recent years a hotly debated issue especially in countries with high migration inflows. From the middle of the last century taking the international migration flows into account one can realize that immigration is a 'matter' of some industrialized Western European countries (e.g., Austria, France, Germany, and UK), some Asian countries (e.g., Australia, Japan) and North America (e.g., Canada and USA), that have attracted increasing numbers of migrants from all of the world, primarily from Africa and Latin America, marked as countries with negative net migration. In 2013, 232 million people - or roughly 3.4% of the world's population - are foreign-born, i.e. they reside in a country where they were not born. A majority of these international migrants, 71%, originated in the South[1]. These considerable migrant flows have consequently caused social, cultural and especially economic changes both for the sending and receiving countries[2] and have also caused to conduct different migration research in different scientific disciplines in order to deal with the general reasons, causes and impacts of immigration.

Austria is a traditional immigration country, marked by gradual migratory waves in consequence of economic factors such as a gap in the labor supplies due to economic booms in the 1960s and 1990s, the recession in the wake of the oil

[1] See: UN International Migration Report, 2013. Note that the term "North" refers to countries or regions traditionally classified for statistical purposes as "developed," while the term "South" refers to those classified as "developing." The developed regions include Europe and Northern America plus Australia, New Zealand and Japan.

[2] International migrants sent $529 billion in remittances back to their home Countries in 2012, according to the World Bank. The United States is the number one sender of international remittances, accounting for nearly a quarter of them (23.3%). India ranks at the top of all countries that receive remittances, with $69 billion on 2012. Moreover, about $4.9 billion in remittances were sent from Austria to other countries in 2012. Serbia ($1.9 billion), Germany ($782 million) and Czech Republic ($275 million) are the top three countries that receive remittances from Austria, respectively. Source: http://www.pewsocialtrends.org/2014/02/20/remittance-map/

crisis in 1974, and political factors such as the fall of the Iron Curtain in 1989, the war in Yugoslavia of the earlier 1990s (BIFFL, 2004). As the fraction of the migrants continuously increases, the role of immigrants and their contribution to the economy become a key issue in Austria as well. One of the main arguments for legally restricting immigration is the fear that immigrants will displace existing native workers or that immigrants are less skilled, have lower chances in finding jobs, and put pressure on the public purse. However, contrary to that, a range of empirical studies on the impact of immigration on the local labor markets for different countries either do not offer clear results or point to small effects of migration so that the economic outcome is difficult to determine a priori. Consequently, whether immigrants displace native workers or create jobs and therefore are responsible for unemployment of the natives depends crucially on the economic structure of a country such as size, openness, degree of labor market flexibility[3], degree of substitution between natives and immigrants, the size of the immigrant inflows and the strictness of immigration policy, and on relative abundance of natives in different skill, education, occupation and/or experience groups, and immigrant's role as producer in supply side and consumer in demand side (GROSS, 1999).

Briefly, it can be argued that human migration and its effects on the overall economy depend crucially on the viewpoint of the social sciences, on the assessment and interpretation of different techniques, methodologies and scientific theories. For this and some other reasons, this research paper adopts a data-driven rather than a theory-driven approach. We estimate an econometric model and we test for causal relationships among immigration, economic growth, wages and especially unemployment, with long-term and short-term distinction. We consider immigration effects on the Austrian labor market solely from the viewpoint of the host country's economy. Thus, the overall research question of this article is the following: Do changes in Austrian immigration rate cause changes in Austria's unemployment? Is there a positive relationship? If any, what are the short-run and long-run effects of immigration

[3] "(..) Research on [wage] for European countries is rare and especially focused on Germany and Austria. As it is common knowledge that wages in Europe are more rigid than in the USA, European studies more often look at (un)employment effects of immigration and less at wage effects, (OKKERSE, 2008)".

on the Austrian unemployment? Moreover, do increases in Austrian immigration rate cause a decrease in Austrian workers' wage?

The paper is organized as follows. The next section presents simple theoretical background of the impact of immigration and surveys the literature on the immigration impacts. In section III we describe Austrian immigration in detail especially from 1960 on. In section IV we present the data used and the descriptive analysis in order to illustrate our econometric time series model using several statistic models by testing the relationship between unemployment and immigration for the Austrian case. We finish with a conclusion in section V.

2. THEORETICAL BACKGROUND AND LITERATURE REVIEW

After WW2, on the ground of the 'economic miracle' that caused a gap in the labor supply, labor migration was permitted legally in most Western European countries. As the flow of immigration increased, questions on the labor market effects of immigration became a key topic for the literature of economic science[4]. Moreover, the question of immigration and -in a wider sense- its effect on countries' economies has also sparked a debate especially in politics thereby in society in these countries. One of the main arguments for legally restricting immigration is the fear that immigrants might have a negative impact on labor market prospects of natives. In other words, this fear arises from the assumption that an increased immigration rate will increase the unemployment rate and reduce the wages of natives and will thus activate the displacement of domestic workers by immigrant workers. However, economic theory and empirical evidence do no offer clear results for the overall immigration effects. Consequently, whether immigrants cause unemployment of native workers, depends crucially on the degree of labor market flexibility such as wages; on the substitution or complementarity of native and immigrant

[4] Why do some people migrate? And what happens when they do? Although these questions are important since they form the basis of different migration theories- such as non-economic factors, role of the social network for explaining of pull and push factors- we forego to go into detail, since this would exceed the scope of our work.

workers, on the size of the immigrant inflows and on the extent to which immigrants' demand for goods and services generate more jobs than they themselves occupy", (GROSS, 1999).

Theoretical aspects of labor market effects of immigration are usually described using a neo-classical competitive model of supply and demand in the market for labor services (see for instance JOHNSON, 1980; CHISWICK, 1982; GREENWOOD & MCDOWELL, 1994). According to standard economic theory an additional supply of workers that is an increase in immigration[5] into an economy is expected to reduce wages for native workers, since more individuals are willing to supply their labor at a given wage. However, the effect of immigrants on wages, especially, depends on whether immigrants and natives are substitutes or complements. When natives and immigrants are homogeneous in terms of their skill level (productivity) with the underlying assumption that all labor enters the firm's production function as a single input and perfect substitutes in production an increase in the supply of immigration[6] in the short-run will lead to an increased competition in the same labor market for both groups. As shown in Figure 1, this will reduce the wage for immigrant workers (from W0 to W1) and increase total employment [7] (from N0 to E1). At the lower wage, however, the number of natives who work declines (from N0 to N1), since firms are expected to respond to immigration by hiring more immigrant workers as they are cheaper than natives. Note that the magnitude of these decreases depends on the size of the immigrant inflows and how responsive labor supply and demand are to changes in wages: For any given responsiveness of labor supply to changes in wages, the bigger the immigrant inflow, the bigger the decreases in natives' wages and employment (ORRENIUS et al., 2013). As a result, for the short-run impact of immigration

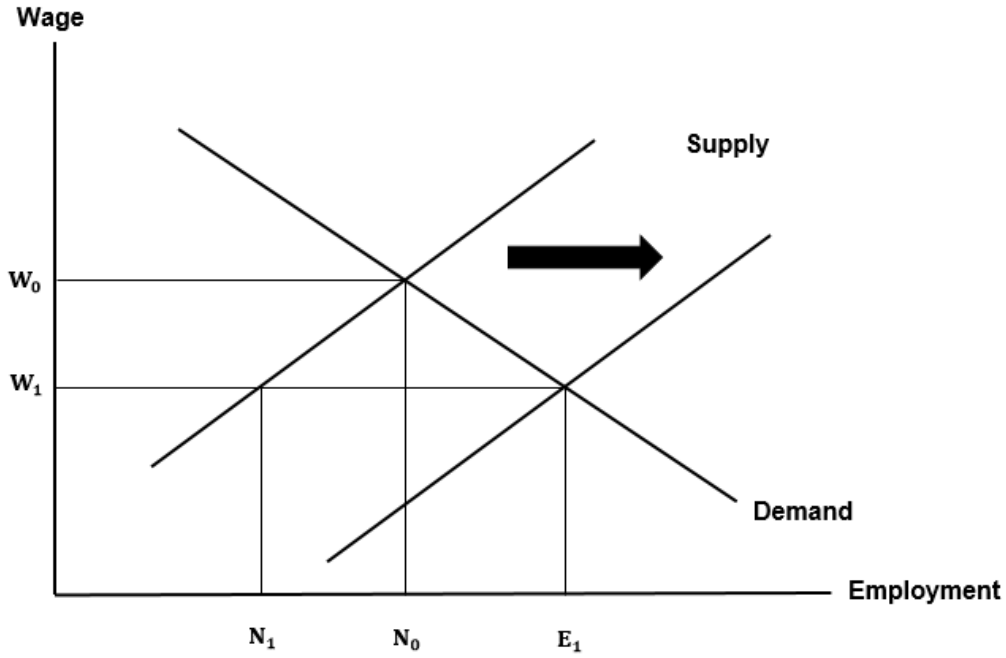
[5] Demand for labor is assumed to be a downward-sloping function of the wage, and also assumed to be unaffected by immigration. Moreover, it assumes an economy that is closed to trade with other regions so that an inflow of immigrants cannot lead to an increase in the production of traded goods or an in- or out-migration of resident labor. The increase in labor relative to capital is not allowed to simulate an inflow of capital or the adoption of new production techniques (CARTER et al., 2006).

[6] Here it is assumed that the supply of immigrant labor is perfectly inelastic; that is, wages do not influence the amount of immigrant labor supplied. (CARTER et al., 2006).

[7] Note that if there are restrictions of wage adjustment because of minimum wage or intervention of union for example then an increase in immigration will cause unemployment.

when immigrants and natives are perfect substitutes, an adverse effect on native workers will occur (FERIDUN, 2007).

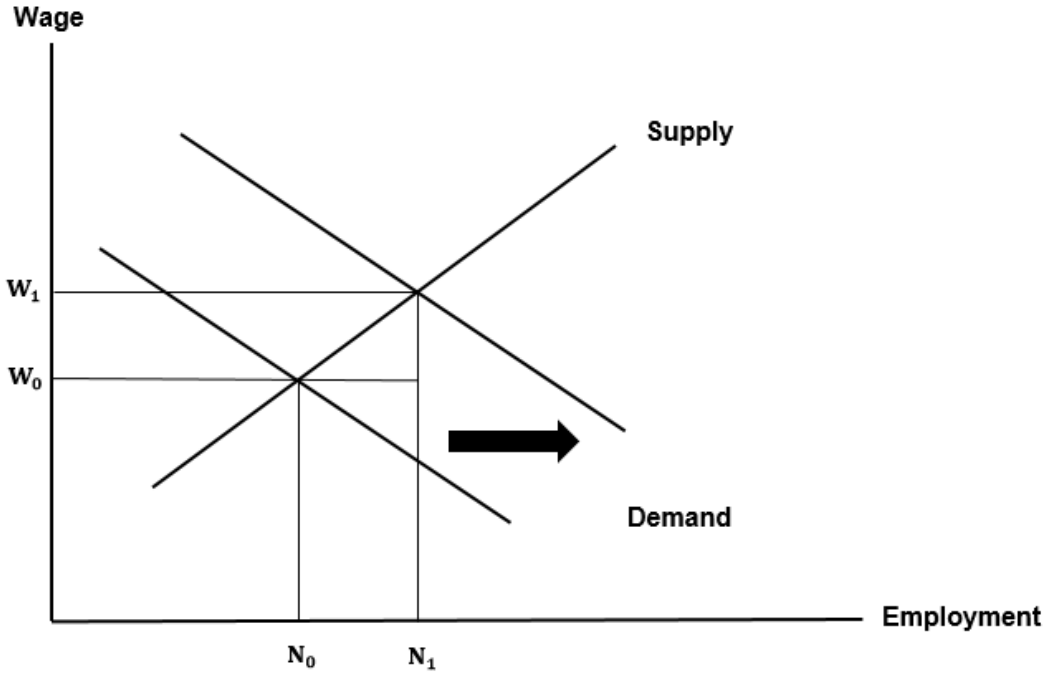
Figure 1: Short-Run Impact of Immigration when Immigrants and Natives are Perfect Substitutes



Source 1: Own representation based on BORJAS (2007).

The assumption that native workers and immigrants are perfect substitutes is questionable. It might be that immigrant and native workers are not competing for the same types of jobs where they are employed in two distinct labor markets. Consequently, if immigrants and native workers are complements in production, then presence of immigrants increases native productivity since natives can now specialize in tasks that are better suited to their skills. If the two groups are complements, an increase in the number of immigrants raises the marginal product of natives, shifting up the demand curve for the native-born workers. As shown in Figure 2, this increase in native productivity raises the native wage (from W_0 to W_1). Moreover, some natives who previously did not find it profitable to work now see the higher wage rates as an additional incentive to enter the labor market, and native employment also raises from N_0 to N_1. As a result, for the short-run impact of immigration when immigrants and natives are complements, a positive effect on native workers will occur (BORJAS, 2007).

Figure 2: Short-Run Impact of Immigration when Immigrants and Natives are Complements



Source 2: Note that the labor market denotes here the supply and demand for native workers. Source: Own representation based on BORJAS (2007).

In the above discussion, product demand was assumed as *fixed*. However, immigration has both demand and supply side effects in goods market that is immigrants are not only competitors on the labor market for native workers since it is possible that they increase productivity and income of the production factors. Moreover, immigrants are also consumers demanding goods and services produced by native firms and laborers. They can increase consumer utility by putting a downward pressure on prices. When both demand and supply effects are present, the net effect on the natives will depend on the immigrants' marginal propensity to consume and the chance of finding a job relative to natives. If, for example, immigrants' relative expenditure is less than their relative employment, then the demand for labor will shift to a less extent than the supply of labor and therefore some natives will lose their jobs (FERIDUN, 2007).

There are large empirical studies that have examined the economic (GDP, Economic Growth, Wage and [UN] Employment), demographic and fiscal

effects of immigration for various countries[8]. Given the above theoretical predictions, most of the empirical evidence suggests that at the national level the effects of immigration on (un)employment outcomes are minimal and that immigrants are complements to natives but there is some evidence of *wage effects* (BLANCHFLOWER et al., 2007). For example BORJAS (1994) finds that immigrants have a small negative effect on the wage of native-born workers. FRIEDBERG and HUNT (2005) have also shown that a 10% increase in immigrants in the US and other advanced Western countries causes a fall in wages of at most 1%. In another paper, BORJAS and KATZ (2005) have shown that an 11% increase in the US labor force between the years 1980-2000 resulted in an overall loss of about 3% of the real value of wages, and that this loss reached 9% for high school dropouts. However, JAEGER (1995) reported that increases in the immigrant share of the labor force during the 1980s accounted for 6% of the increase in the college/high-school wage differential, and that immigration caused a 3 to 5% decrease in the wages of high school dropouts in the aggregate of the 50 largest metropolitan areas. Moreover, ALTONJI and CARD (1991) find significant wage effects during the 1970s and find furthermore an equally small positive effect suggesting the two types of workers are complements rather than substitutes. CARD (2007) finds also that a 10% increase in the immigrant's share of workforce increased average wages by 6%. On the contrary, LEMOS and PORTES (2008) have failed to find any convincing evidence of an effect of A8 immigration either on the average or at any point of the UK wage distribution[9].

The impact of immigration can differ by countries, especially between US and Europe there are important differences regarding the degree of the labor market flexibility (wage flexibility and labor mobility). Countries with a higher degree of labor market flexibility are more able to absorb immigrants without increases in unemployment (RUHS, 2006). Lower labor market flexibility in Europe than in the US could mean that immigration affects employment more than wages.

[8] We will only highlight some of the conclusions of the earlier literature that are relevant for the current analysis.

[9] However, one important limitation of the factor proportion approach is that it relies on outside of estimates of relative wage elasticizes to stimulate the impact of immigration on wages, DiNardo (1997). Thus, its validity depends on both the theoretical model and the estimate relative wage elasticizes to be correct.

Nevertheless, European studies tend to look at potential (un)employment effects of immigration rather than at wage effects. Surprisingly, wage effects found in European studies are more negative than wage effects found in the US studies. Wage effects in the USA are at most −1.5% for a 1 percentage point increase in immigrant share (GOLDIN, 1994). DE NEW & ZIMMERMANN (1994a, b) find wage effects of − 3.3% and even −6.4% for a 1 percentage point increase in immigrant share in Germany.

Empirical studies on the so-called displacement effect through immigration were also stressed by different economists. For example, CARD (2001) finds that, for an in increase in the U.S. immigrant share by 1%, the native employment to population ratio would decrease by at most 1 percentage. ANGRIST and KUGLER (2003) find larger effects for EU countries with a maximal decrease of 1.6 percentage points. For the Austrian case, WINTER-EBMER and ZWEIMÜLLER (2000) refer to an important point namely the *employment effect*. In their study, they find no significant effect of immigration on the probability of entering unemployment in Austria. However, this does not mean that immigration had no employment effect at all; it only means that employed workers were not affected. They show immigration has an impact on the unemployed who find it more difficult to get back to work. When the immigrant share increases by 1 percentage point, unemployment duration increases by 5%. Moreover, BRANDEL (1994) pointed out an interesting displacement effect of the surge of new immigrants during the 1990s in Austria and find a significant displacement of guest-workers of earlier generations, but also of natives: 60% of all firms in their sample with shrinking employment of natives increased the employment of foreigners in the period 1989 to 1991[10]. Nevertheless, it should be noted that wage and employment effects and the degree of substitutability of immigrants with native workers can change over time.

Finally, studies of the aggregate relationship between immigration and unemployment overwhelmingly reject the hypothesis of an adverse effect (GROSS, 1999). For example, POPE and WITHERS (1993) investigate the relationship between immigration and unemployment by applying both a

[10] BORJAS (1994) argues that newly arrived immigrants are inherently different from those who migrated 20 years ago.

structural disequilibrium model and causality tests and found that immigrants to Australia do not increase unemployment, especially, that the long-term effects of immigration on unemployment are negligible. MARR and SIKLOS (1994), examine the influence of past, current, as well as future immigration jointly on the current unemployment rate in Canada, using quarterly data for the period 1992-1990. Their findings show that current increases in the unemployment rate reduced future immigration rates before 1978. After 1978, however, there is a positive association between past immigration and current unemployment. Moreover, they show that the results are in line with those of POPE and WITHERS (1993). In another study, MARR and SIKLOS (1995) examined the relationship between immigration and unemployment in Canada using annual data from 1926 to 1992. They conduct Granger-causality tests on unemployment and immigration and an unrestricted VAR approach on unemployment, immigration, wage and real GDP. The Granger-causality tests showed that immigration was not caused by past unemployment, however, that past immigration did cause unemployment. In other words, the causality runs unidirectional from past immigration to unemployment. On the contrary, SHAN et al. (1999) examine the relationship between unemployment and immigration for Australia and New Zealand by using Vector Autoregression Model (VAR), however, they find no such causality from immigration to unemployment. GROSS (1998) finds a negative relationship between unemployment and immigration in the long-run and a positive, but small, correlation in the short-run in a regional market such as British Columbia. More recently, FERIDUN (2005) examined the relationship between immigration, unemployment and economic development in Norway using Granger causality tests. He finds a positive relationship between immigration and GDP per capita and that immigration has no impact on unemployment, and vice versa. Based on French data from 1970 to 2008 FROMENTIN (2013) examined the relationship between immigration, labor market and economic development. Using Johansen's co-integration procedure, he determines long-run and short-run relationships in a VECM. He finds a negative relationship between immigration and unemployment in both the short and long term. That is, in the short run immigrants seem to displace native workers or take away available jobs that are neglected by native workers.

In the long run, however, they seem to create more jobs through their demand for goods and services. Moreover, the study also reveals that immigration has a positive impact on the real wages, indicating that immigrants are more complements rather than substitutes with natives.

3. IMMIGRATION TO AUSTRIA SINCE THE 1960s

Looking at Austria's migration development reveals that, since WW2, Austria has been simultaneously a country of temporal as well as permanent immigration for both political, demographic and economic reasons. On the basis of political crisis in the former communist countries as a result of the political uprisings and repressions, Austria became a major destination for refugees from these countries. Most of these refugees, however, stayed in Austria for a short time only. In 1956, for example, over 180,000 Hungarian refugees came to Austria but only about 20,000 of them were granted asylum and stayed in Austria. The same pattern occurred for refugees from other countries: for example due to the "Prague Spring" of 1968 and then to the crushing of the "Solidarnosc" movement and the imposition of martial law in Poland in 1981 and 1982 about 162,000 Czechoslovakians and about 150,000 Poles came to Austria respectively. Again the majority of these refugees returned either to their home countries or travelled on to other Western countries (BIFFL, 2004; p.11).

3.1 Phase: From Emigration Country to Immigration Country (1960 – 1974)

In 1960, and after, Austria started to recruit foreign workers, which on the one hand trace back to the business cycle upswings of the 1950s in other Western countries, where most of Austrian workers emigrated especially to Germany and Switzerland and on the other hand due to the gap in the labor supply, immigrants were supposed to reduce labor scarcities in Austria. The so-called "Raab-Olah-Agreement"[11] or "guest worker program"-an agreement between firms and trade unions- was implemented in 1961. The first contract was signed in 1962 with Spain, followed by Turkey in 1964 and two years later by Yugoslavia. As Figure 3 shows, the first peak of the migration is achieved

[11] The former WKO President Julius Raab and ÖBG President Franz Olah signed Raab-Olah Agreement in 1961.

with about 227,000 employed guest workers in 1973. Yugoslav nationals formed the largest share of the guest workers with 78.5% in 1973, followed by Turks with 11.8%. The main principle of the guest worker system was based on “rotation”. The basic idea of policy-makers was to invite immigrants as cyclical shock absorber that can be sent back again when the economic situation is bad (BIFFL, 2004; p.10-11). However, this system never worked, because on the one hand not enough workers were recruited: Austrian companies encouraged their foreign employees to bring close relatives to Austria. On the other hand, in order to cut costs, many companies were not willing to enroll new workers each year[12].

3.2 Phase: Between the Conflicting Priorities of Return and Settlement (1974–1988)

Due to the recession in the wake of the oil crisis in 1974 and the fact that Austrians who had been working abroad returned home, a recruitment ban has been enforced and the number of foreign workers begin to decrease (BIFFL, 2004; p.11). The Alien Employment Act of 1976 governs the preference for Austrian workers over foreign workers. As a result, the share of foreign workers in the Austrian labor force decreased about 40% between 1974 and 1984, but the percentage of foreign residents remained almost at the same level, because the number of returning immigrants was compensated by the incipient family reunions (BIFFL, 2004; p.12).

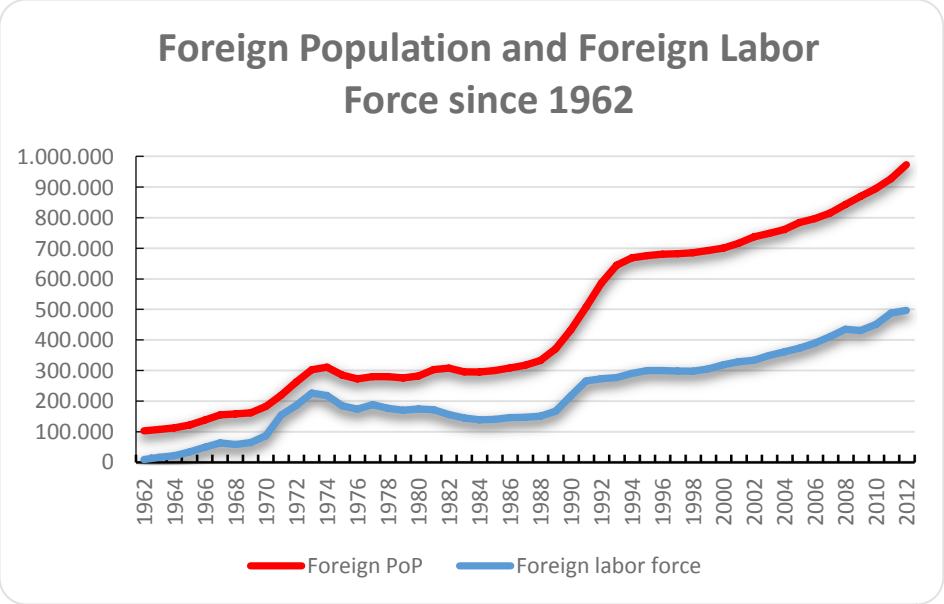
3.3 Phase: Consequences of the end of Europe's division on immigration to Austria (1989-1993)

Between the period 1989 and 1993, with the dismantling of the Iron Curtain, the war in Yugoslavia and the growing need for immigrants due to the economic boom, another peak period of immigration began to start. According to the Census 1991, even approximately 690,000 foreign nationals were living

[12]See:http://medienservicestelle.at/migration_bewegt/2011/05/25/neue-osterreichische-migrationsgeschichte/

in Austria, that is the number of foreigners living in Austria has almost doubled, where the Austrian population was roughly 7.8 million[13].

Figure 3: Foreign Population and Foreign Labor Force in Austria (1962-2012)

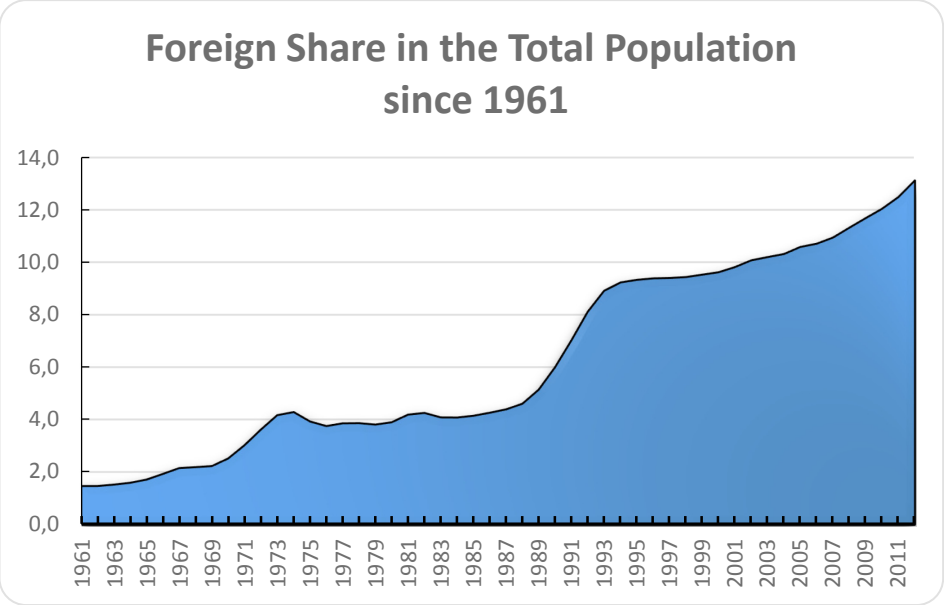


Source 3: Own representation based on Statistics Austria.

Moreover, the foreign share in the total population in Austria rose steadily from approximately 1.5% in 1961 to more than 8 % in the early 1990s and topped the 10% mark for the first time in 2002 (see Figure 4). During the same period, unemployment increased from 149,200 persons (thereof 10,000 foreigners) to 195,100 (27,100 foreigners). In 1989, the net immigration amounted to +64,600 immigrants and in the following three years it passed the level of 80,000 a year (BIFFL, 2004; p.12).

[13]See:http://medienservicestelle.at/migration_bewegt/2011/05/25/neue-osterreichische-migrationsgeschichte/

Figure 4: Foreign Share in the Total Population in Austria (1961-2012)



Source 4: Own representation based on Statistics Austria.

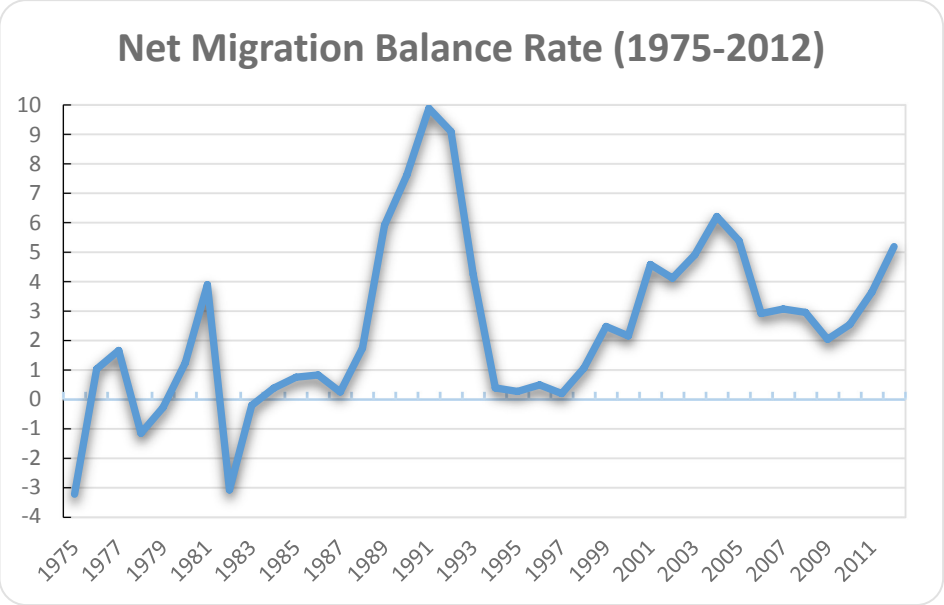
3.4 Phase: From the unregulated to regulated Migration (1994-until today)

In 1990, the Austrian government tightened its immigration policy by implementing a quota for work permits, which bound the maximum share of foreign workers to the total labor force. In detail, a maximum of 10% of the total work force could be foreign workers. Generally, the quotas vary from 8% to 10% of the total work force. The Austrian government tightened its immigration policy by implementing further series of new laws in 1992/1993[14]. The guest workers scheme was replaced by an annual quota system for new residence permits, which reduced continuously the net immigration into Austria. Between 1993 and 2001, the net immigration amounted to 159,000 persons, which means that the yearly net immigration did not exceed 20,000 persons during the 1990s (BIFFL, 2004; p.12). Figure 5 shows the net migration balance rate[15] between 1975 and 2012 for Austria.

[14] In 1993: A new Aliens Act and a new residence law was enforced. From this point, a separation between tourist visas and immigrant visas will be drawn. In the same year, the rightwing Freedom Party (FP) organized the "anti-foreigner referendum" with 416 531 signatures. Shortly thereafter, the "sea of lights" in which around 250,000 people carried protest against xenophobia.
See: http://medienservicestelle.at/migration_bewegt/2011/05/25/neue-osterreichische-migrationsgeschichte/

[15] Difference of immigrants and emigrants of Austria divided per 1,000 inhabitants on an annual average.

Figure 5: Net Migration Balance Rate in Austria (1975-2012)



Source 5: Own representation based on Statistics Austria: "Wanderungen"

ASYLUM APPLICATIONS

The period 1997-2002 for Austria was marked by huge increases in asylum applications. The number of asylum applications has increased six-fold and rose to almost 40,000 in 2002.

ACCESSION TO THE EU:

With its accession to the European Union in 1995 and the two EU enlargement rounds in 2004 and 2007, Austria has attracted increasing numbers of migrants from the EU15 and the enlargement countries, many of them were on a more temporary basis (MAYR et al., 2012)[16] and caused to break new records.

Today, Austria ranks among the EU15 countries with the highest share of foreigners in the population: According to the Census of 2001, 12.5% of the Austrian population was born in foreign countries. In 2012, on average some 1.579 million men and women (18.9% of the population) with foreign background were living in Austria. 1.167 million of them were born abroad, while 412,000 people were descendants of foreign-born parents but born in Austria and thus counted as "second generation". In an international comparison, the

[16] Seasonal workers, who are allowed to stay up to one year and re-apply after a two months break.

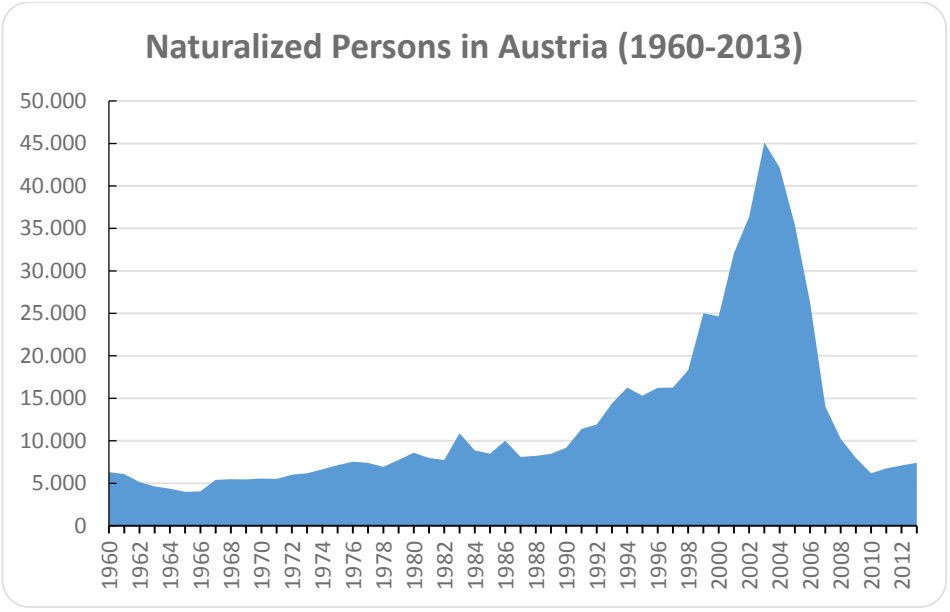
share of foreign-born persons is almost the same as that of the classic immigration country USA, where, according to the 2010 Census, 12.9% of inhabitants were born abroad[17]. Of the 1.579 million people with a migration background over a third (35% or 547,000) came from another EU country, another third (32 % or 512,000) were in the successor states of Yugoslavia (excluding Slovenia, which has been 2004 EU member). Persons with a Turkish background accounted for 17% (275,000 persons), while about 16% came from people from other European countries and other parts of the world (246,000 people). In other words two-thirds of the immigrants come from non-EU countries.

NATURALIZATIONS IN AUSTRIA

Around two fifths of the Austrian resident population born abroad have Austrian citizenship: for the most part they moved to Austria and were subsequently naturalized. The largest group of Austrians born abroad (73,000 people) were those with a place of birth in Germany. Turkey comes second (71,000 people), followed by Bosnia and Herzegovina (55,000), Serbia (42,000), the Czech Republic (33,000), Romania (26,000) and Poland (21,000). (STATISTICS AUSTRIA). As shown in Figure 6, in 2003 about 45,000 foreign nationals were naturalized, which is also the absolute naturalization record for Austria. However, since 2004, the number of naturalizations has declined and fell to 2010 by more than four-fifths compared to the high record of 2003. The sharp increase in the naturalization of national foreigners in 2003, however, has not occurred due to a new more liberal policy, rather the new record has to do primarily with the long lasting residence of migrants in Austria, who are normally granted citizenship after 10 years (BIFFL, 2004; p. 14).

[17] The reason for the high share of foreign nationals living in Austria, however, has crucially to do with the fact that Austria follows the so-called “ius-sanguinis” principle, where a foreign child receives the nationality of its parents, contrary to the “ius-soli” principle, where the place of birth is the decisive factor for obtaining the country’s nationality (BIFFL, 2004; p. 5).

Figure 6: Naturalized Persons in Austria (1960-2013)



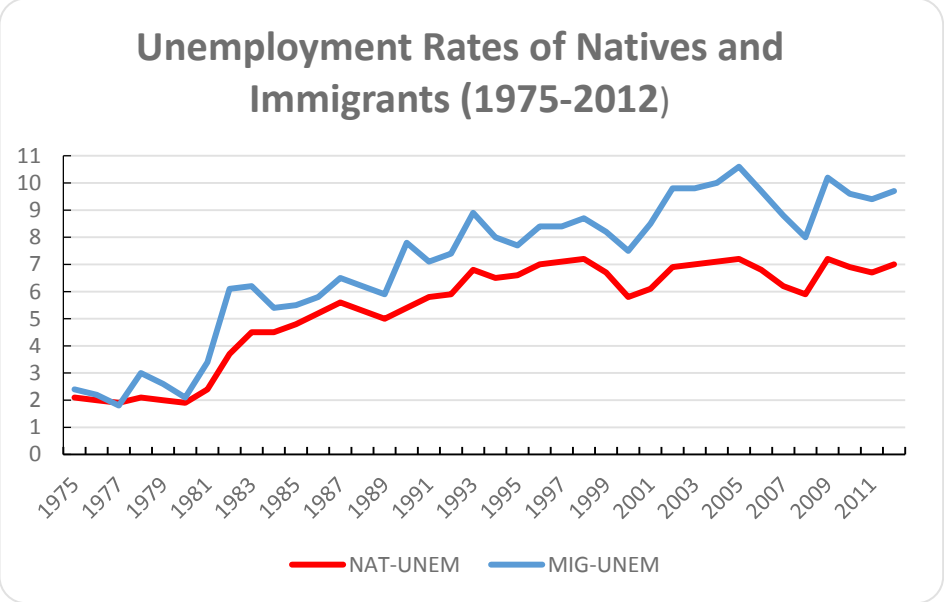
Source 6: Own representation based on Statistics Austria: "Naturalisation".

UNEMPLOYMENT IN AUSTRIA

Overall, around 35% of job-seeking people and around 20% of non-self-employed foreign workers have a migration background in Austria[18]. The share of foreigners in the Austrian labor force continues to rise, increasing from 9.1% in 1991 to 13.4% in 2008 (that of the foreign-born was 16.3% in 2008) (MAYR et al., 2012). Migrants, thus play an important role in the Austrian labor market. Unemployment is on average typically higher among foreign workers than among native workers in Austria. The unemployment rate varied between 7.8% and 10.7% during 1990 - 2013[19] compared with a mean of 6.6% for natives in the same period. As shown in Figure 7, the unemployment rates among natives remain below 7.5%, while unemployment among foreign workers exceeded 10% mark for the first time in 2004.

[18] Media Arbeiterkammer: "Arbeitsmarkt im Fokus-Arbeitsmarktanalyse des 1. Halbjahres 2013".
[19] Own calculation. Based on data of ELISweb.

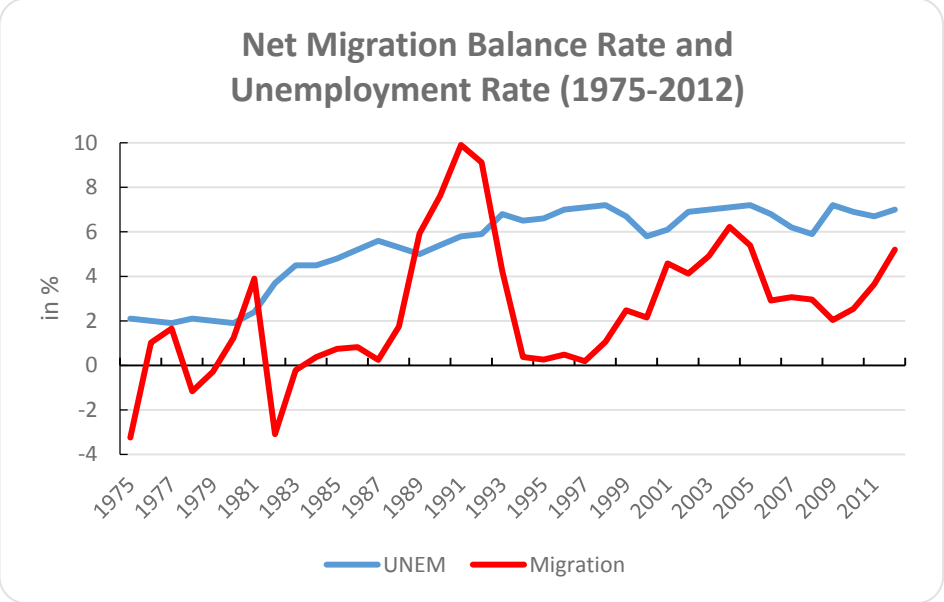
Figure 7: Unemployment Rates of Natives and Immigrants in Austria (1975-2012)



Source 7: Own representation based on data base of ELISweb: "Entwicklung des AusländerInnnenarbeitsmarktes ab 1975".

Moreover, as shown in Figure 8, between 1975 and 1981 the relationship between the unemployment rate and immigration shows an inverse relationship and from 1981 to 1989 a move in the same direction. The period between 1989 and 1993 with a structural break in 1991 shows that net immigration rate exceeded unemployment rate for the first time. Moreover, the period between 1994 and 2002 is marked by an inverse relationship, where unemployment rate reached its first maximum in 1998 with 7.2%. Consequently, these ups and downs in both series point to both economic and political crises and thereby to restrictive policy reactions to immigration.

Figure 8: Net Migration Balance Rate and Unemployment Rate in Austria (1975-2012)

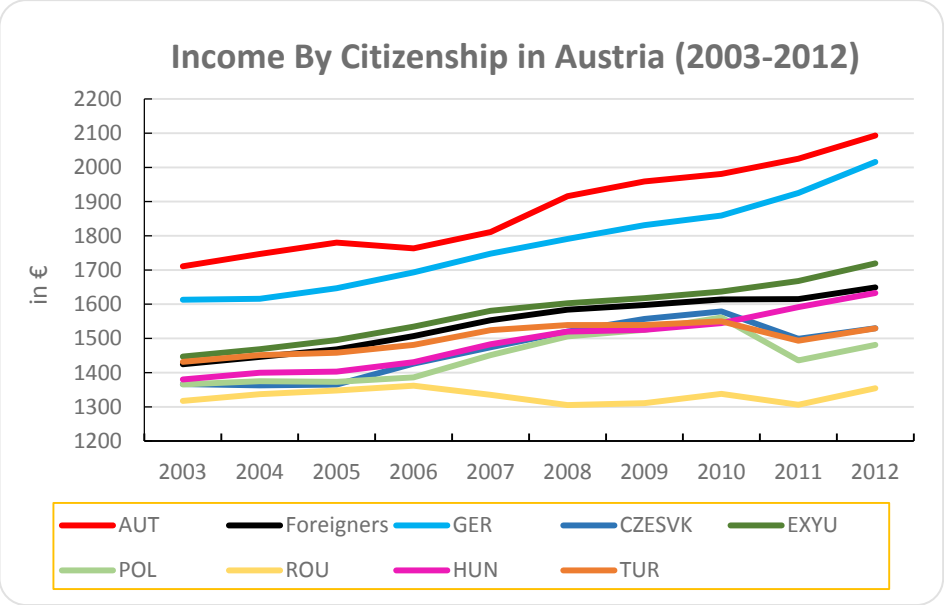


Source 8: Own representation based on data base of ELISweb: "Entwicklung des AusländerInnnenarbeitsmarktes ab 1975"and Statistics Austria: "Wanderungen".

INCOME BY CITIZENSHIP

Immigrants in Austria have on average lower income than natives. As reported in Figure 9, the total median monthly income by citizenship for wage and salary earners in 2012, shows that Austrians (AUT) earned about 2,093 €, whereas foreign nationals (FORNAT) earned about 1,649 €. Moreover, the difference becomes clearer, when incomes of migrants in Austria by their citizenship are compared: Germans (GER) earned on average 2,026 €, followed by successor states and former Yugoslavs (EXYU) with 1,719 €, Hungarians (HUN) with 1,633 €, former Czechoslovakia (CZESVK) with 1,530 €, Turks (TUR) with 1,529 €, Polish (POL) with 1,481 € and Romanian (ROU) with 1,354, respectively. Note that, between the period 2003 and 2012, the median earnings of Germans and former Yugoslavs are above-average among foreign nationals.

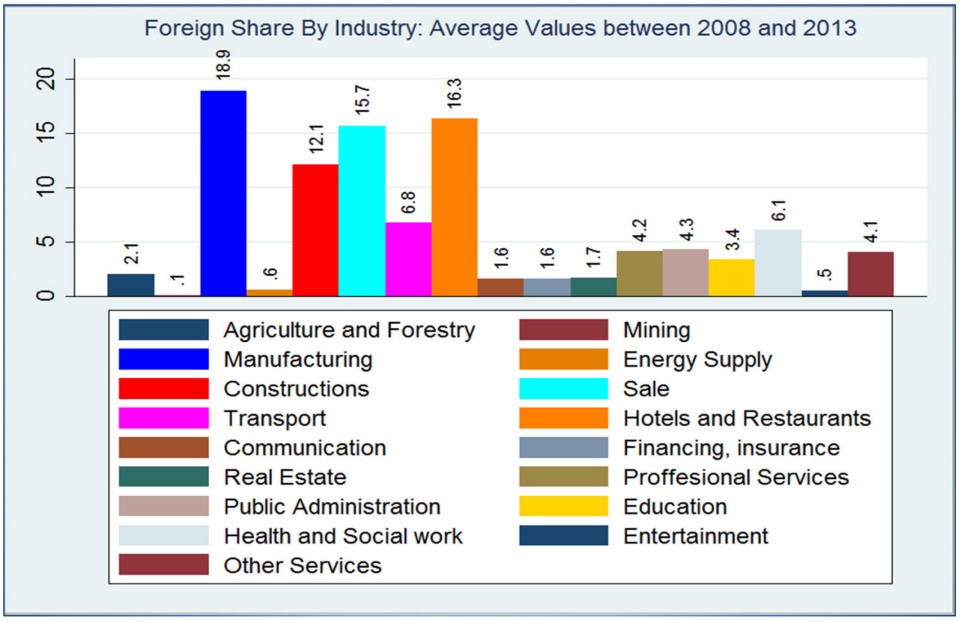
Figure 9: Income by Citizenship in Austria (2003-2012)



Source 9: Own representation based on ELISweb: "Einkommen nach Staatsbürgersaft- Zeitreihe".

These differences in earnings can be explained such that migrants have on average lower skills, working in low-pay sectors, are overrepresented in temporary-jobs, and have lower career opportunities (MAYR et al., 2012). On the other hand, one reason why Germans earn relatively much more than other foreigner nationals in Austria, is that Germans face less language barriers, which make the access to the labor market easier for them. Figure 10 shows that immigrants in Austria are overrepresented in labor-intensive service sectors such as manufacturing (18.9%), hotels and restaurants (16.3%), sale (15.7%) and in constructions (12.1%), respectively, that are more prone to business cycle fluctuations and so to the risk of to be unemployed (MAYR et al., 2012).

Figure 10: Foreign Share by Industry in Austria (2008-2013)



Source 10: Own representation and calculations based on Austrian Social Security Database (ASSD).

Another important reason for the above average incidence of unemployment of migrants results from the fact that there exist an employment protection for native workers, which trace back to the 1930s. Accordingly, a foreign worker is the first to be laid off if the enterprise reduces its work force (BIFFL, 2004; p. 15).

Nevertheless, these differences in unemployment rates and earning between immigrants and natives and the fact that immigrants have demographic effect in enlarging the population (and thus the tax base) and in altering its age – (and gender) composition, are also reflected in the welfare system. Consequently, the effects of immigrants on fiscal policy, taxes, social security system, unemployment benefit system, the public pension system and on social transfer system can be beneficial or harmful for the welfare system (MAYR, 2004).

As noted above, *"Austria is implementing a highly restrictive policy in the area of labor migration, also when it comes to the different permits that one can be granted and to the conditions to be fulfilled for the granting thereof",* (CIRCO and VILICS 2003; p. 16). In principle an employer may only employ immigrants if they hold an appropriate work permit. However, taking the above fact into account, that two-thirds of the immigrants come from non-EU countries and that different work permit laws hold for EEA citizens – these obtained free access to

the labor market with Austria's accession to the European Union in 1995, except the countries that joined in the EU/EEA in 2004 and 2007- and non-EEA citizens for which the work permit takes several years until to obtain free access to the labor market[20], all this shows that, since recently, Austria has given preference to a EU countries first in its immigration policy, whereas citizens of the classical source countries, (former) Yugoslavia and Turkey are relatively less preferred. According to Statistics Austria, in 2013, about 158,000 Germans constitute a share of almost 16% and represent the largest group of foreigners in Austria followed by Turks (113,000) and Serbians (112,000)[21].

4. DATA SOURCE AND DESCRIPTIVE STATISTICS

This study uses annual data for the period 1975 and 2012 for Austria from BUREAU OF LABOR STATISTICS, BALI -an online database query system of market information supervised by the APF team of FEDERAL MINISTRY OF LABOR, SOCIAL AFFAIRS AND CONSUMER PROTECTION-, UNITED NATIONS STATISTICS DIVISION OF THE DEPARTMENT OF ECONOMIC AND SOCIAL AFFAIRS (DESA) and STATISTICS AUSTRIA. Immigration, denoted by MIG, is represented by the net migration rate (difference of immigrants and emigrants of Austria), divided per 1000 inhabitants published by Statistics Austria. Wages, denoted by WAGE, are represented by the hourly compensation costs in U.S. dollars in manufacturing published by Bureau of Labor Statistics. The unemployment rate, denoted by UNEM, in Austria is reported by the Public Employment Service Austria (AMS). It is based on the number of unemployed persons registered at AMS offices and the number of employees recorded by the Main Association of Austrian

[20] Restricted work permit: valid for one year and only for a specific worker, firm and workplace within the firm. General work permit: After one year legal work, it can be applied, which is valid for two years within a given federal state. Finally, immigrants who have been working for 3 years are entitled to an exemption certificate, which is valid for 5 years throughout Austria. Moreover, immigrants with a "settlement permit" that is issued after 5 years of residence have unrestricted access to the labor market. Workers from the New EU member's states could get a "confirmation of free movement" that entailed a work permit after one year of legal employment of 5 years of uninterrupted settlement in a federal state. With 1 July 2011 replaced the Red-White-Red Card the hitherto existing quota system for immigration to Austria (MAYR et al, 2012). The map is based on a points system, rated the German ability, age, and special vocational training and offers qualified third-country workers and their family members a new single permit for working and settling permanently in Austria.

[21] See: Statistik Austria, Statistik des Bevölkerungsstandes, Wanderungsstatistik.

Insurance Institution, published by BALI[22]. GDP per capita at current prices in U.S dollars, denoted by GDP, published by United Nations Statistics Division of the Department of Economic and Social Affairs.

Table 1 reports the summary statistics for observation (obs.), mean, standard deviation (std. dev.), minimum (min), maximum (max), skewness and kurtosis of the data collected. WAGE and GDP are log-transformed since they grow with main aggregates, denoted by L. There are only 38 observations on UNEM, MIG, LGDP and LWAGE. The skewness coefficients for our four series are close to zero and the kurtosis coefficients are close to three, which indicates that the normal distribution is close to normal.

Table 1: Descriptive Statistics

	Obs.	Mean	Std. Dev.	Min	Max	Skewness	Kurtosis
UNEM	38	5.389	1.823	1.9	7.2	-0.927	2.463
MIG	38	0.02	0.023	-0.0246	0.077	0.46	3.022
LGDP	38	9.897	0.661	8.5624	10.82	-0.412	2.013
LWAGE	38	2.825	0.661	1.5239	3.77	-0.374	2.003

Source 11: Own calculation with the use of E-Views software

4.1 ECONOMETRIC MODEL

The econometric model builds on the general equilibrium framework described in GROSS (1998, 2002, 2004), ISLAM (2007) and FROMENTIN (2013). In order to answer the research questions we will the estimate the following equation:

$$\sum_{i=1} \boldsymbol{y_t} = \boldsymbol{\alpha_0} + \sum_{i=1}(\boldsymbol{\beta_i}\, \boldsymbol{y_{t-1}} + \boldsymbol{\gamma_i x_{t-1}}) + \boldsymbol{\varepsilon_t}, \qquad (1)$$

where y_t is a vector consisting of net immigration rates, unemployment rates, hourly wages, in order to measure aggregate domestic labor market conditions and per capita GDP, in order to measure aggregate domestic economic activity, α_0 is a vector of constant terms, β_i and γ_i are all matrices of parameters of the

[22] The number of unemployed and employed persons extracted from the Labor Force Survey (LFS) complies with the Labor Force Concept, which is based on the ILO definition of employment and unemployment.

endogenous and exogenous variables respectively, $\boldsymbol{x_t}$ is a vector of exogenous variables, and ε_t is an error term, where $\varepsilon_t \sim iid\ N\ (0, \Sigma)$. Unemployment, immigration, GDP and wage are endogenously determined in the long term, but not necessarily in the short term. Variables of interest are symmetrically and endogenously determined. Equation (1) accounts for the supply and demand effects of immigration as well as feedbacks from wage and the labor supply to determine the final impact of immigrations on the target place (ISLAM, 2007).

The aim is to identify the dynamics adjustment of the labor market in the short run and in the long run. In order to examine the long-run dynamic response of the labor market to immigration we firstly concentrate on the co-integration procedure developed by Johansen (1998, 1991), where the unemployment rate, hourly wage, real GDP per capita and immigration rates are considered to be simultaneously determined. The method is first used to determine the number of co-integrating vectors, then it also yields a (Vector) Error Correction Model ((V)ECM) that maps the short-run dynamic response of our four series (Gross, 1998).

4.2 UNIT ROOT TESTS

Before following our strategies, it is important to determine whether model series are stationary[23]. It is common, that many economic and financial time series exhibit trending behavior or non-stationarity in the mean so that the problem of the so-called spurious regression occurs. Moreover, it is also important to ensure that time series are integrated of same order. Especially, if the time series are integrated of order 1, denoted by $I(1)$, then co-integration techniques can be used to model these long-run relations. Hence, pre-testing for unit roots is often a first step in co-integration modelling (ZIVOT & ANDREWS, 1992). Consequently, to test whether our time series are stationary or not, we use Augmented Dickey-Fuller tests (1979, 1981) (ADF) and Philips and Perron (1988) (PP) tests for the existence of a unit root. The ADF and PP tests differ mainly in how they treat serial correlation in test regressions. As we shall see later, the results of testing for stationarity are not changed using the

[23] Stationarity is generally defined by the feature that moments such as mean and standard deviation do not change over time and do not follow any trends.

test statistics of ADF or PP. The null hypotheses for ADF test and PP test are always that the variable has a unit root and is thus non-stationary, whereas the alternative hypothesis is that the variable has roots outside the unit circle and is thus stationary.

Both the ADF test and PP test can be used in three variants, which correspond to three versions of the underlying regression models[24]:

a.) Model A: Without intercept and without trend.
b.) Model B: With intercept but without trend.
c.) Model C: With intercept and trend.

Table 2 shows the results of both ADF[25] and PP t-statistic tests in levels as well as the critical values of MacKinnon (1991) for rejection of the hypothesis of a unit root. If the ADF and PP calculated statistics are larger than the McKinnon's critical value, then the null hypothesis is not rejected. In Table 2, we can see that none of our four series are stationary in levels so that existence of unit root is supported.

Table 2: Stationarity Test in Levels (ADF and PP)

	Model A	Model A	Model B	Model B	Model C	Model C
Variables	*t-statistic ADF*	*t-statistic PP*	*t-statistic ADF*	*t-statistic PP*	*t-statistic ADF*	*t-statistic PP*
UNEM	**1.06**	**0.98**	**-1.63**	**-1.7**	**-1.44**	**-1.39**
MIG	**-1.52**	**-1.6**	**-2.54**	**-2.9**	**-2.97**	**-3.07**
LGDP	**3.19**	**3.18**	**-1.81**	**-1.72**	**-2.18**	**-1.99**
LWAGE	**2.79**	**2.78**	**-1.59**	**-1.54**	**-2.81**	**-2.01**
CV (1%)	*-2.66*	*-2.657*	*-3.75*	*-3.736*	*-4.38*	*-4.362*
CV (5%)	*-1.95*	*-1.95*	*-3*	*-2.994*	*-3.6*	*-3.592*
CV (10%)	*-1.6*	*-1.601*	*-2.63*	*-2.628*	*-3.24*	*-3.235*

Note: McKinnon's critical value; the number of lags is determined with Schwarz Information Criterion. Source 12: Own calculation with the use of E-Views software.

A common trend removal or de-trending procedure is first-differencing (a period-to-period change). First differencing is appropriate for $I(1)$ time series: Put another way, a time series $\{r_t\}$ is integrated of order one, if $\{r_t\}$ is non-

[24] Please see Appendix A for further details.
[25] Note that, an examination of our data indicates that the LGDP and LWAGE series contain a linear time trend, whereas MIG and UNEM do not contain a linear time trend.

stationary but the first difference $\{r_t - r_{t-1}\}$ is stationary and invertible. Table 3 reports the result as follows: For the series UNEM, MIG, LGDP and LWAGE, the null hypothesis of a unit root is rejected at the 1% levels. As a result, the time series are $I(1)$, so that they are difference stationary. However, if the time series have unit root and the order of integration is identical, the time series might be co-integrated. This means that we will test for co-integration or the long-run relationship among the four time series.

Table 3: Stationarity Test in First-Differencing (ADF and PP)

	Model A	Model A	Model B	Model B	Model C	Model C
Variables	*t-statistic ADF*	*t-statistic PP*	*t-statistic ADF*	*t-statistic PP*	*t-statistic ADF*	*t-statistic PP*
Δ UNEM	**-4.73*** **	**-4.69*** **	**-5.01*** **	**-4.94*** **	**-5.34*** **	**-5.82*** **
Δ MIG	**-5.88*** **	**-5.93*** **	**-5.82*** **	**-5.85*** **	**-5.69*** **	**-5.71*** **
Δ LGDP	**-3.63*** **	**-3.55*** **	**-4.27*** **	**-4.18*** **	**-4.42*** **	**-4.31*** **
Δ LWAGE	**-3.67*** **	**-3.61*** **	**-4.35*** **	**-4.19*** **	**-4.41*** **	**-4.28*** **
*CV (1%) ****	*-2.66*	*-2.657*	*-3.75*	*-3.736*	*-4.38*	*-4.362*
*CV (5%) **	*-1.95*	*-1.95*	*-3*	*-2.994*	*-3.6*	*-3.592*
*CV (10%) *	*-1.6*	*-1.601*	*-2.63*	*-2.628*	*-3.24*	*-3.235*

Note: McKinnon's critical value; the number of lags is determined with Schwarz Information Criterion. Δ is the first-difference operator. Source 13: Own calculation with the use of E-Views software.

4.3 LONG-RUN RELATIONSHIPS AND COINTEGRATED VARIABLES

The finding that many macro time series may contain a unit root has spurred the development of the theory of non-stationary time series analysis. Engle and Granger (1987) pointed out that a linear combination of two or more non-stationary series may be stationary. If such a stationary linear combination exists, the non-stationary time series are said to be co-integrated. The stationary linear combination is called the co-integrating equation and is interpreted as long-rung equilibrium relationship among the variables. In order to test for co-integration between immigration and three macroeconomic variables, we use Johansen's Approach to Co-integration (1988). The Johansen procedure is useful for investigating co-integration of several $I(1)$ time series, contrary to the Engle-Granger two-stage procedure which runs into problems for larger co-integrating ranks. Moreover, the Johansen procedure enables us to estimate the co-integrating vectors and the entire ECM as well.

The multivariate Johansen co-integration procedure allows testing for the number of co-integrating relationships and it provides standard error of long-run relationships and adjustment coefficients.

The vector autoregressive model (VAR) is a natural starting point for the co-integration analysis developed by Johansen:

For a general VAR of order p, denoted as VAR (p)[26]:

$$y_t = A_1 y_{t-1} + \ldots + A_p y_{t-p} + B z_t + \varepsilon_t, \quad (2)$$

The VAR can be formulated as the long-run strategy:

$$\Delta y_t = \prod y_{t-1} + \sum_{i=1}^{p-1} \Gamma_i \Delta y_{t-i} + B z_t + \varepsilon_t, \; t = 1,2 \ldots, T \quad (3)$$

$$\prod = \sum_{i=1}^{p} A_i - I \quad (4)$$

$$\Gamma_i = -\sum_{j=i+1}^{p} A_j. \quad (5)$$

where y_t is a k-dimensional vector variable that is integrated of order one at most [here: unemployment rate, immigration rate, log of hourly wages and log of per capita GDP], Δ is the first-difference operator, B is coefficient matrix to be estimated, z_t is a vector of deterministic variables (constant, a linear trend, and seasonal dummies), ε_t is a vector of innovations that is assumed to be white noise Gaussian ($\varepsilon_t \sim iid.N\,(0, \Omega)$). Note that if the coefficient matrix $\prod$ has full rank, the vector process y_t is stationary.

A result from linear algebra implies that, if the coefficient matrix $\prod$ has reduced rank $0 < r < K$, then there exist $k\,x\,r$ matrices $\alpha\ and\ \beta$ each with rank r such that $\prod = \alpha\beta'$. The Granger representation theorem says that $\beta' y_t$ is $I(0)$. r is the number of co-integrating vectors (the co-integration rank) and each column of β is a co-integration vector. The elements of α are known as the adjustment parameters in the vector error correction model.

Johansen's method is to estimate the $\prod$ matrix from an unrestricted VAR and to test the restrictions implied by the reduced rank $\prod$. In order to determine the number of co-integration vectors, the trace test (λ_{trace}) and the maximum

[26] Please see Appendix B for further details.

eigenvalue statistic (λ_{max}) can be used. The trace test tests the null hypothesis of r co-integrating vectors against the alternative hypothesis of k co-integration vectors, where k is the number of endogenous variables, for $r = 0, 1, \ldots k - 1$, $[\mathrm{H}_{0(\mathrm{r})}$ against $\mathrm{H}_{\mathrm{A(k)}}]$. The alternative of k cointegration relations corresponds to the case where none of the series has a unit root. The maximum-eigenvalue test tests the null hypothesis of r co-integration vectors against the alternative hypothesis that there are $r + 1$ co-integrating relationships among the series, $[\mathrm{H}_{0(\mathrm{r})}$ against $\mathrm{H}_{\mathrm{A(r+1)}}]$, (HJALMARSSON and ÖSTERHOLM, 2010):

$$\lambda_{trace}\,(r) = -T\sum_{i=r+1}^{k}\ln\,(1-\hat{\lambda}_i) \tag{6}$$

$$\lambda_{max}\,(r, r+1) = -T\sum_{i=r+1}^{k}\ln\,(1-\hat{\lambda}_{r+1}) \tag{7}$$

Here T is the sample size and $\hat{\lambda}_i$ is the i:th largest canonical correlation.

Table 4 reports the Johansen co-integration test results, for the trace statistic and for the maximum eigenvalue statistic: The first and third columns show that the first three eigenvalues are much larger than the last eigenvalues for both tests. This suggests that there exist three co-integrated relations (r=3) at the 5% level, that is, there are three linearly independent combinations of the non-stationary variables that are stationary. As a result, the null hypotheses $r = 0$, $r \leq 1$ and $r \leq 2$ can be clearly rejected.

Table 4: Johansen's Trace Test and Maximum Eigenvalue Results

Null Hypothesis	Alternative	Test statistic	Critical value (5%)
Trace statistic			
$r = 0$	$r > 0$	187.4505	47.85613
$r \leq 1$	$r > 1$	73.60242	29.79707
$r \leq 2$	$r > 2$	19.26056	15.49471
Maximum Eigenvalue			
$r = 0$	$r = 1$	113.8481	27.58434
$r = 1$	$r = 2$	54.34186	21.13162
$r = 2$	$r = 3$	19.23433	14.26460

Note that E-Views displays the critical values forthe trace statistic reported by Osterwald-Lenum (1992), not those tabulated in Johansen and Juselius (1990). Source 14: Own calculation with the use of E-Views software.

By normalizing the coefficient of the series, estimation of the co-integration relationship enables the long-term equations to be obtained using the Johansen approach. Consequently, the three equation relations can be written as follows:

1) If there is one co-integrating relation $(r = 1)$, then the co-integrating equation has the following form[27]:

Vector 1_I:

$$UNEM_t = const. + 3.52MIG_t - 147.14LOGWAGE_t + 127.13LOGGDP_t + Z_t$$

(0.22) (33.45) (32.74) (8)

According to this result, an increase in immigration leads to an increase in unemployment in the long-run.

2) If there are two co-integrating relations $(r = 2)$, then the two co-integrating equations have the following form[28]:

Vector 1_{II}:

$$UNEM_t = const. + 86.06LOGWAGE_t - 81.29LOGGDP_t + Z_t$$

(9.04) (8.86) (9)

Vector 2_{II}:

$$MIG_t = const. + 66.43LOGWAGE_t - 59.37LOGGDP_t + Z_t$$

(9.84) (9.65) (10)

In equations 9 and 10, the variables LWAGE and LGDP are nearly proportional to each other. According to the vector 1_{II} high wages relative to per capita GDP levels lead to a higher unemployment in the long-run, whereas according to the vector 2_{II} high wages leads to a higher immigration in the long-run, which is coherent with the economic theory as well.

3) If there are three co-integrating relations $(r = 3)$, then the three co-integrating equations have the following form[29]:

Vector 1_{III}:

[27] Standard error in parentheses.
[28] Standard error in parentheses
[29] Standard error in parentheses.

$$UNEM_t = const. + 23.34 LOGGDP_t + Z_t$$

(6.48) (11)

Vector 2_{III}:

$$MIG_t = const. + 21.39 LOGGDP_t + Z_t$$

(5.01) (12)

Vector 3_{III}:

$$LOGWAGE_t = const. + 1.21\ LOGGDP_t + Z_t$$

(0.07) (13)

According to vector 1_{III}, vector 2_{III} and vector 3_{III} in equations 11, 12 and 13, an increase in GDP per capita levels lead to higher unemployment, to higher migration and to higher wage levels in the long-run, respectively.

4.4 SHORT-RUN RELATIONSHIPS

Engle and Granger (1987) have shown that co-integration implies the existence of a vector error correction model (VECM). The VECM links the long-rung equilibrium relationship implied by co-integration with the short-run dynamic adjustment mechanism that describes how the variables react when they move out of long-run equilibrium. In other words, we identify the short-run between immigration flows and the regional labor market using VECM. Based on Fromentin (2013) and Gross (2004), our four-equation-system is as follows:

$$\Delta m = \alpha_1 + \sum_k \beta_{11ik}\,\Delta u_{t-k} + \sum_k \beta_{12ik}\,\Delta w_{t-k} + \sum_k \beta_{13ik}\,\Delta m_{t-k} + \sum_k \beta_{14ik}\,\Delta y_{t-k} + \lambda_{1i} ecm_{t-1} + e_t$$

$$\Delta u = \alpha_2 + \sum_k \beta_{21ik}\,\Delta u_{t-k} + \sum_k \beta_{22ik}\,\Delta w_{t-k} + \sum_k \beta_{23ik}\,\Delta m_{t-k} + \sum_k \beta_{24ik}\,\Delta y_{t-k} + \lambda_{2i} ecm_{t-1} + u_t$$

$$\Delta w = \alpha_3 + \sum_k \beta_{31ik}\,\Delta u_{t-k} + \sum_k \beta_{32ik}\,\Delta w_{t-k} + \sum_k \beta_{33ik}\,\Delta m_{t-k} + \sum_k \beta_{34ik}\,\Delta y_{t-k} + \lambda_{3i} ecm_{t-1} + v_t$$

$$\Delta y = \alpha_4 + \sum_k \beta_{41ik}\,\Delta U_{t-k} + \sum_k \beta_{42ik}\,\Delta w_{t-k} + \sum_k \beta_{43ik}\,\Delta m_{t-k} + \sum_k \beta_{44ik}\,\Delta y_{t-k} + \lambda_{4i} ecm_{t-1} + s_t$$

where, $t = 1, 2, \ldots, T$, Δ corresponds to the first differences, $m, u, w \; and \; y$ are the endogenous variables, $\alpha_1, \alpha_2, \alpha_3 \; and \; \alpha_4$ correspond to the intercepts for each variables, ecm_{t-1} is a one-period lagged error correction term, $e_t, u_{t,} v_t \; and \; s_t$ are serially uncorrelated error terms. Note that under the hypothesis of co-integration all the variables in the ECM model are I(0).

Table 5: Results of Adjustment Coefficients from Normalized Co-Integrating Vectors:

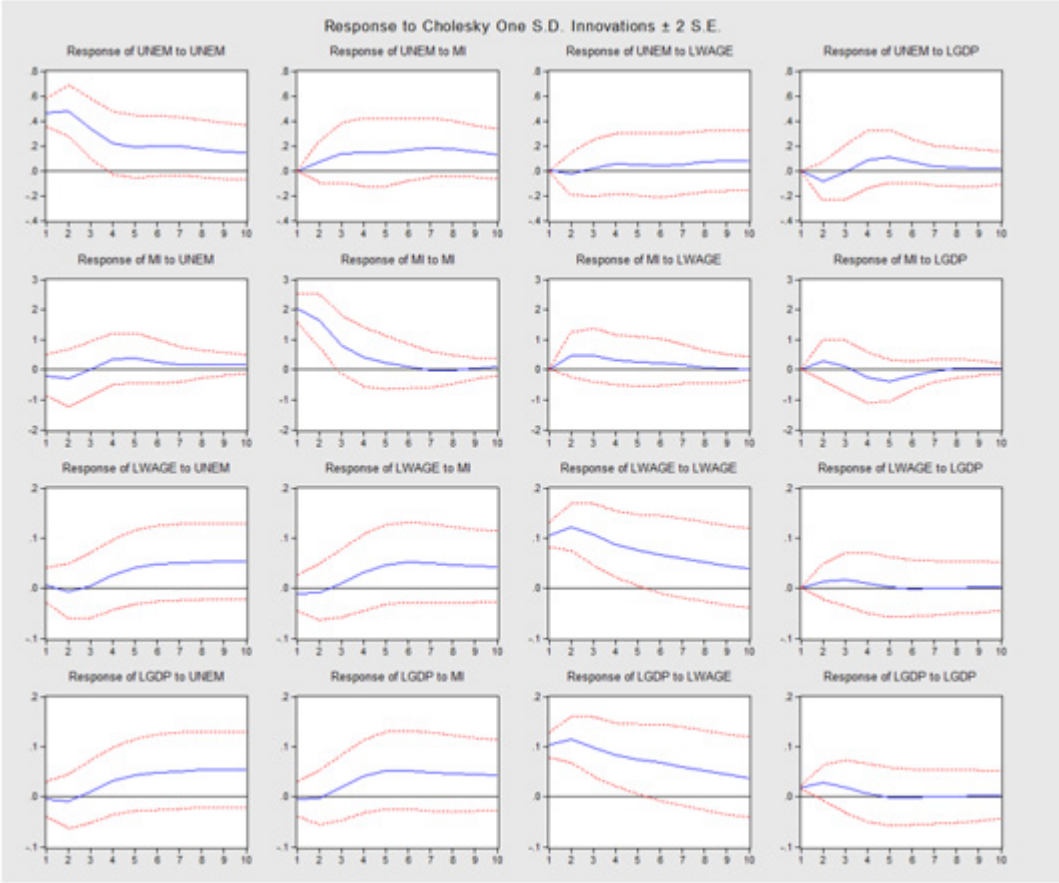
	Rank 1 (r=1)	Rank 2 (r=2)		Rank 3 (r=3)		
Variables	Vector 1_I	Vector 1_{II}	Vector 2_{II}	Vector 1_{III}	Vector 2_{III}	Vector 3_{III}
ΔUNEM	-0.086 (0.014)	-0.056 (0.133)	0.302 (0.045)	-0.048 (0.131)	0.290 (0.048)	-14.639 (11.323)
ΔMIG	0.206 (0.132)	1.937 (1.235)	-0.734 (0.424)	2.205 (0.947)	-1.118 (0.353)	-100.945 (81.649)
ΔLWAGE	-0.004 (0.005)	0.108 (0.046)	0.016 (0.016)	-0.101 (0.040)	0.028 (0.014)	-10.972 (3.463)
ΔLGDP	-0.002 (0.005)	0.084 (0.043)	0.009 (0.014)	-0.077 (0.038)	0.019 (0.014)	-8.347 (3.293)

Standard errors in parentheses. Δ corresponds to the first-differences.

According to the results in Table 5 - if there is one co-integrating relation $(r = 1)$ is assumed - then in the short-run, especially, unemployment shows a significant reaction: Migration increases, the vector UNEM-3.5MIG decreases (Equation 8), that is changes in unemployment rate (ΔUNEM) react positively only, other variables have little power of reaction. Moreover, about 8.6% (-0.086) of disequilibrium is corrected each year by changes in unemployment rate.

Furthermore, for the short-run relationship the estimates of adjustment coefficients for vector 1_{II} in Table 5 show that, wages significantly corrects the disequilibrium by 10.8% (0.108) each year by changes in unemployment rates. For vector 2_{II} only unemployment reacts to changes where about 30.2% (0.302) of disequilibrium is corrected each year by changes in immigration rates.

Figure 11: Impulse Response of Unemployment Rate on Migration Rate



Source 15: Own Calculation with the use of E-Views software: "Response to Cholesky ONE S.D Innovations +/- 2 S.E". Note that the impulse response function is statistically significant when both standard-error bands are above or below zero on the y-axis. Note also that in E-Views we selected an unrestricted VAR model with r=4.

4.5 IMPULSE RESPONSE FUNCTIONS

Due to the difficulty of interpreting the estimated coefficients for the VAR model, it is common to summarize the results by means of response to shocks. Figure 11 shows the response of the unemployment, immigration, real wages and per capita GDP levels to shocks in each variables. In particular, a shock in each variable is allowed to affect all four series, with the effect of the shock having

both short-run and long-run impacts. Using a Cholesky decomposition on the VAR model[30], the impulse response functions in Figure 11 show that a one standard shock in the change in the unemployment rate positively and significantly impacts future changes in the unemployment rate in the short-run. In the long-run, however, the effect seems to be insignificant ('Response of UNEM to UNEM')[31].

Figure 11 also shows that a one standard deviation shock to immigration increases (insignificantly) unemployment both in the short-run and in the long-run: Unemployment reaches a maximum about 3 years after the initial net migration rate shock to the economy ('Response of UNEM to MI').

Furthermore, as shown in Figure 11, real wages and per capita GDP are nearly proportional to each other. According to that a shock in the change in immigration positively and insignificantly impacts both future changes in real wages and in per capita GDP levels ('Response of LWAGE to MI' and 'Response of LGDP to MI').

Also shown in Figure 11 the impact of a shock in the change in the unemployment rate negatively and insignificantly impact future changes in immigration both in the in the short-run and in the long-run. ('Response of MI to UNEM'). The finding is in line with previous empirical studies (Pope and Withers, 1985; Marr and Siklos, 1994 and Islam, 2007) as well. Moreover, the impulse response function in Figure 11 shows also that immigration responds positively and insignificantly to real wages in the short-run, but, this effect dies off shortly and has no long-run effect ('Response of MI to LWAGE').

Summarized it can be said that only the impact of real wages on per capita GDP is positive and significant, but again, this effect dies off shortly ('Response of LGDP to LWAGE').

5. CONCLUSIONS

[30] Note that due to the yearly frequency of the data, a 10-year period after the occurrence of the shocks is used for the analysis.
[31] This also true for ('Response of MI to MI), ('Response of LAWAE to LWAGE) and ('Response of LGDP to LGDP')

This paper investigated the long-run and the short-run impacts of immigration to the Austrian labor market variables, such as unemployment rate, wage level and per capita GDP by using Johansen co-integration tests, a vector error correction model, and impulse response functions, respectively. The estimation results reveal that there exist a statistical connection between immigration and unemployment in Austria using yearly data for the period 1975-2012. The Johansen co-integration tests, through the statistics of the trace and of the maximum-eigenvalue, revealed the existence of three co-integration vectors[32]. The findings of the Johansen co-integration procedure show that the immigration rate has a significant and positive effect on the unemployment rate in the long-run in Austria. That is an increase in immigration leads to an increase in unemployment in the long-run. Contrary to this result, impulse response function, shows that the impact of immigration on the unemployment rate is positive but insignificant both in the short-run and in the long-run. Furthermore, the findings of the Johansen co-integration procedure induce also that, a higher level of wages relative to GDP per capita levels leads both to a higher level of unemployment and to immigration in the long-run, which is in line with the economic theory as well.

The vector error correction model (VECM) indicates that the changes in unemployment rate react significantly and positively to the immigration shocks in the short-run, whereas both wage levels and per capita GDP react little to the immigration shocks. One possible explanation of the positive impact of immigration on unemployment in the short-run - as emphasized by OKKERSE (2008) - could be attributed to an increase in job search time rather than to displacement of native workers. Moreover, contrary to wage levels and GDP per capita, the variations of unemployment rates have significant and positive reactions to shocks in the short-run.

Furthermore, the finding of impulse response functions shows that the impact of unemployment on immigration, and vice versa, is insignificant, whereas the impact of real wages on per capita GDP seems to be positive and significant, but, this effect dies off shortly.

[32] Note that the interpretation of the results depend crucially on the number of co-integration relations and its difficulty increases the more co-integrating ranks exist.

6. REFERENCES

Altonji, J., & Card, D. (1991). *The effects of immigration on the labor market outcomes of less-skilled natives. In J. Abowd and R. Freeman (eds), Immigration, Trade, and the Labor Market (pp.201-234).* Chicago: IL: University of Chicago Press.

Angrist, J., & Kugler, A. (2002). *Protective or Counter Productive? Labr Market Institutions and the Effect of Immigration on EU natives.* The Economic Journal. 113: 302-331.

Austrian Social Security Database (ASSD). (n.d.). Retrieved from http://iambweb.ams.or.at/ambweb/

Biffl, G. (2004). *The impact of immigration on Austria's Society.* Vienna: A survey of recent Austrian migration research.

Blanchflower, D., Saleheen, J., & C., S. (2007). *The Impact of Recent Migration from Eastern Europe on the UK Economy.* UK: Research paper based on speech at te Cambrigeshire Chamber of Commerce, 4th January.

Boeri, T., & Brücker, H. (2005). *Migration, Co-ordination Failures and EU Enlargement.* Germany: IZA. Discussion Paper No. 1600.

Borjas, G. (1994). *The Economics of Immigration.* Journal of Economic Literature, Vol.32, No.4, pp. 1667-1717.

Borjas, G. (1996). *The New Economics of Immigration. Affluent Americans Gain; Poor Americans Lose*. Retrieved from THE Atlantic Online: http://www.theatlantic.com/past/docs/issues/96nov/immigrat/borjas.htm

Borjas, G. (2007). *Labor Economics, Sixth Edition.* McGraw-Hill Internation Edition 2013.

Borjas, G., & Katz, L. (2005). *The Evolution of the Mexican-born workforce in the United States.* NBER Working Paper. No. 11281.

Borjas, G., Freeman, R., & Katz, L. (1992). *On the labor market effects of immigration and trade. In g.Borjas and R.B Freeman (eds), Immigration and the Work Force: Economic Consequences for the United States and Source Areas (pp.213-214).* Chicago: IL: National Bureau of Economic Research, University of Chicago Press.

Brandel, F. H. (1994). *Verdrängungsprozesse am Arbeitsmarkt.* Vienna: Research Memorandum No. 345, Institute for Advanced Studies.

Card, D. (2001). *Immigrant Inflows, Native Outflows, and the Local Market Impacts of higher Immigration .* Journal of Labor Economics. 19: 22-64.

Card, D. (2007). *How Immigration affects U.S. Cities.* Center for Research and Analysis of Migration, Discussion Paper Series CDP No. 11/07.

Carter, S., & R., S. (2006). *Labor Market Flooding? Migrant Destination and Wage Change during America's Age of Mass Migration.* Manuscript.

Chiswick, B. (1982). *The impact of immigration on the level and distribution of economic well-being.* Washington DC: American Enterprose Institue for Public Policy Research.

De New, J., & Zimmermann, K. (1994a). *Blue collar labor vulnerability: wage impacts of migration. In G.Steinmann and R.E Ulric (eds), The Economic Consequences of Immigration to Germany (pp. 81-99). .* Heidelberg: Physica.

De New, J., & Zimmermann, K. (1994b). *Native wage impacts of foreign labor: a random effects panel analysis.* Journal of Population Economics 7: 117-192.

DiNardo, J. (1997). *Comments and Discussion.* Broking Papers on Economic Activity 1: 68-76.

Dvorak, J. a. (2011). *Staat-Migration-Globalisierung.* Wien: Facultas.

ELISweb- Wirschafts-und Arbeitsmarktinformationssystem. "Entwicklung des AusländerInnenarbeitsmarktes seit 1975". (n.d.). Retrieved from Ein Service des APF-Teams der Sektion VI/6 im Bundesministerium für Arbeit, Soziales und Konsumentenschutz.: http://www.dnet.at/elis/Arbeitsmarkt.aspx

Engle, R., & Granger, C. (1987). *Co-integration and error correction: representation, estimation and testing.* Econometrica. 55:251-276.

Feridun, M. (2005). *Investigating the Economic Impact of Immigration on the Host Country: the Case of Norway.* Journal of Economic Perspectives. 9: 23-44.

Feridun, M. (2007). *Immigration, Income and Unemployment: An Application of the Bounds Testing Approaoch to Cointegration.* Journal of Developing Areas, 41(1), 37-51.

Friedberg, R. M., & Hunt, J. (2005). *The Impact of Immigrants on Host Country Wages, Employment and Growth.* Journal of Economic Perspectives, 9(2): 23-44.

Fromentin, V. (2013). *The Relationship between Immigration and Unemployment: The Case of France.* France: Economic Analysis and Policy. Vol. 43, p. 51-66.

Goldin, C. (1994). *The political economy of immigration restriction in the United States, 1890 to 1921. In G.Goldin and G. Libecap (eds), The Regulated Economy: An Historical Analysis of Political Economy (pp.223-257).* Chicago: IL: University of Chicago Press.

Greenwood, M., & McDowell, J. (1994). *The national labor market consequences of US immigration. In H.Giersch (ed.), Economic Aspects of Internatinal Migration (pp. 155-194).* Heidelberg: Springer.

Gross, D. (1998). *Immigration Flows and Regional Labor Market Dynamics. .* IMF Working Paper.

Gross, D. (1999). *Three Million Foreigners, Three Million Unemployled? Immigration and the French Labor Market.* Working Paper, International Monetary Fund.

Gross, D. (2002). *Financial Intermediation: A Contributing Factor to Economic Growth and Employment.* ILO Working Papers 351412, International Labour Organization.

Gross, D. (2004). *Impact of Immigrant Workers On A Regional Labour Market.* Applied Economic Letters. 11: 405-408.

Hjalmarsson, E., & Österholm, P. (2010). *Testing for Cointegration Using the Johansen Methodolog when Variables are Near-Integrated.* IMF Working Paper. WP/07/141.

Islam, A. (2007). *Immigration, Unemployment Relationship the Evidence from Canada.* Australian Economic Papers. 46: 52-66.

Jaeger, D. (1995). *Skill differences and the effect of immigrants on the wages of natives.* US Bureau of Labor Statistics Economic Working Paper No. 273.

Johansen, S. (1988). *Statistical analysis of cointegrating vectors.* Journal of Economic Dynamics and control. 12:231-254.

Johansen, S. (1991). *Estimation and hypothesis testing of cointegration vectors in Gaussian vectors autoregressive models.* Econometrica. 59: 1551-1580.

Johnson, G. (1996). *The labor market effects of immigration.* Industrial and Labor Relations Review 33(3): 331-341.

Lemos, S., & Portes, J. (2008). *New Labour? The Impact of Migration from Central and Eastern European Countries on the UK Labour Market.* IZA Discussion Papers 3756. Institute for the Study of Labor (IZA).

MacKinnon, J. (1991). *"Critical Values for Cointegration Tests," in Long-Run Economic Relationships, Readings in Cointegration, eds. R.F Engele nad C.W.J Granger .* New York: Oxford University Press, pp. 266-276.

Marr, W., & Siklos, P. (1994). *The Link Between Immigration and Unemployment in Canada.* Journal of Policy Modeling 16(1): 1-25.

Marr, W., & Siklos, P. (1995). *Immigration and Unemployment: A Canadian Macroeconomic perspective, in : D.J. DeVoetz (ed.), Diminishing*

Returns: The economics of Canada's recent Immigration Policy. Toronto: The C.D: Howe Institute and the Laurier Institution: 293-330.

Mayr, K. (2004). *The Fiscal Impact of Immigrants in Austria- A Generational Accounting Analysis .* Linz: Working Paper No. 0409.

Mayr, K., & Prean, N. (2012). *Unemployment of immigrants and natives over the business cycle: evidence from the Austrian labor market.* Austria: NORFACE Migration Discussion Paper 2012-19 and NRN: The Austrian Center for Labor Economics and the Analysis of the Welfare State, Working Paper 1210.

Media Arbeiterkammer: Arbeitsmarkt im Fokus. Arbeitsmarktanalyse des 1. Halbjahres 2013. (2013). Retrieved from http://media.arbeiterkammer.at/PDF/Arbeitsmarkt_im_Fokus_1_2013.pdf

Medien-Serviecestelle. Neue ÖsterreicherInnen. Das Portal für JournalistInnen zu Migration und Integration. (2001, 5 25). Retrieved from http://medienservicestelle.at/migration_bewegt/2011/05/25/neue-osterreichische-migrationsgeschichte/

Mückler, H. (2004). *Migrationsdynamiken: Auslöser, Erklärungsmodelle, Konsequenzen.* WUV-Univ.-Verl.

Okkerse, L. (2008). *How to Measure Labour Market Effects of Immigration: A Review .* Journal of Economic Surveys. 22: 1-30.

Orrenius, P., & Zavodny, M. (2013). *Immigrants in the U.S. Labor Market.* USA: Federal Reserve Bank of Dallas. Research Depertment. Working Paper 1306. .

Osterwald-Lenum, M. (1992). *A Note with Quantiles of the Asymptotic Distribution of the Maximum Likelihood Cointegration Rank Test Statistics.* Oxford Bulletin of Economics and Statistics 54(3): 461-472.

Pope, D., & Withers, G. (1985). *Immigration and Unemployment.* Economic Record 61: 554-563.

Pope, D., & Withers, G. (1993). *Do migrants rob jobs? Lessons of Australian history, 1861-1991.* Journal of Economic History 53(4): 719-742.

Ruhs, M. (2006). *Greasing the Wheels of the flexible labour market: East European Labour Immigration in the UK.* Centre on Migration, Policy and Society. Working Paper No.38, University of Oxford.

Shan, J., Morris, A., & Sund, F. (1999). *Immigration and Unemployment: New Evidence from Australia and New Zealand. .* International Review of Applied Economics 13(2): 253-260.

Statistik Austria: "Wanderungen (Zuzüge und Wegzüge)". (n.d.). Retrieved from www.statistik.at/web_de/statistiken/bevoelkerung/wanderungen/index.html

Statistik Austria: Einbürgerungen seit 1946 nach Bundesländern. (n.d.). Retrieved from http://www.statistik.at/web_de/statistiken/bevoelkerung/einbuergerungen/index.html

United Nations, U. (2013). *Department of Economic and Social Affairs - Population Division (2013).* International Migration Report 2013.

Winter-Ebmer, R., & Zweimüller, J. (1996). *Immigration and the earnings of young native workers.* Oxford Economic Papers 48: 473-491.

Winter-Ebmer, R., & Zweimüller, J. (1999). *Do Immigrants Displace Young Native Workers: The Austrian Experience.* Austria: Journal of Population Economics, Vol. 12, 1999, 327-340.

Winter-Ebmer, R., & Zweimüller, J. (2000). *Consequences of trade creation and increased immigration for the Austrian labour market. In M.Landesmann and K. Pichelmann (eds), Unemployment in Europe (pp.250-267).* Basingstoke: Macmillan.

Zivot, E., & Andrews, D. (1992). *Further Evidence on the Great Crash, the Oil-Price Shock, and the Unit-Root Hypothesis.* Journal of Business and Economic Statistics. Vol.10, No.3, p. 251-270.

7. APPENDIX A

Unit Root Tests:

For unit root test we use augmented Dickey-Fuller (ADF) test and Phillips-Perron (PP) test.

1. **The Augmented Dickey-Fuller (ADF) Test**

   Consider first an AR(1) process, and for the moment let's ignore the deterministic trend:

   $$y_t = \mu + p y_{t-1} + \varepsilon_t, \qquad (1.1)$$

   where μ is a constant and p is a coefficient parameter. ε_t is assumed to be white noise: $(\varepsilon_t \sim iid.N\,(0,\Omega))$ and y is a stationary series if $-1 < p < 1$.

   The unit root test is then carried out for the null hypothesis $p = 1$ against the one-sided alternative hypothesis of $p < 1$:

   $$H_0: p = 1 \; vs \; H_1: p < 1$$

Note that PP tests take also the unit root as the null hypothesis.

Subtracting y_{t-1} from both sides of the equation (1) yields:

$$y_t - y_{t-1} = \mu + py_{t-1} - y_{t-1} + \varepsilon_t \quad (1.2)$$

$$\Delta y_t = \mu + y_{t-1}(p-1) + \varepsilon_t \quad (1.3)$$

where Δ is the first-difference operator. Using $(p-1) = \gamma$, we get:

$$\Delta y_t = \mu + \gamma y_{t-1} + \varepsilon_t \quad (1.4)$$

Thus, the null and alternative hypotheses are

$$H_0: \gamma = 0 \; vs \; H_1: \gamma < 0$$

The null hypothesis is that the variable contains a unit root ("y_t is a random walk") and implies that the variables are non-stationary. The alternative hypothesis is that the variable does not contain unit root ("y_t is a stationary AR(1)"). Under the null, y_t is first order integrated: $I(1)$, because it is stationary after one difference. Under the alternative it is a mean reverting AR(1).

Moreover, the t-statistic under the null hypothesis of a unit root does not have the conventional t-distribution. For this reason MacKinnon (1991) critical values for unit root tests are taken into account. Notice that the test is left-tailed.

When testing for unit roots, it is crucial to specify the null and alternative hypotheses appropriately to characterize the trend properties of the data at hand. Thus, whether the null hypothesis includes a drift term and whether the regression used to obtain the test statistic includes a constant term and time trend.

Two other cases of test equation:

a.) Without intercept and without trend:

$$y_t = py_{t-1} + \varepsilon_t$$

$$y_t - y_{t-1} = py_{t-1} - y_{t-1} + \varepsilon_t$$

$$\Delta y_t = (p-1)y_{t-1} + \varepsilon_t$$

$$\Delta y_t = \gamma y_{t-1} + \varepsilon_t$$

Thus, the null and alternative hypothesis of ADF t-test is

$$H_0: p = 1 \; \leftrightarrow \; H_0: \gamma = 0$$

$$H_1: p < 1 \; \leftrightarrow H_1: \gamma < 0$$

The null hypothesis is that the variable contains a unit root and implies that the variables are non-stationary.

b.) With intercept and trend.

$$y_t = \mu + py_{t-1} + \lambda t + \varepsilon_t$$

$$y_t - y_{t-1} = \mu + py_{t-1} - y_{t-1} + \lambda t + \varepsilon_t$$

$$\Delta y_t = \mu + (p-1)y_{t-1} + \lambda t + \varepsilon_t$$

$$\Delta y_t = \mu + \gamma y_{t-1} + \lambda t + \varepsilon_t$$

Thus, the null and alternative hypothesis of ADF t-test is

$$H_0 : p = 1 \leftrightarrow H_0 : \gamma = 0$$

$$H_1 : p < 0 \leftrightarrow H_1 : \gamma < 0$$

The null hypothesis is that the variable contains a unit root and implies that the variables are non-stationary. Under the alternative it is trend stationary.

2. Phillips-Perron (PP) Test:

Consider first an AR(1) process, and for the moment let's ignore the deterministic trend:

$$y_t = \alpha + \beta y_{t-1} + \varepsilon_t, \quad (2.1)$$

where α is a constant parameter and β is a coefficient parameter. ε_t is assumed to be white noise: $(\varepsilon_t \sim iid.N\,(0,\Omega))$ and y is a stationary series if $-1 < \beta < 1$.

$$y_t = \alpha + \beta y_{t-1} + \varepsilon_t \quad (2.2)$$

$$y_t - y_{t-1} = \alpha + \beta y_{t-1} - y_{t-1} + \varepsilon_t \quad (2.3)$$

$$\Delta y_t = \alpha + \beta y_{t-1} + \varepsilon_t \quad (2.4)$$

In (2.4), ε_t might be autocorrelated. The Phillips-Perron (PP) Test uses a non-parametric method of controlling for higher-order serial correlation. In this sense, the PP test statistic is a Dickey-Fuller statistic that has been made robust to serial correlation by using the Newey-West autocorrelation consistent covariance matrix estimator:

$$\widehat{w}^2 = \gamma_0 + 2\sum_{v=1}^{q}(1 - \frac{v}{q+1})\gamma_j,$$

where

$$\gamma = (\sum_{t=j+1}^{T} \hat{\varepsilon}_t\, \hat{\varepsilon}_{t-j})/\mathrm{T}$$

and q is the truncation lag. The PP t-statistic is computed as

$$t_{pp} = \frac{\gamma_0^{1/2} t_b}{\hat{w}} - \frac{(\hat{w}^2 - \gamma_0) T_{s_b}}{2\hat{w}s}$$

where t_b, s_b are the t-statistic and standard error of β and s is the standard error of the test regression. The critical values are the same as for the Dickey-Fuller statistic and again we use McKinnon's critical values.

8. APPENDIX B

When time series variables are non-stationary, it is interesting to see if there is a certain common trend between those non-stationary series. If two non-stationary series $X_t \sim I(1), Y_t \sim I(1)$ have a linear relationship such that $Z_t = m + \alpha X_t + \beta Y_t$, ($Z_t$ is stationary), then we call the two series X_t and Y_t are co-integrated. Thus, Johansen's Approach to co-integration (1987) is used.

The two time series are summarized to a vector of y_t and transferred in a VAR model.

$$y_t = A y_{t-1} + \theta + \varepsilon_t, \quad (1)$$

where y_t is a $k\,x\,1$ vector of endogenous variables, A is the $k\,x\,k$ matrix of coefficients, θ is a $k\,x\,1$ vector of constants and ε_t is a $k\,x\,1$ of error terms that are assumed to be white noise Gaussian ($\varepsilon_t \sim iid.N\,(0, \Omega)$).

Matrix notation:

$$y_t = \begin{pmatrix} y_t^1 \\ y_t^2 \end{pmatrix}, y_{t-1} = \begin{pmatrix} y_{t-1}^1 \\ y_{t-1}^2 \end{pmatrix}, A = \begin{pmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{pmatrix}, \theta = \begin{pmatrix} \theta_0^1 \\ \theta_0^2 \end{pmatrix}, \varepsilon_t = \begin{pmatrix} \varepsilon_t^1 \\ \varepsilon_t^2 \end{pmatrix}. \quad (2)$$

The VAR model contains for each row a separate equation and can be easily generalized to higher lags p. A *p-th* order VAR, denoted $VAR(p)$, is

$$y_t = A_1 y_{t-1} + \ldots + A_p y_{t-p} + \theta + \varepsilon_t, \quad (3)$$

It is also possible to take real exogenous repressors as vector x_t into the VAR model;

$$y_t = A_1 y_{t-1} + \ldots + A_p y_{t-p} + B x_t + \varepsilon_t, \quad (4)$$

where y_t is a vector of non-stationary $I(1)$ variables, $A_1 - A_p, B$ are $k\,x\,k$ matrices of coefficients to be estimated and x_t is a vector of deterministic variables (that may contain a constant, a linear trend and seasonal dummies).

A VAR model can be rewritten as a Vector Error Correction Model (VECM) (trick $y_t = y_{t-1} + \Delta y_t$) . For a VAR of order two, denoted as VAR (2), it can be formulated:

$$y_t = A_1 y_{t-1} + A_2 y_{t-2} + Bx_t + \varepsilon_t \quad |+ A_2 y_{t-1} - A_2 y_{t-1} \tag{5}$$

$$y_t = A_1 y_{t-1} - A_2(y_{t-1} + y_{t-2}) + A_2 y_{t-1} + Bx_t + \theta + \varepsilon_t \tag{6}$$

$$y_t = (A_1 + A_2) y_{t-1} - A_2(y_{t-1} - y_{t-2}) + Bx_t + \theta + \varepsilon_t \; |-y_{t-1} \tag{7}$$

$$y_t = (A_1 + A_2 - I)\, y_{t-1} - A_2(y_{t-1} - y_{t-2}) + Bx_t + \theta + \varepsilon_t, \tag{8}$$

$$\Delta y_t = \prod y_{t-1} + A_2 \Delta y_{t-1} + Bz_t + \theta + \varepsilon_t \tag{9}$$

where I is the identity matrix.

For general p, VAR(p) can be written as

$$\Delta y_t = \prod y_{t-1} + \sum_{i=1}^{p-1} \Gamma_i \Delta y_{t-i} + Bz_t + \theta + \varepsilon_t, \tag{10}$$

where $\prod = \sum_{i=1}^{p} A_i - I$ (11)

and

$$\Gamma_i = -\sum_{j=i+1}^{p} A_j. \tag{12}$$

where, Δ is the first-difference operator and $\Gamma_i (i = 1, 2, \dots, p-1)$ are $k\,x\,k$ matrices of coefficients, where p is the number of lags.

A result from linear algebra implies that, if the coefficient matrix $\prod$ has reduced rank $0 < r < K$, then there exist $k\,x\,r$ matrices α and β each with rank r such that $\prod = \alpha\beta'$ and $\beta' y_t$ is $I(0)$. Granger's representation theorem then states that β can be interpreted as co-integrating vectors.

Thus, equation (10) can be rewritten as:

$$\Delta y_t = \alpha\beta' y_{t-1} + \sum_{i=1}^{p-1} \Gamma_i \Delta y_{t-i} + Bz_t + \theta + \varepsilon_t, \tag{13}$$

where $\alpha\beta' = -\Gamma(1) = -I_k + \Gamma_1 + \Gamma_2 + \dots + \Gamma_p$

Furthermore, r is the number of cointegrating vectors (the cointegration rank) and each column of β is the cointegration vector. One motivation for the VECM (p) form is to consider the relation $\beta' y_t = c$ as defining the underlining economic

relations and assume that the agents react to the disequilibrium error $\beta' y_t - c$ through the adjustment coefficient α to restore equilibrium; that is, they satisfy the economic relations. The co-integrating vector β is sometimes called the **long-run parameters**. Thus, Johansen's method is to estimate the $\prod$ matrix from an unrestricted VAR and to test whether we can reject the restrictions implied by the reduced rank$\prod$.

Interpretation of $\Delta \boldsymbol{y_t} = \prod \boldsymbol{y_{t-1}} + \sum_{\boldsymbol{i=1}}^{\boldsymbol{p-1}} \boldsymbol{\Gamma_i} \Delta \boldsymbol{y_{t-i}} + \boldsymbol{B z_t} + \boldsymbol{\varepsilon_t}$**:**

1. If $\prod = 0 \Leftrightarrow rank\,(\prod) = 0,$ then there is no cointegration. Non-stationarity of $I(1)$ type vanishes by taking differences. That is y_t are stationary in difference.
2. If $\prod$ has full rank $\Leftrightarrow rank\,(\prod) = \mathrm{k}$, then the $y's$ cannot be $I(1)$ but are stationary, so that all components of y_t are $I(0)$.
3. The most interesting case is $rank\,(\prod) = \mathrm{r}$, where $0 < r < k,$ as this is the case of cointegration. That is there are $k - r$ linear combinations that are non-stationary and r stationary cointegrating relations. In other words, we write

$$\prod = \alpha\beta'.$$

$$(kxk) = (kxr)[(\mathrm{kxr})']$$

where the columns of β contain the r cointegrating vectors, and the columns of α the r adjustment vectors.

Test for the Co-integration:

In order to distinguish between trend stationary and drift stationary series, the Johansen-test (1995) is applied as follows:

1. The time series have linear trend and the co-integrating equations have intercepts:

$$H_1^*(r): \prod \mathrm{y_{t-1}} + Bx_t = \alpha(\beta' y_{t-1} + p_0) + \alpha\,\gamma_0$$

2. The time series have linear trend and the co-integrating equations have linear trends:

$$H^*(r): \prod \mathrm{y_{t-1}} + Bx_t = \alpha(\beta' y_{t-1} + p_0 + p_1 t) + \alpha\,\gamma_0$$

In order to test the number of co-integration vectors, the *trace test* (λ_{trace}) and the *maximum-eigenvalue statistic* (λ_{max}) are used in this model. The trace test tests the null hypothesis of r co-integrating vectors r against the alternative hypothesis of k co-integration vectors, where k is the number of endogenous variables, for $= 0, 1, \ldots k - 1$, $[H_{0(r)}\ against\ H_{A(k)}]$. The alternative of k cointegration relations corresponds to the case where none of the series has a unit root. The maximum-eigenvalue test tests the null hypothesis of r co-integration vectors r against the alternative hypothesis that there are $r + 1$ cointegrating relationships between the series, $[H_{0(r)}\ against\ H_{A(r+1)}]$:

$$\lambda_{trace}\ (r) = -T \sum_{i=r+1}^{k} \ln\ (1 - \hat{\lambda}_i) \quad (14)$$

$$\lambda_{max}\ (r, r+1) = -T \sum_{i=r+1}^{k} \ln\ (1 - \hat{\lambda}_{r+1}) \quad (15)$$

Here T is the sample size and $\hat{\lambda}_i$ is the i:th largest canonical correlation.

Note that in some cases trace and maximum-eigenvalue tests may yield different results. Which of the two tests should be given priority, this is somehow unsettled in the literature. Most authors tend to prefer the trace version.

9. CV

Cihan Yaylali, Bakk. rer. soc. oec

Nationality: Turkish
Marital status: single
E-Mail: cihanyaylali@gmail.com

Ausbildung

-Master in economics at the University of Vienna
2012-214
-Bachelor in economics at the Karl-Franzens-University in Graz
2007-2009
-Bachelor in constructional engineering at TU-Graz
2006-2007
-AHS-Matura
BORG Dreierschützengasse Graz
2005

Publications

-In the modulus Gesundheit-und Pharmaökonomie: Bachelor thesis: "Patente in der Pharmabranche, 2012".

-In the modulus Wachstum und Verteilung: Bachelor thesis: "Industriliazation and the Big Push, 2009".