# Business cycles and international migration among OECD countries*

Michel Beine†, Pauline Bourgeon ‡and Jean-Charles Bricongne§

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**Abstract**

Traditional theories of integration such as the optimum currency area approach attribute a prominent role to international labour mobility in coping with relative business cycle fluctuations between countries. However, recent studies on international migration have overlooked the role of short-run factors in explaining international migration flows. This paper aims to fill that gap. We first derive a model of optimal migration choice based on an extension of the traditional Random Utility Model. Our model predicts that an improvement in economic activity in a potential destination country relative to any origin country may trigger some additional migration flows on top of the impact exerted by long-run factors such as the wage differential or the bilateral distance. Compiling a dataset with annual gross migration flows between 30 developed origin and destination countries over the 1980-2010 period, we empirically test the magnitude of the effect of short-run factors on bilateral flows. Our econometric results indicate that relative business cycles and employment rates affect the intensity of bilateral migration flows. We also provide compelling evidence that the Schengen agreements and the introduction of the euro significantly raised the international mobility of workers between the member countries.

**JEL Classification:** F22, O15. **Keywords:** International Migration, Business cycles, OECD countries, Income Maximization.

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†CREA, University of Luxembourg, CES-Ifo and Banque de France, michel.beine@uni.lu

‡Banque de France and Université Paris 1 - Panthéon Sorbonne

§Banque de France

# 1 Introduction

International movements of workers between OECD countries have steadily increased over the last 50 years. According to OECD data, this trend clearly intensified as of the early 1980s.[1] Historically, migration has always been a labor market alternative for economic agents. In the face of adverse economic developments, households or workers may choose to migrate to a particular external country (from a set of alternative destinations) based on considerations that are essentially related to expectations regarding future income. Such decisions are generally based on their perceptions of current and future economic conditions both within their country of origin and in a number of potential destinations. Although many other factors are relevant for migration decisions, this paper focuses on the role of short-run economic factors in shaping the migration choice, and in particular on the role of business cycle fluctuations and employment prospects.

For many years, economists have considered labour mobility as an important macroeconomic adjustment mechanism. The literature on optimum currency areas pioneered by Robert Mundell in 1961, has underscored the role of labor mobility as an adjustment mechanism within a currency union in the face of asymmetric shocks between the participating countries or regions. The criterion of labour mobility has been used as a key measure in assessing whether or not a particular area represents a so-called optimum currency area. Indeed, during the 90s, numerous studies disqualified Europe as an optimum currency area because of its lack of labour mobility. In contrast, Blanchard and Katz (1992) argued that labour mobility could be seen as a dominant adjustment mechanism in reaction to transitory fluctuations in the United States. In the absence of reliable data on labour movements, the supporting evidence was however obtained via an indirect analysis based on a VAR approach involving price, wage and unemployment dynamics. One of the underlying assumptions used to infer the degree of labour mobility is that labor mobility will induce wage and employment adjustment. This is a debatable assumption in the light of recent literature on the impact of immigration on wages (Borjas et al. (1996), Card (2001), Docquier et al. (2011)). As an alternative to this indirect approach, this paper proposes a direct analysis of the relationship between labour mobility and business cycle fluctuations, taking advantage of new data on migration flows and building on recent developments in microfounded estimable gravity models. In other words, our aim is to tackle an old problem with a fresh approach.

In particular, we test how international migration flows react to economic fluctuations in a sample of mostly OECD countries. To do so, we build and use data of annual migration flows between 30 countries over the 1980-2010 period. We also focus on the European Monetary Union and in particular on the impact of the Schengen agreements and the EMU itself on the degree of labour mobility between European countries. Such an investigation might be useful in assessing whether Europe may be more of an OCA ex-post rather than ex-ante.[2] If the

[1] Cf. OECD, International Migration Outlook 2007.

[2] Work in this area was primarily conducted in the 90s, but using different criteria. See for instance Frankel and Rose (1998) relating trade integration to the asymmetry in business cycle fluctuations.

integration process itself leads to a change in the sensitivity of labour mobility to asymmetric shocks, this in turn lowers the need to rely on alternative adjustment mechanisms within a monetary union.

Our analysis belongs to the extensive literature on the determinants of migration. Up to now, this literature has mostly focused on long-run factors of an economic, geographic, cultural and demographic nature.[3] We build on this extensive literature and extend it by looking at the specific marginal role of short-run factors such as the business cycle and the employment rate. In doing so, we integrate the traditional impact of long-run factors identified in the previous literature in order to isolate the specific role of the short-run variables.

There is, however, a body of recent literature acknowledging the importance of short-run factors. Coulombe (2006) empirically investigates the determinants of internal labor mobility in Canada. He finds an important role for the wage differentials between Canadian provinces but finds no impact from business cycle fluctuations. Simpson and Sparber (2012) disentangle the reaction of immigrant inflows to short-run and long-run factors between American States. Other papers also consider these short-run factors in an international perspective. Mc Kenzie, Thoharrides and Yang (2010) focus on the impact of economic fluctuations in destinations on the intensity of emigration from the Philippines. Bertoli et al. (2013b) analyze the reaction of German immigration flows to the onset of the economic crisis in Europe. We contribute to this literature by generalizing this type of approach to a large set of origin and destination countries over a period including various episodes of macroeconomic fluctuations. In turn, the use of a large pool of origin and destination countries observed over a relatively long period gives additional flexibility in the empirical identification of the factors. One important element is our use of relative measures of business cycle fluctuations and employment rates allowing the capture of situations in both origin and destination countries.

Our empirical strategy directly results from the derivation of a random utility model commonly used in the literature of determinants of migration (Borjas (1987), Grogger and Hanson (2011), Beine et al. (2011)). The income maximization framework allows the capture of migrants' choices of destination from a set of alternative destinations. The traditional benchmark model is extended to allow some role for short-run factors. In the model, business cycles and current employment rates exert an ultimate role on migration as they signal the evolution of future employment opportunities for economic agents. The theoretical equilibrium then leads to a pseudo-gravity model of international migration which can be readily estimated (Anderson, (2011)).

To sum up, our contribution is thus fourfold. First, we look at the importance of cyclical shocks

[3]Since the early work of Mayda (2010), empirical literature on the determinants of migration has developed rapidly. For instance, among many others, Chiquiar and Hanson (2005) focus on the role of education. Grogger and Hanson (2011) look at the role of wages while Rosenzweig (2006) focuses on skill prices. Other papers such as Beine et al. (2011) or McKenzie and Rapoport (2010) look at the role of networks. Clark, Hatton and Williamson (2007) investigate the role of distance in a broad sense. Beine and Parsons (2012) focus on push factors like climatic shocks and natural disasters. Bertoli and Fernandez-Huerta Moraga (2012) investigate the role of bilateral migration policies.

in explaining international migration flows in a cross-country perspective. Second, we derive an empirical specification with theoretical microfoundations. Third, we compile a complete dataset of annual gross bilateral flows covering a large set of countries over 1980-2010 and including macroeconomic indicators both at origin and at destination. Fourth, this overall framework allows us to account for short-run and long-run factors within the same model. Our results suggest that short-run economic developments (business cycles fluctuations and employment prospects) both at origin and at destination affect the level of bilateral migrant flows on top of the long-run factors such as the wage differential. As a by-product of the empirical analysis, we also provide evidence that the Schengen agreements and the introduction of the euro significantly raised international mobility between the countries.

The remainder of the paper is organized as follows. Section 2 presents the theoretical foundations of our empirical model. Section 3 describes in detail the data used, thereby providing a number of stylized facts on migration flows. Section 4 outlines the econometric model(s) and presents the main empirical results and section 5 concludes.

# 2 Theoretical background: the income maximization approach

Our theoretical foundation is derived from the income maximization framework, which is used to identify the main determinants of international migration and to pin down our empirical specification. The income maximization approach was first introduced by Roy (1951) and Borjas (1987) and further developed by Grogger and Hanson (2011) and Beine et al. (2011). It is also directly related to the extensive literature dealing with discrete choice models initiated by the seminal work of McFadden (1974). This approach allows the capture of migrants' choices of destination from a set of alternative destinations. The theoretical equilibrium leads to the use of pseudo-gravity models of international migration which can be readily estimated (on this point, see Anderson (2011)). One of the main strengths of the income maximization approach is its ability to generate predictions in line with the recent (macro-economic) literature on international migration. By grounding our empirical specification in a theory with a well-established track record, we try to eliminate any ad-hoc specifications and to rationalize the obtained empirical relationships. This model has been successfully applied to analysis of the impact of various determinants of international migration. For instance, it has been used to capture the specific role of wage differentials (Grogger and Hanson (2011)), the significance of social networks (Beine et al. (2011 a and b)), the "brain-drain" phenomenon (Gibson and McKenzie, (2011)) and the impact of climatic factors (Beine and Parsons (2012)).

Our model considers homogeneous agents who decide whether or not to migrate, and then their optimal destination in the event they should decide to move. Agents therefore maximize their expected utility across the full set of possible destinations which includes the home country as well as all possible foreign countries globally. In this study, we analyze migrations among developed countries. All included countries are therefore considered as potential origin and destination countries. Time is included and the model is estimated over a period ranging from 1980 onwards using annual data. In contrast with the Benchmark model of Random Utility Maximisation used by McFadden (1974), we do not assume full employment at origin and destination. In the traditional model, agents do not face any uncertainty about future employment, so that what matters for their optimal decision is only the amplitude of wage differential and the level of migration costs. In a world with unemployment rates closer to 10% rather than to what can be viewed as the natural unemployment rate, this assumption may well be too strong. We have therefore extended the traditional RUM approach and assumed that agents will form expectations of future employment based on information provided by the current state of the economy. This involves the current level of economic dynamism (here, the business cycle) and the current employment rate.

## 2.1 Utility, income, unemployment and expectations

An individual's utility is log-linear in expected income ($E(y_{i,t})$) and depends on the characteristics of their country of residence, the characteristics of any particular destination among the set of potential destinations, and the costs of moving between the origin and the selected destination.[4] The utility of an individual born in country $i$ and staying in country $i$ at time $t$ is given by:

$$u_{ii,t} = ln(E(y_{i,t})) + A_{i,t} + \varepsilon_{i,t} \tag{1}$$

where $A_i$ denotes country $i$'s characteristics (amenities, public expenditures,social benefits and other push or pull factors) and $\varepsilon_{i,t}$ is a iid extreme-value distributed random term. The utility related to migration from country $i$ to country $j$ at time $t$ is given by:

$$u_{ij,t} = ln(E(y_{j,t})) + A_{j,t} - C_{ij,t}(.) + \varepsilon_{j,t} \tag{2}$$

where $C_{ij,t}(.)$ denotes the migration costs of moving from $i$ to $j$ at time $t$.

Agents form expectations regarding the future incomes prevailing in all possible destinations including their country of origin. Expected incomes in country $i$ and country $j$ are given by the expected income conditional upon being employed (the average wage level) times the expected probability of being employed in that country. We suppose that each individual receives some unemployment benefits in his/her native country denoted by $B$ but not abroad. For the sake of simplicity, $B$ is supposed to be the same across countries, across individuals and over time, i.e. $B_{i,t} = B$. For country $i$, expected income is given by:

$$E(y_{i,t}) = E(y_{i,t}|e_{i,t} = 1).E(e_{i,t}) + B.(1 - E(e_{i,t})) = w_{i,t}.E(e_{i,t}) + B.(1 - E(e_{i,t})). \tag{3}$$

[4] The assumption of a log-linear utility function is discussed in Anderson (2011). Note that in contrast with utility linear in income, the log-linear utility implies constant relative risk aversion (with a degree of relative risk aversion equal to 1). Endogeneizing the wages, Anderson (2011) derives a pseudo-gravity model including inward and outward multilateral resistance for a degree of relative risk aversion equal to 2.

where $e_{j,t} = 1$ if the individual is employed in country $j$ at time $t$, 0 otherwise. Expected income under employment $E(y_{i,t}|e_{i,t} = 1)$ is given by the average level $w_{i,t}$. For country $j$, we have:

$$E(y_{j,t}) = E(y_{j,t}|e_{j,t} = 1).E(e_{j,t}) = w_{j,t}.E(e_{j,t}). \tag{4}$$

We suppose that when migrating to a new country, the migrant is not immediately eligible for unemployment benefits. Hence we suppose that $B_{j,t} = 0$.

In turn, agents form expectations regarding the probability of being employed in the future. Given that there is uncertainty about the future stance of the economy, the expected probability of employment is supposed to be given by a mixture of the current level of employment in the economy and its current cyclical state. The current cyclical stance is supposed to exert some signal to the migrants about the future rate of employment in the economy. The rationale behind such a signalling process refers to the feedback mechanisms from output changes to unemployment as captured for instance by Okun's well-known law. This law relates the business cycle and future labour market tightness at the aggregate level. Empirical literature has shown the relevance of this law in many developed countries and has also documented that there are lags in the transmission of the cycle to the labour market.[5]

Based on these assumptions, the expected probability of employment in country $i$ is given by :

$$E(Prob(e_{i,t} = 1)) = (1 - ur_{i,t})^{\theta}(bc_{i,t})^{1-\theta}. \tag{5}$$

where $ur_{i,t}$ denotes the unemployment rate and $bc_{i,t}$ is a business cycle indicator. This indicator may be expressed on a $0 - 100\%$ scale to match the metric in the employment rate. $\theta$ is a parameter capturing the importance of current employment rate for predicting unemployment. $\theta = 1$ can be seen as the limit case with full hysteresis in the unemployment rate.

## 2.2 Equilibrium migration rate

Let $N_{i,t}$ be the size of the native population in country $i$ at time $t$. When the random term follows an iid extreme-value distribution, we can apply the results in McFadden (1974) to write the probability that an agent born in country $i$ will move to country $j$ as:

$$\Pr\left[u_{ij,t} = \max_k u_{ik,t}\right] = \frac{N_{ij,t}}{N_{i,t}}$$

where $N_{ij,t}$ is the number of migrants in the $i$-$j$ migration corridor at time $t$. Similarly, $N_{ii,t}$stands for the proportion of workers remaining in their country of origin during period $t$.

[5]For some recent evidence on Okun's law in OECD countries, see among others Ball et al. (2013) Gordon (2010) and Lee (2000). In general the empirical literature points to the relevance of Okun's law for all developed countries, although with different sensitivities of unemployment rate to output fluctuation. There is also a general controversy on whether there has been a shift in the average key elasticity and on whether there are asymmetries in the response of unemployment to output shocks.

This gives:

$$\frac{N_{ij,t}}{N_{i,t}} = \frac{\exp\left[ln(w_{j,t}) + \theta ln(1 - ur_{j,t}) + (1-\theta)ln(bc_{j,t}) + A_{j,t} - C_{ij,t}\right]}{\sum_k \exp\left[ln(w_{k,t}) + \theta ln(1 - ur_{k,t}) + (1-\theta)ln(bc_{k,t}) + ln(B * ur_{k,t}) + A_{k,t} - C_{ik,t}\right]} \quad (6)$$

Likewise we may compute the equilibrium rate of stayers over natives, giving the equilibrium probability for a native to stay in his or her own country rather than emigrating as:

$$\frac{N_{ii,t}}{N_{i,t}} = \frac{\exp\left[ln(w_{i,t}) + \theta ln(1 - ur_{i,t}) + (1-\theta)ln(bc_{i,t}) + ln(B * ur_{i,t}) + A_{i,t}\right]}{\sum_k \exp\left[ln(w_{k,t}) + \theta ln(1 - ur_{k,t}) + (1-\theta)ln(bc_{k,t}) + ln(B * ur_{k,t}) + A_{k,t} - C_{ik,t}\right]} \quad (7)$$

The equilibrium bilateral migration rate between $i$ and $j$ is obtained by taking the ratio $(N_{ij,t}/N_{ii,t})$ at equilibrium :

$$\frac{N_{ij,t}}{N_{ii,t}} = \frac{\exp\left[ln(w_{j,t}) + \theta ln(1 - ur_{j,t}) + (1-\theta)ln(bc_{j,t}) + A_{j,t} - C_{ij,t}\right]}{\exp\left[ln(w_{i,t}) + \theta ln(1 - ur_{i,t}) + (1-\theta)ln(bc_{i,t}) + ln(B * ur_{i,t}) + A_{i,t}\right]} \quad (8)$$

Taking logs, we obtain an expression giving the log of the bilateral migration rate between $i$ and $j$ over stayers at time t:

$$ln(\frac{N_{ij,t}}{N_{ii,t}}) = ln(\frac{w_{j,t}}{w_{i,t}}) + \theta ln(\frac{1 - ur_{j,t}}{1 - ur_{i,t}}) + (1-\theta)ln(\frac{bc_{j,t}}{bc_{i,t}}) - ln(B) - ln(ur_{i,t}) + A_{j,t} - A_{i,t} - C_{ij,t}(.) \quad (9)$$

Expression (9) allows us to identify the main components of the aggregate bilateral migration rate:(i) the wage differential in the form of the wage ratio $(\frac{w_{j,t}}{w_{i,t}})$, (ii) differential in employment rates, (iii) differential in business cycles; (iv) differential in pull and push factors at destination $A_{j,t}$, and at origin $(A_{i,t})$; (v) the level of unemployment benefits in the origin country; (vi) the unemployment rate in the country of origin and (vii) finally the bilateral migration costs between $i$ and $j$, $C_{ij,t}$. It should be emphasized that in that framework, a rise in unemployment in the origin country exerts two separate effects. The first one is that in presence of unemployment benefits, an increase in unemployment rate might reduce the propensity to migrate. This effect is stronger the higher the average level of unemployment benefits paid to native workers. If the native is not eligible for unemployment benefits or if the origin country does not pay benefits $(B = 0)$, then this effect does not exist and only the second effect prevails.[6] Second, an increase in current unemployment lowers the probability of employment for the individual and increases the differential with respect to the potential destinations. This favors emigration from country $i$.

[6] Note however that our framework does not account for liquidity constraints in the migration process. If unemployment at origin makes those constraints more binding, this could lead to an additional decrease in the bilateral migration flows. We do not account explicitely for such a possibility but this could be done easily by making the bilateral migration costs $C_{ij,t}$ to depend on $ur_{i,t}$. In that case, the estimated coefficient of $ur_{i,t}$ will capture the joint effect due to unemployment benefits and liquidity constraints.

## 2.3 Migration costs

Putting everything together, our cost function may be expressed as:

$$C_{ij,t} = c(x_i, x_j, x_{ij}, x_{it}, x_{jt}, x_t, x_{ijt}) \tag{10}$$

The cost function is supposed to be separable (i) into time-invariant origin country factors ($x_i$) such as being an island, being landlocked, time-invariant destination country factors ($x_j$) such as being an island, being landlocked (ii) country pair specific time-invariant ($x_{ij}$) that include for instance linguistic proximity or bilateral migration policies that are constant over the period under investigation, (iii) time-varying origin country factors ($x_{it}$) that include for instance unemployment benefits at origin or human capital level of the country, (iv) time-varying destination specific factors ($x_{jt}$) such as unilateral immigration policies and finally (v) time-varying pair-specific factors $x_{ijt}$ such as diasporas at destination or time-varying bilateral policies between the origin and the destination, such as the Schengen agreements in Europe. Given the data dimension, all those cost components,except one can be either directly observed or captured by the relevant combination of fixed effects. The main exception is of course the last component which requires only observable variables for that component to be explicitly accounted for, otherwise, it would encompass all other variables.

# 3 Data

The estimation of the equilibrium condition (9) requires the collection of data relative to international migration, relative to economic outcomes such as aggregate wage, GDP, employment rates and relative to relationships between countries such as bilateral agreements or geographic distance.

## 3.1 Migration and population data

The key data needed to estimate equation (9) is about international migration. From equation (9), we can identify three important and desirable features for this data. First, the data must capture flows of international migration between countries. Second, the dimension must be dyadic, i.e. the data must capture flows between country pairs. Furthermore, the international migration data must have a large enough time dimension. Finally, given the focus on the role of economic fluctuations in explaining international migration flows, the migration flows must be observed at a business cycle frequency. To the best of knowledge, there is no ready-to-use dataset combining those desirable features.[7]

[7] For instance, two well-known cross-country data on international migration, namely Docquier and Marfouk (2007) on the one hand and Ozden et al. (2011) on the other hand are suited more capturing the long-run determinants of international migration. Docquier, Marfouk and Lowell (2009) provide bilateral migration

To estimate equation (9), we also need to know the population of native workers $N_{ii,t}$. Since this data is not available and cannot be computed on an annual basis, we proxy it by $N_{i,t}$. This latest data of total population in a given country i at year t is obtained from the World Population Prospects (2010 revision database). This database is produced by the Population Division (Department of Economic and Social Affairs) of the United Nations. Data cover total populations (both genders combined) of major countries, on an annual basis, from 1950 to 2010. The corresponding data can be found on http://esa.un.org/unpd/wpp/Excel-Data/population.htm.

As a result, following number of previous authors who have studied migration flows, we built our own dataset combining different sources of information.[8] Our migration data displays important features in terms of cross-country coverage and in terms of time span. First, our bilateral migration flows cover 30 origin and destination countries.[9] Overall, our data captures an important share of total international migration to and from OECD countries.[10] Second, we capture annual migration flows over a period of 30 years, from 1980 to 2010. Our sample period therefore covers a number of major episodes of economic fluctuations in the modern era, such as the recession following the second oil shock in the early 80's, the recovery of the late eighties in many OECD countries, the US recession in the early nineties, the European recession of the mid-nineties, the US expansion in the late nineties and last but not least the financial crisis in 2008.

Appendix A gives the details of the collected migration data in terms of definitions, sources and available information.We combine two sources, the international migration flows dataset from the UN [11] and the OECD International Migration database.[12] These two databases

stocks with information about education levels (as well as gender) for two years only, 1990 and 2000. Ozden et al. (2011) provide a complete coverage at the global level of bilateral stocks for 5 years (1960, 1970, 1980, 1990 and 2000) by gender only.

[8] For instance, Belot and Ederveen (2012) build their own dataset to analyse the role of cultural barriers between 22 OECD countries over the 1990-2003 period. Pedersen et al. (2008) build migration flows for 27 OECD countries and more than 120 origin countries for the 1990-2000 period. They combine information provided by the natioanl statistical offices of the destination countries with OECD data extracted from "Trends in International Migration".

[9] The list of countries is: Australia, Austria, Belgium, Canada, Croatia, Czech Republic, Denmark, France, Finland, Germany, Greece, Hungary, Iceland, Ireland, Israel, Italy, Luxembourg, the Netherlands, New Zealand, Norway, Portugal, Romania, Russia, Slovenia, Slovakia, Sweden, the United States, Spain and the UK.

[10] Comparing our data with the most comprehensive data provided by Docquier, Marfouk and Lowell (2007), we cover most of the migration process between OECD countries. Our data does not include 6 destination countries (out of 31) covered by Docquier et al. (2007): Japan, Korea, Mexico, Poland, Turkey and South Africa. Still, the 25 common destination countries represent respectively 90 and 91% of total migration stocks captured in Docquier et al. (2007) respectively for 1990 and 2000; and it represents 96% of skilled migrants observed in 1990 and 2000. With respect to Docquier et al. (2007), we capture 4 additional destination countries, namely Romania, Russia, Slovakia and Croatia.

[11] This dataset is provided by United Nations Population division. More information may be found on http://www.un.org/esa/population/migration/ .

[12] Downloadable on http://stats.oecd.org/

give us, for all destination countries, migrant inflows by origin country. They both aggregate information registered at the country level. Since the national authorities use different data collection processes and because we associate two different sources, we face some potential problems of data comparability. The first one is geographic and time coverage. Only a few countries provide data for all origin countries over the whole period (1980-2010). In order to keep a sufficiently balanced panel data set, we retained in our final selection only countries which provided data on a substantial number of origins and over a long enough period of time. Another issue relates to the definition of migrant flows because national authorities use three distinct criteria to register immigrants. We tried to keep the same criterion for all countries to obtain as harmonized a sample as possible. Most countries in our sample use the residence criterion, others use the citizenship criterion and only one country uses the country of birth criterion.[13] The last issue refers to particular migrant groups. Some countries register only foreigners migrants and do not consider citizens who migrate back to their country of origin.[14] The residence criterion allows us to capture better short-term mobility since it covers the last origin of migrants, while citizenship and birth criteria capture respectively long-term immigrants and immigrants from a permanent origin. The residence criterion involves the delivery of a residence permit, the duration of stay considered varies among countries.[15] In addition, it is important to remember that the date of a residence permit may or may not coincide with the date of arrival of a migrant.

In spite of a strong selection of countries, our panel data set remains quite unbalanced in terms of migration flows. Overall, we have a significant number of missing observations but very few zero values. For all years, all origins and destination countries, we have 11816 missing values, i.e. 43.8% of all potential observations. In contrast, we have only 206 zero flows, i.e. less than 1% of our observations. These 206 zero flows represent less than 1.5% of the non-missing observations. In terms of econometric implications, the low occurrence of zeros allows us to use the traditional panel data methods as opposed to the alternative techniques such as Poisson Maximum likelihood or hurdle models.[16]

The number of missing observations for bilateral migration flows is highly unbalanced in terms of years and destinations countries. In terms of time, we have a higher proportion of missing data in the eighties. There is a steady decrease of missing values over time reflecting a global improvement of the statistical collection of migration flows as well as the progressive integration of Eastern European countries such as Slovenia, Slovakia and Russia. The data for 2010 shows nevertheless a high number of missing observations as well, because the data collection for that year was still underway at the time this paper is written.

[13] For countries for which it was possible, we checked the correlation between alternative criteria. We get quite a positive correlation in the range of 0.8.

[14] We also checked that this, in terms of migrant definition, would not be an issue for our analysis.

[15] More information is available on http://www.un.org/esa/population/migration/CD-ROM%20DOCUMENTATION_UN_Mig_Flow_2010.pdf

[16] On this point, see Santos Silva and Tenreyro (2006). These techniques are specifically designed to deal with the statistical consequences of the presence of a large proportion of zeros for the dependent variable. They are nevertheless associated with a high level of computational difficulties.

The proportion of missing values is unequally distributed across destination countries, reflecting differences in size and quality of data collection. In short, there is a large proportion of missing values in relatively small destination countries such as Luxembourg, Greece, Portugal and Israel. There is also a significant proportion of missing values for Eastern European countries such as Russia, Romania and Croatia. There are nevertheless exceptions to that rule, with large developed countries such as France and the UK displaying a relatively high number of missing observations.

Figure 3.1 reports the number of zeroes and missing observations for the bilateral flows over the full period 1980-2010 for each destination.

## 3.2 Wages, business cycles, employment rates and bilateral migration costs

Our key equilibrium equation (9) implies that we also need data on wages, business cycles, employment and unemployment rates at origin and destination. Many cross-country analyses of migration flows face issues in finding comparable measures of wages across countries. Grogger and Hanson (2011) definitely provide the best approach with respect to this issue, recovering wages by education level from the observed wage distribution in microeconomic databases specific to each destination country. This is made possible however by the relatively low number of countries (only 13) considered in their analysis. Some studies capture wages by proxies such as GDP per capita, which might imply significant measurement errors in some cases. [17] Other analyses do not directly observe wage data but capture their role through the use of fixed effects. [18]

In this paper, in contrast to those previous studies, we use explicit measures of wages at origin and destination (see Appendix A for more detail).

We extract cyclical stance from GDP data and use two different measures. The first one relies on the deviation from GDP trend and uses the traditional Hodrik-Prescott filter for that purpose. Given the annual frequency, we extract the trend based on a value of the smoothing parameter $\lambda$ equal to 400. As an alternative, we use a more simple measure based on the annual growth rate of GDP. We also rely on the standardized unemployment rates provided by the OECD. These are used to build differential in employment rates and unemployment rates at origin as identified in equation (11). The exact data sources are also provided in Appendix A.

In addition to these measures, we also capture time-varying dyadic variables ($x_{ijt}$ in terms of equation (10)) thought to affect bilateral migration costs. We use three main measures to tackle integration between countries: (i) Schengen agreements between (a subset of) European

[17] See for instance Beine and Parsons (2012) who capture wage differentials by differences in GDP per capita for all origin and destination countries.

[18] See for instance Beine et al. (2011) and Bertoli and Fernandez-Huerta Moraga (2013a).

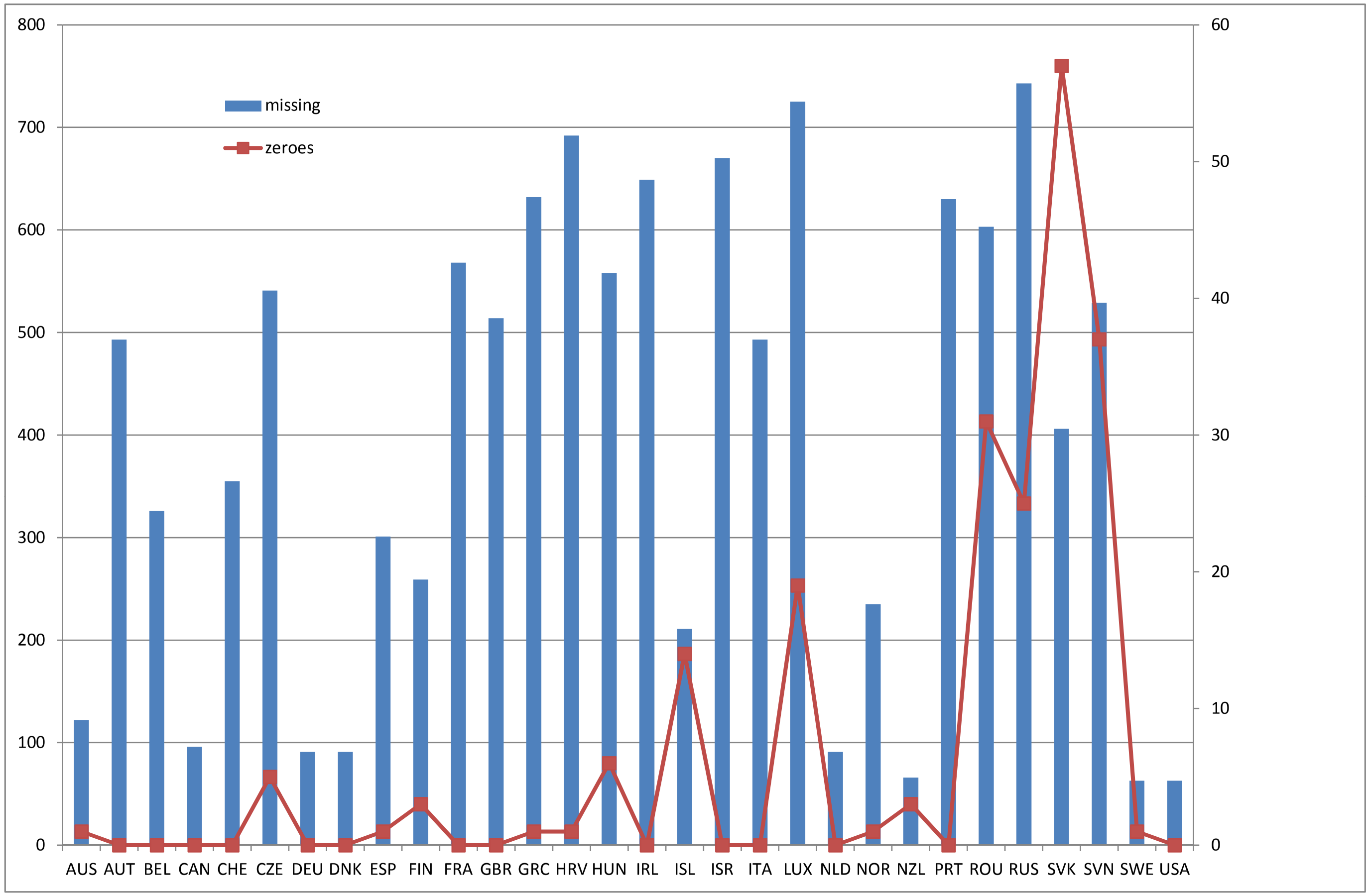


Figure 1: Number of missing (left axis) and zero (right axis) values for bilateral migration flows by destination country.

countries, (ii) other bilateral agreements favouring the international mobility of workers and (iii) joint membership of the European Monetary Union. These measures are explained below in more details when discussing the benchmark econometric specification (see section 4.1.). The exact construction and sources of the bilateral agreements are also described more in details in Appendix B.

### 3.3 Migration stilyzed facts

Table 1 reports some summary statistics for the sample of destination countries. For countries which recently joined the European Union (Czech Republic, Hungary, Slovakia) we observe over the 2000s a large decrease in the average growth rate of emigrant outflows. We also see that Germany is the pimary destination country with an average yearly immigrant inflow of 11,613 people. Correspondingly, United Kingdom appears as the first origin country with average yearly emigrant outflow of 7,403 people.

Table 1: Inflows and outflows figures by destination and origin country of the sample

| | Immigrant inflows | | | | | | Emigrant outflows | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Countries | N flows | Mean | Median | Average Growth rate 1980-1990 | Average Growth rate 1990-2000 | Average Growth rate 2000-2010 | N flows | Mean | Median | Average Growth rate 1980-1990 | Average Growth rate 1990-2000 | Average Growth rate 2000-2010 |
| Australia | 777 | 4644 | 1000 | 5.57% | 8.65% | 3.87% | 564 | 1909 | 376 | 8.00% | -1.12% | 7.47% |
| Austria | 406 | 1322 | 479 | n.a | 3.83% | 6.07% | 564 | 1219 | 228 | 4.16% | 8.70% | 20.93% |
| Belgium | 573 | 1523 | 491 | 3.95% | 4.19% | 5.93% | 568 | 899 | 410 | 16.20% | 5.88% | 50.35% |
| Canada | 803 | 1361 | 442 | 3.68% | 9.29% | 2.86% | 614 | 1802 | 372 | 4.50% | 4.66% | 7.45% |
| Croatia | 207 | 393 | 173 | n.a | 17.64% | 0.73% | 347 | 1177 | 145 | n.a | 48.04% | 9.10% |
| Czech Republic | 358 | 572 | 93 | n.a | -2.57% | 69.02% | 322 | 839 | 222 | n.a | 33.13% | 16.80% |
| Denmark | 808 | 937 | 444 | 6.55% | 7.10% | 4.92% | 526 | 763 | 343 | 6.69% | 1.70% | 35.45% |
| Finland | 640 | 372 | 99 | 35.09% | 16.98% | 10.95% | 539 | 567 | 216 | 7.53% | 10.49% | 35.76% |
| France | 331 | 1854 | 668 | n.a | 4.34% | -2.42% | 516 | 3027 | 1361 | 3.06% | 8.87% | 48.15% |
| Germany | 808 | 11613 | 6445 | 4.84% | 0.34% | 0.80% | 615 | 4578 | 2667 | 3.82% | 177.99% | 34.49% |
| Greece | 267 | 2019 | 289 | -0.66% | 14.43% | 12.87% | 520 | 1489 | 275 | 10.99% | 20.90% | 56.44% |
| Hungary | 341 | 509 | 82 | n.a | 7.72% | 475.99% | 554 | 1202 | 698 | 15.00% | 7.62% | 45.46% |
| Iceland | 688 | 122 | 28 | 39.92% | 24.52% | 35.34% | 391 | 218 | 44 | 11.80% | 7.32% | 17.58% |
| Ireland | 250 | 961 | 302 | 34.23% | 6.35% | 17.83% | 495 | 1085 | 280 | 12.56% | 7.77% | 59.63% |
| Israel | 229 | 879 | 88 | n.a | -6.75% | 6.39% | 510 | 653 | 216 | 6.12% | 101.06% | 13.10% |
| Italy | 406 | 3319 | 653 | n.a | 8.29% | 7.52% | 528 | 3478 | 575 | -1.01% | 6.57% | 38.26% |
| Luxembourg | 174 | 125 | 11 | n.a | -1.34% | 21.77% | 542 | 270 | 37 | 11.61% | 7.21% | 8.60% |
| Netherlands | 808 | 949 | 402 | 7.26% | 7.41% | 6.39% | 552 | 1760 | 716 | 0.96% | 5.95% | 18.56% |
| New Zealand | 833 | 1318 | 93 | 22.10% | 12.91% | 15.31% | 435 | 2350 | 119 | 10.41% | 9.56% | 9.92% |
| Norway | 664 | 687 | 221 | 2.59% | 11.71% | 10.64% | 517 | 753 | 260 | 9.47% | 3.90% | 20.96% |
| Portugal | 269 | 3076 | 1058 | 13.69% | 4.98% | 24.65% | 499 | 1999 | 369 | 22.09% | 4.51% | 40.65% |
| Romania | 296 | 106 | 29 | n.a | 74.36% | 33.88% | 500 | 6334 | 353 | 64.12% | 26.66% | 32.11% |
| Russian Fed. | 156 | 434 | 74 | n.a | 1411.00% | 7.00% | 361 | 5330 | 920 | n.a | 19.73% | 14.68% |
| Slovakia | 493 | 116 | 21 | n.a | -2.00% | 68.02% | 354 | 1104 | 190 | n.a | 63.53% | 42.43% |
| Slovenia | 370 | 78 | 15 | n.a | 58.66% | 62.19% | 345 | 209 | 38 | n.a | 38.79% | 38.57% |
| Spain | 598 | 3753 | 718 | 18.76% | 42.83% | 6.88% | 540 | 2084 | 608 | 2.09% | 8.73% | 24.44% |
| Sweden | 836 | 972 | 427 | 6.35% | 9.77% | 7.99% | 566 | 1066 | 473 | 6.86% | 2.84% | 30.03% |
| Switzerland | 544 | 2248 | 656 | n.a | 1.60% | 6.59% | 593 | 1490 | 358 | 5.00% | 6.80% | 5.81% |
| United Kingdom | 385 | 5473 | 2545 | -1.35% | 9.06% | 18.74% | 558 | 7403 | 2978 | 3.94% | 11.49% | 118.58% |
| United States | 836 | 2933 | 1135 | 3.70% | 16.78% | 2.49% | 619 | 4570 | 2289 | 4.82% | 40.43% | 6.05% |

# 4 Estimation

We start from equation (9) and estimate a set of alternative specifications that are all consistent with the equilibrium equation. We propose different specifications depending on the specification of the cost component in equation (10).

## 4.1 A suboptimal benchmark specification

Combining equations (9) and (10), we estimate the following benchmark equation:

$$
\begin{aligned}
ln(\frac{N_{ij,t}}{N_{ii,t}}) = \beta_0 + \beta_1 ln(\frac{w_{j,t}}{w_{i,t}}) + \beta_2 ln(\frac{1-ur_{j,t}}{1-ur_{i,t}}) + (\beta_3)(\frac{bc_{j,t}}{bc_{i,t}}) \\
- \beta_4 ln(ur_{i,t}) + \beta_5 Schengen_{ij,t} + \beta_6 EMU_{ij,t} + \beta_7 Bilateral_{ij,t} + \alpha_{ij} + \alpha_t + \epsilon_{ij,t} \quad (11)
\end{aligned}
$$

$Schengen_{ij,t}$, $EMU_{ij,t}$ and $Bilateral_{ij,t}$ are respectively dummy variables capturing the joint participation at time $t$ of to the Schengen agreements, the joint participation at time $t$ to the European Monetary Union and the existence at time $t$ of other bilateral agreements favoring worker's mobility between the two countries. Details on how these variables are explicitly measured are provided here below.

We capture the $c(x_{ij,t})$ terms by three important observable factors. The first two focus on agreements that could lead to a decrease in the mobility costs within a subset of European countries (namely the Schengen agreement and EMU), while the last one captures other bilateral agreements that favour economic migration between any two countries included in our sample. First and more importantly, we account for the fact that two European countries involved in the pair have already implemented the Schengen agreements. More precisely, the Schengen variable ($schengen_{ij,t}$) is a time-moving dyadic variable taking 1 if both countries had implemented the Schengen rule at time $t$, and 0 otherwise. The Schengen agreements were progressively signed and implemented by a subset of European countries and were designed to favour mobility between European countries. We take into account the implementation criterion, i.e. by considering cases in which the country signed and implemented the Schengen rules of people mobility. There is a significant variation of member and non-member European countries.[19]. There is also a significant variation in terms of timing between member countries of the Schengen area. [20]

We also introduce a second measure of integration that is dyadic and moving over time. More particularly, we capture the fact that two countries belong to the European Monetary Union (EMU) that for a subset of European countries was launched in 1999. The use of a common currency between countries should mean a significant drop in currency conversion costs between the destination and the origin countries for migrants. It also favours direct comparison of economic aggregates between countries, such as wages and prices. EMU implementation also led to facilities and economies in terms of international bank transfers. There is also a drop in uncertainty regarding the converted wage amount at destination due to the full eradication of bilateral exchange rate volatility. It is important if the prospective migrants

[19]Among the European countries, Ireland, the UK, Croatia are not members. Romania is a future member and was not a member during the sample period.

[20]Basically, implementation for signing members followed three different waves. The first wave took place for most of the European founders around 1995-1997. A second wave concerning mostly Scandinavian countries plus Greece occurred around 2000-2001. Finally joining East European countries implemented the Schengen agreements around 2007.

intend to remit part of their earnings to their relatives staying behind. As for the Schengen agreements, the $uem_{ij,t}$ variable takes 1 if both countries were (EMU) members at time $t$, and 0 otherwise. As for the Schengen agreements, there is a balanced mix of EMU and non-EMU members in our sample of countries. There is also a significant variation between member countries in terms of timing of adhesion to the EMU for our sample of origin and destination.

Finally, we capture the existence of bilateral agreements in terms of labour mobility between countries included in the sample beyond the agreements specific to European countries. These bilateral agreements are supposed to facilitate the migration of economic agents through a set of mechanisms. For example, one mechanism is visa waiving arrangements for the candidates to migration. We build a dyadic dummy variable $bilateral_{ij,t}$ taking 1 if there is a bilateral agreement at time $t$ favouring the mobility of workers between countries $i$ and $j$, and 0 otherwise. The existence of those bilateral agreements is identified using the agreements collected by the International Organization of Migration (IOM). Details about the sources and the exact nature of those agreements are provided in Appendix B. We find that out of 26970 possible observations, we have 871 observations for which there was a bilateral agreement of that kind between the two countries at that time. This represents about 3 % of the observations.

A couple of important comments are in order here. First, due to lack of data, we do not have a direct observable measure for $ln(N_{ii,t})$, i.e. the total number of native workers of country $i$ staying in their own country at time $t$. Unlike in Beine and Parsons (2012), since we do not have full information regarding emigration flows, i.e. just a subset of destinations $j$, so it is not possible to estimate $N_{ii,t}$ from the population stock ($N_{i,t}$ and the full set of emigration flows $\sum_k N_{ik,t}$). As a second best alternative, we approximate $N_{ii,t}$ by $N_{i,t}$ that is available on an annual basis. While it makes the estimated model closer to the equilibrium equation, we should be aware that for some origin countries with high emigration rates, $N_{ii,t}$ will be plagued with significant measurement errors.

A second comment concerns the set of included fixed effects. In this set-up, $\alpha_{ij} = c(x_{ij})$ and $\alpha_t = c(x_t)$. In other terms, the dyadic fixed effects and the time-fixed effects respectively capture the part of the migration costs that are pair-specific and time-specific. In contrast, we do not include here origin-time dummies ($\alpha_{i,t}$), at least at this stage, since such an inclusion would prevent estimation of the role of the unemployment rate at origin, i.e. the estimation of $\beta_4$. However, failure to include $\alpha_{i,t}$ might generate various problems. First, if $N_{ii,t}$ is not correctly measured by $N_{i,t}$, model (11) might be subject to measurement errors. Second, the model does not account for multilateral resistance to migration. Multilateral resistance to migration terms capture the fact that any change in the flow between $i$ and $j$ will affect the other bilateral relationships. Concepts of multilateral resistance have been originally identified in literature analysing bilateral trade flows (Anderson and van Wincoop (2003), Anderson (2011)). It has also recently received some specific attention in the migration literature (see Bertoli and Fernandez-Huertas Moraga (2013a)).[21] In turn, failure to account for the multilateral resistance to migration might lead to a violation of the underlying independence from irrele-

[21] Bertoli and Fernadez-Hertas Moraga (2013a, 2012) propose to capture multilateral resistance to migration by using the Pesaran CCE estimator. This requires the use of nests of destination countries. The underlying

vant alternatives (IIA) hypothesis. The IIA hypothesis underlies the discrete choice model *à la* McFadden (1974) in the income maximization approach that we outlined in section 2. It is therefore important to check after estimation that the IIA hypothesis holds given the adopted specification.

These concerns shed some doubts on the validity of the estimates of model (11). This is why we report the full results in Appendix C and give here only a quick summary of the main results. The main value added of model 11 is that it allows identification of the marginal impact of unemployment at origin. Overall, the estimation results support a negative impact of unemployment on the bilateral emigration rate on top of the impact of the differential in employment opportunities. This result is consistent with the one considered in the model. If unemployment benefits are only available for native workers and not for migrants (at least shortly after arrival) and in the presence of uncertainty of being employed in the destination, an increase in unemployment might reduce the propensity to emigrate. This marginal negative impact offsets the positive impact of the differential in employment rates between the origin and the destination, so that the net total effect of unemployment is uncertain. A second mechanism, not considered in our theoretical model, might also generate the negative marginal impact of unemployment, namely the presence of liquidity constraints. If unemployment raises the number of people subject to liquidity constraints, this would decrease the number of potential migrants able to cover the migration costs, which in turn would lead to a decrease in the emigration rates.

Beyond the impact of unemployment, we find some support for the key mechanisms identified in equation (11). In particular, we find a positive impact of the wage differential, the business cycle differential and employment opportunities. Results also support a significant impact of Schengen agreements and EMU participation in terms of lowering migration costs between countries. Nevertheless, given the reservations mentioned above, these results should be completed with other models taking into account the influence of countries other than the origin and the destination countries. These models are considered in the next sections.

The results in Table 6 and 7 yield some interesting insights. First, we find some support for the key mechanisms identified in equation (11). In particular, we find a positive impact of the wage differential, the business cycle differential and employment opportunities. Results also support a significant impact of Schengen agreements and EMU participation in terms of

assumption is that shocks $\epsilon_{ij,t}$ are correlated across countries belonging to the same nests but are independent across countries included in different nests. In the context of our study, the exact composition and the number of the nests would first rely on arbitrary criteria that could be difficult to justify. Furthermore, the use of 30 time periods along with 30 origin countries would lead to a strong inflation of the number of included parameters (871*the number of nests). To illustrate, the inclusion of 6 nests as in Bertoli and Fernadez-Hertas Moraga (2012) would lead to 5226 additional parameters to estimate. Since we rely on the Least Square Dummy Variable approach instead of the within transformation approach -due to the fact that our panel data set is strongly unbalanced (due to zeros, missing observations over time, missing destinations for given origins) (see Baltagi, 1995)-, the implementation of that approach would lead to important computational problems. As a result, while recognizing its value, we disregard the Bertoli and Fernadez-Hertas Moraga (2013a) approach and follow instead the Ortega and Peri (2009) strategy, as outlined in the next section.

lowering migration costs between countries. Nevertheless, given the reservations mentioned above, these results should be completed with other models taking into account the influence of countries other than the origin and the destination countries. The main value added of model 11 is that it allows identification of the marginal impact of unemployment at origin. Overall, the estimation results support a negative impact of unemployment on the bilateral emigration rate on top of the impact of the differential in employment opportunities. This result is consistent with the one considered in the model. If unemployment benefits are only available for native workers and not for migrants (at least shortly after arrival) and in the presence of uncertainty of being employed in the destination, an increase in unemployment might reduce the propensity to emigrate. This marginal negative impact offsets the positive impact of the differential in employment rates between the origin and the destination, so that the net total effect of unemployment is uncertain. A second mechanism, not considered in our theoretical model, might also generate the negative marginal impact of unemployment, namely the presence of liquidity constraints. If unemployment raises the number of people subject to liquidity constraints, this would decrease the number of potential migrants able to cover the migration costs, which in turn would lead to a decrease in the emigration rates.

Nevertheless, overall those results should be treated with caution, to the extent that model (11) might suffer from mis-specification problems. By way of a straightforward illustration the results relative to the bilateral agreements cast some doubts on the estimation properties. The impact is found to be significantly negative while we would expect either a positive or a negligible impact. One reason might be that model (11) fails to include some multilateral resistance terms that might be correlated with the bilateral agreements. In that case, it would generate a bias in the estimation due to omitted variables. The negative elasticity obtained in columns (1) and (5) suggests that this might be the case here. In turn, failure to integrate those terms might lead to a violation of the IIA assumption. The inclusion of time-origin fixed effects $\alpha_{it}$ in a slightly modified specification (see next section) will capture the outward multilateral resistance to migration.

## 4.2 Accounting for origin-time fixed effects

In order to take into account important elements like the outward multilateral resistance to migration, we modify model (11) and consider an alternative specification that specifically includes $\alpha_{it}$ fixed effects. The specification takes the following form:

$$\begin{aligned} ln(N_{ij,t}) = \beta_0 + \beta_1(ln(\frac{w_{j,t}}{w_{i,t}})) + \beta_2 ln(\frac{1-ur_{j,t}}{1-ur_{i,t}}) + \beta_3(\frac{bc_{j,t}}{bc_{i,t}}) + \beta_4 Schengen_{ij,t} \\ + \beta_5 EMU_{ij,t} + \beta_6 bilateral_{ij,t}[+\beta_7 x_{ij} + \alpha_j][+\alpha_{ij}] + \alpha_{it} + \epsilon_{ij,t} \quad (12) \end{aligned}$$

In terms of the equilibrium equation (9), $\alpha_{it} = ln(N_{ii,t}) - ln(B) - ln(ur_{i,t}) + c(x_{it}) + c(x_i) + c(x_t)$. This specification therefore also explicitly accounts for the size of the native population. It also captures the impact of unobserved migration costs which are origin specific and that move over time. These include the push factors such as international violence or demographic shocks as well as domestic barriers to movement such as passport costs. It also incorporates the role of origin specific time-invariant factors such as geographic factors. On top of that, the inclusion of the $\alpha_{it}$ fixed effects allows to migration (see Anderson, 2011) to be taken into account.[22]. The price to pay for using specification (12) instead of specification (11) is that we are no longer able to have an explicit estimation of the marginal impact of unemployment rates at origin.

We use two alternative specifications with respect to the role of time-invariant dyadic factors. In a first estimation, we include dyadic fixed effects of type $\alpha_{ij}$. The inclusion of these fixed effects allows accounting for the impact of time-invariant dyadic non-included factors such as distance, common language or colonial links.[23] However, since we are interested in uncovering the impact of some of those factors (for instance when both countries belong to the EMU), we use an alternative specification including explicit variables such as $x_{ij}$. In this alternative specification, we include $\alpha_j$ that capture the role of time-invariant destination specific unobserved factors. In other terms, in this latter specification, $\alpha_{ij}$ is replaced by $(\beta_7 x_{ij} + \alpha_j)$. While interesting, this latter specification should yield inferior results in terms of goodness-of-fit since the observed set of dyadic variables $x_{ij}$ captures only part of the variation with respect to the one captured by the $\alpha_{ij}$ fixed effects. [24] The results based on this specification should therefore be regarded with much caution and are provided here only for the sake of capturing the possible impact of those time-invariant dyadic observed factors. We consider four pair-specific factors of that kind: geographic distance, contiguity, existence of a common official language and location on the European continent.

Table 2 reports the estimates with the business cycle being measured using the deviation of GDP from the trend extracted using the HP filter. Table **??** reports exactly the same information, but using the annual growth rate of GDP as an alternative measure of the economic cycle. We use two different measures for the numerator of the dependent variable $ln(\frac{N_{ij,t}}{N_{ii,t}})$. The first one takes the log of $1 + N_{ij,t}$ in the numerator in order to keep the country pairs with zero observations for $N_{ij,t}$ in the estimation sample. This is sometimes called Scaled OLS estimation (Simpson and Sparber,2012). The second one uses simply $ln(N_{ij,t})$ in the numerator as in the equilibrium condition, which leads to a modest decrease in the sample size.[25] Columns

[22]A similar strategy has been used by Ortega and Peri (2009). While the inclusion of the $\alpha_{it}$ fixed effects de facto allows them to account for outward multilateral resistance to migration, their initial motivation was to capture the heterogeneity between stayers and migrants at origin.

[23]Note that the joint inclusion of $\alpha_{it}$ and $\alpha_{ij}$ fixed effects makes the inclusion of monodic fixed effects (such as $\alpha_o$ for $o = i, j$ or $t$) unnecessary since these are embedded in the first ones.

[24]For instance, one type of factor that is clearly omitted in this specification are bilateral explicit or implicit agreements based on historical links or colonial links. One obvious example is relationships between countries belonging to the Commonwealth. These agreements are implicit and are therefore not reported in the IOM database of bilateral agreements. Nevertheless, since they are in place for the whole period of estimation (1980-2010), they are well captured by the $\alpha_{ij}$ fixed effects.

[25]Actually, we have only a reduction of 43 data points, which reflects that the proportion of (true) zeroes for the bilateral flows in our dataset is negligible. This further justifies the use of OLS estimators instead of the Poisson Pseudo Maximum Likelihood estimators advocated by Santos Sylva and Tenreyro (2006).

(1) and (2) give the estimates using $ln(\frac{1+N_{ij,t}}{N_{ii,t}})$ as our dependent variable while Columns (3) and (4) give the estimates based on $ln(\frac{N_{ij,t}}{N_{ii,t}})$ .

Table 2: Business cycle and migration with $\alpha_{it}$ FE and HP extraction

| Estimation Method | Scaled OLS | | OLS | |
|---|---|---|---|---|
| Variables | (1) | (2) | (3) | (4) |
| Wage differential | 0.732*** | 0.433*** | 0.714*** | 0.397*** |
| | (12.05) | (3.92) | (11.29) | (3.49) |
| Business cycles Diff. | 0.0074*** | 0.005 | 0.0074*** | 0.005 |
| | (3.24) | (1.00) | (3.15) | (0.98) |
| Employment rates | 4.475*** | 4.938*** | 4.464*** | 4.922*** |
| | (13.51) | (9.29) | (13.18) | (9.13) |
| Schengen | 0.247*** | 0.489*** | 0.259*** | 0.501*** |
| | (11.20) | (11.68) | (11.63) | (11.84) |
| UEM | 0.163*** | 0.284*** | 0.161*** | 0.275*** |
| | (5.51) | (5.99) | (5.43) | (5.76) |
| Bilateral Agreements | 0.076*** | 0.277*** | 0.076*** | 0.275*** |
| | (3.37) | (4.98) | (3.32) | (4.91) |
| Ln(distance) | - | -0.656*** | - | -0.664*** |
| | | (18.46) | | (18.55) |
| Common language | - | 0.851*** | - | 0.859*** |
| | | (21.04) | | (21.08) |
| Contiguity | - | 0.304*** | - | 0.289*** |
| | | (5.99) | | (5.69) |
| Europe | - | -0.167* | - | -0.175* |
| | | (1.89) | | (1.95) |
| Destination FE ($\alpha_j$) | No | Yes | No | Yes |
| Dyadic FE ($\alpha_{ij}$) | Yes | No | Yes | No |
| Origin-time FE ($\alpha_{it}$) | Yes | Yes | Yes | Yes |
| # observations | 11055 | 11055 | 11012 | 11012 |
| $R^2$ | 0.956 | 0.792 | 0.955 | 0.787 |

Estimated equation: equation (12).Estimation period: 1980-2010.

Dep. variable in (1-2): $ln(1+N_{ij,t})$; Dep. variable in (3-4):$ln(N_{ij,t})$.

Business cycle extraction method: HP filter.

Superscripts ***, **, * denote statistical significance at 1, 5 and 10% respectively.

Robust standard errors are provided in parentheses.

Table 3: Business cycle and migration with $\alpha_{it}$ FE and growth rates

| Estimation Method | Scaled OLS | | OLS | |
|---|---|---|---|---|
| Variables | (1) | (2) | (3) | (4) |
| Wage differential | 0.879*** | 0.486*** | 0.855*** | 0.457*** |
| | (13.71) | (11.60) | (12.80) | (3.81) |
| Business cycles | 0.021*** | 0.013** | 0.019*** | 0.010* |
| | (7.08) | (2.19) | (6.28) | (1.66) |
| Employment rates | 4.863*** | 5.204*** | 4.874*** | 5.217*** |
| | (17.10) | (11.09) | (16.93) | (11.01) |
| Schengen | 0.237*** | 0.486*** | 0.249*** | 0.498*** |
| | (10.75) | (11.60) | (11.25) | (11.45) |
| UEM | 0.166*** | 0.284*** | 0.163*** | 0.274*** |
| | (5.65) | (6.01) | (5.53) | (5.77) |
| Bilateral | 0.074*** | 0.274*** | 0.075*** | 0.274*** |
| | (3.31) | (4.93) | (3.31) | (4.88) |
| Ln(distance) | - | -0.649*** | - | -0.657*** |
| | | (18.10) | | (18.19) |
| Common language | - | 0.852*** | - | 0.860*** |
| | | (20.93) | | (20.97) |
| Contiguity | - | 0.310*** | - | 0.295*** |
| | | (6.06) | | (5.76) |
| Europe | - | -0.153* | - | -0.161* |
| | | (1.72) | | (1.79) |
| Destination FE ($\alpha_j$) | No | Yes | No | Yes |
| Dyadic FE ($\alpha_{ij}$) | Yes | No | Yes | No |
| Origin-time FE ($\alpha_{it}$) | Yes | Yes | Yes | Yes |
| # observations | 10883 | 10883 | 10840 | |
| $R^2$ | 0.957 | 0.793 | 0.957 | 0.788 |

Estimated equation: equation (12). Estimation period: 1980-2010.

Dep. variable in (1-2): $ln(1 + N_{ij,t})$; Dep. variable in (3-4):$ln(N_{ij,t})$.

Business cycle measure: annual growth rates.

Superscripts ***, **, * denote statistical significance at 1, 5 and 10% respectively.

Robust standard errors are provided in parentheses.

Before looking specifically at the key parameters estimates we should look at a comparison between the two alternative specifications, i.e. on the one hand the specification with $\alpha_{ij}$ fixed effects and on the other hand the model with $\alpha_j$ fixed effects and observable time-invariant factors. A straightforward comparison reveals that the share of explained variability by the first specification significantly outperforms the second one, with $R^2$ close to 0.96 instead of 0.80. This suggests that there are many other unobserved time-invariant dyadic factors that are not accounted for in the second specification but which are captured in the first. Again, this suggests that interpretations based on results reported in columns (1) and (3) of tables 3 and 4 are the most reliable.

Overall, we find evidence in favour of long-run and short-run factors on the bilateral migration flows. First, and importantly, we find a very robust and stable elasticity for the wage differential. An increase of around 10% in the wage ratio leads on average to an increase in the bilateral migration flows of about 8.5% (see Table 4). Nevertheless, on top of that, we find support for a role of short-run factors, i.e. of business cycles and employment rates. Starting with the specification including the $\alpha_{ij}$ fixed effects, the positive impact of the relative business cycles is observed regardless of the business cyclical stance measure. The same holds for the differential employment rates. These results are consistent with the idea developed in our theoretical framework that the cyclical stance provides an additional signal to the candidates to migration for choosing the optimal destination. According to this interpretation, this signal is in terms of the future probability of employment for those migrants, which ultimately affects the expected wage at destination and in turn the net gain derived from moving to that destination.

An important by-product of our estimation is the impact of the time-varying dyadic factors affecting the migration costs. We find a positive impact on mobility for the Schengen agreements between European countries, a positive role for currency unification as well as a positive impact for the other bilateral agreements. The first two results are important in terms of our discussion about the optimal nature of the European Monetary Union. The traditional Optimum Currency Area literature (Mundell, 1961; De Grauwe, 2009) emphasized the important role of labour mobility in coping with asymmetric business cycle shocks. Our estimation results show that with respect to labour mobility, the Schengen agreement as well as the inception of the Euro made Europe closer to an Optimum currency area. This of course does not mean that Europe is or has become an OCA. Nevertheless it shows that integration measures increased the net gains (or decreased the net costs) derived from introduction of the Euro. For example, migration flows from the Netherlands to Belgium, which amounted to around 6,000 in the nineties rose to 12,000 in 2007. The corresponding impact of the euro area, equal to 16% (Cf. tables 3 and 4), would thus represent almost 1,000 migrants .[26] Also, the results are in line with the new OCA literature that shows that the optimal nature of a monetary union is itself endogenous with the monetary unification process (Frankel and Rose, 1998; Beetsma and Giuliodori, 2010). Frankel and Rose (1998) show that the optimality of a currency union

[26] To take another case, flows from Germany to Italy, between 8,000 and 10,000 in the nineties, rose up to 14,000 in 2004, with a contribution of the euro area that would thus represent almost 1,500 migrants.

depends on the degree of asymmetric shocks within the union, which itself depends on the monetary unification process. The same holds for the intensity of trade flows. Related to those findings, we show that currency unification decreases the costs of moving between Euro area countries, and therefore increases the scope of labour mobility as an alternative adjustment mechanism to the flexibility in exchange rates.

The estimates relating to the bilateral agreement in columns (1) and (3) of Tables 2 and 3 are all found positive, which is more in line with the expected impact of bilateral agreements on the migration costs. We find that the existence of bilateral agreements favouring worker mobility between two countries raises the bilateral migration flow by 7 to 8 %. The positive semi-elasticity obtained in this specification, as opposed to the negative elasticity yielded by the former model, suggests that the current model does a better job in accounting for important determinants. We will further assess the relevance of the model, particularly regarding the validity of the IIA assumption.

Turning to the specification involving time-invariant dyadic observable variables (columns 2 and 4 of Tables 2 and 3), we find evidence in favour of a role of the usual determinants such as distance, contiguity and common language. The insignificant impact of Europe is more surprising but might be rationalized at least in two ways. First, the role of European integration is already captured by the Schengen agreements and the EMU membership. Second, the results should be viewed with caution for the reasons mentioned above, namely, the obvious scope for a mis-specified model due to omitted time invariant dyadic factors.

An indirect way of testing for the validity of the IIA assumption is to look at the stability of estimated coefficients when some destinations are dropped from the estimation sample. This method was used, for example, by Head et al. (1995) for an analysis of location choices in the US by Japanese manufacturing firms during the 1980's. We implement this method by dropping one destination at a time and by plotting the estimated coefficients. Before examining the patterns of coefficients, two comments are in order. First, we rely on visual examination only rather than on a formal test because our sample is strongly unbalanced. It is unbalanced in several ways. For some country pairs, there may be missing years. For some origins, there might be missing destinations for the whole time period, and for some destinations, there might also be missing origins. Therefore, the removal of different destinations might lead to quite different subsamples. For instance, since the US is the most important destination, removing the US reduces the sample by a maximum number of observations (30*29=870 data points). In contrast, removing Romaniahas little impact on the sample as the Romanian destination is widely unavailable for most origins. Tests of equality of estimates with different subsamples are therefore difficult to implement. Second, the fact that removing different destinations leads to different subsamples means that our evaluation of the IIA assumption is done assuming that there is no selection issue here. This late assumption might of course be too strong.

Figures 4, 5, 6 and 7 reported in Appendix C plot the evolution of the estimated key coefficients of equation (12) when dropping successively one destination country from the regression.[27]

[27] The measure of the cycle differential is given by the differential in growth rate.

Overall, with few exceptions in terms of destinations (Spain) and in terms of coefficients ($\hat{\beta}_2$) of equation (12), the rolling estimates display quite stable estimated coefficients.[28] Comparing the key estimated coefficients of Table 3 with the range displayed in those figures, we find that in general the estimated impact is robust to the exclusion of alternative destinations. The estimate of the wage differential elasticity (0.88) lies in the middle of the range in terms of the coefficients displayed in Figure 10. The same basically holds for the other coefficients of interest, particularly those related to the employment rate differential, the business cycle differential and the Schengen agreements.

## 4.3 Focusing on destination driven shocks

While specification (12) yields better estimation results, the inclusion of the $\alpha_{it}$ raises a number of statistical issues. One of them is the high degree of coilinearity between the $\alpha_{it}$ and the time-varying dyadic variables such as the wage differential, the differential in business cycles and the differential in employment opportunities. In other terms, while accounting for many unobserved factors, the inclusion of $\alpha_{it}$ eliminates much of the variability of those variables due to the fact that they are built using time-varying origin specific variables. This might result in a magnification of the standard errors of those variables and, in turn, a decrease in the significance of the variables. A second aspect is that the business cycle considerations and employment prospects that agents take into account could be essentially destination specific. It is possible that agents will consider migrating to destination countries with higher wages if the employment prospects are good enough, regardless of the cyclical stance of the origin economy. If so, what matters are destination-specific shocks. The specification implied by such a scenario is close to the one adopted by Ortega and Peri (2009).

To deal this issue, we re-estimate the same model but define the key variables in terms of destination specific variables only. This yields the following model:

$$\begin{aligned} ln(N_{ij,t}) = \beta_0 + \beta_1 ln(w_{j,t}) + \beta_2 ln(1 - ur_{j,t}) + \beta_3(bc_{j,t}) + \beta_4 Schengen_{ij,t} \\ + \beta_5 EMU_{ij,t} + \beta_6 bilateral_{ij,t}[+\alpha_{ij}] + \alpha_{it} + \epsilon_{ij,t} \end{aligned} \quad (13)$$

Note that the exclusion of wages, business cycles and employment rates at origin leads to a more than 20% increase in the size of the sample. This mitigates the comparability of the results with respect to the previous specification. This new specification leads to a change in the implicit composition of $\alpha_{it}$ with $\alpha_{it} = ln(N_{ii,t}) + \beta_1 w_{it} + \beta_2 bc_{it} + \beta_3(1 - ur_{it}) - ln(B) - ln(ur_{i,t}) + c(x_{it}) + c(x_i + c(x_t))$. It now includes the role of wages, business cycles and employment rates at origin.

[28] More precisely, the removal of Spain from the sample tends to decrease the magnitude of the impact of the employment differential (but not its statistical significance). This can be rationalized by the fact that Spain is precisely a country having attracted a lot of migrants due to the economic boom and an improving labour market, especially in the 90's and the years prior to the financial crisis. This is well documented in Bertoli and Fernandez-Huerta Moraga (2013a).

The results are reported in Table 4. Columns (1) and (3) report the results obtained with the HP component as the measure of the business cycle at destination. Columns (2) and (4) report the results obtained with the growth rate as the alternative measure of the business cycle at destination. For the sake of parsimony, we do not report the estimations with the time-invariant dyadic variables since this specification has proved to be dominated by the current adopted one. Overall, the results with the destination-specific variables are substancially in line with the ones obtained with the differentials between the origin and the destination. Regardless of the business cycle measure and the estimation method, we find a positive role for the wage at destination, the employment rate and the business cycle. The results suggest that while the differential between the origin and the destination definitely plays a role, the most important role is played by the economic developments at destination. Also, the results relative to the role of the Schengen agreements, bilateral policy agreements and EMU membership are much in line with the estimations obtained from model 12. The estimated coefficients for the three time-varying dyadic dummies are quite close to the ones obtained in columns (1) and (3) of Tables 2 and 3. This suggests that the estimation results of those variables are fairly robust to alternative specifications.

In order to assess the validity of the IIA assumption we reiterate the previously implemented procedure of dropping one destination at a time. As before, Figures 8 to 11 in Appendix C plot the evolution of the estimated key coefficients of equation (13) when dropping successively one destination country from the regression.[29] The same conclusions drawn concerning the relevance of model 12 can be made for model 13. With few exceptions in terms of dropped destination (once again in the specific case of Spain) and in terms of coefficients (employment rate at destination- coefficient $\hat{\beta}_2$), the Figures report a strikingly stable range of the key coefficients, supporting the relative validity of the IIA assumption for the adopted specification.

[29]The measure of the cycle at destination is measured by the growth rate at destination.

Table 4: Business cycles and migration: destination specific variables

| Estimation Method | Scaled OLS | | OLS | |
|---|---|---|---|---|
| Variables | (1) | (2) | (3) | (4) |
| Wage | 0.766*** | 0.903*** | 0.736*** | 0.872*** |
| | (13.40) | (15.04) | (12.45) | (13.99) |
| Business cycle | 0.0067*** | 0.019*** | 0.0068*** | 0.018*** |
| | (2.91) | (6.77) | (2.91) | (6.11) |
| Employment rate | 5.250*** | 5.614*** | 5.223*** | 5.611*** |
| | (14.52) | (18.32) | (14.37) | (10.70) |
| Schengen | 0.252*** | 0.243*** | 0.262*** | 0.252*** |
| | (11.66) | (11.25) | (12.03) | (11.63) |
| UEM | 0.137*** | 0.139*** | 0.139*** | 0.140*** |
| | (4.88) | (4.99) | (4.94) | (5.03) |
| Bilateral | 0.097*** | 0.095*** | 0.094*** | 0.094*** |
| | (4.36) | (4.27) | (4.22) | (4.20) |
| Destination FE ($\alpha_j$) | No | Yes | No | Yes |
| Dyadic FE ($\alpha_{ij}$) | Yes | No | Yes | No |
| Origin-time FE ($\alpha_{it}$) | Yes | Yes | Yes | Yes |
| # observations | 13483 | 13277 | 13416 | 13211 |
| $R^2$ | 0.952 | 0.952 | 0.951 | 0.951 |

Estimated equation: equation (13).Estimation period: 1980-2010.

Dep. variable in (1-2): $ln(1 + N_{ij,t})$; Dep. variable in (3-4):$ln(N_{ij,t})$.

Business cycle measure: (1) and (3): HP filter.

Business cycle measure: (2) and (4): Annual growth rates.

Superscripts ***, **, * denote statistical significance at 1, 5 and 10% respectively.

Robust t-stats are provided in parentheses.

## 4.4 Caveats: network effect and unilateral immigration policies

### 4.4.1 Unilateral immigration policies

In the estimation of models 12 and 13, immigration policies are explicitly accounted by the Schengen agreements among European countries as well as by the additional bilateral agreements captured by the IOM database. These variables refer to bilateral policies, i.e. policies that are specific to a particular migration corridor. They include preferential treatments often granted by the host country. Due to absence of data, we do not capture explicitly the other dimension of immigration policies, i.e. the unilateral dimension. These include immigration policies that are conducted towards all the partner countries. Models 12 and 13 include $\alpha_{it}$ and $\alpha_{ij}$ fixed effects but these do not capture the role of immigration policies conducted at destination. One legitimate concern is that the omitted variable can lead to biased estimates. The discussion is about the expected magnitude and size of that possible bias.

The bias related to the omission of immigration policies arises if these immigration policies are contemporaneously correlated with our business cycle measures. While one can expect a negative correlation of liberal immigration policies and the business cycle over time, the timing of that correlation is more debatable. A contemporaneous correlation which is needed to generate such a bias requires that the immigration policy and its implementation reacts within a year to adverse or positive economic developments at the country level. While it might be the case for some particular episodes, on average, the design and the implementation of such immigration policies takes time. In other terms, a underlying assumption in our estimates is that the contemporaneous correlation between unilateral immigration policies the cycle is quite low and requires more than a year to be of significant magnitude.

**** Jean-Charles, tu avais parle de prendre qqes cas et de discuter ce point sur base d'exemples concrets. ***

### 4.4.2 Migrants Networks

A second source of concerns is that specifications 12 and 13 do not account for the effect of migrants network. Diasporas at destination are known to generate mechanisms that lower the migration costs of the natives of their country of origin. This effect has been documented in various papers dealing with macroeconomic data (Beine et al., 2011 among others). In those models, the network is often captured by the size of the bilateral migration stock at the start of the migration period. Most of the papers consider migration periods of ten years and use either cross sectional data (Beine et al. 2011; Bertoli and Ferandez-Huertas Moraga (2012) or panel data (Beine and Parsons, 2012). In the context of this paper, bilateral migration stocks are unavailable at a annual frequency, which explains the omission of the network in specifications 12 and 13. One question is whether this is detrimental for the estimations of our models. In that respect, some comments are in order here.

First, the empirical literature emphasizes the variation of network elasticities across types of migration process. The network effect is obviously more important for unskilled migrants and for South-North migration. While it is not negligible for Noth-North migration and skilled migrants, the fact that we focus on migration flows among OECD countries makes the omission of the network less important. Second, at the annual frequency, migration stocks are quite stable over time. These are for a lot of country pairs quite collinear to some fixed effects, and in particular with the dyadic ones ($\alpha_{ij}$). This implies that models with $\alpha_{ij}$ fixed effects partly account for some implicit network effect. Finally, our observable variable capturing the bilateral agreements is likely to be highly correlated with some of the bilateral stocks. In that sense, part of the effect associated to the migrants networks is also reflected in the elasticity of that variable. All in all, while the inclusion of the network variables should be desirable if data were available, the specifications of our models and the sample of countries over which estimations are conducted makes the omission of those effects less concerning.

# 5 Conclusion

In this paper, we empirically test the impact of macroeconomic fluctuations on migration flows. We revisit an old issue but with a fresh approach building the recent advances in the empirical literature on international migration. By contrast with some previous macroeconomic approaches evaluating the degree of labour mobility through indirect evidence, we adopt a more direct approach relating gross migration flows and macroeconomic fluctuations. In particular, we rely on micro-founded gravity models that include the traditional long-run determinants and take into account important concepts such as the multilateral resistance terms. Our analysis looks specifically at the sensitivity of gross migration flows to relative business cycles and relative employment rates. These variables act as signals in the formation of expectations about future employment probabilities among prospective agents.

In particular we find evidence that relative business cycles and employment rates affect the intensity of gross bilateral flows. We also find that the destination-specific variables such as the business cycle or the growth rate at destination are particularly important for prospective migrants in choosing their optimal destination. As a by-product of this analysis, we also show that the introduction of Schengen agreement and the inception of the common currency in Europe significantly raised the international mobility of workers between the relevant countries. These results are important as they show that compared to previous studies conducted in the 90's, labour mobility in Europe seems to have increased and has become more reactive to asymmetric shocks. This dimension is key in the traditional definition of an Optimum Currency Area. This of course does not mean that Europe has become an Optimum Currency Area but suggests that labour mobility as an adjustment mechanism is more a reality than in the past. A caveat of this analysis is that we consider only homogeneous labour. Due to data constraints, we are unable to evaluate the sensitivities of agents per skills or education level to business cycles. Such an investigation would indeed be a natural direction for future research agenda.

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# 7 Appendix A: Data sources and details

Two sources are used: the international migration flows dataset from the UN [30] and the OECD International Migration database.[31] These two databases give us, for all destination countries, migrant inflows by origin country. They both aggregate information registered at country level. The fact that national authorities use different processes of data collection and that we have associated two different sources of data naturally raises a number data comparability problems.The first is geographic and time coverage. Few countries provide data for all origin countries over the whole period (1980-2010); however in our final selection we retained only countries that provided data on a substantial number of destinations and over a significant period. Another issue relates to the definition of migrant flows because national authorities use three distinct criteria to register immigrants. We tried to keep the same criterion for all countries in order to obtain as harmonized a sample as possible.

Most countries in our sample use the residence criterion, others use the citizenship criterion

[30]This dataset is provided by United Nations Population division. More information may be found on http://www.un.org/esa/population/migration/ .

[31]Downloadable on http://stats.oecd.org/

and only one country uses the birth-place criterion.[32] The last issue refers to particular migrant groups. Some countries register only foreign migrants and do not count citizens who migrate back.[33] The residence criterion gives us a better appreciation of short-term mobility since it captures migrants' last country of residence, while citizenship and birth-place criteria capture respectively long-term immigrants and their country of origin. The residence criterion involves the delivery of a residence permit, and the duration of that permit varies between countries.[34] However, it is important to remember that the date of a residence permit may or may not coincide with a migrant's date of arrival in a country.

Total population $N_{i,t}$ in a given country i at year t is obtained from the World Population Prospects: the 2010 Revision database. This database is produced by the Population Division (Department of Economic and Social Affairs) of the United Nations. Data cover total populations (both sexes combined) of major countries, on an annual basis, from 1950 to 2010. The corresponding data can be viewed at http://esa.un.org/unpd/wpp/Excel-Data/population.htm

Annual data relating to GDP, unemployment and wages (more precisely hourly wages in the manufacturing sector) are taken from the World Economic Outlook data of the International Monetary Fund. Wages series most often start from the beginning of the period under review (1980) but are sometimes available later (for the Czech Republic, Slovenia or even United Kingdom) or may be missing completely (Russia). Unemployment data are more complete, but may also begin after 1980 in the case of Eastern European countries.

Before merging migration series and other data, we applied statistical controls on migrations to search for potential problems. In particular, we checked the years in which there was a strong increase or decrease compared to data in the rest of the period, for most significant flows (above 1,000 migrants on average). Indeed, flows may possibly increase from 1 migrant to 10 migrants in the following year; but an increase from 10,000 to 100,000 migrants for a couple of countries and over two consecutive years is far more unlikely. Having identified a few cases, we have checked for possible political or economic reason to retain the data. In cases of doubt, we have replaced the series by missing data. Conversely, when a series was very stable with a missing point during the period, we have interpolated the values of the preceding and the following year. We have also checked for the comparability of migrations flows between the different concepts (residence, birth-place and citizenship).

[32] For countries for which it was possible, we checked the variation between alternative criteria. This was acceptable for the countries of the sample.

[33] We also checked that this, in terms of migrant definition, would not be an issue for our analysis.

[34] More information is available on http://www.un.org/esa/population/migration/CD-ROM%20DOCUMENTATION_UN_Mig_Flow_2010.pdf

Data sources and details

| Destination Country | Sources | Period | Origin Countries | Migration criterion & category |
|---|---|---|---|---|
| Australia | UN | 1980-2008 | All origin countries | Residence, foreigners and citizens |
| Austria | UN | 1996-2009 | All origin countries | Residence, foreigners |
| Belgium | UN | 1980-2007 | All origin countries | Citizenship, foreigners |
| Canada | UN | 1980-2009 | Other origin countries | Residence, foreigners |
| | | 1992-2009 | Croatia, Russian Federation, Slovenia | |
| | | 1993-2009 | Slovakia | |
| Croatia | UN | 1992-2009 | Other origin countries | Residence, foreigners and citizens |
| | | 1999-2009 | New Zealand | |
| | | 2002-2009 | France, Hungary, Netherlands | |
| | | 2008-2009 | Belgium, Czech Republic, Russian Federation, Slovakia, United Kingdom | |
| | | Not available | Denmark, Finland, Greece, Iceland, Ireland, Israel, Luxembourg, Norway, Portugal, United Kingdom, United States | |
| Czech Republic | UN | 1993-2007 | Other origin countries | Residence, foreigners and citizens |
| | | 1994-2007 | Croatia, Slovenia, Israel | |
| | | 2001-2007 | Ireland | |
| | | 2004-2007 | Iceland, Luxembourg, New Zealand, Portugal | |
| Denmark | UN | 1980-2009 | Other origin countries | Residence, foreigners and citizens |
| | | 1992-2009 | Croatia, Russian Federation, Slovenia | |
| | | 1993-2009 | Czech Republic, Slovakia | |
| Finland | UN | 1987-2009 | Other origin countries | Residence, foreigners and citizens |
| | | 1992-2009 | Croatia, Russian Federation, Slovenia, Slovakia | |
| | | 1993-2009 | Czech Republic | |
| France | UN | 1994-2003 | Other origin countries | Citizenship, foreigners |
| | | 1994-2006 | Australia, Canada, Czech Republic, Croatia, Hungary, israel, New Zealand, Romania, Russian Federation, Slovakia, Slovenia, United States | |
| | | 1994-2008 | Switzerland | |
| Germany | UN | 1980-2009 | Other origin countries | Residence, foreigners and citizens |
| | | 1992-2009 | Croatia, Russian Federation, Slovenia | |
| | | 1993-2009 | Czech Republic, Slovakia | |
| Greece | OECD | 1985-2001; 2006 | United Kingdom | Residence, foreigners |
| | | 1988-2009 | Belgium, Germany, Sweden | |
| | | 1995-2009 | Hungary, Norway | |
| | | 1996-2009 | Canada, Luxembourg | |
| | | 1997-2009 | Australia, Denmark, Finland, Spain, Switzerland, United States | |
| | | 1998-2000 | Italy | |
| | | 1998-2009 | Austria, Israel | |
| | | 2000-2009 | Netherlands | |
| | | 2003-2009 | Slovakia | |
| | | 2006-2009 | New Zealand | |
| | | Not available | Croatia, Czech Republic, France, Iceland, Ireland, Portugal, Romania, Slovenia | |
| Hungary | UN | 1995-2008 | Other origin countries | Citizenship, foreigners |
| | | 2008 | Australia, Czech Republic, Iceland, New Zealand, Slovenia | |
| Iceland | UN | 1986-2010 | Other origin countries | Residence, foreigners and citizens |
| | | 1993-2010 | Russian Federation, Slovenia | |
| | | 1995-2010 | Slovakia | |
| Ireland | OECD | 1982-2009 | United States | Residence, foreigners |
| | | 1985-2001; 2009 | United Kingdom | |
| | | 1990-2009 | Belgium | |
| | | 1991-2009 | Australia | |
| | | 1995-2009 | Germany, Hungary, Norway | |
| | | 1996-2009 | Canada, Luxembourg | |
| | | 1997-2009 | Denmark, Finland, Spain, Switzerland | |
| | | 1998-2009 | Austria | |
| | | 2000-2009 | Netherlands, Sweden | |
| | | 2003-2009 | Slovakia | |
| | | 2006-2009 | New Zealand | |
| | | Not available | Croatia, Czech Republic, France, Greece, Iceland, Israel, Italy, Portugal, Russian Federation,Romania, Slovenia | |
| Israel | UN | 1995-2009 | Other origin countries | Residence, foreigners |
| | | 1995-2001; 2009 | Russian Federation | |
| | | 2000 | Ireland, Norway | |
| | | 2000-2001 | Australia, Denmark, Finaland, New Zealand, Sweden | |
| | | Not available | Croatia,Czech Republic, Iceland, Luxembourg, Portugal, Slovakia, Slovenia | |
| Italy | UN | 1995-2008 | All origin countries | Residence, foreigners and citizens |
| Luxembourg | OECD | 1995-2009 | Germany, Hungary | Residence, foreigners |
| | | 1996-2009 | Canada | |
| | | 1997-2008 | Denmark | |
| | | 1997-2009 | Australia, Finland, Norway, Spain, Switzerland, United States | |
| | | 1998-2009 | Austria | |
| | | 2000-2009 | Netherlands, Sweden | |
| | | 2005-2009 | Slovakia | |
| | | 2006-2009 | New Zealand | |

| | | | | |
|---|---|---|---|---|
| | | 2008-2009 | Belgium | |
| | | Not available | Croatia, Czech Republic, France, Greece, Ireland, Italy, Portugal, Romania, Russian Federation, Slovenia, United Kingdom | |
| Netherlands | UN | 1980-2009 | Other origin countries | Citizenship, foreigners |
| | | 1992-2009 | Croatia, Russian Federation, Slovenia | |
| | | 1993-2009 | Czech Republic,Slovakia | |
| New Zealand | UN | 1980-2010 | Other origin countries | Residence, foreigners and citizens |
| | | 1993-2010 | Croatia, Czech Republic, Russian Federation, Slovenia | |
| | | 1993-2010 | Slovakia | |
| Norway | UN | 1986-2009 | Other origin countries | Residence, foreigners and citizens |
| | | 1992-2009 | Croatia, Russian Federation, Slovenia | |
| | | 1993-2009 | Czech Republic, Slovakia | |
| Portugal | OECD | 1985-1989; 1995-2001 | United Kingdom[35] | Residence, foreigners |
| | | 1986-2009 | United States | |
| | | 1988-2009 | Belgium, Germany, Luxembourg, Switzerland | |
| | | 1991-2009 | Australia | |
| | | 1995-2009 | Hungaru, Norway | |
| | | 1996-2009 | Canada, Finland | |
| | | 1997-2008 | Denmark | |
| | | 1997-2009 | Spain | |
| | | 2000-2009 | Netherlands | |
| | | 2003-2009 | Slovakia | |
| | | 2006-2009 | New Zealand | |
| | | Not available | Croatia, Czech Republic, France, Greece, Ireland, Iceland, Israel, Italy, Romania, Russian Federation, Slovenia | |
| Romania | UN | 1994-2009 | Canada, France, Germany, Hungary, Israel, Italy, Romania | Residence, foreigners and citizens |
| | | 2001-2008 | Other origin countries | |
| Russian Federation | UN | 1991-2009 | Australia, Canada, Germany, Greece, Finland, Sweden | Residence, foreigners and citizens |
| | | 1991-2010 | Israel, United States | |
| | | Not available | Other origin countries | |
| Slovakia | UN | 1993-2009 | All origin countries | Residence, foreigners and citizens |
| Slovenia | UN | 1996-2009 | Austria | Citizenship, foreigners |
| | | 1998-2008 | Ireland, Iceland, Israel, Luxembourg, Norway, New Zealand, Portugal, Spain, Slovakia | |
| | | 1998-2009 | Other origin countries | |
| Spain | UN | 1983-2010 | Other origin countries | Residence, foreigners and citizens |
| | | 1985-2010 | Italy | |
| | | 1983-84; 2005-10 | Norway | |
| | | 1985-1987; 1995-2010 | Finland | |
| | | 1988-2010 | Greece | |
| | | 1992-2010 | Romania | |
| | | 1994-2000; 2005-2010 | Croatia | |
| | | 1994-2010 | Czech Republic, Slovakia, Slovenia | |
| | | 1996-2010 | Russian Federation | |
| | | 2001-2010 | Hungary | |
| | | 2006-2010 | Iceland, Israel, New Zealand | |
| Sweden | UN | 1980-2010[36] | Other origin countries | Residence, foreigners and citizens |
| | | 1991-2010 | Russian Federation | |
| | | 1992-2010 | Croatia, Czech republic, Slovenia | |
| | | 1994-2010 | Slovakia | |
| Switzerland | UN | 1991-2009 | Other origin countries | Citizenship, foreigners |
| | | 1992-2009 | Croatia, Russian Federation, Slovenia | |
| | | 1993-2009 | Slovakia | |
| United Kingdom | OECD | 1980-2009 | Canada, United States | Residence, Foreigners |
| | | 1986-2003 | Netherlands, Norway | |
| | | 1988-2009 | Sweden, Switzerland | |
| | | 1991-2009 | Australia, Belgium | |
| | | 1992-2009 | Finland, Portugal | |
| | | 1994-2008 | Denmark | |
| | | 1994-2009 | Ireland, New Zealand | |
| | | 1995-2009 | Germany, Hungary | |
| | | 1996-2009 | Luxembourg | |
| | | 1997-2009 | Spain | |
| | | 1998-2004 | Italy | |
| | | 1998-2009 | Austria, Israel, Slovenia | |
| | | 2003-2009 | Czech Republic, Slovakia | |
| | | Not available | France, Greece, Ireland, Romania, Russian Federation | |
| United States | UN | 1980-2010 | Other origin countries | Birth, foreigners |
| | | 1992-2010 | Croatia, Russian Federation, Slovenia | |
| | | 1993-2010 | Slovakia | |
| | | 1994-2010 | Czech Republic | |

Sources: United Nations Population division, OECD international migration database.

[35] we also have available data for years : 1988, 1989, 1993, 2004.

[36] year 1982 is not available for Greece and United Kingdom

Figure 2: Total emigrant flows by country

Figure 3: Total immigrant flows by country

# 8 Appendix B: Sources of data capturing the bilateral agreements

| Signatory country A | Signatory country B | Date of effectiveness | Title of the agreement |
|---|---|---|---|
| Switzerland | Spain | 1961 | Accord entre la Suisse et l'Espagne sur l'engagement des travailleurs espagnols en vue de leur emploi en Suisse |
| Switzerland | Spain | 1990 | Echange de lettres des 9 août/31 octobre 1989 entre la Suisse et l'Espagne concernant le traitement administratif des ressortissants d'un pays dans l'autre après une résidence régulière et ininterrompue de cinq ans |
| Switzerland | France | 1947 | Traité de travail entre la Suisse et la France |
| Switzerland | France | 1958 | Accord entre la Suisse et la France relatif aux travailleurs frontaliers |
| Switzerland | Italy | 1965 | Accord entre la Suisse et l'Italie relatif à l'émigration de travailleurs italiens en Suisse |
| Switzerland | Portugal | 1990 | Echange de lettres du 12 avril 1990 entre la Suisse et le Portugal concernant le traitement administratif des ressortissants d'un pays dans l'autre après une résidence régulière et ininterrompue de cinq ans |
| Switzerland | 27 European members | 2002 | Accord entre la Confédération suisse, d'une part, et la Communauté européenne et ses Etats membres, d'autre part, sur la libre circulation des personnes |
| Switzerland | Law concerning all foreign countries | 2006 | Loi fédérale sur les étrangers |
| Austria | Law concerning all foreign countries | 2006 | Federal Act concerning settlement and residence in Austria (the Settlement and Residence Act-SRA) |
| Italy | Legislative Decree concerning all foreign countries | 1998 | Combined text of measures governing immigration and norms on the condition of foreign citizens |
| United States | Canada | 1994 | North America Free Trade Agreement |

To complement international texts such as the Schengen agreements, which legally facilitate migrations, we build a variable taking a value of 1 for a couple of countries when a bilateral labour agreement exists between these two countries, or when a general law easing foreigners' entrance is passed. When no agreement or law exists, the variable is equal to zero.

The main source is the International Organization for Migrations. The corresponding list of agreements can be consulted at the following link: http://www.imldb.iom.int/changeLocale.do

This main source has been complemented with the information from the North America Free Trade Agreement, which to a certain extent, facilitated labour migrations between the United States and Canada after 1994.

On the other hand, important migrations exist between the members of the Commonwealth, but without any formal agreement, as confirmed in an OECD source:
http://www.oecd-ilibrary.org/fr/social-issues-migration-health/migration-et-emploi_9789264108707-fr

In this latter case, the variable taking into account bilateral agreements does not take the value of one because these agreements are only implicit and, as this situation existed already before the beginning of the period under review in our article, there is no time variance. Thus, these implicit agreements are absorbed by dyadic fixed effects.

# 9 Appendix C: Results from the suboptimal benchmark specification.

Table 6 reports the estimates of model (11). The business cycle is measured using the deviation of GDP from the trend extracted using the HP filter. Table 7 reports exactly the same information, but using the annual growth rate of GDP as an alternative measure of the economic cycle. In each table, we use two different measures for the numerator of the dependent variable $ln(\frac{N_{ij,t}}{N_{ii,t}})$. The first one takes the log of $1 + N_{ij,t}$ in the numerator in order to keep the country pairs with zero observations for $N_{ij,t}$ in the estimation sample. This is sometimes called Scaled OLS estimation (Simpson and Sparber,2012). The second one uses simply $ln(N_{ij,t})$ in the numerator as in the equilibrium condition, which leads to a modest decrease in the sample size.[37] Columns (1-4) give the estimates using $ln(\frac{1+N_{ij,t}}{N_{ii,t}})$ as our dependent variable while Columns (5-8) give the estimates based on $ln(\frac{N_{ij,t}}{N_{ii,t}})$ . Columns (1) and (5) report estimates based on the full model as given in equation (11). In columns (3) and (7) the cycle is measured only at destination while in columns (4) and (8), the business cycle and the employment rate are both measured at the destination only.

[37] Actually, we have only a reduction of 43 data points, which reflects that the proportion of (true) zeroes for the bilateral flows in our dataset is negligible. This further justifies the use of OLS estimators instead of the Poisson Pseudo Maximum Likelihood estimators advocated by Santos Sylva and Tenreyro (2006).

Table 6: The impact of business cycles on migration: benchmark regression

| Estimation Method | Scaled OLS | | | | OLS | | | |
|---|---|---|---|---|---|---|---|---|
| Variables | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| Wage differential | 0.139*** | 0.139*** | 0.138*** | 0.133*** | 0.135*** | 0.135*** | 0.133*** | 0.128*** |
| | (10.28) | (10.28) | (10.16) | (9.74) | (9.86) | (9.86) | (9.72) | (9.31) |
| Business cycles | 0.0048*** | 0.0049*** | 0.017*** | 0.010*** | 0.0043** | 0.0043** | 0.017*** | 0.010*** |
| | (2.77) | (2.77) | (7.52) | (4.19) | (2.36) | (2.37) | (7.23) | (4.01) |
| Employment rates | 2.640*** | 2.668*** | 2.237*** | 4.091*** | 2.669*** | 2.697*** | 2.239*** | 4.098*** |
| | (9.67) | (9.77) | (8.44) | (11.66) | (9.58) | (9.48) | (8.28) | (11.46) |
| Unempl. at origin | -0.154*** | -0.159*** | -0.121*** | -0.006 | -0.150*** | -0.154*** | -0.117*** | -0.002 |
| | (8.59) | (8.91) | (6.55) | (0.45) | (8.19) | (-8.50) | (-6.21) | (-0.15) |
| Schengen | 0.189*** | 0.192*** | 0.187*** | 0.204*** | 0.192*** | 0.196*** | 0.190*** | 0.207*** |
| | (9.68) | (9.91) | (9.68) | (10.60) | (9.62) | (9.83) | (9.60) | (10.50) |
| UEM | 0.145*** | 0.146*** | 0.154*** | 0.127*** | 0.142*** | 0.143*** | 0.151*** | 0.124*** |
| | (5.22) | (5.26) | (5.55) | (4.68) | (5.05) | (5.09) | (5.38) | (4.52) |
| Bilateral | -0.077*** | - | - | - | -0.075*** | - | - | - |
| | (3.75) | | | | (3.58) | | | |
| Dyadic FE ($\alpha_{ij}$) | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| time FE ($\alpha_t$) | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| # observations | 11055 | 11055 | 11055 | 11055 | 11012 | 11012 | 11012 | 11012 |
| $R^2$ | 0.942 | 0.939 | 0.942 | 0.943 | 0.941 | 0.941 | 0.941 | 0.942 |

Estimated equation: equation 11.Estimation period: 1980-2010.

Dependent variable in (1-4):$ln((1+N_{ij,t})/N_{ii,t})$; Dependent variable in (5-8): $ln(N_{ij,t}/N_{ii,t})$.

Superscripts ***, **, * denote statistical significance at 1, 5 and 10% respectively.

Absolute value of Robust t-stats are provided in parentheses.

(3) and (7) business cycle at destination only;(4) and (8): business cycle and employment rate at destination only.

Table 7: The impact of business cycles on migration: growth rate as a measure of cyclical satnce

| Estimation Method | Scaled OLS | | | | OLS | | | |
|---|---|---|---|---|---|---|---|---|
| Variables | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| Wage differential | 0.166*** | 0.166*** | 0.168*** | 0.157*** | 0.150*** | 0.160*** | 0.161*** | 0.150*** |
| | (9.37) | (9.37) | (9.44) | (8.85) | (8.43) | (8.93) | (9.01) | (8.41) |
| Business cycles | 0.013*** | 0.013*** | 0.018*** | 0.015*** | 0.014*** | 0.012*** | 0.016*** | 0.013*** |
| | (6.18) | (6.08) | (7.52) | (5.07) | (4.52) | (5.38) | (5.13) | (4.35) |
| Employment rates | 2.900*** | 2.937 | 2.937*** | 4.634*** | (4.617) | 2.944*** | 2.947*** | 4.657*** |
| | (11.83) | (11.99) | (11.93) | (15.30) | (15.01) | (11.82) | (11.77) | (15.15) |
| Unempl. at origin | -0.162*** | -0.167*** | -0.159*** | -0.003 | 0.005 | -0.162*** | -0.155*** | 0.0017 |
| | (8.64) | (9.01) | (6.55) | (0.19) | (0.33) | (8.59) | (8.17) | (0.11) |
| Schengen | 0.185*** | 0.189*** | 0.190*** | 0.205*** | 0.204*** | 0.192*** | 0.193*** | 0.209*** |
| | (9.49) | (9.73) | (9.78) | (10.68) | (10.33) | (9.66) | (9.69) | (10.57) |
| UEM | 0.147*** | 0.148*** | 0.150*** | 0.123*** | 0.119*** | 0.145*** | 0.146*** | 0.120*** |
| | (5.30) | (5.34) | (5.38) | (4.52) | (4.31) | (5.17) | (5.20) | (4.35) |
| Bilateral | -0.086*** | - | - | - | -0.082*** | - | - | - |
| | (4.16) | | | | (3.96) | | | |
| Dyadic FE ($\alpha_{ij}$) | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| time FE ($\alpha_t$) | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| # observations | 10883 | 10883 | 10883 | 10883 | 10840 | 10840 | 10840 | 10840 |
| $R^2$ | 0.943 | 0.943 | 0.943 | 0.944 | 0.942 | 0.941 | 0.941 | 0.942 |

Estimated equation: equation (11). Estimation period: 1980-2010.

Dependent variable in (1-4): $ln((1 + N_{ij,t})/N_{ii,t})$; Dependent variable in (5-8):$ln(N_{ij,t}/N_{ii,t})$.

Superscripts ***, **, * denote statistical significance at 1, 5 and 10% respectively.

Absolute value of Robust t-stats are provided in parentheses.

(3) and (7) business cycle at destination only;(4) and (8): business cycle and employment rate at destination only.

# 10 Appendix D: Robustness check: estimations with dropped destinations

This section provides the figures relative to the robustness checks of the estimation of models 12 and 13. The evolution of the coefficients can be used as indirect evidence in favour or against the validity of the underlying IIA assumptions in the estimated specifications.

The Figures 2 to 5 plot the evolution of the estimated key coefficients of equation (12) when dropping successively one destination country from the regression.[38] Figure 2 plot the estimated values of the coefficient relative to cycle differential, i.e. $\hat{\beta}_1$ of equation (13. Figures 3, 4 and 5 do the same for coefficients $\hat{\beta}_2$, $\hat{\beta}_3$ and $\hat{\beta}_4$ respectively.

The figures plot the evolution of the estimated key coefficients of equation (13) when dropping successively one destination country from the regression. in growth rate. Figure 6 plot the estimated values of the coefficient relative to cycle differential, i.e. $\hat{\beta}_1$ of equation (13. Figures 7, 8 and 9 do the same for coefficients $\hat{\beta}_2$, $\hat{\beta}_3$ and $\hat{\beta}_4$ respectively.

[38] The measure of the cycle differential is given by the differential in growth rate.

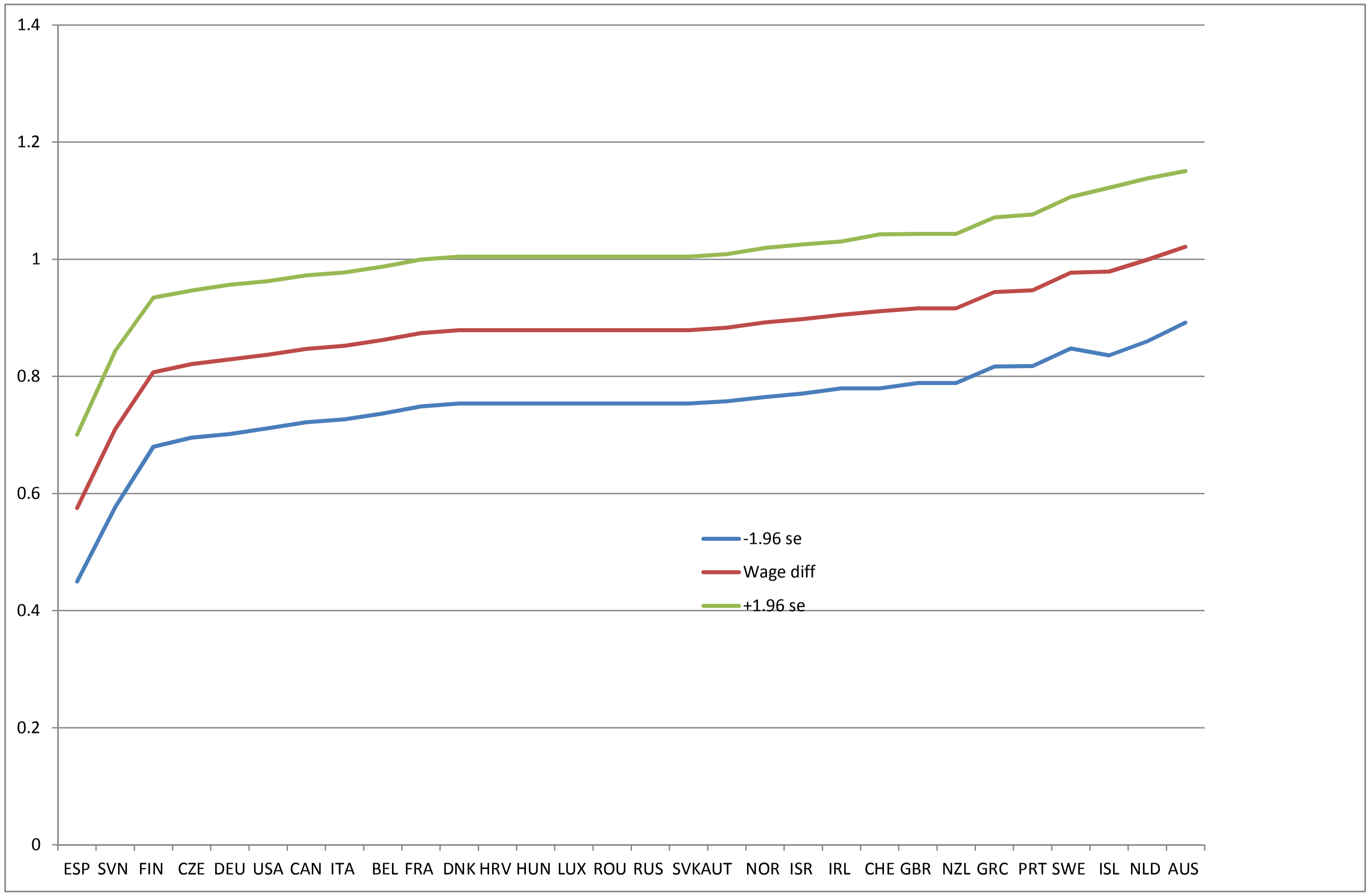


Figure 4: Wage differential coefficient estimates ($\hat{\beta}_1$) (equation 12) with 95% confidence interval; dropped destination reported on X axis

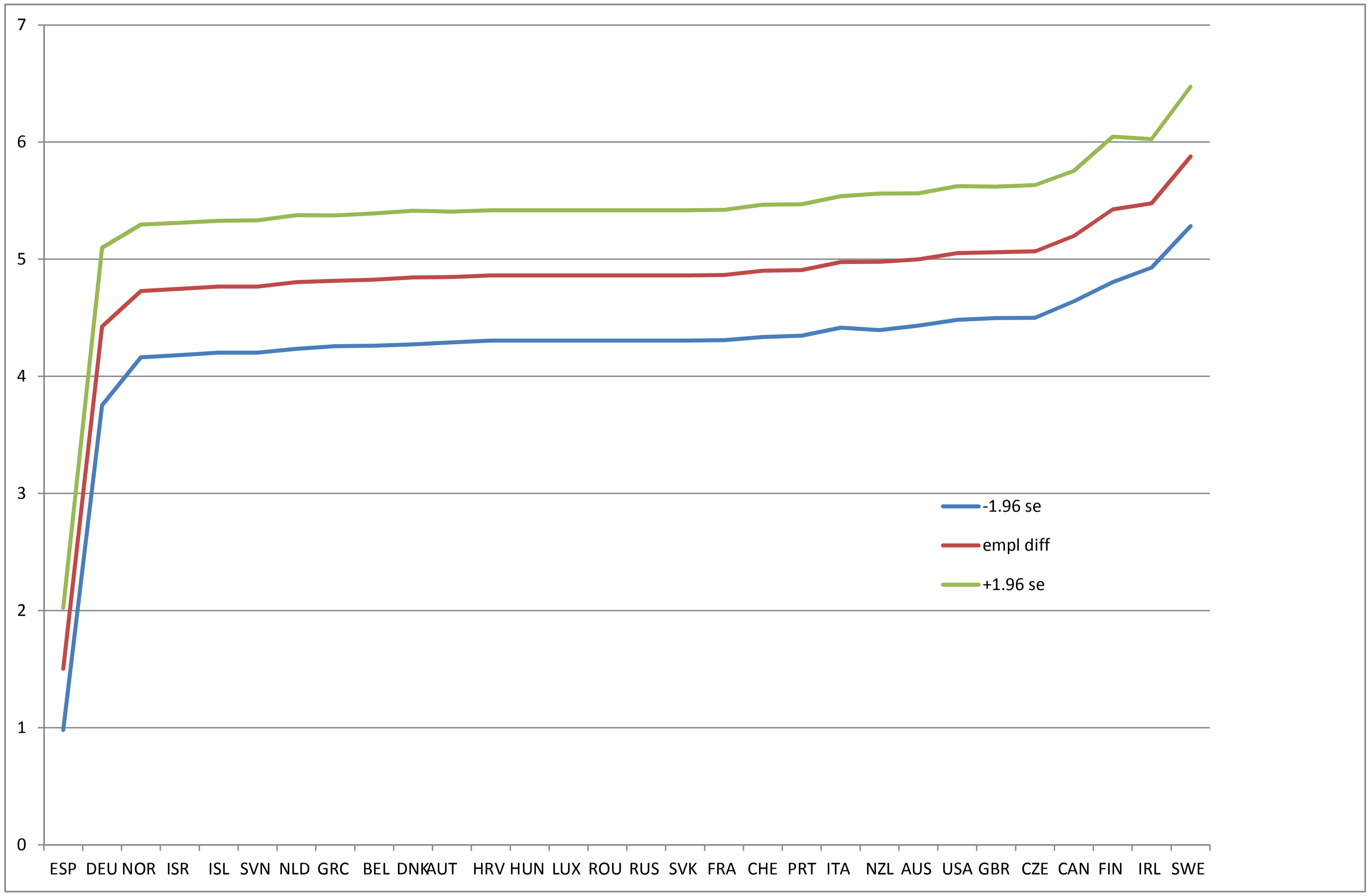


Figure 5: Employment rate differential coefficient estimates ($\hat{\beta}_2$) (equation 12) with 95% confidence interval; dropped destination reported on X axis

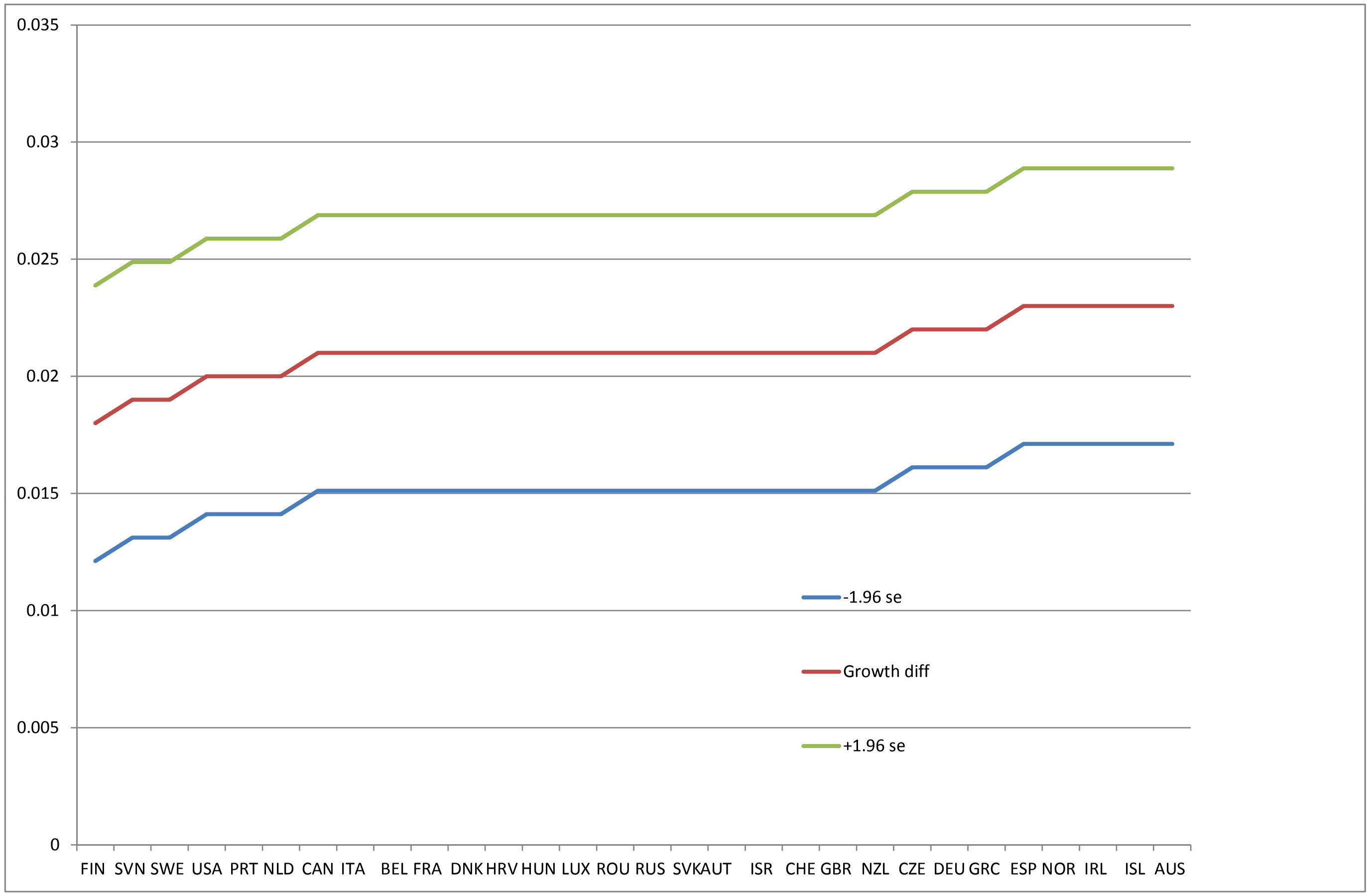


Figure 6: Business Cycle differential coefficient estimates ($\hat{\beta}_3$) (equation 12) with 95% confidence interval; dropped destination reported on X axis

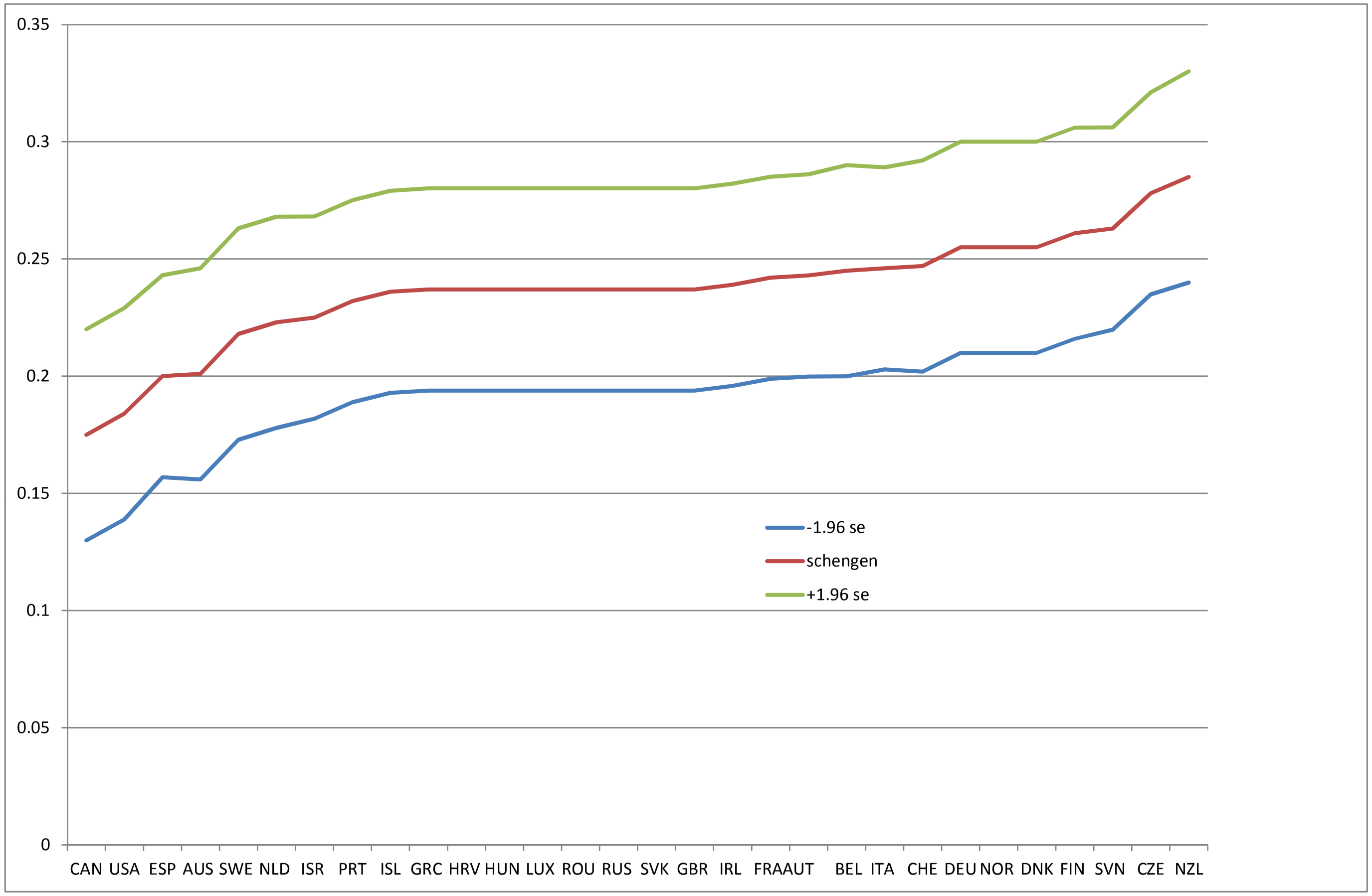


Figure 7: Schengen coefficient estimates ($\hat{\beta}_4$) (equation 12) with 95% confidence interval; dropped destination reported on X axis

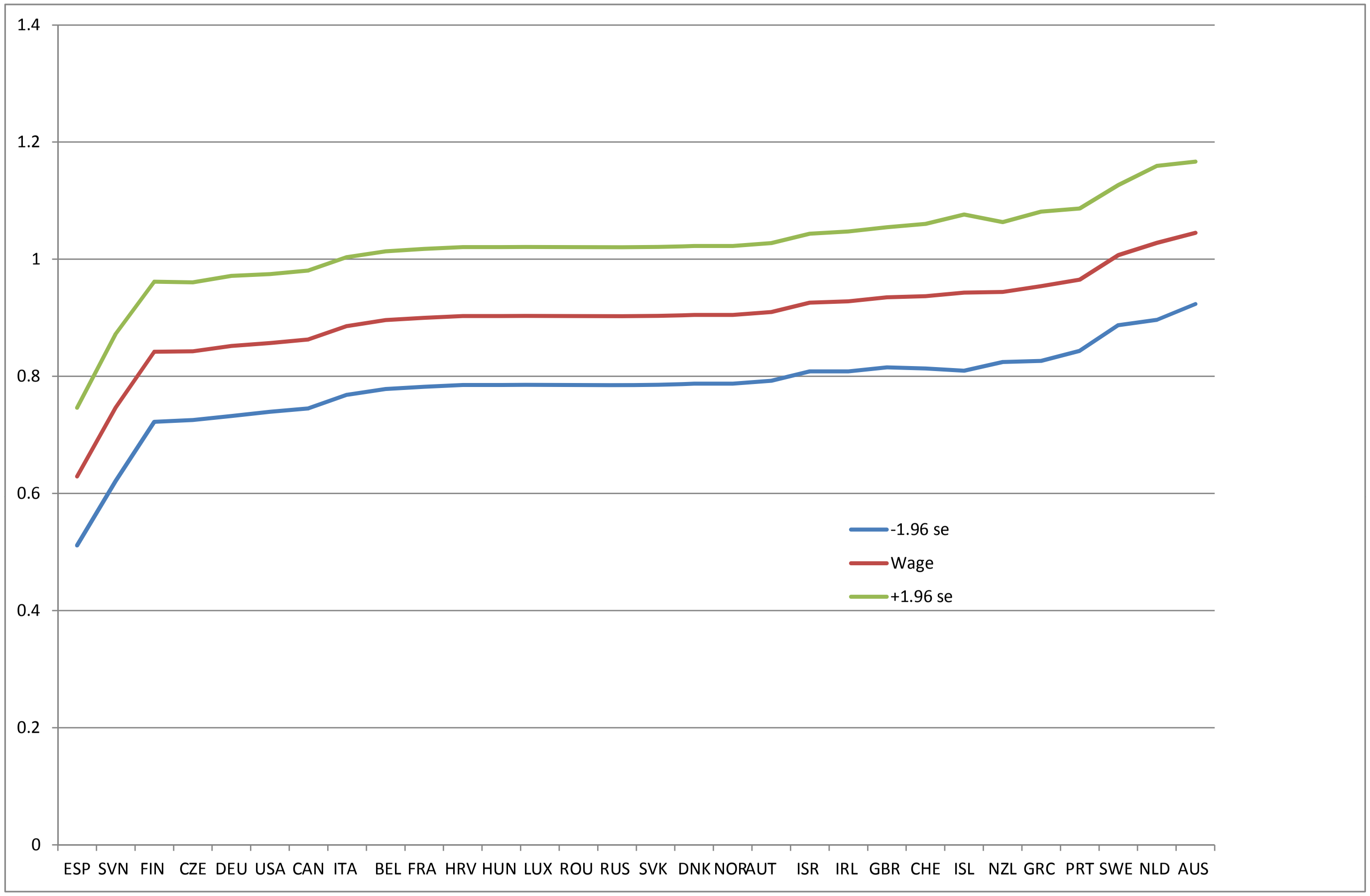


Figure 8: Wage differential coefficient estimates ($\hat{\beta}_1$) (equation 13) with 95% confidence interval; dropped destination reported on X axis

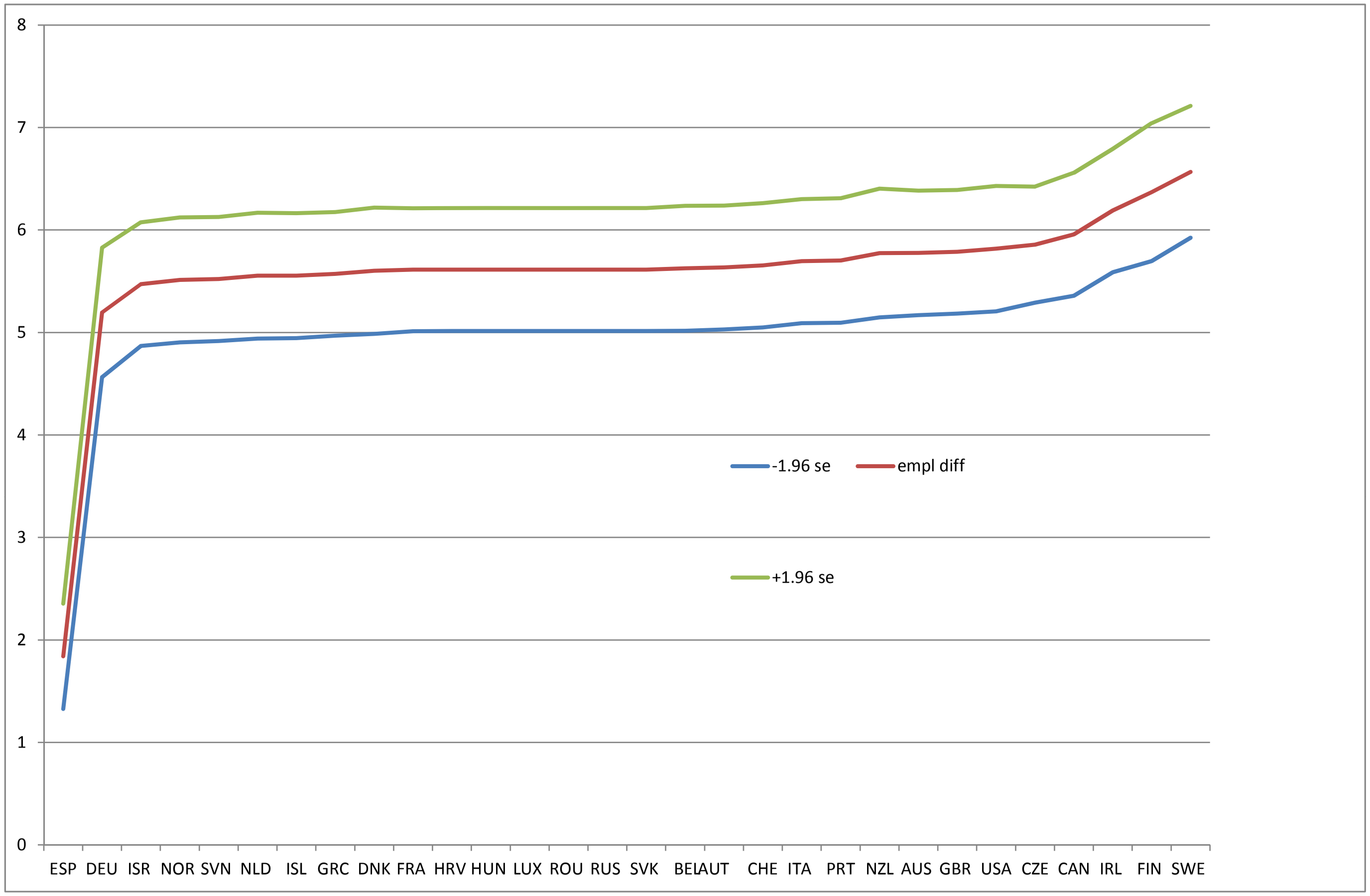


Figure 9: Employment rate at destination coefficient estimates ($\hat{\beta}_2$) (equation (13)) with 95% confidence interval; dropped destination reported on X axis

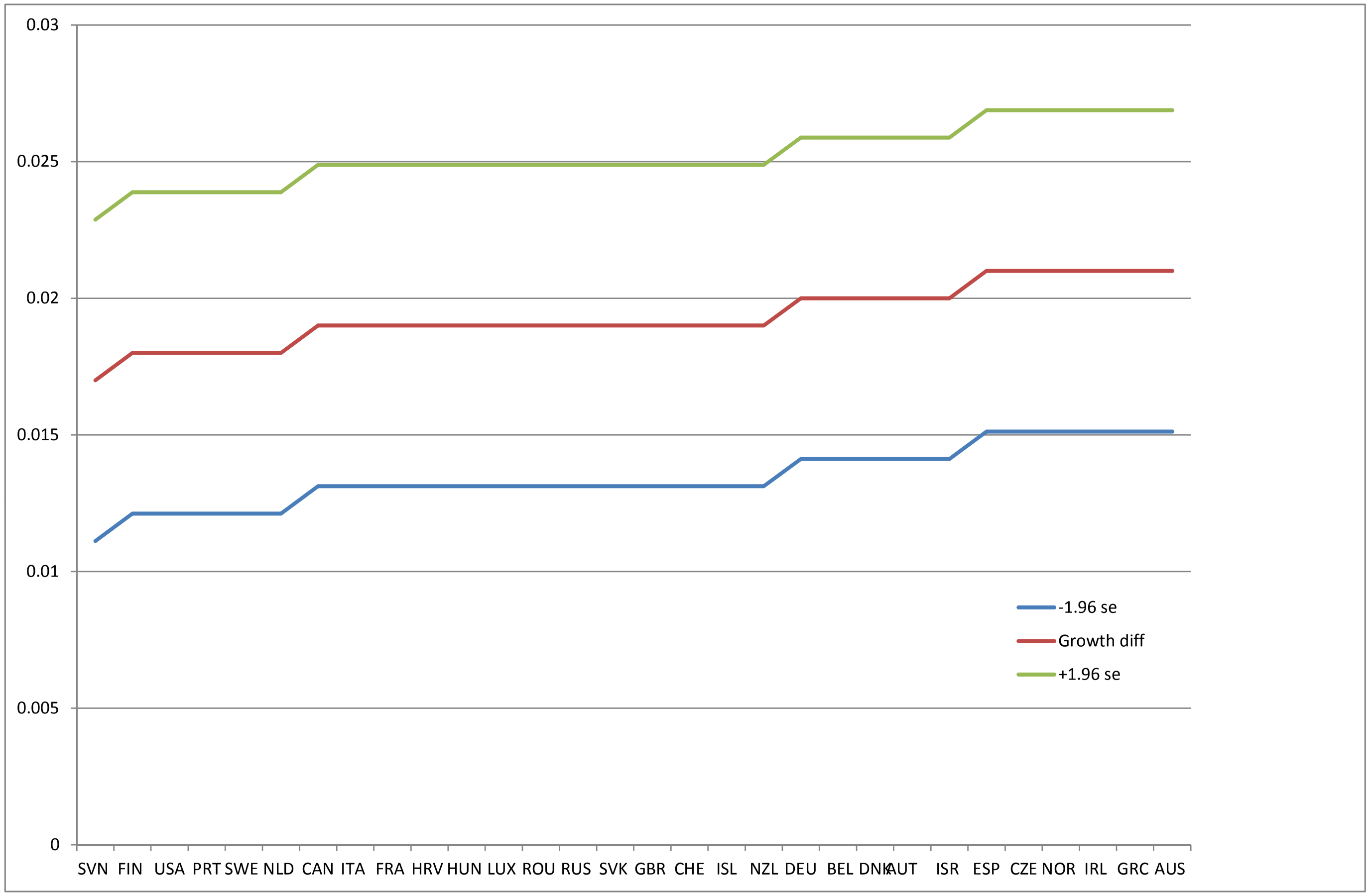


Figure 10: Business Cycle at destination coefficient estimates ($\hat{\beta}_3$) (equation (13)) with 95% confidence interval; dropped destination reported on X axis

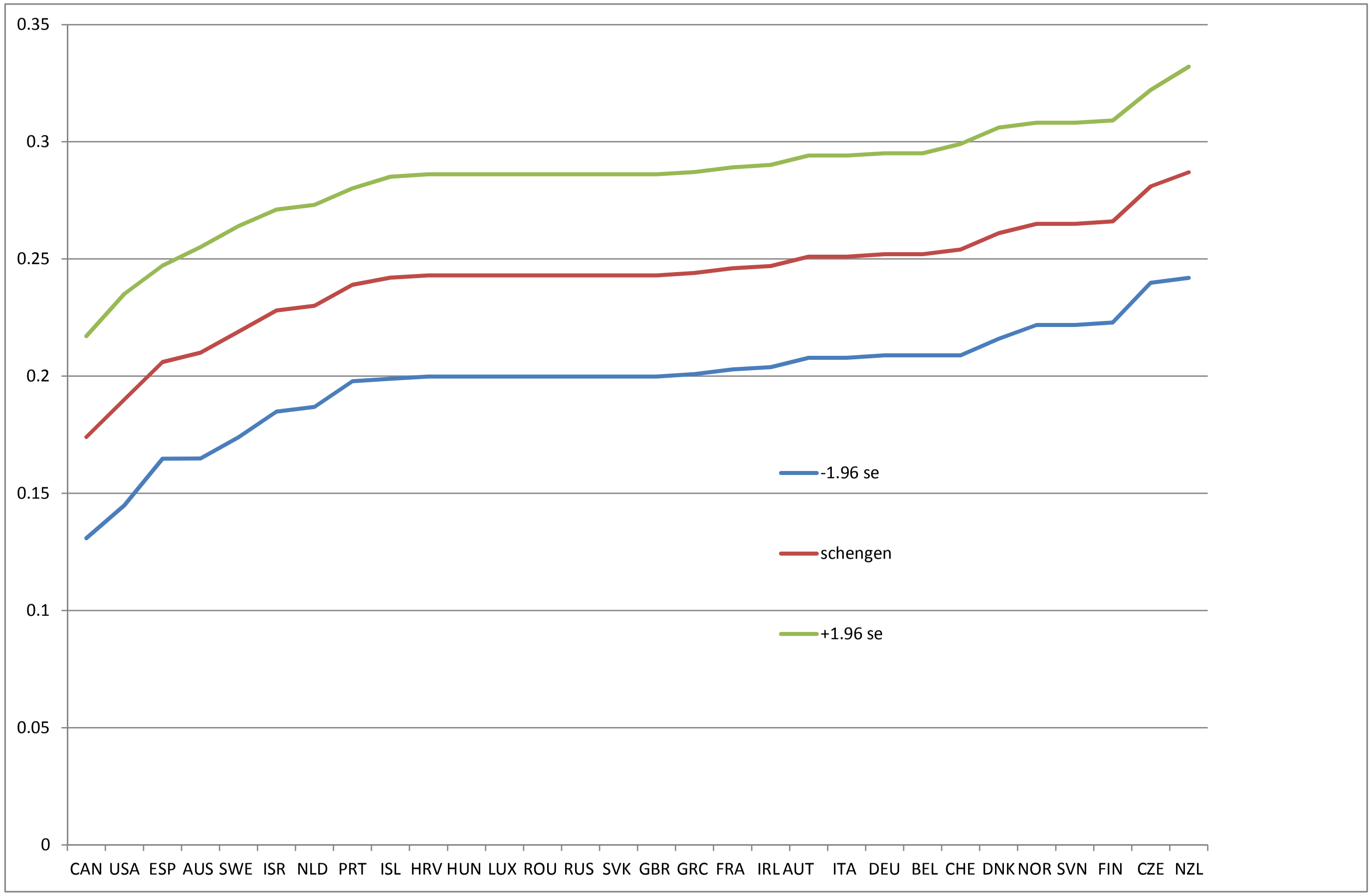


Figure 11: Schengen coefficient estimates ($\hat{\beta}_2$) (equation (13)) with 95% confidence interval; dropped destination reported on X axis