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Immigration, Income and Productivity of Host Countries: A Channel Accounting Approach

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NON-TECHNICAL SUMMARY

During the last decade immigration has increased in most of the OECD countries. Yet, some countries have been receiving significant inflows of immigrants starting already from the 1960-es. Immigration has become an important component of the OECD labor force, shaping its structure and dynamics over a relatively long period of time.

Despite the fact that immigration is at the forefront of the economic and political arena, the real impact of immigration on the host economy is still hotly debated. There is a strong literature tradition to focus on the immigrants' impact on employment and wages of natives; however, it seems important to understand the economy-wide impact of immigration, as well as various channels, in addition to and beyond employment, through which the effect of immigration can be propagated. European countries have different patterns and histories of immigration; it thus also seems important to understand whether immigration has been one of the sources of cross country income and productivity differences.

In order to investigate these issues, we construct a new and unique dataset on migrant characteristics by age and education level in 20 OECD countries, decomposing total shares of migrants over natives by three age and two skill groups, by five-year intervals, in the period from 1960 to 2005, using individual country-year censuses and labor force surveys. Our data set on migrants by age and schooling show that immigrants have demographics and educational characteristics complementary to those of natives, even in countries that are traditionally non selective. Moreover, the share of immigrants within groups defined by age and education has significant variation over time and across countries.

Using these data, we study the impact of heterogeneous migration on income and labor productivity, as well as its main components: total factor productivity, physical capital, human capital, and employment, thus analyzing though which channels the migration impact is diffused.

The main findings of this paper are that, on average, immigrants have a positive impact on income and labor productivity in host countries, which works primarily through the TFP, and mostly in the long run. We show that this aggregate result can be explained by complementarities in age and education dimensions of immigrant relative to native population.

Decomposition of immigration rate by age reveals negative short-term effect of immigration on income and TFP, and a positive impact on overall employment; however, in contrast, these effects are outweigh by large positive long-term effects on income, labor productivity, and TFP, and an equal negative long-term effect on employment. Controlling for both age and education reveals other finer, local, complementarities between immigrants and natives. Wherever negative effects are found on some channels of productivity, they are compensated by positive effects on others. For example, we observe negative impact on capital accumulation of larger groups of skilled immigrants in the short run, while a positive adjusting impact on capital accumulation of larger groups of skilled immigrants in the medium run, as well as the positive impact of unskilled immigrants in the long run. Similarly, there are employment effects that point in different direction in the short and in the long run. These results suggests that studies which focus uniquely at one type of effect, such as impact on employment, overlook other channels

through which economy adjusts to immigration, and also that studies that look at one-point-in-time effect of immigration underestimate potential adjustment effects.

ABSTRACT

This paper investigates the contribution of immigration to income and productivity of host countries. Using a dataset constructed from census data and labor force surveys for 20 OECD countries in the period from 1960 to 2005, we explore the information on age and educational attainment of immigrants to assess the contribution of immigration to income components: changes in physical capital, human capital, employment, and total factor productivity. We combine level accounting approach with panel income regressions, and also account for the endogeneity of migration choices to productivity shocks. Our main findings are that, overall, higher shares of immigrants over natives have a positive effect on income and productivity of their host countries. Under the assumption that older immigrants are also the ones with the longest duration of stay, this effect is due to the long run changes in TFP, and is robust to educational disparities between immigrants and natives. The decomposition by age and education suggests that only unskilled immigrants have a non-neutral impact on income and productivity, which is negative in the short run but positive, and larger in magnitude, in the long run. We also find a dispersed impact of the presence of other immigrant groups on some income channels.

JEL Classification: F22, J24, J31, O31

Keywords: International migration, productivity, income, employment, instrumental variable, channel accounting

IMMIGRATION, REVENU ET PRODUCTIVITÉ DANS LES PAYS D'ACCUEIL : UNE APPROCHE PAR LES FACTEURS DE LA CROISSANCE

RÉSUME NON TECHNIQUE

Au cours de la dernière décennie, la part des immigrés dans la population a augmenté dans la plupart des pays de l'OCDE. Pour certains d'entre eux, l'immigration est depuis longtemps une composante significative de la taille et de la structure de leur population. L'impact des migrants sur l'économie des pays d'accueil est plus difficile à appréhender. Une importante littérature s'attache à l'identifier en analysant les effets sur l'emploi et les salaires des natifs d'un pays, d'une région ou d'une ville donnés, au cours d'une période donnée. Peu de travaux ont cherché à dégager sur un ensemble de pays aux histoires migratoires différentes les effets que les migrants peuvent avoir, à long terme, sur le revenu et la productivité. C'est ce à quoi nous nous attachons ici.

Le manque de données de longue période sur les migrants et leurs caractéristiques est l'un des obstacles à ce type d'études. La première étape de notre travail consiste donc à construire, à partir des données des recensements et des enquêtes-emplois des pays hôtes, une base de données sur les migrants couvrant 20 pays de l'OCDE sur la période 1960-2005. Ces données, qui détaillent l'âge et le niveau d'éducation des migrants, révèlent que ceux-ci possèdent souvent des caractéristiques complémentaires de celles des natifs, y compris dans des pays aux politiques migratoires non sélectives. En outre, la proportion d'immigrés est beaucoup plus variable (à la fois dans le temps et dans l'espace) au niveau fin des groupes d'âge et d'éducation qu'en moyenne dans l'ensemble de la population.

Ces données nous permettent d'étudier l'impact des migrants sur le revenu et la productivité en prenant en compte leur hétérogénéité par rapport aux populations des pays d'accueil. Dans le cadre d'une fonction de production, l'impact des migrants sur le revenu par tête et la productivité est analysé en distinguant leurs effets sur la productivité globale des facteurs, sur l'accumulation de capital physique, sur l'accumulation de capital humain et sur l'emploi. On peut ainsi identifier les principaux canaux à travers lesquels l'impact des migrants se manifeste au niveau macroéconomique.

Le principal résultat est que, en moyenne, les migrants augmentent la productivité et le revenu par tête des pays d'accueil. Ces effets se matérialisent essentiellement à long terme par une amélioration de la productivité globale des facteurs. Celle-ci provient des complémentarités entre migrants et natifs. La décomposition des taux d'immigration par groupe d'âge et par qualification permet de préciser ce résultat. Chez les jeunes, la proportion d'immigrants a un effet négatif sur la productivité. Cet effet disparait pour les groupes d'immigrants d'âge intermédiaire et devient positif pour les cohortes les plus âgées. Dans la mesure où l'âge des immigrés est fortement corrélé avec leur durée de résidence dans les pays d'accueil, on conclut à un effet net positif à long terme de l'immigration, malgré l'existence de coûts d'ajustement à court terme. Une décomposition supplémentaire des effets par âge selon les niveaux de qualification révèlent que les complémentarités entre immigrants et natifs jouent uniquement pour les travailleurs peu qualifiés. S'agissant des migrants plus qualifiés, leur impact sur les facteurs de production et sur la productivité globale des facteurs se compensent de sorte qu'on ne trouve aucun effet sur la productivité ou le revenu pour ce groupe de migrants.

Ces résultats soulignent l'intérêt de disposer de mesures fines des caractéristiques des migrants ; ils soulignent aussi que l'évaluation de leur impact doit porter sur une période suffisamment longue pour que puissent s'y produire les ajustements des différents facteurs de production et de la technologie. Enfin, la diversité de ces mécanismes d'ajustement ouvre un champ d'étude important sur la façon dont les travailleurs natifs et les migrants interagissent dans la production.

RÉSUMÉ COURT

Ce papier s'intéresse à la contribution de l'immigration au revenu et à la productivité des pays d'accueil. Nous construisons une base de données à partir des recensements et des enquêtes emplois pour 20 pays de l'OCDE sur la période 1960-2005. L'information sur l'âge et le niveau d'instruction des immigrés permet de décomposer l'impact des immigrants sur les différentes composantes de la production : capital physique, capital humain, emploi et productivité globale des facteurs (PGF). Nous combinons une approche comptable avec des estimations sur données de panel qui prennent en considération le caractère endogène de l'immigration. Le principal résultat est que les migrants augmentent la productivité et le revenu par tête des pays d'accueil. Considérant que les immigrants plus âgés ont une durée moyenne de résidence dans le pays d'accueil plus élevée, cet effet est attribué à des changements dans le long terme de la PGF. Ce résultat est robuste à la prise en compte des différences de niveau d'éducation entre les migrants et les natifs. La décomposition par âge et niveau d'éducation révèle que seuls les immigrants non qualifiés ont un effet significatif sur le revenu et la productivité ; cet effet est négatif à court terme et positif à long terme. S'agissant des migrants plus qualifiés, leur impact sur les facteurs de production et sur la productivité globale des facteurs se compensent de sorte qu'on ne trouve aucun effet sur la productivité ou le revenu pour ce groupe de migrants.

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Mots clés : Migrations internationales, productivité, revenu, emploie, variables instrumentales, comptabilité de la croissance

IMMIGRATION, INCOME AND PRODUCTIVITY OF HOST COUNTRIES: A CHANNEL ACCOUNTING APPROACH[1]

Aleksynska Mariya* Ahmed Tritah†

1. INTRODUCTION

During the last decade immigration has increased in most OECD countries. Yet, some countries have been receiving significant inflows of immigrants starting already from the 1960s. As a consequence, immigrants became an important component of OECD labour force, shaping its structure and dynamics over a relatively long period of time. In this paper, we use this simple observation to investigate whether immigration has been an important source of cross country income and productivity differences over this period.

Despite the fact that immigration is at the forefront of the economic and political arena, the real impact of immigration on the host economy is still hotly debated. There is a strong literature tradition to focus on the immigrants' impact on employment and wages of natives (Borjas, 2003; Card, 2005), however, some authors (Lewis, 2005; Ottaviano & Peri, 2008) have stressed the importance of taking into account general equilibrium effects at the country level. Being "more than a simple labour supply shock" (Ottaviano & Peri, 2008), immigration affects relative supply of workers with different characteristics. As such, it has an impact that goes beyond simple expansion of labour supply, and affects specialization patterns, investment decisions, and choice of technology.

The contribution of this paper is to explore these long term economy-wide effects of immigration on aggregate output and labour productivity (or output per worker).[2] Using development accounting methods and factor-proportions approach (Hall & Jones, 1999; Caselli, 2005; Feyrer, 2007), we study the impact of immigration on the decomposed factors of production: physical capital, human capital, total factor productivity, and also on employment rates. By doing so, we identify the most important channels through which economies adjust to immigration.

[1]We wish to thank Agnès Bénassy-Quéré, Martine Carré, Benjamin Carton, Xavier Chojnicki, Francesc Ortega, Giovanni Peri, Jennifer Hunt and Max Steindhart for valuable suggestions. Part of this research was done while the second author was visiting the Robert Schuman Center for Advanced Studies at the European University Institute, which is gratefully acknowledged for its hospitality and help with data access. We thank participants in the Barcelona INSIDE workshop, the Instanbul SMYE meetings and the AFSE congress, in particular Jean Christophe Dumont for discussion and important suggestions. Usual disclaimer applies.

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[2]As compared to the literature on migration, growth and convergence, such as Barro & Sala-i-Martin (2003).

In addition, we explore the heterogeneity of immigrants' labour input with respect to the labour input of natives, the importance of which is highlighted by Friedberg & Hunt (1995), and more recently by Ottaviano & Peri (2005, 2008). Specifically, we proceed in three steps. First, we analyze the effect of the total immigration rate on output and labour productivity. Second, we decompose the ratio of immigrants over natives into three age groups, which allows us to address the debate on the importance of labour market experience, and also on the long-run and short-run effects of immigration, under the assumption that older immigrants have longer tenure in a host country.[3] We take the discussion even further by decomposing the ratio of immigrants over natives into six groups, by three age and two education categories, and by exploiting the variation in these characteristics of immigrants as opposed to natives across countries and over time. The latter decomposition allows us examining skill complementarity or substitutability of immigrants with natives, and how this affects different production channels. Up till now, existing cross-country studies on the economy-wide impact of immigrants has failed to take into account their skill composition. This weakness clashes with most micro empirical labour studies that stress the importance of complementarities in assessing the impact of immigrants on natives labour market outcome. For example, Ottaviano & Peri (2005) consider immigrants as being imperfectly substitutable to native workers, notably due to their different education and experience, and show that to fully account for immigrants impact on wages at national level, one needs to consider physical capital adjustments to migration shocks within detailed education and experience groups of workers. Thus, we are offering a complementary approach to the studies that have essentially focused on local impact of immigration within a single country.[4]

The main findings of this paper are that, on average, once the endogeneity of migration choices is controlled for, immigrants have a positive impact on income and labour productivity in host countries, which works primarily through total factor productivity (TFP), and mostly in the long run.

We show that this aggregate result can be explained by complementarities in age and education dimensions of immigrants relative to native population. The decomposition of immigration rate by age reveals negative short-term effect of immigration on income and TFP; however, these effects are outweighed by a larger positive long-term effects on income, labour productivity, and TFP.

Controlling for both age and education reveals other finer, local complementarities between immigrants and natives. First, only unskilled immigrants have a non neutral impact on income and productivity which is negative in the short run but positive in the long run, mainly because of a positive adjustment of TFP and physical capital. Thus, the first aggregate effect uncovered result from positive complementarities in production between native and immigrants among unskilled workers. This finding is consistent with the view that immigrants create new opportunities for

[3] As will be discussed further, this assumption is not unreasonable in the current framework.

[4] Among studies done in a setting of several countries and years are Angrist & Kugler (2003) and Jean & Jimenez (2007), however, they mainly focus on the employment effect of immigration.

investment that raises labour productivity, increase saving capacity of hosts countries, and increase return to capital by raising the labour input. Second, for skilled immigrants, whenever negative effects are found on some channels, they are compensated by other balancing positive effects on others. These results suggest that complementarity of immigrants with natives also goes beyond their observable characteristics, such as age and education, and in the long run materializes through changes in factor accumulation, such as changes in equilibrium investment rate, or changes in technology.

The investigation of the effect of immigrants on labour productivity and income using cross-country panel analysis has been hindered by the lack of detailed data on the number of immigrants across countries and over time. An important contribution of this paper is to build the analysis on a new and unique dataset on migrant characteristics by age and education level in 20 OECD countries. We undertake a challenging construction of the shares of migrants over natives decomposed by three age and two skill groups, by five-year intervals, in the period from 1960 to 2005, using individual country-year censuses and labour force surveys. Our data set on migrants by age and schooling shows that immigrants have demographic and educational characteristics that are complementary to those of natives, even in countries that are traditionally non selective. Moreover, the share of immigrants within groups defined by age and education has significant variation over time and across countries.

Another highlight of this paper is the use of data on past population age structure to deal with endogeneity of factor accumulation to growth, which takes the form of inflows of immigrants to highly productive countries (Bils & Klenow, 2000). At the same time, we address the issue of measurement errors in the share of immigrants arising from the data collection from various sources.

Unlike many other variables used in cross-country panel setting, current demographic structure is strongly predetermined relatively to current output movements, as it results from fertility decisions made 20 to 60 years earlier (Feyrer, 2007). Moreover, even though the general tendency in the core OECD countries is the labour force ageing, the demographic structure presents substantial variation over time and across countries, providing the necessary variance in the panel data setting. It is well known that predetermined variables with time series variation are rare in empirical growth literature. For most variables that change over time, such as trade and education, reversed causality can not be rejected. Unlike our demographic variables, other plausible exogenous variables that could be used as instruments, such as geographic measures, tend to lack time series variation. Thus, we use lagged demographic structure of the current labour force population as an exogenous immigrants' destination country pull factor. In addition, we explore further our immigration data, and instrument changes in immigration rates with the time varying lagged ratio of females to males in the migrant population, as well as with the lagged share of immigrants.

The paper is organized as follows. The next section presents the production function channel accounting framework. It is followed by the data description and descriptive statistics in Section

3. Section 4 describes the estimation strategy, while the empirical analysis is carried out in section 5. Section 6 provides some robustness check and the last section concludes. Details regarding the construction of the dataset on immigrants and some additional tables are presented in the Appendices.

2. METHODOLOGICAL FRAMEWORK

We work within an income decomposition framework, which allows us distinguishing the impact of immigrants on the host country income and labour productivity through different components of countries' aggregate production functions. In other words, we seek to assess to what extent immigration explains differences in per capita output and labour productivity across countries and to identify the most important channels of this process. Following Hall & Jones (1999), Wong (2007), and Feyrer (2007), we extend the development accounting decomposition to cross-country panel accounting.

Assume that Y_{it}, the output in country i at period t, is produced with physical capital K_{it} and human capital H_{it} according to:

$$Y_{it} = K_{it}^{\alpha}(A_{it}H_{it})^{1-\alpha} \tag{1}$$

where A_{it} is a labour-augmenting total factor productivity. The aggregate human capital input H_{it} can be further decomposed into the product of raw labour, L_{it} and human capital per worker h_{it}:

$$H_{it} = h_{it} * L_{it} = h_{it} * emp_{it} * P_{it} \tag{2}$$

where raw labour L_{it} is the product of emp_{it}, the share of the total population which is employed, and the total population P_{it}. Following Bils & Klenow (2000), human capital per worker embeds the exponential structure of years of schooling, S_{it}, of a representative worker:

$$h_{it} = e^{\beta_{it}S_{it}} \tag{3}$$

and β_{it} represents the Mincerian return to a year of schooling (Mincer, 1974). An additional year of schooling increases effective labour by 100*β_{it}% and therefore increases labour productivity by the same amount. The exponential structure assumed in this production function is traditional in labour economics, and is also consistent with the literature on growth empirics that estimates log output as a linear function of years of education (Cohen & Soto, 2007). It has also been followed by most studies on development accounting such as Hall & Jones (1999) and Caselli (2005).

Noting that output per capita, y_{it}, is the product of output per worker, Y_{it}/L_{it} and employment rate, the former can usefully be rewritten as:

$$y_{it} = A_{it}\kappa_{it}^{\frac{\alpha}{1-\alpha}} * h_{it} * emp_{it} \tag{4}$$

where κ_{it} is the capital output ratio. The capital output ratio is used instead of capital per worker because the former captures variations in capital accumulation that are not induced by differences in A. For instance, in the steady state of the Solow model, the ratio depends only on the saving rates and population growth rate, while capital per worker is also a function of A.

Taking logs on both sides yields the following output decomposition:

$$\log(y_{it}) = \log(A_{it}) + \frac{\alpha}{1-\alpha}\log(\kappa_{it}) + \log(h_{it}) + \log(emp_{it}) \tag{5}$$

Within this channel accounting exercise, we regress each of the components of output per capita on various measures of immigration. At the onset assume that the log of output per capita, and any of its component z_{it}, in country i at period t, is a function of a time invariant fixed-effect f_i, a time trend common to all countries μ_t and a vector of explanatory variables x_{it}, including the share of immigrants over natives in various demographic and skill sub-groups:

$$\log(z_{it}) = f_i + \mu_t + \beta x_{it} + u_{it} \tag{6}$$

All variables are measured at five-year time intervals, which partially mitigates the problem of serial correlation in the error term. Serial correlation, while not affecting the consistency of the parameter estimated, can lead to misstated standard errors. To deal with this issue, we exploit the panel structure of the data and cluster standard errors by country. This approach allows for an arbitrary covariance structure within countries and produces consistent estimates of the standard errors.

Equation (5) is an identity. Therefore, any impact of immigrants on output should go through any of the four determinants of income identified in Eq. (5), the first three components amounting to worker productivity. In particular, given any linear conditional expectation function E, the conditional expectation of $\log(y_{it})$, given the explanatory random variable x_{it} can be decomposed as:[5]

$$\begin{aligned} E\left[\log(y_{it})|x_{it}\right] &= E\left[\log(A_{it})|x_{it}\right] + \frac{\alpha}{1-\alpha}E\left[\log(\kappa_{it})|x_{it}\right] \\ &\quad + E\left[\log(h_{it})|x_{it}\right] + E\left[\log(emp_{it})|x_{it}\right] \\ &= (\hat{\beta}_A + \frac{\alpha}{1-\alpha} * \hat{\beta}_\kappa + \hat{\beta}_h + \hat{\beta}_{emp}) * x_{it} + E(u_{it}/x_{it}) \\ &= \hat{\beta} * x_{it} + E(u_{it}/x_{it}) \end{aligned} \tag{7}$$

where $\hat{\beta}_j$ is the vector of coefficient estimates obtained from the regression of the variable j on the explanatory vector of variable x_{it}. We refer to $\hat{\beta}_j$ as the contribution of x_{it} to income, or

[5] For the sake of presentation the expectation of country and time fixed effects have been omitted.

labour productivity, that goes through factor $j, j = A, k, h, emp$. This decomposition allows us to compare the magnitude of coefficients, since by construction they sum to $\hat{\beta}$, and identify the main channels through which immigrants impact host countries' income and labour productivity. Moreover, even if one does not find any impact on overall income and labour productivity, Equation (7) can still provide explanation to whether economies adapt to specific migration through changes in factors' efficiency, A_{it}, or accumulable inputs κ_{it}, h_{it}, emp_{it}.

3. DATA AND DESCRIPTIVE STATISTICS

Macroeconomic data

Our panel database consists of 20 OECD countries observed every 5 years over the period from 1960 to 2005. Data sources and definitions are in the Appendix, Tables 6-7. The macroeconomic aggregates are from the Penn World Table version 6.3 (PW6.3). Specifically, output per worker y_{it}, is the real PPP adjusted GDP per worker. Physical capital, K_{it}, is generated using the perpetual inventory method (Barro & Sala-i-Martin, 2003):

$$K_t = I_t + (1 - \delta) * K_{t-1}, \tag{8}$$

where I_t is the PPP real aggregate investment and δ is the depreciation rate. The initial capital stock K_0 is computed as $I_0/(g + \delta)$, where I_0 is the value of the investment series in the first year available, and g is the average geometric growth rate for the investment series between the first year of available data and 1970. Following the literature, δ is set equal to 0.06.[6] The number of workers L_t is obtained by dividing real GDP per capita by real GDP per worker and multiplying by the total population. The capital output ratio is obtained by dividing the capital labour ratio by real GDP per worker.[7]

Human capital is constructed according to Equation (3). The data on average years of education of the population aged 15 to 64 comes from the new Cohen & Soto (2007) database, and returns to education are from the database on Mincerian returns assembled by Hendricks (2006). We work with the estimates obtained for the total population. For a few countries Mincerian returns are missing, and we impute the values from a regression of returns to years of education and their square.[8]

[6] Sensitivity tests performed by Caselli (2005) show that the sources of income differences across countries are not very responsive to the assumptions made to compute K_0.

[7] The number of worker is obtained by multiplying the output per capita by the total population and by dividing by the output per worker, that is using the PW6.3 variables' names: $POP * \frac{RGDPL}{RGDPWOK}$. Capital per worker is then simply obtained by dividing the computed stock of capital by the number of workers.

[8] This regression shows that there is a U shape relationship between years of education and Mincerian returns with a minimum at around 10 years of education. The $R2$ of this regression with country and time dummies is 0.77. A similar pattern has been found in a sample of 28 countries by Trostel et al. (2002).

Demographic and immigration data

Host countries population shares by age groups are obtained from the United Nations (UN) demographic database.

Immigration data are gathered from a combination of sources. First, the total number of immigrants comes from the UN: we work with the estimated number of international migrants at midyear (both sexes) net of estimated number of refugees. The total number of natives is the total population minus migrants. We create our reference variable "share of immigrants" as a ratio of immigrants to natives. We prefer the specification that uses this ratio instead of the ratio of immigrants over the whole population (i.e. the immigration rate) because it reflects better the view that immigrants and natives enter differently in the production function. For instance, with a CES production function, in which both immigrants and natives are labor inputs with an elasticity of substitution $\frac{1}{1-\sigma}$, the output per capita can be written as: $\frac{M/N}{M/N+1}[1+(N/M)^{1/\sigma}]^{\sigma}$ which depends only on the ratio of immigrants, M, over natives, N. In most cases, the UN data define immigrants as foreign born. However, in some cases, such as in Germany and Austria, citizenship is used to determine the immigrant status.

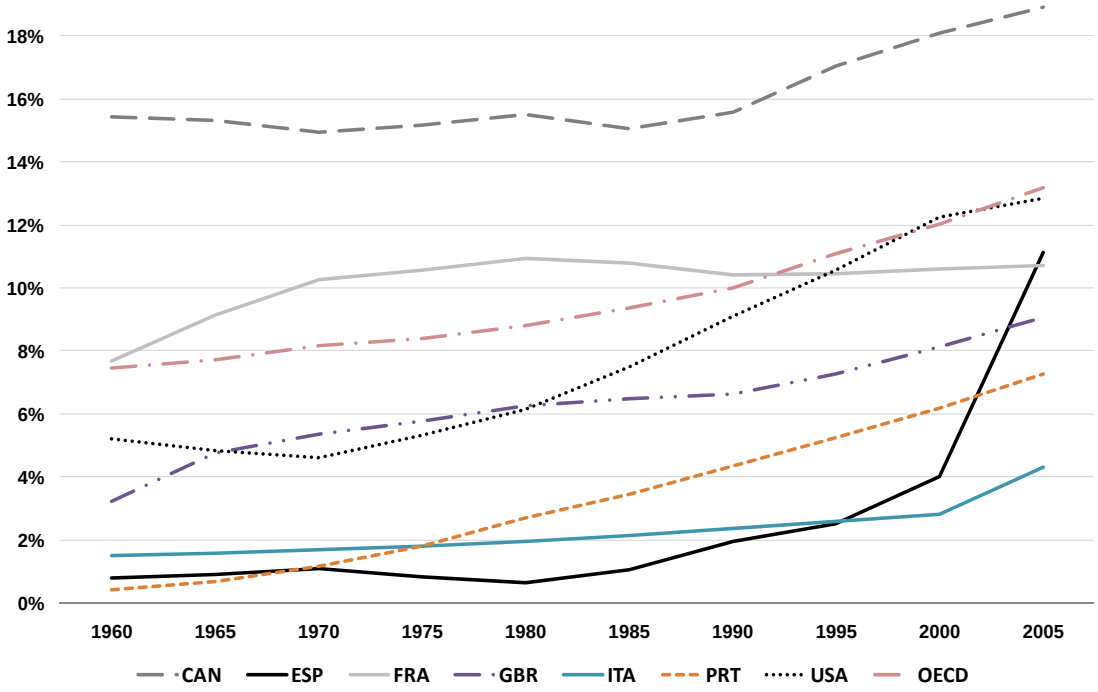
Second, the compilation of a dataset on the number of immigrants and natives in different age, education and age/education categories has been a more challenging task. We rely on host country data, using censuses and labor force surveys. Census data are particularly attractive to measure population shares by characteristics. Most of the OECD countries have run censuses since 1960 on a regular basis (for most countries, by decade), and, most importantly, around the same years. For some countries, we can go back as early as 1960 (France, USA, The Netherlands) or 1970 (Canada, Greece, Austria, Switzerland). Starting from 1985, and for countries-years where censuses are not available, we use the data from representative European Labor Force surveys and the US June Current Population Surveys. Thus, for the year 2005, for all countries except Canada, we use Labor Force Surveys.

For most countries, immigrant status is defined according to an individuals' country of birth. Appendix A provides migration data sources for each country and the period covered, and the adopted definition of immigrants. Overall, we obtained an unbalanced panel data for a maximum of 20 countries starting from 1960 and with a minimum of three observations per country, which allows us to control for country fixed effects in the channel accounting exercise. Details on construction of immigrants share by age and education are provided in Appendix A.

Immigration trends

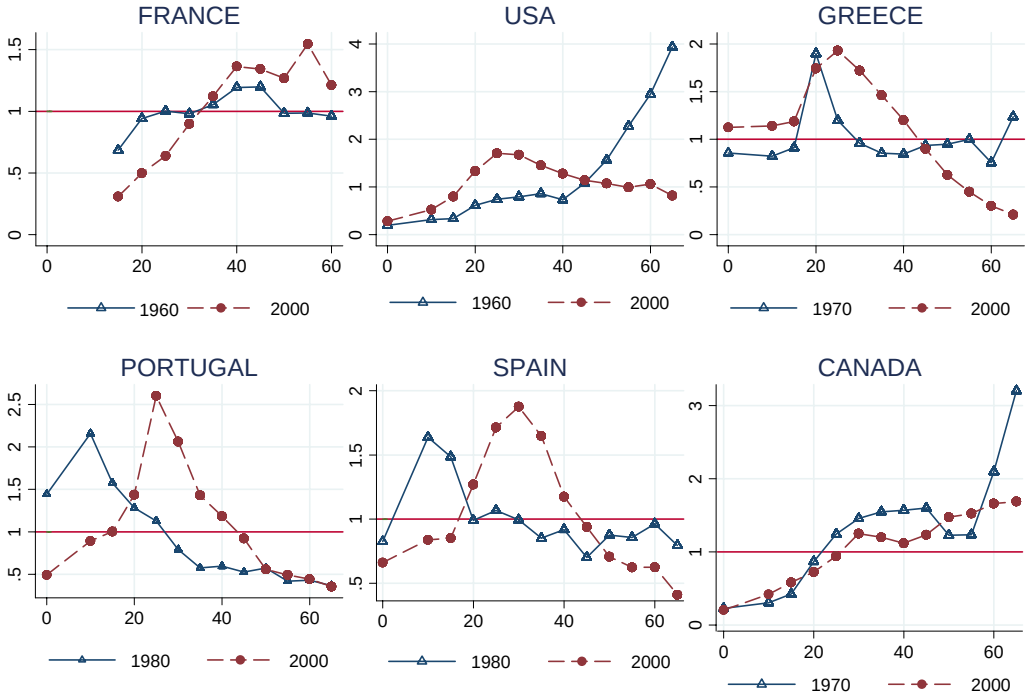
Figure 1 shows the evolution of the share of immigrants in the total population in a selection of countries. From 7.5% in 1960, the share of immigrants in the total OECD population rose to 13% in 2005. Starting from the mid-1980s, immigrants' weight in total population has been accelerating. Despite this general trend, the graph highlights different migration patterns on a

Figure 1 – Immigration Rates (Immigrants/Total Population) in Selected Countries (1960-2005)



Source: Authors' calculations from UN data

Figure 2 – Distribution of Immigrants by Age Categories (relative to natives)



Source: Authors' calculations from countries' censuses

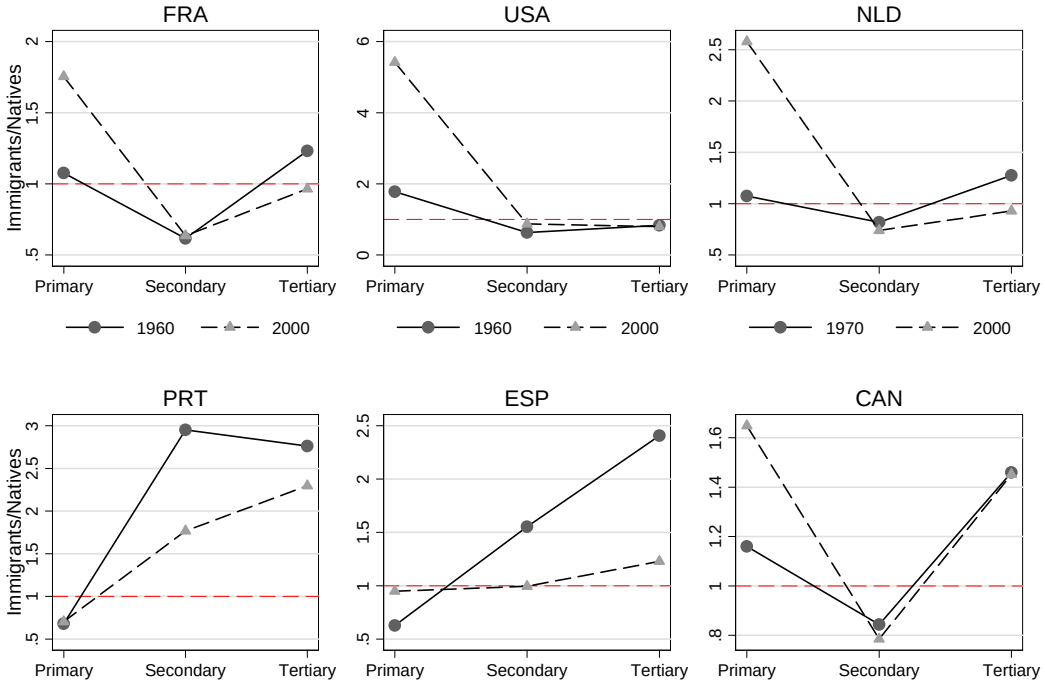
country per country basis: while in Canada this proportion stayed relatively constant throughout the decades and even had periods of decline, other countries, such as Spain, Portugal, or the USA, witnessed a drastic increase.

Immigrants and natives demographic and skill composition

While being important in its own right, the aggregate data on the share of immigrants in the population hides many characteristics of migrants that may matter for their impact on hosts countries. For instance, for the very reason that immigration is a result of an investment choice, immigrants tend to be over represented in the working age population. Moreover, the fact that migrants differ from natives in education and age, and that there are higher proportions of migrants in specific age and education groups, may mean that migrants and natives are not perfect substitutes, and need to be considered as a differentiated input in production (Ottaviano & Peri, 2005).

This heterogeneity of immigrants relative to natives is portrayed in Figure 2 which shows the evolution of the ratio of the share of migrants in specific age groups over the share of natives in the same age groups, by five-year age categories, in the first and last available census for a selection of countries. When the share of immigrants in an specific age group in the total number of immigrants is equal to the share of natives in a specific age, the ratio is equal to one. Thus,

Figure 3 – Distribution of Immigrants by Educations Categories (relative to natives



Source: Authors' calculations from countries' censuses

values above one suggest that immigrants are over represented relatively to natives in this age group. Immigrants have clearly different age distribution than natives. In most countries they are over-represented among prime-age workers (25-54), and under-represented among youth and older workers. Moreover, these relative distributions are changing over time and across countries. For instance, in France, the proportion of older immigrants has increased significantly between the 1960 and 2000, while the proportion of young immigrants has decreased, implying a right shift in the age distribution, or a relative ageing, of migrants. In Portugal, while the old-migrant population stayed at relatively low level in both decades, the number of medium-age immigrants has increased dramatically over the past twenty years. Similar patterns are observed in Spain and Greece, while in the USA and Canada the share of old-age immigrants has gone down.

A second important dimension of immigrants' characteristics considered in the paper is their schooling. This characteristic is at the heart of the current debate on migration policies that increasingly target skilled immigrants. We construct ratios of immigrants over natives in three education categories: unskilled (those with primary education or less), middle-skilled (those with secondary, non-tertiary, education) and skilled (those with tertiary education), over natives in the same education groups. Figure 3 presents the relative distribution of immigrants by edu-

Table 1 – Ratio of immigrants over natives within age and education group, 2005, selected countries

Age-skill category	BEL	DNK	ESP	FRA	GBR	GER	GRC	IRL	ITA	NLD	PRT	USA
smigr15uk	0.08	0.09	0.10	0.06	0.13	0.20	0.10	0.07	0.04	0.12	0.07	0.15
smigr25uk	0.18	0.09	0.13	0.16	0.14	0.26	0.10	0.09	0.07	0.18	0.08	0.30
smigr55uk	0.14	0.03	0.03	0.18	0.09	0.24	0.03	0.04	0.02	0.10	0.02	0.19
smigr15sk	0.03	0.06	0.04	0.05	0.14	0.27	0.05	0.11	0.03	0.08	0.11	0.12
smigr25sk	0.16	0.11	0.13	0.13	0.14	0.18	0.08	0.20	0.06	0.13	0.16	0.17
smigr55sk	0.09	0.08	0.08	0.16	0.11	0.22	0.10	0.12	0.04	0.11	0.09	0.12

Source: Authors' calculations from countries' censuses and labor force surveys

cation categories. Each point of the graphs reflects the share of immigrants in a given education category relative to natives, and points along the unit horizontal line indicate the same distribution of education. Immigrants have clearly different schooling distribution than natives and tend to be over-represented among low skilled immigrants. In most countries, and to different extent, immigrants are over-represented among low skilled workers. In some countries, this share has dramatically increased. In the USA in particular, the change is largely reflecting the shift away from European immigration and towards immigration from developing countries that has followed the 1965 Immigration Act. Consistent with the important progress of natives' educational attainment throughout the last three decades in Europe, relatively to natives, the share of immigrants with tertiary education has decreased in most countries. However, immigrants are still over represented among high skilled workers in traditionally selective countries such as Canada, but also among non selective countries such as Spain and Portugal.

Finally, we also consider the relative distribution of migrants within cells defined by age and education. We present a three age and two education grouping (unskilled and middle-skilled bundled together, and skilled), creating six categories. From Table 1, which contains ratios of immigrants over natives in these six categories, for a selection of countries, in the year 2005, one can observe a significant variability across countries. For example, while in Belgium the group of young skilled immigrants represents only 3 percent of young skilled natives, this indicator is as high as 27 percent in Germany. Within countries variation is also large. For instance, in the USA, the share of skilled immigrants in young and old age groups is the same and equals 12 percent of skilled natives in the same age groups. At the same time, unskilled migrants of the main working age group represent as much as 30 percent of the similar native population. We explore this important variability in the relative age and skill distribution to assess the contribution of immigrants to hosts countries average income and productivity. This variability implies that we have a much more accurate measure of migration labor supply shocks than a simple measure of migrants' share that assume that migrants' characteristics resemble those of natives.

4. ESTIMATION STRATEGY

In what follows, we estimate the impact of immigration on output and labour productivity through its impact on factors of production, using decomposition (7). Our main interest is in the overall effect of immigration, measured by the share of immigrants to natives, and in the impact of immigration disaggregated by age and by age and education, measured by shares of immigrants over natives in corresponding age, and age and education groups.

We explicitly recognize the presence of measurement errors and endogeneity of migration variable in basic estimations. Indeed, the concern of measurement error stems from the fact that migration stocks are gathered from different national agencies over a long time period. Their presence can bias the estimated impact toward zero, a possibility mooted by Card & DiNardo (2000). As to simultaneity, this issue is relevant for each determinant of output. For instance, a shock to productivity will raise labour demand and exert a pull effect on immigrants. Similarly, immigrants are more likely to settle in countries with good and growing employment opportunities, which means that the coefficient on employment is biased upwards in least square estimations. Simultaneity between immigration and productivity results in a positive correlation between the disturbance in the productivity regressions and differences in immigration rates, that is $E(u_{it}/x_{it}) \neq 0$, and needs to be properly accounted for.

To address both concerns, we use instrumental variables on within groups. As main instruments in regressions measuring the aggregate effect of immigration, we use the logarithm of the ratio of male to female immigrants, and the logarithm of the ratio of immigrants over natives. Both instruments are lagged twice, and this choice is the result of an arbitrage between having a sufficiently distant variable to eliminate as much endogeneity as possible and not going too far back in time to preserve sufficient number of observations. The intuition behind using these variables as instruments is the following. An imbalanced gender ratio among immigrants should encourage additional immigration of the disadvantaged gender. At the same time, the gender ratio can serve as a proxy for the type of migration policy. A more balanced sex-ratio is likely to reflect a family oriented type policy targeted toward permanent residence. Instead, in a guest-worker type of program, the sex-ratio is more likely to be unbalanced. In its turn, past immigration rate is a measure of networks and previous migration history of a country. In all IV regressions, the results are systematically completed by specifications tests.

In addition to these instruments, in regressions with migration effect disaggregated by age, we use lagged corresponding demographic age structure of the current population in the labour force, to instrument the current shares of immigrants over natives by age groups. Such instruments have already been successfully used in the literature on growth empirics (Feyrer, 2007) and the logic behind them is the following. Demographics has a natural feature: native population structure depends on past fertility decisions. These decisions are highly predetermined and are orthogonal to unobserved factors that influence current productivity and its components. However, they shape the size and age distribution of current native population, and hence are strongly correlated with the denominator of our endogenous independent variables. At the same

time, past demographic structure also influences directly the number of immigrants, which is in the numerator of our instrumented variables. To illustrate, a small cohort of young individuals entering the labour market and a large cohort of old individuals leaving it due to past negative and positive demographic shocks, means that the economy is affected by a pre-determined negative labour supply shock, and that this shock is unevenly distributed across various demographic segments of the working age population. An economy short of young labour supply should be more open to young immigrants.[9]

Finally, in regressions with migration effect disaggregated by age and education, the set of instruments includes lagged demographic structure of native population also decomposed by education, with the idea being that not only fertility, but also education choices are made well in advance by natives. In particular, for each type of skill, we compute the share of young, middle and old age individuals, using the recent data set of the education distribution by age provided by Lutz et al. (2007), which covers the period from 1970 to 2000 in five-year intervals.

For our identification to be valid, past demographic structure should affect income and productivity only through its effect on the share of immigrants. However, as emphasized in the literature on growth and demographics, one obvious variable through which past demographics can affect productivity and income is the dependency ratio. For example, Bloom et al. (2007) find that an increase in the size of the working-age population can produce a "demographic dividend" to economic growth. Kogel (2005) finds a negative relationship between total factor productivity and the youth dependency ratio. Given that immigrants are more likely to go to countries that are short of labour and, as a consequence, have higher dependency ratio, omitting the dependency ratio can bias downwards the estimated impact of immigration on productivity. Thus, in all estimations, we also add the logarithm of the dependency ratio as an additional control variable. The dependency ratio is computed from the UN population data as the share of the population below 15 and above 64 over population aged 15 to 64. For similar identification arguments, in all regressions we also control for the weight of current prime-age working population (aged 25 to 54) over the population aged 15 to 64.

5. RESULTS

5.1. Immigration and output: aggregate results

To estimate the aggregate impact of immigration on productivity and its channels, based on Equation (6), we use the full dataset of immigration rates, collected from the UN statistics, for 20 OECD countries between years 1960 and 2005, at five-year intervals. The chosen method of estimation is panel data within-group (fixed-effect), which allows distinguishing the effect

[9]This should also reinforce a positive attitude toward migration policy on the part of employers (capital owners) and middle-age native workers, i.e. those that could presumably benefit from migration. Ortega (2004), presents an interesting political economy model of migration policy with capital and labor complementarity that support these presumptions.

Table 2 – Effect of immigrants on productivity and per capita output: channel decomposition

	(1)	(2)	(3)	(4)	(5)	(6)
	Log(Y/L)	Log(y)	Log(A)	α/(1-α)* Log(K/Y)	Log(h)	Log(emp)
Log(smigr)	0.129**	0.131**	0.139**	0.024	-0.035	0.002
	(0.024)	(0.012)	(0.018)	(0.162)	(0.256)	(0.943)
Log(depratio)	0.049	-0.450	0.733	0.450	-0.910***	-0.498**
	(0.942)	(0.411)	(0.206)	(0.156)	(0.009)	(0.012)
Log(sh2554/1564)	-0.116	0.127	-1.258*	0.019	1.133**	0.243
	(0.833)	(0.796)	(0.079)	(0.951)	(0.014)	(0.167)
Observations	194	194	194	194	194	194
R-squared	0.874	0.937	0.462	0.649	0.756	0.765
Number of countries	20	20	20	20	20	20

Robust p-values in parentheses. Significant at: *** 1%, ** 5 %, * 10 %. All regressions include a full set of time dummies.

of immigration on economic outcomes from changes over time in the pattern of cross-sectional variation, and to eliminate the country fixed effect. Table 2 contains results of estimating a set of basic regressions, in which dependant variables are the log of output per capita (y), log of output per worker (Y/L), as well as their decomposition into capital–output ratio (K/Y), human capital per worker (h) employment rate (emp), and residual productivity (A). The independent variable of interest is the ratio of immigrant to native population. By construction, the coefficients of the first three component of output (columns 3 to 5) sum to the coefficient on output per capita (column 2) and the coefficient on all components (columns 3 to 6) sum to the coefficient on output per worker, provided that in each case the coefficient on capital output ratio (column 4) is multiplied by $\alpha/(1-\alpha)$.

Point estimates in Table 2 indicate that differences across countries in the relative share of immigrants are positively significantly correlated with differences in both income (column 1) and labour productivity(column 2). The main channel through which this impact is propagated is TFP and not changes in factor accumulation. We also note that this is in contrast with other demographic controls included in the regression: the dependency ratio and the share of prime-age workers in the workforce affect also human capital and employment rates.

Basic results show that, other things being held constant, a one percent increase in the ratio of immigrants to natives increases the output per worker by 0.13 percent, and that the whole effect works through the TFP channel. The magnitude of the estimated impact is almost the same whether we consider output per worker or per capita, suggesting that differences in migration share do not correlate with differences in employment rate. The latter is confirmed by the last column that shows no significant relationship between migration share and employment rate, implying no crowd-out effect of immigration on employment of natives.

Table 3 – Effect of Immigrants on Productivity and per Capita Output: Channel Decomposition (IV estimates)

	(1)	(2)	(3)	(4)	(5)	(6)
	Log(Y/L)	Log(y)	Log(A)	α/(1-α)* Log(K/Y)	Log(h)	Log(emp)
Log(smigr)	0.096***	0.105***	0.130***	0.003	-0.037	0.008
	(0.008)	(0.002)	(0.007)	(0.874)	(0.257)	(0.645)
Log(depratio)	-0.582	-0.981***	0.068	0.176	-0.739***	-0.399***
	(0.118)	(0.003)	(0.859)	(0.482)	(0.002)	(8.89e06)
Log(share2554/1564)	0.141	0.534*	-1.134***	-0.132	1.341***	0.392***
	(0.682)	(0.077)	(0.009)	(0.604)	(6.22e-06)	(2.83e06)
Observations	154	154	154	154	154	154
R-squared	0.831	0.919	0.291	0.416	0.686	0.844
Number of countries	20	20	20	20	20	20
Hansen J statistic (p-value)	0.933	0.766	0.461	0.223	0.735	0.421
F statistic for weak identification: 31.86						
Kleibergen-Paap rk LM statistic: Chi-sq(2)=27.10 P-val=0.0000						
Kleibergen-Paap rk Wald statistic: Chi-sq(2)=69.41 P-val=0.0000						
Robust p-values in parentheses. Significant at: *** 1%, **5 %, * 10 %. All regressions include a full set of time dummies						

These results are contrasted with the IV estimates in Table 3, and the first stage results are also in the Appendix B Table B.1. The results are robust to instrumentation: both income and labour productivity undergo a positive influence of overall immigration. The instruments fare well according to test statistics. In all cases, F-test of excluded instruments shows that instruments are rather strong, and the Sargan (Hansen) test of over-identifying restrictions suggests that the excluded instruments are uncorrelated with the error term and correctly excluded from the estimated equations. Hypotheses of weakly exogenous instruments are rejected at all conventional levels of significance.

The coefficients suggest that part of positive bias has been clearly eliminated from the estimations of income per capita and income per worker. Other things being the same, a one percent increase in the ratio of immigrants to natives increases the output per worker by 0.096 percent. Using this partial coefficient, in Appendix B we are calculating the partial annualized contribution of the change in the immigrants over natives ratio to the growth of GDP per capita in the countries of our sample, over the whole period considered, and over the last ten years. Countries in which the contribution of this factor to the economic growth is the highest are the "new" European immigration countries, such as Spain, Greece, and Portugal, and this effect has been especially pronounced in the last decade. Large differences in this effect reflect different immigration trends across countries and time portrayed in Figure 1.

The positive impact of the share of immigrants on TFP is consistent with Lazear (1998), who argues that one of the economic benefits of migration goes through its effect on productivity,

Table 4 – Effect of Immigrants on Productivity and per Capita Output: Channel Decomposition by Age groups (IV estimates)

	(1)	(2)	(3)	(4)	(5)	(6)
	Log(Y/L)	Log(y)	Log(A)	α/(1-α)* Log(K/Y)	Log(h)	Log(emp)
Log(smigr1524)	-0.140**	-0.120**	-0.195*	-0.004	0.0593	0.020
	(0.038)	(0.0312)	(0.093)	(0.866)	(0.432)	(0.366)
Log(smigr2554)	-0.003	-0.006	0.051	0.038	-0.073	-0.003
	(0.975)	(0.932)	(0.718)	(0.626)	(0.405)	(0.921)
Log(smigr5564)	0.203**	0.174**	0.281*	-0.032	-0.062	-0.029
	(0.022)	(0.027)	(0.052)	(0.686)	(0.496)	(0.305)
Log(depratio)	-0.968**	-1.538***	-0.947**	0.695**	-0.368	-0.570***
	(0.029)	(9.91e-05)	(0.047)	(0.027)	(0.232)	(4.85e-10)
Log(sh2554/1564)	0.250	0.719**	-0.324	0.184	0.482	0.469***
	(0.497)	(0.019)	(0.506)	(0.498)	(0.140)	(8.91e-06)
Observations	91	91	91	91	91	91
R-squared	0.834	0.921	0.191	0.497	0.685	0.858
Number of countries	17	17	17	17	17	17
Hansen J statistic (p-value)	0.918	0.904	0.612	0.698	0.616	0.957

F statistic for weak identification: P-value of F(6, 48) = 0.00 for all three endog. variables
Kleibergen-Paap rk LM statistic: Chi-sq(4)=8.28 P-val=0.0819
Kleibergen-Paap rk Wald statistic: Chi-sq(2)=69.41 Chi-sq(4)=12.06 P-val=0.0169

Robust p-values in parentheses. Significant at: *** 1%, ** 5 %, * 10 %. All regressions include a full set of time dummies

because diversity contributes to creativity and enhances the environment in which individuals trade. Similar argument is explored by Ottaviano & Peri (2006), who show that cultural diversity at the US city level increases productivity of natives. This is also in line with Niebuhr (2006), who shows that differences in knowledge and capabilities of workers from diverse cultural backgrounds enhance performance of German regional R&D sectors (a component of TFP). More generally, labour market efficiency requires that the value of the marginal product of workers be equalized across labour markets. This is the argument first raised by Borjas (2001), suggesting that immigrants grease the wheels of hosts countries labour market. Indeed since immigrants are more mobile than natives, they are more likely to be "marginal" workers whose location decisions arbitrage wage differences across regions or industries within countries. In this context, a higher share of immigrants raises the overall efficiency of labour market input allocation, contributing to higher TFP (Borjas, 2001).

Finally, as excepted, countries with higher dependency ratio have lower income, while those with higher ratios of prime-aged populations enjoy higher income per capita.

5.2. Accounting for immigrants heterogeneity

5.2.1. Age of immigrants

Figure 2 shows that immigrants' age distribution is very different from that of the natives, and this difference has a remarkable variability both across countries and over time. Thus, controlling for age of immigrants should result in a better account of the importance of immigrants' labour shocks in host countries, as well as of the time pattern of its cross sectional variability. Moreover, it can also capture both positive and negative production complementarities that are "local" in a sense that they are specific to an age group. For instance, if young immigrants perform jobs complementary to those of young natives, then having more young immigrants can rise the overall productivity, as the productivity of the abundant factor (the natives) increases, shifting upward the labour demand curve. Instead, if immigrants and natives are, after controlling for their age, mainly substitutes to each other, we should not observe any impact on productivity.

In the current framework, we are not able to separate the age and the length of stay effect. However, a closer look at the data suggests that age is highly informative of immigrants duration of residence in a host economy, as older immigrants, on average, have been present for a longer period of time in a given host country. Indeed, in France, for instance, among immigrants in the 55-64 age group, over 90 percent have more than ten years of residence, with the average tenure being 29,45 years in the host country. For immigrants in the 15-24 age group, the average residence is 12 years. In the case of the USA, for the same age groups, corresponding average durations of stay are 27,38 and 8 years, respectively. Thus, in our case, the age decomposition has also a notion of duration, and as such, has at least two implications. First, those with longer residence have a larger country specific experience, the importance of which has been highlighted, among others, by Friedberg (2000): productivity of immigrants increases with their years of residence in host countries. Second, older immigrants are more likely to catch long-term effect of immigration, pointing out to the gradual adjustment of countries to immigration shocks, such as, for example, long-term and usually delayed adjustments in factor input accumulation or technological change.[10]

Thus, we switch to a sub-sample of country-years, collected from individual country census and labour force surveys data, which includes disaggregated information on age distribution of immigrants, and re-estimate the decomposition equations based on Equation 7. The share of immigrants among working age (15 to 64 years old) population is decomposed into three variables: ratios of the number of immigrants to the number of natives in each age group: between 15 to 24; 25 to 54; and 55 to 64. For instance, the variable $smigr1524$ is computed as M_{1524}/N_{1524}, where M_{1524} is the number of migrant aged 15 to 24 and N_{1524} is the corresponding number of natives. Table 4 presents the results of these estimations, where we continue exploring the

[10]For instance, Eckstein & Weiss (1998) show that during the periods of mass migration, such as in Israel in 1990-1997, a constant capital quality-adjusted labor ratio can be preserved, provided that immigrants gradually adapt to the labour market and move across occupations and industries.

panel structure of the data and accounting for country fixed effects. The age distribution of 5 to 54 years old population (ratios of the population in age groups 5-14, 15-24, etc, and 50 to 60, over the population aged 5 to 54) lagged twice is used as instruments, in addition to the lagged twice immigrants gender ratio and lagged twice aggregate migration rate.

In comparison with Table 3, the decomposed results reveal several ways in which immigration affects income and labour productivity. In particular, the positive overall impact on output per worker and output per capita is due mainly to the presence of older workers, while larger share of young immigrants has a smaller negative effect. As found previously, changes in TFP, and not factor accumulation, is the main channel through which this effect materializes. We interpret the contrasting effect across age groups as long-term versus short term effects of immigration: higher share of immigrants in the old age group reflects past migration shocks, and immigrants in this age group are also most probably long-term stayers, who have also experienced assimilation. Conversely, higher share of young immigrants reflects short-term impact of newly arrived. In this context, the negative impact of a higher share of young immigrants on productivity can also reflect differences in the sectoral distribution of immigrants and natives: upon their arrival, young immigrants may be systematically employed in low-TFP sectors, such as construction or services, thus contributing to higher size of these sectors in the economy. Finally, TFP is a measure of residual productivity. This means that, given the observed level of human capital h, if young immigrants lack country specific skills, their lower, unobserved, human capital should be reflected in the residual productivity term even though they have the same observable characteristics as natives.[11] Both of these effects tend to disappear in the long run as immigrants accumulate more experience in host country and move gradually across sectors.

A serious concern for studies that wish to identify separately the effect of age, years of residence, and entry cohort (quality effect) with cross sectional data is the presence of cohort effects. This is less of a problem here, as an account for cohort effects is made by using panel data with year fixed effects, such that the impact of immigrants of a given age group is identified through differences in the time pattern of the cross-sectional distribution of migration shocks specific to that age group. Furthermore, any cohort effect specific to a time period and common to all countries is absorbed by time-period dummies additionally included in all regressions. Thus, we are more confident that our age measure captures pure age effect that reflects the length of stay and/or complementary input adjustment.

5.3. Accounting for skill heterogeneity within age groups

After controlling for one dimension of difference between immigrants and natives, such as age, important differences can still remain within other dimensions. As highlighted in Figure 3, education is another important dimension of immigrants' heterogeneity relative to natives. Table

[11]This argument is related to the fact that the Solow residual (TFP) is, as labeled by Abramovitz (1956) "the measure of our ignorance". The level of TFP converges to the true underlying technological level only if all the variety of inputs is accurately identified and measured.

Table 5 – Effect of Immigrants on Productivity and per Capita Output: Channel Decomposition by Education-Age groups (IV estimates)

	(1)	(2)	(3)	(4)	(5)	(6)
	Log(Y/L)	Log(y)	Log(A)	α/(1-α)* Log(K/Y)	Log(h)	Log(emp)
Log(smigr15uk)	-0.239**	-0.166*	-0.309**	-0.026	0.096	0.073***
	(0.015)	(0.053)	(0.044)	(0.531)	(0.236)	(0.002)
Log(smigr25uk)	-0.002	-0.017	-0.008	-0.047	0.053	-0.015
	(0.981)	(0.848)	(0.960)	(0.193)	(0.570)	(0.506)
Log(smigr55uk)	0.210**	0.168**	0.349***	0.048*	-0.186**	-0.042*
	(0.012)	(0.017)	(0.006)	(0.094)	(0.021)	(0.059)
Log(smigr15sk)	-0.096	-0.064	-0.059	-0.088***	0.051	0.032
	(0.317)	(0.398)	(0.638)	(0.009)	(0.559)	(0.227)
Log(smigr25sk)	0.300	0.256	0.475	0.210***	-0.385**	-0.0437
	(0.106)	(0.107)	(0.106)	(0.002)	(0.037)	(0.348)
Log(smigr55sk)	-0.091	-0.100	-0.247*	-0.052	0.208**	-0.009
	(0.296)	(0.165)	(0.071)	(0.101)	(0.017)	(0.694)
Log(depratio)	-0.854*	-1.476***	-1.019	-0.021	0.186	-0.622***
	(0.094)	(0.001)	(0.114)	(0.902)	(0.634)	(3.65e-08)
Log(sh2554/1564)	0.573	0.954***	-0.786	0.185	1.173***	0.380***
	(0.147)	(0.005)	(0.155)	(0.166)	(0.001)	(1.45e-05)
Observations	75	75	75	75	75	75
R-squared	0.799	0.913	0.239	0.265	0.695	0.839
Number of countries	15	15	15	15	15	15
Hansen J statistic (p-value)	0.964	0.776	0.564	0.165	0.787	0.521
F statistic for weak identification: P-value of F(5, 34) = 0.00 for all endog. variables						
Kleibergen-Paap rk LM statistic: Chi-sq(2)=8.02 P-val=0.0181						
Kleibergen-Paap rk Wald statistic: Chi-sq(2)=8.83 P-val=0.0121						
Robust p-values in parentheses. Significant at: *** 1%, ** 5 %, * 10 %. All regressions include a full set of time dummies						

1 also revealed that immigrants' skill distribution within an age group is also very different from that of the natives, and this difference has a remarkable variability both across countries and over time. Thus, controlling for both dimensions of heterogeneity should result in a better account of the importance of immigrants' labour shocks in host countries, as well as of the time pattern of its cross sectional variability. Moreover, it can also better catch local complementarities in production which are specific to an age-education group. For instance, if young unskilled immigrants perform jobs complementary to those of young unskilled natives, then having a higher share of unskilled among immigrants can raise the overall productivity, as the productivity of the abundant factor (the natives) increases, shifting upward the labour demand curve.[12] At the same time, however, potentially having more young unskilled immigrants may lead to the productivity decline, as they lack important non-observable human capital, or are over-employed in low TFP sectors.

To investigate these possibilities, we further decompose the overall ratio of migrants over natives into six categories: each of the three age groups (young, middle, and old) is decomposed into two groups of education: unskilled (without tertiary education) and skilled (with tertiary education). Table 5 contains the results of this decomposition.

Globally, only unskilled immigrants contribute to the income and labour productivity differences, while a higher share of skilled immigrants have no overall impact (columns 1 and 2). As in the previous table, TFP component remains to be the main driving factor for this result. Comparing unskilled immigrants of different ages, we find that they have contrasting impacts on output, productivity, and the TFP. This impact is positive for older unskilled immigrants, and negative for younger ones. Under the assumption that age embeds also the information about the duration of stay, for unskilled immigrants, we confirm our initial finding of the negative short-term impact on both income and labour productivity, and a positive robust long-term effect.

This same result can also be stated from a different angle: the negative contribution of young immigrants to income and productivity documented in Table 4 was the result of the negative complementarity between immigrants and natives among unskilled workers. Again, the negative effect of young unskilled immigrants on input efficiency, i.e. TFP, could be due to the fact that recently arrived and low educated immigrants are the ones who are most likely to lack important productive country specific skills given their short duration of stay. The latter intuition is further reinforced by the fact that we find a positive TFP effect for the group of unskilled old individuals, i.e. for those with longer duration in host country.

In addition to the previous findings, our decomposition unveils long-term effects of unskilled immigration on both physical and human capital. Both results are consistent with expectations. The long-term impact of a higher share of immigrants among the unskilled on overall human capital is negative. At the same time, there is a positive response, or adjustment, of physical

[12]Recent studies show that unskilled immigrants helped increasing labor force participation of unskilled Spanish natives by providing cheap domestic services.

capital to the long-run presence of unskilled immigrants. This complementarity works through a higher equilibrium investment rate in countries that received larger inflows of unskilled immigrants in the past. This is the case for instance if immigrants create new opportunities for investments that raises productivity, or they increase the saving capacity of hosts countries. For instance, in the standard Solow growth model, the steady state capital output ratio in country i is equal to $s_i/(ni + \delta)$, where s_i and n_i are respectively the saving rate and population growth rate. If immigrants affect the average saving rate either through a composition effect (because they are older) or because they have genuine different preferences, they can contribute to higher equilibrium capital output ratio by rising s_i.

The impact of unskilled immigration on employment varies according to their age. However, within current setting, it is impossible to identify the employment effect due to the fact that immigrants may crowd in, or crowd out, unskilled native workers, being either substitutes or complements to them, and the employment effect due to the fact that unskilled immigrants, for example, may simply have different employment rate as opposed to unskilled natives.

In contrast, the presence of larger shares of skilled workers has more sporadic and less robust effects. While there is no overall effect on income and productivity, there is certain impact on their components, which tend to balance out in the aggregate.

There is a negative TFP effect in the long-run, albeit significant only at 10%, which most probably reflects the difference in the quality of human capital that can be lower for immigrants even within the group of skilled individuals.[13] Likewise, it may also signify that skilled immigrants work in less productive sectors as opposed to the skilled natives.

Regarding physical capital, there is a negative impact of a larger share of young skilled immigrants, i.e. in the short-run, which is more than compensated in the medium-run, or with the presence of the larger share of skilled prime-aged workers. This result is rather in line with expectations, and reflects once again the physical capital adjustment pattern.

Finally, we observe opposing effects of the presence of highly-skilled immigrants in prime and in old age groups on human capital. The fact that in the long run the higher share of skilled immigrants, the ones with a relatively high number of years of schooling, increases overall human capital in the economy, which is also measured as a function of years of schooling, conforms to the expectations if immigrants with tertiary education have more years of schooling than native-born with tertiary education. However, there seems to be a contradiction, since we also find a negative effect of this group in the medium run, and the latter finding rather points to the lower schooling of immigrants with tertiary education as opposed to the native-born counterpart. In fact, both results can be reconciled, and may be due to the gradual adjustment of natives' human capital. This is the case if, for instance, native-born and immigrants with tertiary education perform complementary jobs, and the jobs performed by natives embed more years of schooling.

[13]There may also be differences in the level of human capital. Tertiary educated immigrants for instance may have lower educational attainment (below master degree) relatively to natives.

As an example, one may think of technicians and engineers, or nurses and physicians, the latter having more years of education than the former, but when both have tertiary education. Then, a higher share of immigrants among individuals with tertiary education decreases average education, and at the same time rises wages of native-born with tertiary education (say, engineers), because of tasks complementarity. In the long run, as the engineers' wage premium is higher relative to that of technicians, more natives upgrade their skills, and the aggregate outcome is a higher level of human capital in the economy. While this mechanism is theoretically plausible, it is worth noting that the results that we obtain may also be due to the fact that we are still missing some further disaggregation, such as, for example, by gender, and capture additional heterogeneity within this group of immigrants.

6. ROBUSTNESS

In this section we check the robustness of our results, and in particular, we investigate whether they could have been affected by period-specific, or cohort-specific processes. The influence of the latter has been already mitigated by the use of panel data with year fixed effects and time-period dummies in all regressions. In this section we perform an additional check by splitting the sample in two parts: prior to 1985, and 1985 and after, and repeating the estimations for both sub-samples. The idea behind this is that immigration policies of the European countries, as well as migration processes and types of immigrants who were arriving prior to and after mid-eighties are rather different. While in the sixties, the seventies, and the early eighties, western European countries were marked by labour migration programs and family reunifications, the end of the eighties was associated with new immigration waves, notably from Eastern Europe, with significant immigration to South European countries, and with new immigration policies (for the review of the latter see Mayda & Patel (2006)). In the US, the second period is also marked by the intensification of inflow of Mexicans, who by the year 2000 comprised 30% of foreign-born population in the US. According to several authors, this trend has contributed to a declining quality of US immigrants (Borjas & Katz (2007); Card & Lewis (2007)).

The results of the estimations using the split sample are in Table 6, they are based on age-decomposition and employ the same set of instruments in the panel data setting as before. The precision of inferences is affected by the very limited number of observations. Despite this, the positive effect of the larger ratio of older immigrants holds in both sub-periods, suggesting that the long-term adjustment impact of immigration has been observed in both periods, too. Short-term effects are on the verge of significance in the second period, and not significant overall in the first period, albeit they have the same sign as in pooled-sample estimation. We also observe some negative effects of the prime-age group in the first period. Importantly, had our full-sample results been driven by pre-1980s cohort effects, these negative effects of the prime-age group in the first period would have translated into the negative impact of oldest group in the second period, as the prime-age group would simply grow older. However, this is only partly the case: while the impact of the ratio of older immigrants in the second period is smaller in magnitude than the same ratio in the first period, the overall effect is still positive,

Table 6 – Robustness: Sample Split

Variables	(1) Log(Y/L)	(2) Log(y)	(3) Log(A)	(4) α/(1-α)* Log(K/Y)	(5) Log(h)	(6) Log(emp)
Prior 1985:						
Log(smigr1524)	-0.029	-0.019	-0.122	0.057	0.123**	-0.048
	(0.816)	(0.856)	(0.297)	(0.464)	(0.0285)	(0.231)
Log(smigr2554)	-0.144	-0.162**	-0.175***	-0.025	0.043	-0.017
	(0.126)	(0.041)	(0.003)	(0.652)	(0.362)	(0.607)
Log(smigr5564)	0.642***	0.651***	0.366***	0.372***	0.091	0.009
	(1.07E-09)	(8.77E-10)	(0.001)	(8.35E-07)	(0.208)	(0.836)
Observations	17	17	17	17	17	17
R-squared	0.884	0.927	0.724	0.854	0.889	0.938
Number of cntry	6	6	6	6	6	6
Hansen J (p-val)	0.341	0.3	0.261	0.294	0.657	0.837
1985 and onwards:						
Log(smigr1524)	-0.108*	-0.115*	-0.212*	0.058	0.075	-0.007
	(0.081)	(0.058)	(0.078)	(0.269)	(0.291)	(0.591)
Log(smigr2554)	0.0886	0.111	0.287	-0.148	-0.125	0.022
	(0.627)	(0.566)	(0.428)	(0.459)	(0.587)	(0.612)
Log(smigr5564)	0.161*	0.158*	0.381**	-0.099	-0.171	-0.003
	(0.087)	(0.081)	(0.032)	(0.277)	(0.115)	(0.872)
Observations	72	72	72	72	72	72
R-squared	0.862	0.902	0.163	0.133	0.412	0.828
Number of cntry	17	17	17	17	17	17
Hansen J (p-val)	0.353	0.532	0.607	0.243	0.343	0.174

Robust p-values in parenthesis. Significant at: *** 1%, ** 5 %, * 10 %. All regressions include a full set of time dummies and control for the dependency ratio (*Log(depratio)*) and the share of prime age workers in the working age population (*Log(sh2554/1564)*).

suggesting that positive long-term adjustment is still taking place.

7. CONCLUSION

Do countries that attract different numbers and quality of immigrants differ in income and productivity as a result? What are the channels through which immigration can affect host country outcomes? This paper tries to answer these questions within channel accounting approach, focusing on the economy-wide impact of immigration.

The results show that, on aggregate, there is an overall positive impact of immigration on the host countries income and labour productivity, which works primarily through TFP, and mostly in the long run. Considering very different migration histories and patterns in the receiving countries, this evidence can be linked to the research showing that TFP, and not factor accu-

mulation, is the main source of the differences in incomes between countries (Hall & Jones, 1999).

A closer look at the type of immigrants, and at the components of income and productivity, suggests that the impact of immigration works through finer, local, complementarities between immigrants and natives, consistently with the microeconomic labour literature on the impact of immigrants. This impact is propagated through various channels, such as capital adjustment, employment, and human capital accumulation, and has different directions and size, depending on skill groups and time.

Though unequivocal, this paper shows that studies which focus uniquely on one type of effect, such as the impact on employment, overlook other channels through which economy can adjust to immigration, and also that studies that look at one-point-in-time effect of immigration underestimate important adjustment effects. It reinforces the notion that immigration is a complex phenomenon, and that more research is needed in the direction of accounting for complementarity and substitutability effects between immigrants and natives on different levels.

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APPENDIX

A. Dataset on immigrants

This appendix describes the procedure used to construct our data set of immigrants' shares in the host countries population by age group and age-education groups. The following three aggregate datasets were combined with micro censuses and labour Force Surveys (LFS):

- World Population Prospects (WPP), the 2008 revision: this UN dataset provides the age distribution of the whole population by year, gender and 5-years age groups
- World Migrant Stock (WMS): The 2005 Revision Population Database UN dataset provides the stock of migrants/natives by sex for all countries from 1960 to 2005.
- The dataset of Lutz et al. (2007): unlike other education datasets (Barro & Lee, 2001; Cohen & Soto, 2007) it provides population data by sex, 5-year age group and four levels of education from 1970 to 2000.

A.1. Shares of immigrants over natives by age

For periods in which a census or a LFS is available, the share of immigrants over natives in age group a is obtained as:

$$\frac{M_a}{N_a} = \frac{M * sh_a^m}{N * sh_a^n} \tag{9}$$

where $sh_a^m$and sh_a^n are respectively the share of age group a among migrants and natives derived from countries' censuses or LFS and M and N are the stock (by gender) of immigrants and natives obtained from the WMS data. While we could have used directly the number of immigrants obtained in censuses or LFS, we prefer to use the stock of immigrants from the UN data since this is a source which is common to all countries for every period. For periods between two consecutive censuses, these shares are computed using the following two stages procedure:

- Stage 1: Compute the share of the working age population (15-64 years old) among migrants and natives

  The share of 15-64 years old among natives (by gender) is computed by interpolation of the share of a birth cohorts that are aged 15-64 years old at the mid period point separating two consecutive censuses. For instance, the share of natives aged 15-64 in 1965 is computed by using a linear interpolation of the share of native aged 10-59 years old in 1960 and the share of 20-69 years old among natives in 1970.

  UN census data allow us to compute the share of the population aged 15-64 between 1960 and 2005 at 5-year interval. To compute the share of 15-64 years old among immigrants, we note that the share of 15-64 years old in the whole population at year t (by gender) is a

Table A.1 – List of countries, Sources and Immigration Status Definition

Country	Years	Source	Immigrants' status definition
Australia	1985-2005	Australian Census	Nativity
Austria	1970-2005	Census and LFS	Citizenship
Belgium	1985-2005	LFS	Nativity
Canada	1980-2005	LFS	Nativity
Denmark	1985-2005	LFS	Nativity
Finland	1995-2005	LFS	Nativity
France	1960-2005	Census and LFS	Nativity
Germany	1995-2005	LFS	Citizenship
Greece	1980-2005	Census and LFS	Nativity
Ireland	1985-2005	LFS	Nativity
Italy	1995-2005	LFS	Nativity
Luxembourg	1985-2005	LFS	Citizenship
Netherlands	1970-2005	Census and LFS	Nativity
New-Zealand	1960-2005	Census and LFS	Nativity
Norway	1995-2005	LFS	Nativity
Portugal	1980-2005	Census and LFS	Nativity
Spain	1980-2005	Census and LFS	Nativity
Sweden	1995-2005	LFS	Nativity
Switzerland	1970-2005	Census	Nativity
United Kingdom	1990-2005	Census and BLS	Nativity
USA	1960-2005	Census and CPS	Nativity

LFS stands for European Labor Force Survey; BLS stands for British Labor Force Survey, and CPS stands for the Current Population Survey.

Table A.2 – Summary Statistics

Variables	Obs	Mean	Std. Dev.	Min	Max
Dependent variables					
Output per capita (*Y/L*)	194	18113	7468	3677	52568
Output per worker (*y*)	194	39499	14877	9543	122246
Capital output ratio (*K/Y*)	194	2.52	0.52	1.28	4.28
Human Capital (*h*)	194	2.01	0.45	1.38	3.87
TFP (*A*)	194	2.01	0.45	1.38	3.87
Employment rate (*emp*)	194	12086	2934	5213	20494
Independent variables					
Dependancy ratio (*depratio*)	194	0.35	0.03	0.31	0.42
share 25-54 over 15-64	194	0.61	0.03	0.55	0.68
Ratio of migrants over natives (*smigr*)	194	0.10	0.10	0.00	0.60
Ratio of migrants over natives in age group j (m_j):					
smigr1524	103	0.10	0.13	0.00	0.73
smigr2554	103	0.11	0.13	0.00	0.72
smigr5564	103	0.07	0.09	0.00	0.49
Ratio of migrants over natives in age group i (15 to 24, 25 to 54, 55 to 64) and skill type j (uk,sk):					
smigr15uk	87	0.09	0.07	0.00	0.38
smigr25uk	87	0.13	0.12	0.00	0.72
smigr55uk	87	0.11	0.12	0.00	0.56
smigr15sk	87	0.10	0.10	0.00	0.68
smigr25sk	87	0.16	0.18	0.01	1.15
smigr55sk	87	0.14	0.16	0.00	1.03

Note: summary statistics refer to the period 1960-2005. Variables are measured at 5 years interval and all statistics refer to the pool sample of the 20 OECD countries mentioned in the text.

weighted average of immigrants' ($sh^m_{1564,t}$) and natives' ($sh^n_{1564,t}$) shares:

$$i_t * sh^m_{1564,t} + (1 - i_t) * sh^n_{1564,t} = sh^p_{1564,t} \tag{10}$$

where i_t is the share of immigrants in the population $\frac{M_t}{M_t+N_t}$(by gender) at time period t. The share of 15-64 years old in the migrants population is then easily obtained as:

$$sh^m_{1564,t} = \frac{sh^p_{1564,t} - (1 - i_t) * sh^n_{1564,t}}{i_t} \tag{11}$$

The number of immigrants and natives aged 15-64 (by gender) is computed as:

$$M_{1564,t} = sh^m_{1564,t} * M_t and N_{1564,t} = sh^n_{1564,t} * N_t \tag{12}$$

where M_t and N_t are the stock of immigrants (by gender) from the WMS dataset. Once the share of the working age population (i.e. 15-64 years old) among migrants and natives is obtained we can proceed to obtain the age and education distribution within that age group.

- Stage 2: Age distribution of migrants and natives in their respective working age population

Let t and t' denote two consecutive censuses periods (1960, 1970, ..., 2000; and $t' - t = 10$). The natives' age distribution at period $t + 5$, is derived from the age distribution of natives aged 10-59 in t and 20-69 in $t + 1$. We compute the number of native in age group a ($a \in [15, 64]$) by applying the following linear interpolation expression:

$$N_{a,t+5} = \left(\frac{N_{a+5,t'+5}}{N_{a-5,t}} \right)^{0.5}. \tag{13}$$

Thus, we are implicitly assuming that events that affect the size of a natives birth cohort over time within the 15-64 age group, i.e. its rate of depreciation due to mortality or emigration are equally distributed within a decade.

The share of immigrants in the same age group within the immigrants working age population ($sh^m_{a,t+5;1564}$) is derived similarly to (11):

$$sh^m_{a,t+5;1564} = \frac{sh^p_{a,t+5;1564} + (1 - i_{t+5;1564}) * sh^n_{a,t+5;1564}}{i_{t+5;1564}} \tag{14}$$

where $sh^p_{a,t+5;1564}$ is the share of a years old population in the total population aged 15-64; obtained from the WPP dataset; and $i_{t+5;1564}$ is the share of immigrants in the population aged 15-64.

The number of immigrants in each age group is obtained as:

$$M_{a,t+5} = M_t * sh^m_{1564,t} * sh^m_{a,t+5;1564}, \tag{15}$$

and the share of immigrants over native in age group a is:

$$sm_{a,t+5} = \frac{M_{a,t+5}}{N_{a,t+5}} = \frac{M_t}{N_t} \frac{sh^m_{1564,t+5} * sh^m_{a,t+5,1564}}{sh^n_{1564,t+5} * sh^n_{a,t+5,1564}} \tag{16}$$

This procedure has been slightly modified for countries for which the census period is not a decade endpoint. For instance, to compute the age distribution of natives in France in 1970 we use the 1968 and 1975 census and focus on the birth cohort aged 13-62 in 1968 and 20-69 in 1970, as those are aged 15-64 in 1970. Otherwise, the procedure remains the same. Few countries had censuses one year before or after a decade endpoint period. For censuses one year before a decade end point period we use the natives aged 14-63 to derive the age distribution of natives age 15-64; and for countries with censuses one year after the end of a decade we use the age distribution of native aged 16-65 to derive the age distribution of 15-64 years old natives at the end of the decade endpoint period.

*A.2. Shares of immigrants over natives by age*education groups*

For periods for which a census or LFS is available the share of immigrants over natives in age*education group is obtained as:

$$\frac{M_a}{N_a} = \frac{M * sh^m_a * sh^m_{as}}{N * sh^n_a * sh^n_{as}} \tag{17}$$

where $sh^m_{as}$and sh^n_{as} are respectively the share of skill group s among migrants and natives' age group a.

To construct the immigrants' shares by age and education for periods between two censuses t and $t\prime$ ($t\prime - t = 10$) which are not covered by an LFS we proceed as before. Namely, we derive the educational distribution of 15-64 years old natives in $t' - 5$ from that of 20-69 years old natives in period t'. We consider three levels of education, skilled (tertiary education), middle skilled (secondary education) and unskilled (primary education). Given this educational partition, and assuming that individuals enter tertiary education no younger than at 19 years old of age, in period t', the 24-69 years old natives have already reached their highest educational attainment 5 years back in time. Thus, we can directly derive the education distribution of those aged 19-64 in period $t' - 5$ from the educational distribution of those aged 24-69 in t'. To compute the educational distribution of natives aged 15-18 in $t' - 5$ we use the education distribution of natives aged 20-23 in period t' and proceed as follows: all those who report tertiary education in t' ought to be in secondary education in $t' - 5$, since we assume that no one enters tertiary education younger than 19 years old. For those who report either secondary or primary education in t' their education type is the same in $t' - 5$ since in all countries students enter secondary education at 12 or 13 years old (OECD, 2007). Next, let's $sh^n_{as,t'-5}$ be the share

of skill group s among natives in age group a such as:

$$\sum_{s=1}^{3} sh^{n}_{as,t'-5} = 1 \tag{18}$$

where s stands in ascending order for primary, secondary and tertiary education. We derive the educational distribution of immigrants for age group a in period $t'-5$ ($sh^{m}_{as,t'-5}$) using the following accounting expression:

$$sh^{m}_{as,t'-5} = \frac{sh^{p}_{as,t'-5} - (1 - i_{a,t'-5}) * sh^{m}_{as,t'-5}}{i_{a,t'-5}} \tag{19}$$

where $sh^{p}_{as,t'-5}$ is the share of skill group s in age group a in the total population at period $t'-5$. This share is derived from Lutz et al. (2007) Education Database. Once $sh^{m}_{as,t'-5}$ is obtained, the share of immigrants over natives in age group a and education type s in period $t'-5$ is computed as:

$$sm_{as,t'-5} = \frac{M_{a,t'-5} * sh^{m}_{as,t'-5}}{N_{a,t'-5} * sh^{n}_{as,t'-5}} \tag{20}$$

where the number of immigrants and natives in age group a, $M_{a,t'-5}$ and $N_{a,t'-5}$ has been computed in the previous stage. Aggregation for two-skill groups is straightforward.

B. Additional tables

Table B.1 – Instrumenting the ratio of immigrants over natives: first stage results

	Coefficient	Robust St. Error	P>|t|
Log_sexratio_lag2	-0.691	0.218	0.002
Log_smigrMN_lag2	0.738	0.097	0.000
Logdepratio	-2.0.99	0.718	0.004
Logshare2555/1564	1.147	0.997	0.252
Year dummies	Yes		

N. Obs: 154; Centered R2 = 0.791; F-test of excl. instr: F(2;123) = 31.86; Prob>F=0.000;

Tests of joint significance of endogenous regressors B1 in main equation,
Ho: B1=0 and overidentifying restrictions are valid:
Anderson-Rubin Wald test F (2,123) = 3.37 P-value = 0.694
Anderson-Rubin Wald test Chi-sq(6) = 2.61 P-value = 0.856
Stock-Wright LM S statistic Chi-sq(6) = 2.42 P-value = 0.877

Table B.2 – Yearly contribution of immigrants to real growth of GDP per capita, 1960-2005

Country	Yearly growth of real GDP per capita	Yearly growth of the share of immigrants over natives	Immigrants' contribution to yearly growth of real GDP per capita
Austria	2.75%	5.65%	0.59%
Greece	3.17%	6.26%	0.66%
Spain	3.30%	6.35%	0.67%
Portugal	3.53%	6.61%	0.69%
Denmark	2.11%	3.19%	0.34%
Sweden	2.10%	2.79%	0.29%
Finland	2.68%	3.26%	0.34%
Norway	3.00%	3.45%	0.36%
United Kingdom	2.16%	2.47%	0.26%
Netherlands	2.12%	2.28%	0.24%
Ireland	3.90%	4.14%	0.44%
Iceland	2.88%	3.02%	0.32%
Switzerland	1.50%	1.47%	0.15%
Luxembourg	3.17%	3.11%	0.33%
USA	2.34%	2.21%	0.23%
Italy	2.66%	2.46%	0.26%
France	2.53%	0.81%	0.09%
Belgium	2.66%	0.85%	0.09%
Australia	2.18%	0.56%	0.06%
Canada	2.26%	0.55%	0.06%
New Zealand	1.45%	0.33%	0.03%

Note: Germany is missing as no data on real GDP per capita or immigration is available before 1990

Table B.3 – Yearly contribution of immigrants to real growth of GDP per capita, 1995-2005

Country	Yearly growth of real GDP per capita	Yearly growth of the share of immigrants over natives	Immigrants' contribution to yearly growth of real GDP per capita
Spain	2.74%	17.05%	1.79%
Italy	1.20%	5.49%	0.58%
Austria	2.00%	6.13%	0.64%
Denmark	1.70%	4.38%	0.46%
Iceland	3.53%	7.52%	0.79%
Portugal	1.76%	3.51%	0.37%
Greece	3.32%	5.86%	0.62%
Norway	2.27%	3.69%	0.39%
Finland	3.30%	4.12%	0.43%
Ireland	6.22%	7.60%	0.80%
Switzerland	1.05%	1.10%	0.12%
United Kingdom	2.47%	2.42%	0.25%
USA	2.31%	2.24%	0.23%
Germany	1.19%	1.10%	0.12%
Sweden	2.56%	2.12%	0.22%
Netherlands	1.85%	1.26%	0.13%
Canada	2.50%	1.26%	0.13%
Luxembourg	3.76%	1.75%	0.18%
France	1.87%	0.25%	0.03%
Australia	2.30%	-1.38%	-0.14%
New Zealand	2.23%	-2.72%	-0.29%
Belgium	1.80%	-2.80%	-0.29%

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