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IMMIGRANTS-NATIVES COMPLEMENTARITIES IN PRODUCTION: EVIDENCE FROM ITALY

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Immigrants-natives complementarities in production: evidence from Italy

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Abstract

This paper studies the impact of immigration on the Italian labor market using administrative data on Italian private-sector employees during the period 1987-2004. The analysis adopts a structural model based on a three level CES production function extending the model in Card (2001) in order to allow for imperfect substitution both between immigrants and natives within the same area-skill cell, and between females and males within the same area-skill-immigration status cell. The endogeneity of labor supply is controlled for by using an instrument based on the past immigrants' settlement as in Card (2001). The results, robust to the offsetting role of natives out-migration, provide evidence of a small but detectable degree of imperfect substitution between immigrants and natives, whereas female and male workers turn out to be perfect substitutes. Despite immigrants not having any effect on natives' employment, the simulation based on the estimated parameters suggests that a flow of low-skilled immigrants reduces mostly the wages of similarly skilled immigrants (-3.5%), and to a lesser extent those of natives (-1%).

Keywords: Wages, International Migration, Labor Supply.
JEL codes: J61, J23, F22.

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1 Introduction and Literature Review

A great body of literature has been focused on estimating whether and to what extent immigrants might have an impact on the labor force of natives[1]. The issue is controversial, as the complementarity or substitutability between the different labor types can generate opposite outcomes. If natives and immigrants are perfect substitutes, a boom in immigration would generate a supply increase and, as a consequence, a contraction in wages as follows from the standard economic theory. However, if the two groups are imperfect substitutes, complementarities between the two groups are at work, thus an increase in immigrants' supply generates an increase in the productivity of the native group, enhancing the latter's wage. Thus, immigration could also bring about a positive effect on the labor market outcomes of natives.

Most of the empirical results on the impact of immigration on the labor market of host countries come from the U.S., where this strand of literature has been particularly fertile and where scholars have obtained mixed findings. The large majority of the results finds that immigrants had either a non-significant or a positive effect on the salary of natives: Card (1990, 2001, 2007), Ottaviano and Peri (2006, 2008), Peri (2007), Lalonde and Topel (1991) and Friedberg and Hunt (1995), to mention only some of those belonging to this broad category. In contrast, fewer studies obtain different results by concluding that immigration had a detrimental effect on the wage structure of natives (Borjas *et al.* (2008), and Borjas (2003)). Some of these studies adopt a spatial correlation approach (Card (1990), Lalonde and Topel (1991), and Friedberg and Hunt (1995)) which consists in a reduced form aiming at comparing labor outcomes in different local markets (i.e. cities or regions) affected by different concentration of immigrants. An alternative method has developed in the last decade and rests on a structural approach, whose distinctive feature is to set first a theoretical model, by defining a CES type production function and disaggregating the labor input according to different dimensions, such as education or skill, experience or age. The production function allows to define labor demand functions and to estimate the impact of flows of immigration on natives' wages using the actual flow or simulating different policy scenarios of immigration. In this structural setting the unit of analysis is mostly defined at the national level with few exceptions adopting a production function locally defined (Card (2001, 2009)). In the last decade this issue has been investigated also for European countries, a few results are represented by Manacorda, Manning, and Wadsworth (2006), and Dustmann, Fabbri, and Preston (2005) for the UK, and by D'Amuri, Ottaviano and Peri (2010) for Western Germany, all of them in favor of a non-significant effect of immigrant labor supply on natives' wages. As for Italy, to my knowledge, there is only one study focusing on the potential displacement of natives due to the immigrants' flow and is represented by Venturini, and Villosio (2006), who find that immigrants don't displace natives. In turn Gavosto, Venturini, and Villosio (1999) is the only study investigating the wage impact of immigrants on natives. The authors adopt a spatial correlation approach in order to detect a complementary effect between immigrants and natives. Nonetheless, their estimates can be severely affected by potential bias since they don't account for the endogeneity of immigrants, thus underestimating the potential negative impact of

[1] For a recent review of the relevant literature see Okkerse (2008).

immigration on wages.

This paper contributes to the existing literature on the impact of immigration on the host country and aims to expand the evidence for Italy where very little is known about the impact of the recent immigration on the wage structure and on the employment of natives since the few studies exploring this issue date back to at least a decade ago,[2] despite immigrants have increased their weight by more than ten times in the current decade (as shown in Figure 1) by generating a pronounced change in the structure of the Italian force. Immigration is quite a recent phenomenon in Italy where immigrants were barely represented among the resident population in the 1990 (0.9%) but their presence has steadily risen up to reaching the 7% of the resident population in 2010. More recent Italian studies account for other aspects of the impact of immigration on the host country: the impact on natives' labor supply and on natives' internal mobility. Barone and Mocetti (2009) find that immigrants specialized in household production increase the labor supply of Italian highly skilled women at the intensive margin, whereas Mocetti and Porello (2009) provide evidence that immigrant concentration in the northern regions has partially replaced the South-North mobility of less skilled-natives. Romiti and Rossi (2011) investigate the impact of immigration on retirement decisions and their findings are in favor of a strong positive effect on females, particularly those with strong family commitments such as older non co-resident parents. Given that no impact has been found on males, they argue that immigrants, due to their concentration in the household services sector, affect the retirement decisions of those more involved in household production by reducing the market cost of services such as housekeeping and long-term care.

This study draws from the existing literature on immigration and use a structural approach extending the model in Card (2001) by allowing both immigrants and natives and females and males to be imperfect substitutes and estimate their degree of substitution through the data. To our knowledge there are no previous studies which allow gender specific input to be less than perfect substitutes within the same skill-immigration-area cell, therefore there are no estimates of their elasticity of substitution. The CES production function adopted in Card (2001) is extended by allowing immigrants and natives to be imperfect substitutes within the same skill-area cell and the elasticity of substitution between females and males within the same skill-area-immigration status cell is also estimated. The endogeneity of the labor aggregates is accounted for by using the well-known *supply push component* developed by Card (2001), which is based on the past settlement of immigrants, as an instrument for current immigrants and for current skill specific aggregate labor input as detailed below. Then a simulation analysis, based on the results of the estimation, provides additional evidence on the wage impact of different scenarios of immigration. There is evidence (Card (2009)) that the estimates of the elasticity of substitution between natives and immigrants obtained by defining the labor market at the country level are consistent with those obtained by adopting a local definition of the labor market. Nevertheless previuos studies (Borjas (2003), Ottaviano and Peri (2008), Peri (2007), D'Amuri *et al.* (2008), Manacorda *et al.* (2006)) justify the adoption of a national approach following the main critique to the spatial correlation approach (Borjas,

[2]Gavosto, Venturini and Villosio (1999) analyze the labor market impact for the period 1986-1995 whereas Venturini and Villosio (2004) study the period 1993-1997.

Freeman and Katz (1997)), motivated by the fact that factors movements re-equilibrate the market: natives may move away from areas where immigrants concentrate, capital inflows into cities with labor supply shocks, and, as a consequence, the offsetting role of these movements may reduce the adverse impact of immigration, producing biased results. By adopting as geographical unit of analysis the nation as a whole all these flows are taken into account. However the evidence that natives "vote with their feet" is not as clear-cut: Borjas *et al.* (1997) document the reduction of natives' inflow to the main immigrant-receiving states, and Borjas (2005) shows that outflows of natives is in place as a reaction to the immigrants' inflow. On the other hand Card and Di Nardo (2000) and Card (2001) find that there is no outflow of natives as a consequence of immigrants' arrival. Since the evidence for Italy shows that immigrants reduce the traditional native internal mobility between Southern and Northern regions (Mocetti and Porello (2009)), and since this study adopts a structural approach where each labor market is defined in terms of local areas, we try to deal with the previous issue by carrying out different robustness checks, such as comparing the results obtained by alternative definition of local labor market. First the labor market is defined at the regional level, then all regions are aggregated into five macro-areas, estimates are obtained according to these two definitions and finally the analysis is replicated on a sub-sample of only those who never change their region of work.

2 Data description & descriptive statistics

This paper uses Italian administrative data for a representative sub-sample of all private-sector non agricultural employees collected by the Social Insurance Institute (INPS-Istituto Nazionale per la Previdenza Sociale) and covering the period 1987-2004. Information on demographic factors (such as age, gender and place of birth) is provided, along with the information on the type of contract, sector, and place of work. The share of immigrants range from 0.9% in 1985 to reach 9.13% of the sample in almost twenty year time. Tables 1 reports the main descriptive statistics of the variables included in the analysis: average daily wage is higher for natives than for immigrant workers. Immigrant workers are on average younger, work mainly in the North, with the same distribution as natives across sectors but mainly employed as blue collar workers. Men constitute the large majority of immigrant workers with respect to the native counterpart (83% vs 66%) and this feature can be easily explained by the fact that the largest share of female immigrant workers is employed in the household services sector which is not represented in this archive. The selected age range is between 15 and 65 year old, and only full-time workers are chosen since the dataset doesn't provide information about the number of hours worked, thus the distinction between part-time and full-time is crucial in order to gain more homogeneity in the computation of the daily wage rate. Workers differ according to area of birth, type of occupation, immigration status and gender, and occupation is used as a proxy for the skill, as the education level is not known. Occupation-skill categories are defined as white collars and blue collars, since for the other categories available in the dataset (Executives, and Apprentices) the distinction between part time and full time is not available. The labor supply is measured in terms of employment, and wage represents daily wage, gross of income taxes and social contribution paid by employees and net of social contribution paid by employers. Earnings are expressed in

Euros and converted to a common scale using the ISTAT (Istituto Nazionale di Statistica) consumer price index for families containing a dependent employee with base 2000=100. The final sample is constituted by 2740 cell observations, where each cell is identified by regions, skill, immigration status, and time[3]. We consider the period 1987-2004 due to the strategy adopted in order to implement the instrumental variable approach detailed below. As a robustness check the geographic variability is defined according to 5 macro-areas (following the ISTAT classification: South, Islands, North East, North West and Center) and the analysis is replicated based on this alternative definition. Immigrants are defined as those who were born outside North America or outside one of the EU-15 member states (since EU membership has been enlarged to 25 members only in May 2004, the last year covered by the dataset). This definition of immigrants is motivated by the purpose of a more homogeneous group. Figure 1 plots the trend in the stock of resident immigrants over the period 2002-2010 (first and latest year available) disaggregated by macro-areas of origin. The upward trend in the immigrants' flow is clearly shared by all countries, the only exception being immigrants coming from one of the EU members and immigrants coming from eastern EU. The upward peak drawn by the former represents the entrance of the group of eastern countries joining the EU25 in 2007, in fact this peaks is simultaneous to the downward trend experienced by the Eastern European group.

3 Theoretical set-up

Extending the theoretical framework adopted by Card (2001), consider an aggregate production function F of a competitive firm as follows:

$$Y_{rt} = F(K_{rt}, L_{rt}) \tag{1}$$

Where subscript r and t stand for area and time, K for capital and non-labor input and L is the CES type aggregate of skilled and unskilled labor input as follows

$$L_{rt} = \left[\sum_{k=s,u} \theta_{rkt} L_{rkt}^{\frac{\sigma-1}{\sigma}}\right]^{\frac{\sigma}{\sigma-1}} = \left[\theta_{cst} L_{cst}^{\frac{\sigma-1}{\sigma}} + \theta_{cut} L_{cut}^{\frac{\sigma-1}{\sigma}}\right]^{\frac{\sigma}{\sigma-1}} \tag{2}$$

with elasticity of substitution equal to σ. Subscript s stands for skilled and u for unskilled respectively.

In turn, immigrants and natives sharing the same skill are allowed to be imperfect substitutes. This is justified because of language difficulties for immigrants and because of discrimination motives on behalf of employers. Immigrants and natives likely don't perform the same tasks despite having similar skills because language difficulties and scarce comprehension of local rules and costumes make easier for immigrants to be hired

[3]The final number of cells would be 2880 if no empty cells were present, since it is obtained by multiplying 20 regions, 2 occupations, 2 genders, 2 immigration status and 18 years, however, a few cells contain no immigrants, therefore have been excluded from the analysis.

to perform more manual tasks with respect to natives. In addition to that discrimination motives may make some firms to prefer natives. Due to this factors immigrants and natives are allowed to be imperfect substitutes within the same skill-cell by defining each skill-specific labor input, L_{rkt} as a CES type aggregate of natives and immigrants with elasticity of substitution equal to δ. The prior is that $\delta > \sigma$ since it is likely that a firm finds easier to substitute immigrants with natives with the same skill than a low-skilled with a high-skilled worker.

$$L_{rkt} = \left[\theta^I_{rkt} I_{rkt}^{\frac{\delta-1}{\delta}} + \theta^N_{rkt} N_{rkt}^{\frac{\delta-1}{\delta}}\right]^{\frac{\delta}{\delta-1}} \tag{3}$$

Without loss of generality the relative productivity term between natives and immigrants is normalized as follows $\theta^I_{rkt} + \theta^N_{rkt} = 1$. At the lowest level of aggregation females and males in each skill-immigration status cell are allowed to be imperfect substitutes since there is no reason whereby workers sharing the same skill and the same immigration status have to be considered as different in production[4]. Thus (each immigrant and native) labor aggregate S_{rkt}, is expressed as a CES combination of female and male workers with elasticity η,

$$S_{rkt} = \left[\theta^F_{rkSt} F_{rkSt}^{\frac{\eta-1}{\eta}} + \theta^M_{rkSt} M_{rkSt}^{\frac{\eta-1}{\eta}}\right]^{\frac{\eta}{\eta-1}} \tag{4}$$

where θ^F_{rkSt}, θ^M_{rkSt} are gender relative (for female and male, respectively) productivity shocks specific to a skill-area-immigration status cell. However this type of production function has the drawback that the estimated elasticity of substitutions are constant: between low-skilled and high-skilled workers σ doesn't vary regardless of gender and immigration status, at the same time the elasticity of substitution between immigrants and natives, δ doesn't vary regardless of gender and is constant across skills (i.e. low- and high-skilled pairs of immigrants-natives are characterized by the same value of δ.)

4 Optimality conditions

Imposing the equality between marginal productivity and the relevant price, we derive the labor demand functions for any input. Therefore the optimal labor demand for input of skill k in area r is obtained by differentiating the profit function with respect to the labor aggregate L_{rkt} as in (2), normalizing to one the price of the output and taking logs:

$$\ln w_{rkt} = \ln F_{L_{rt}} + \ln \theta_{rkt} - \frac{1}{\sigma} \ln L_{rkt} + \frac{1}{\sigma} \ln L_{rt} \tag{5}$$

The demand for labor input specific to skill k, immigration status S, and area r is derived differentiating the profit function with respect to the labor aggregate S_{rkt} (with S=N,I) as in (3), thus yielding:

[4] The only exception to this argument may be due to discrimination of females because of the maternity risk the employer faces in hiring them.

$$\ln w_{rkSt} = \ln F_{L_{rt}} + \ln \theta_{rkt} + \ln \theta^S_{rkt} - \left(\frac{1}{\sigma} - \frac{1}{\delta}\right) \ln L_{rkt} + \frac{1}{\sigma} \ln L_{rt} - \frac{1}{\delta} \ln S_{rkt} \tag{6}$$

The demand for labor input specific to gender G, skill k, immigration status S, and area r is derived differentiating the profit function with respect to the labor aggregate G_{rkSt} (with G=F,M) as in (4), thus yielding:

$$\ln w_{rkSgt} = \ln F_{L_{rt}} + \ln \theta_{rkt} + \ln \theta^S_{rkt} + \ln \theta_{rkSgt} - \left(\frac{1}{\sigma} - \frac{1}{\delta}\right) \ln L_{rkt} + \frac{1}{\sigma} \ln L_{rt} - \left(\frac{1}{\delta} - \frac{1}{\eta}\right) \ln S_{rkt} - \frac{1}{\eta} \ln G_{rkSt} \tag{7}$$

5 Empirical strategy

In order to estimate the elasticity of substitution between females and males within the same skill-immigration status cell, subtract equation (7) for females by equation (7) for males and obtain the following relative demand function

$$\ln\left(\frac{w_{rkSFt}}{w_{rkSMt}}\right) = \ln\left(\frac{\theta_{rkSFt}}{\theta_{rkSMt}}\right) - \frac{1}{\eta} \ln\left(\frac{F_{rkSt}}{M_{rkSt}}\right) \tag{8}$$

Thus, following a similar approach found in Ottaviano and Peri (2006, 2008), assume the unobserved relative productivity term to vary additively by area c, skill k, immigration status S, and time t and obtain the following specification in order to estimate (8)

$$\ln\left(\frac{w_{rkSFt}}{w_{rkSMt}}\right) = D_r + D_k + D_S + D_t - \frac{1}{\eta} \ln\left(\frac{F_{rkSt}}{M_{rkSt}}\right) + \epsilon_{rkSt} \tag{9}$$

where the unobservable relative productivity is controlled for by the four additive fixed effects, D_k represent skill effects, D_r area effects, D_S are immigration status effects, and D_t are time fixed effects.

In order to estimate the elasticity of substitution between natives and immigrants within the same skill-cell, express equation (6) for both immigrants and natives and take the relative expression as follows

$$\ln\left(\frac{w_{rkIt}}{w_{rkNt}}\right) = \ln\left(\frac{\theta^I_{rkt}}{\theta^N_{rkt}}\right) - \frac{1}{\delta} \ln\left(\frac{I_{rkt}}{N_{rkt}}\right) \tag{10}$$

Thus consider the following specification in order to estimate (10)

$$\ln\left(\frac{w_{rkIt}}{w_{rkNt}}\right) = D_r + D_k + D_t - \frac{1}{\delta} \ln\left(\frac{I_{rkt}}{N_{rkt}}\right) + \xi_{rkt} \tag{11}$$

where the unobservable relative productivity is controlled for by three additive fixed effects, D_t time effects, D_r area effects, and D_S immigration status effects and ξ_{rkt} is a zero mean cell-specific error term.

Lastly in order to estimate the elasticity of substitution between high and low skilled workers, adopt the following specification for equation (5):

$$\ln w_{rkt} = D_{rt} + (\text{linear trend})_{kr} - \frac{1}{\sigma} \ln L_{rkt} + \nu_{rkt} \tag{12}$$

where the linear trend interacted with skill-area specific effects controls for the terms $\ln L_{rkt}$, and $\ln \theta_{rkt}$ whereas D_{rt} are area-time fixed effects, which control for the terms $\ln F_{L_{rt}}$, and ν_{rkt} is a zero mean cell-specific error term.

An OLS estimation strategy doesn't allow to correctly identify the inverse elasticities of substitution in equations (9), (11), and (12) since the labor input terms don't represent an exogenous shift in the relevant supply functions, as a consequence the estimated parameters would turn out to be a mixture of demand and supply elasticities. Immigrants may be considered an exogenous supply shock, since they move to the nation as a whole driven by source country factors, however the local distribution of immigration is probably less supply-driven, immigrants are not randomly allocated to local areas, but it is likely that they cluster into regions with thriving economies which in turn push up wages. In order to deal with this bias we need to isolate the supply component of immigration which is not driven by any demand factors and an instrumental variable approach is adopted, following the popular supply-push component initiated in Card (2001). Empirical findings largely report the tendency of newly arriving immigrants to move to enclaves established by earlier immigrants from the same source country in order to take advantage of network effect (Cutler et al. (2008), Damm (2009)). Exploiting this phenomenon the current total inflow of immigrants coming to Italy from a given country is allocated to regions according to the past regional country-specific distribution. In addition to that the regional stock of immigrants is allocated to different occupations according to the current country specific distribution. The instrument for each skill-area labor input has been computed according to the following formula

$$IV_{rkt} = \Sigma_g \tau_{gkt} \lambda_{gr,t_0} M_{gt} \tag{13}$$

where τ_{gkt} is the proportion of immigrants from country g at time t falling in skill group k, λ_{gr,t_0} is the proportion of immigrants at time $t_0 = 1985$ from country g working in region r, and M_{gt} is the total flow of immigrants from country g at time t. In order to implement the instrument consider 5 groups of immigrants according to their country of origin: Eastern Europe, Eastern and Southern Asia, Middle East and Rest of Asia, Central and South America, Africa and Oceania. The formula (13) is used as an instrument for L_{rkt} in equation (12), and as an instrument for the skill specific immigrants to natives ratio in equation (11). The validity of this approach rests on the fact that the endogeneity of the labor supply consists only in selecting the regions where working, whereas the selection into a given occupation is exogenously predetermined. As a results both the total inflow of country specific immigrants, M_{gt} and their current distribution into occupations, τ_{gkt} are exogenously determined, since completely unrelated to any local demand factors, whereas the past regional distribution is also not driven by any current local demand factors under the assumption of the absence of their time persistence.

6 Estimation results

As opposed to the other estimating equations which are estimated by both OLS and 2SLS, the estimation of equation (9) is carried out by adopting only an OLS approach. This is a potential drawback since after all we are regressing wages on employment. The resultant parameter likely identifies a mixture between demand and supply changes. However we believe that our estimates don't suffer from bias for the following two reasons: in addition to the benchmark estimating regression as in (9) where we control for fixed effects due to occupation, region, time and immigration status, we further experiment with a series of additional controls, by using interactions between regional and time effects and occupation and time effects. The results are robust to any of these different sensitivity tests, as a consequence we argue that, after controlling for any potential demand pull factors, what is left are demographic factors affecting differently males and females within the same cell. In addition to that, since equation (9) uses relative female-male wages and employment, any demand shock shared by both gender within the same cell cancels out. However gender specific demand shocks are left unaccounted and can be responsible for the bias in our estimation. Tables 2 and 6 report the results. All estimates obtained by using both the macro-area and the regional definition of local labor market show an inverse elasticity of substitution not statistically different from zero, and this result holds throughout the different specifications, supporting the evidence of perfect substitution between female and male workers within the same area, occupation and immigration status. This result is confirmed once again by replicating the analysis on the sample restricted to workers who never change the region where they work as reported in Table 6. Due to the perfect substitution between female and male workers the labor aggregate expressed as in (4) can be obtained by simply summing up all the female and male workers within the same cell.

The estimates of the inverse elasticity of substitution between natives and immigrants (equation 11), reported in Tables 3 and 7, are in favour of a small but detectable degree of imperfect substitution, with values of $-1/\delta$ around -0.05. The log of the supply push component of immigrants by cells, $\ln IV_{rkt}$ as described in (13) is used as an instrument for the log of the relative immigrants-natives supply by cell, $\ln\left(\frac{I_{rkt}}{N_{rkt}}\right)$. The estimates of $-1/\delta$ are robust to the different definition of local labor market adopted and to the restriction of the sample to only non-mover workers, thus providing further evidence that the outflow of natives as a consequence of immigrants doesn't play any role.

In order to estimate the inverse elasticity of substitution between high and low skilled workers as in equation (12) the term L_{rkt} needs to be computed according to the estimated value of δ and the two productivity terms. Exploiting the normalization previously imposed $\theta^I_{rkt} + \theta^N_{rkt} = 1$, after some algebra follows

$$\hat{L}_{rkt} = \left[\hat{\theta}^I_{rkt} I_{rkt}^{\frac{\hat{\delta}-1}{\hat{\delta}}} + \hat{\theta}^N_{rkt} N_{rkt}^{\frac{\hat{\delta}-1}{\hat{\delta}}} \right]^{\frac{\hat{\delta}}{\hat{\delta}-1}}$$

Results in Tables 4 and 8 provide evidence of a strong complementarity between high and low skilled workers, with an estimates of $-1/\sigma$ around -0.6 which is obtained by adopting a 2SLS strategy using as instrument for $\hat{L}_{rkt}$ the term IV_{rkt} described in (13). All the estimates obtained by 2SLS methods report lower coefficients supporting the hypothesis that not accounting for the endogeneity of the employment terms result in upward biased coefficients. All first stage F-statistics in estimating (11) and (12) are largely above the standard critical thresholds (The lower bound often used in the literature on weak instruments is 16.38 (Cragg-Donald F-statistics critical value, Stock and Yogo (2001)) providing strong evidence that the adopted instrument doesn't suffer from any weakness.

The evidence found in a recent study (Mocetti and Porello (2010)) that the immigration flow to Italy has brought about a reduction in the inflow of similarly skilled natives to the regions where immigrants concentrate would suggest that the outflow of natives might reduce the true impact of immigration on natives, and thus would also affect the estimation of the structural parameters. However this study provides substantive evidence that this phenomenon doesn't affect the estimation, in fact replicating all the analysis on a sub-sample of those who never change the region of work the results previously obtained by using the entire sample are confirmed.
Our results are higher than those found in few previous studies: Ottaviano and Peri (2006) reported estimates in the range of 0.1 to 0.2 using aggregate U.S. data comparing immigrants and natives within the same education and experience cell, and Manacorda *et al.* (2006) report estimates for natives and immigrants within the same education and age category around 0.15 as for UK; on the other hand our estimates are consistent with results found in other more recent works: Ottaviano and Peri (2008) present estimates that range from 0.04 to 0.08, and estimates provided by Card (2009) for immigrants and natives within the same education category centers at around 0.04. Also D'Amuri et al. (2010) report a value around 0.03 for their study on German data.

7 Simulation

Selecting a specific functional form for the aggregate production function (1), consider the following simplified version

$$Y_{rt} = A_{rt} L_{rt} \tag{14}$$

which can be interpreted as a short run production function where capital is considered as fixed or endogeneized in the technology parameter A_{rt}, L_{rt} is defined as in (2), accordingly also L_{rkt} is defined as in (3) and female and male workers are assumed to be perfect substitutes as follows from the estimated value of η. Ortega and Peri (2009) provide evidence that capital adjusts to keep its price constant as a consequence of yearly inflow of immigrants to OECD countries, therefore the chosen production function is not restrictive for the purpose of the simulation. In fact even considering a more general production function such as a Cobb Douglas where capital is present, once we develop the simulating equation where each factor is left changing as a consequence of immigration, capital would disappears because of its full adjustment. Therefore the first order condition on (14) produces the following demand function for each immigration-skill-area specific labor aggregate:

$$\ln w_{rkSt} = \ln A_{rt} + \ln \theta_{rkt} + \ln \theta_{rkSt} + \frac{1}{\sigma} \ln L_{rt} - \left(\frac{1}{\sigma} - \frac{1}{\delta}\right) \ln L_{rkt} - \frac{1}{\delta} \ln S_{rkt} \tag{15}$$

In order to simulate the labor market impact of immigration on native and immigrant workers follow a similar approach found in Manacorda *et al.* (2006). By totally differentiating equation (15) we derive the following formula for evaluating the impact of immigrants on natives

$$d \ln w^N_{rkt} = \frac{1}{\sigma} \left[\Sigma_k s_{rkt} \left(S^I_{rkt} \frac{dI_{rkt}}{I_{rkt}} + S^N_{rkt} \frac{dN_{rkt}}{N_{rkt}} \right) \right] + \left(\frac{1}{\delta} - \frac{1}{\sigma}\right) \left[S^I_{rkt} \frac{dI_{rkt}}{I_{rkt}} + S^N_{rkt} \frac{dN_{rkt}}{N_{rkt}} \right] - \frac{1}{\delta} \frac{dN_{rkt}}{N_{rkt}} \tag{16}$$

and the impact of immigrants on immigrants themselves

$$d \ln w^I_{rkt} = \frac{1}{\sigma} \left[\Sigma_k s_{rkt} \left(S^I_{rkt} \frac{dI_{rkt}}{I_{rkt}} + S^N_{rkt} \frac{dN_{rkt}}{N_{rkt}} \right) \right] + \left(\frac{1}{\delta} - \frac{1}{\sigma}\right) \left[S^I_{rkt} \frac{dI_{rkt}}{I_{rkt}} + S^N_{rkt} \frac{dN_{rkt}}{N_{rkt}} \right] - \frac{1}{\delta} \frac{dI_{rkt}}{I_{rkt}} \tag{17}$$

where

$$S^S_{rkt} = \frac{w^S_{rkt} S_{rkt}}{\Sigma_s w^S_{rkt} S_{rkt}}$$

is the wage bill share of the labor aggregate specific to each immigration status among the relevant skill-area- and time cell, and

$$s_{rkt} = \frac{w_{rkt} L_{rkt}}{\Sigma_k w_{rkt} L_{rkt}}$$

is the wage bill share of the labor aggregate specific to each skill among the relevant area- and time cell. Before estimating equation (16) using the previously estimated parameters we need to recover the term $\frac{dN_{rkt}}{N_{rkt}}$ representing the potential employment effect of immigrants' flow on natives; a shock in the supply of immigrants brings about a reduction in their wages, and, due to the complementarity between natives and immigrants, this shock triggers also a shift in the natives' labor demand curve, which is defined at the new equilibrium point for immigrants (set at an higher value of their employment). Since, as opposed to the case for immigrants, the labor supply function is assumed to be highly elastic for natives, there might be an employment effect for natives as a consequence of a shock in the supply of immigrants. The following reduced form approach is adopted in order to verify whether this employment effect is ultimately in place

$$\frac{dN_{rkt}}{N_{rkt}} = \beta \frac{dI_{rkt}}{I_{rkt}} + D_t + D_r + D_k + \mu_{rkt} \tag{18}$$

where β is the parameter of interest, D_t are time fixed effects, D_r are area fixed effects, D_k are occupation fixed effects and μ_{rkt} is a zero mean cell-specific random shock. Equation (18) represents the benchmark specification, mortality rate and its interaction with occupation fixed effects are additional set of regressors included to control for any systematic changes in employment due to demographic factors and their change across different occupations[5]. The 2SLS strategy adopted in order to identify the parameter β uses the growth rate of the supply push component previously described as an instrument for the growth of immigrants by cell. Table 5 provides evidence that immigrants don't displace natives with the same skill and geographic location, nor have such a complementary effect to enhance their employment level, since in the preferred estimates the coefficient β is almost zero and not significant at any conventional confidence levels. At the same time this suggests, if any, a potential complementary effect on natives' employment as it is clear from its always positive sign[6]. Table 9 confirms the absence of any employment effect also restricting the sample to only non-mover workers. This result is consistent with the low but detectable degree of imperfect substitution found between immigrants and natives within the same skill-area-time cell, since the complementarity found between the two labor input is too low to be able to drive a significant enhancing effect on natives' employment. As a consequence, having ruled out any employment effect, equations (16) and (17) simplify as follows

$$d \ln w_{rkt}^{N} = \frac{1}{\sigma} \left[\Sigma_k s_{rkt} S_{rkt}^{I} \frac{dI_{rkt}}{I_{rkt}} \right] + \left(\frac{1}{\delta} - \frac{1}{\sigma} \right) \left[S_{rkt}^{I} \frac{dI_{rkt}}{I_{rkt}} \right] \tag{19}$$

$$d \ln w_{rkt}^{I} = \frac{1}{\sigma} \left[\Sigma_k s_{rkt} S_{rkt}^{I} \frac{dI_{rkt}}{I_{rkt}} \right] + \left(\frac{1}{\delta} - \frac{1}{\sigma} \right) \left[S_{rkt}^{I} \frac{dI_{rkt}}{I_{rkt}} \right] - \frac{1}{\delta} \frac{dI_{rkt}}{I_{rkt}} \tag{20}$$

Finally, in order to run the simulation, we consider four different hypothetical scenarios of the immigration's flow. First, an increase of both high and low skilled immigrants of the same amount equal to 10% (hereafter denoted as "skilled neutral" immigration shock), an inflow of only high skilled immigrants equal to 20% (hereafter denoted as "high skilled" immigration shock) and an inflow of only low skilled immigrants equal to

[5]Mortality rate is computed from registry data and the first year available for this variable is 1991, therefore the specifications including mortality rate have to restrict the time-span to 1991-2004.

[6]Estimates in column 3 and 4 of Table 5 are positive and significant at 10% level.

20% (hereafter denoted as "low skilled" immigration shock), and lastly the actual flow of immigration as provided by the data (hereafter denoted as "actual" immigration shock). Table 6 and Figure 2 reports the results of these simulations computed by using the wage bill share relevant to the year 2002. The actual flow of immigrants in 2002 has a negative impact on low-skilled immigrants since it reduces their wages by 3.5%, whereas to a lesser extent reduces the wages of low skilled natives by 1%. All other scenarios don't have any substantive impact either on natives or on immigrants apart from a slight negative impact of the low skilled immigration shock which brings about a more detrimental effect on similar immigrant workers (-2%) and almost no impact on natives.

Figure 2 plots the results of the simulation under the "actual" scenario. The left panel describes the impact of the actual flow of immigrants on the wage growth of low-skilled natives and immigrants. The right panel draws the impact of the actual immigration shock on high-skilled natives and immigrants. Clearly the group suffering most from immigration are immigrants themselves especially their low-skilled component which experiences a steady decrease in wages throughout the period of analysis. However also low-skilled natives experience a slight negative impact on their wages, although always lower than 1%. Despite being low, the degree of complementarity between natives and immigrants is clear from the right panel where high skilled natives always gain from immigration whereas the impact on immigrants is rather volatile, varying between being positive and negative.

8 Concluding Remarks

This study contributes to the existing literature on the impact of immigration on the host country by adopting a structural approach. We estimate the labor market impact of immigration to Italy defining the local labor market in terms of area, skill, immigration status, and gender. Immigrants and natives within the same skill-area cell and females and males within the same skill-area, and immigration status cell are allowed to be imperfect substitutes and their elasticity of substitution is estimated through the data. Our findings provide evidence that natives and immigrants within the same skill-area cell are less than perfect substitutes with an estimated inverse elasticity of substitution of 0.05, whereas females and males workers with the same skill and immigration status are perfect substitutes. Strong complementarity has been found between high- and low-skilled workers and the estimate of its elasticity is around 2, a lower value with respect to a range of 5-10 reported by Card (2001) using U.S. census data. These results, despite being based on a local definition of labor market, are consistent with other time-series estimates which explicitly account for the offsetting role of other input in detecting the real impact of immigration on the wage structure. Moreover the estimates turn out to be robust to different definitions of local labor market, confirming that the potential outflow of natives plays a minor role in offsetting the actual impact of immigration. Finally the simulation obtained by using the estimated parameters suggests that, based on the year 2002, the group suffering most from immigration are immigrants themselves, particularly low-skilled immigrants, who experiment a reduction in their wages equal to (3.5%) as a consequence of the actual shock of immigration occurring in the same year, whereas the impact on low-skilled natives is lower corresponding to a decrease of 1% of their wages. On the other hand we confirm previous findings (Venturini and Villosio

(2004)) that immigrants don't displace natives, since natives' employment results to be unaffected by the immigration flow occurring during the period of analysis, despite being always positive but weakly significant, results which is in line with the estimated low but detectable degree of imperfect substitution between the two groups, which is too low in order to enhance employment for natives.

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Table 1: Descriptive statistics

	Total		Natives		Immigrants	
variable	**mean**	**sd**	**mean**	**sd**	**mean**	**sd**
Daily Wage	56.88	26.32	57.48	26.59	47.09	18.86
Female	0.33	0.47	0.34	0.47	0.17	0.37
Male	0.67	0.47	0.66	0.47	0.83	0.37
Immigrants	0.06	0.23				
Age 15-35	0.53	0.50	0.53	0.50	0.59	0.49
Age 36-50	0.36	0.48	0.36	0.48	0.38	0.48
Age 51-65	0.11	0.32	0.12	0.32	0.03	0.18
Industry	0.49	0.50	0.49	0.50	0.46	0.50
PA	0.06	0.25	0.07	0.25	0.02	0.13
Artisans	0.12	0.32	0.11	0.32	0.22	0.41
Agriculture	0.00	0.05	0.00	0.05	0.00	0.02
Insurance	0.04	0.19	0.04	0.20	0.01	0.07
Commerce	0.28	0.45	0.28	0.45	0.30	0.46
North West	0.34	0.47	0.34	0.47	0.37	0.48
North East	0.25	0.43	0.24	0.43	0.39	0.49
Center	0.19	0.39	0.19	0.39	0.18	0.39
South	0.15	0.36	0.16	0.36	0.05	0.22
Islands	0.07	0.25	0.07	0.26	0.01	0.11
Asia	0.15	0.36			0.15	0.36
Africa	0.48	0.50			0.48	0.50
South America	0.08	0.27			0.08	0.27
Easter EU	0.29	0.45			0.29	0.45
Blue Collars	0.62	0.48	0.61	0.49	0.92	0.28
White Collars	0.38	0.48	0.39	0.49	0.08	0.28
Permanent	0.15	0.36	0.15	0.36	0.22	0.41
Temporary	0.83	0.38	0.83	0.37	0.76	0.43
Seasonal	0.02	0.13	0.02	0.13	0.03	0.16

Source: INPS: 1987-2004

Table 2: Inverse elasticity of substitution between females and males.

	(1) WLS Region	(2) WLS Region	(3) WLS Region	(4) WLS Macro-area	(5) WLS Macro-area	(6) WLS Macro-area
$-1/\eta$	0.011	0.013	0.006	0.063	0.064	0.060
	(0.034)	(0.036)	(0.034)	(0.045)	(0.051)	(0.049)
Region*Time	No	Yes	No	No	Yes	No
Skill*Time	No	No	Yes	No	No	Yes
N	1370	1370	1370	360	360	360
adj. R^2	0.722	0.694	0.725	0.826	0.821	0.824

Note: The benchmark specification (1 and 4) is described in equation (9) in the text. The dependent variable is the female-male log wage differential by skill, immigration, time, and area cell. The independent variables are: log female-male relative supply by skill, immigration, time, and area cell, area fixed effects, skill fixed effects, a dummy for immigration status, and time fixed effects. Standard errors are robust to heteroskedasticity since each observation is weighted by the inverse of the estimated variance of the dependent variable, and clustered at the immigration-skill-area cell in order to control for serial correlation. * significant at 5% level,** significant at 1% level, *** significant at 0.1% level.

Table 3: Inverse elasticity of substitution between natives and immigrants.

	(1) WLS Region	(2) 2SLS Region	(3) WLS Macro-area	(4) 2SLS Macro-area
$-1/\delta$	-0.023	-0.048**	-0.016	-0.037*
	(0.013)	(0.017)	(0.014)	(0.015)
N	710	710	180	180
adj. R^2	0.381	0.361	0.667	0.649
First stage				
Kleibergen-Paap Wald F-stats		94.68		204.17
Anderson-Rubin Wald test (p-value)		0.00		0.04

Note: The benchmark specification is described in equation (11) in the text and regions are aggregated in 5 macro-areas. The dependent variable is the native-immigrant log wage differential by skill, and area cell. The independent variables are: log native-immigrant relative supply by skill, time and area cell, area fixed effects, skill fixed effects, and time fixed effects. Standard errors are robust to heteroskedasticity since each observation is weighted by the inverse of the estimated variance of the dependent variable, and clustered at the skill-area cell in order to control for serial correlation. The instrument adopted for $\ln\left(\frac{I_{rkt}}{N_{rkt}}\right)$ is the $\ln(sp_{rkt})$ as described in the text. * significant at 5% level,** significant at 1% level, *** significant at 0.1% level.

Table 4: Inverse elasticity of substitution between high- and low-skilled.

	(1) WLS Region	(2) 2SLS Region	(3) WLS Macro-area	(4) 2SLS Macro-area
$-1/\sigma$	-0.385***	-0.597***	-0.483***	-0.640***
	(0.045)	(0.126)	(0.091)	(0.075)
N	710	710	180	180
adj. R^2	0.701	0.545	0.950	0.924
First stage				
Kleibergen-Paap Wald F-stats		175.78		89.55
Anderson-Rubin Wald test (p-value)		0.00		0.00

Note: The benchmark specification is described in equation (12) in the text. The dependent variable is the low-high skilled log wage differential by area cell. The independent variables are: log low-high skilled relative supply by area cell, area-time fixed effects and a time trend interacted with area-skill fixed effects. Standard errors are robust to heteroskedasticity since each observation is weighted by the inverse of the estimated variance of the dependent variable, and clustered at the skill-area cell in order to control for serial correlation. Specifications (1) and (3) use Weighted Least Squares, specifications (2) and (4)use Weighted 2SLS using as instrument for $\ln L_{rkt}$ the $\ln sp_{rkt}$ as described in the text. * significant at 5% level,** significant at 1% level, *** significant at 0.1% level.

Table 5: Immigration effect on employment of natives.

	(1) WLS Region	(2) WLS Region	(3) 2SLS Region	(4) 2SLS Region	(5) WLS Macro-area	(6) WLS Macro-area	(7) 2SLS Macro-area	(8) 2SLS Macro-area
β	0.006	0.015	0.033	0.049	0.001	0.005	-0.012	0.034
	(0.006)	(0.008)	(0.028)	(0.027)	(0.010)	(0.022)	(0.022)	(0.064)
Mortality rate	No	Yes	No	Yes	No	Yes	No	Yes
Mortality rate*Skill	No	Yes	No	Yes	No	Yes	No	Yes
N	720	560	720	560	180	140	180	140
adj. R^2	0.252	0.301	0.222	0.262	0.494	0.522	0.490	0.514
First stage								
Kleibergen-Paap Wald F-stats			8.83	12.37			6.52	20.21
Anderson-Rubin Wald test (p-value)			0.07	0.00			0.01	0.00

Note: The basic specification (1 and 5) is described in equation (18) in the text. The dependent variable is the yearly change in natives' employment by skill and area divided by the initial total employment in the same cell. The independent variables are: the yearly change in immigrants' employment by skill and area divided by the initial total employment in the same cell, area specific mortality rate, and its interaction with skill, time fixed effects and area fixed effects. Standard errors are robust to heteroskedasticity since each observation is weighted by the inverse of the estimated variance of the dependent variable, and clustered at the skill-area cell in order to control for serial correlation. Weighted 2SLS uses as instrument for $\ln I_{rkt}$ the $\ln sp_{rkt}$ as described in the text. * significant at 5% level,** significant at 1% level, *** significant at 0.1% level.

Table 6: Inverse elasticity of substitution between females and males. Sample of non-movers.

	(1) WLS Region	(2) WLS Region	(3) WLS Region	(4) WLS Macro-area	(5) WLS Macro-area	(6) WLS Macro-area
$-1/\eta$	-0.015	-0.004	-0.019	0.031	0.031	0.028
	(0.041)	(0.039)	(0.041)	(0.051)	(0.057)	(0.050)
Region*Time	No	Yes	No	No	Yes	No
Skill*Time	No	No	Yes	No	No	Yes
N	1335	1335	1335	360	360	360
adj. R^2	0.631	0.596	0.633	0.767	0.757	0.775

Note: The basic specification (1 and 4) is described in equation (9) in the text. The dependent variable is the female-male log wage differential by skill, immigration, time, and area cell. The independent variables are: log female-male relative supply by skill, immigration, time, and area cell, area fixed effects, skill fixed effects, a dummy for immigration status, and time fixed effects. Standard errors are robust to heteroskedasticity since each observation is weighted by the inverse of the estimated variance of the dependent variable, and clustered at the immigration-skill-area cell in order to control for serial correlation. The sample is restricted to those who don't change the region where they work.* significant at 5% level,** significant at 1% level, *** significant at 0.1% level.

Table 7: Inverse elasticity of substitution between natives and immigrants. Sample of non-movers.

	(1) WLS Region	(2) 2SLS Region	(3) WLS Macro-area	(4) 2SLS Macro-area
$-1/\delta$	-0.030	-0.060***	-0.025*	-0.050***
	(0.018)	(0.018)	(0.011)	(0.015)
N	697	697	180	180
adj. R^2	0.421	0.396	0.743	0.717
First stage				
Kleibergen-Paap Wald F-stats		124.00		158.70
Anderson-Rubin Wald test (p-value)		0.00		0.00

Note: The basic specification is described in equation (11) in the text. The dependent variable is the native-immigrant log wage differential by skill, and area cell. The independent variables are: log native-immigrant relative supply by skill, time and area cell, area fixed effects, skill fixed effects, and time fixed effects. Standard errors are robust to heteroskedasticity since each observation is weighted by the inverse of the estimated variance of the dependent variable, and clustered at the skill-area cell in order to control for serial correlation. Specifications (1) and (3) use Weighted Least Squares, specifications (2) and (4)use Weighted 2SLS using as instrument for $\ln L_{rkt}$ the $\ln sp_{rkt}$ as described in the text. Sample restricted to those who don't change the region where they work. * significant at 5% level,** significant at 1% level, *** significant at 0.1% level.

Table 8: Inverse elasticity of substitution between high- and low-skilled. Sample of non-movers.

	(1) WLS Region	(2) 2SLS Region	(3) WLS Macro-area	(4) 2SLS Macro-area
$-1/\sigma$	-0.371***	-0.575***	-0.463***	-0.634***
	(0.047)	(0.120)	(0.078)	(0.070)
N	697	697	180	180
adj. R^2	0.704	0.548	0.955	0.919
First stage				
Kleibergen-Paap Wald F-stats		181.90		60.29
Anderson-Rubin Wald test (p-value)		0.00		0.00

Note: The benchmark specification is described in equation (12) in the text. The dependent variable is the low-high skilled log wage differential by area cell. The independent variables are: log low-high skilled relative supply by area cell, area-time fixed effects and a time trend interacted with area-skill fixed effects. Standard errors are robust to heteroskedasticity since each observation is weighted by the inverse of the estimated variance of the dependent variable, and clustered at the skill-area cell in order to control for serial correlation. Specifications (1) and (3) use Weighted Least Squares, specifications (2) and (4)use Weighted 2SLS using as instrument for $\ln L_{rkt}$ the $\ln sp_{rkt}$ as described in the text. Sample restricted to those who don't change the region where they work.* significant at 5% level,** significant at 1% level, *** significant at 0.1% level.

Table 9: Immigration effect on employment of natives. Sample of non-movers.

	(1) WLS Region	(2) WLS Region	(3) 2SLS Region	(4) 2SLS Region	(5) WLS Macro-area	(6) WLS Macro-area	(7) 2SLS Macro-area	(8) 2SLS Macro-area
β	0.003	0.007	-0.000	0.005	-0.009	0.002	-0.019	0.039
	(0.006)	(0.009)	(0.012)	(0.014)	(0.010)	(0.016)	(0.019)	(0.063)
N	720	560	720	560	180	140	180	140
adj. R^2	0.216	0.236	0.215	0.236	0.503	0.530	0.502	0.522
First stage								
Kleibergen-Paap Wald F-stats			3.21	2.41			5.06	11.77
Anderson-Rubin Wald test (p-value)			0.04	0.1			0.01	0.00

Note: The basic specification is described in equation (18) in the text. The dependent variable is the yearly change natives' employment by skill and area divided by the initial total employment in the same cell. The independent variables are: yearly change in immigrants' employment by skill and area divided by the initial total employment in the same cell, area specific mortality rate, and its interaction with skill, time fixed effects and area fixed effects. Standard errors are robust to heteroskedasticity since each observation is weighted by the inverse of the estimated variance of the dependent variable, and clustered at the skill-area cell in order to control for serial correlation. Weighted 2SLS uses as instrument for $\ln I_{rkt}$ the $\ln sp_{rkt}$ as described in the text. Sample restricted to those who don't change they region where they work. * significant at 5% level,** significant at 1% level, *** significant at 0.1% level.

Table 10: Simulations. Impact of immigrants on wage growth of natives and previuos immigrants. Year 2002.

	Actual Immigration flow	Skill Neutral 10% rise	Low skilled 20% rise	High skilled 20% rise
$d\ln w_{Lt}^{I}$	-0.035	-0.008	-0.017	0.000
$d\ln w_{Lt}^{N}$	-0.013	-0.003	-0.007	0.000
$d\ln w_{Ht}^{I}$	-0.003	-0.004	0.003	-0.011
$d\ln w_{Ht}^{N}$	0.004	0.000	0.003	-0.001

Simulations are based on actual wage bill shares in 2002 and setting parameters according to the following estimated values (pooled men and women): $-1/\delta$=-0.05, $-1/\sigma$=-0.6.
$d\ln w_{Lt}^{S}$, and $d\ln w_{Ht}^{S}$ represent, respectively, the growth of mean daily wages for low skilled workers with immigration status equal to S, and the growth of mean daily wages for high skilled workers with immigration status equal to S (S=I, N).
Column 1 uses the "Actual shock" of immigrants as found in the data, column 2 uses a simulated "Skill Neutral" shock in immigration (+10% for both low and high skilled immigrants), column 3 simulates a "Low Skilled" shock in immigrants equal to 20% for only low skilled immigrants, and column 4 simulates the "High skilled" shock in immigrants equal to 20% for only high skilled.

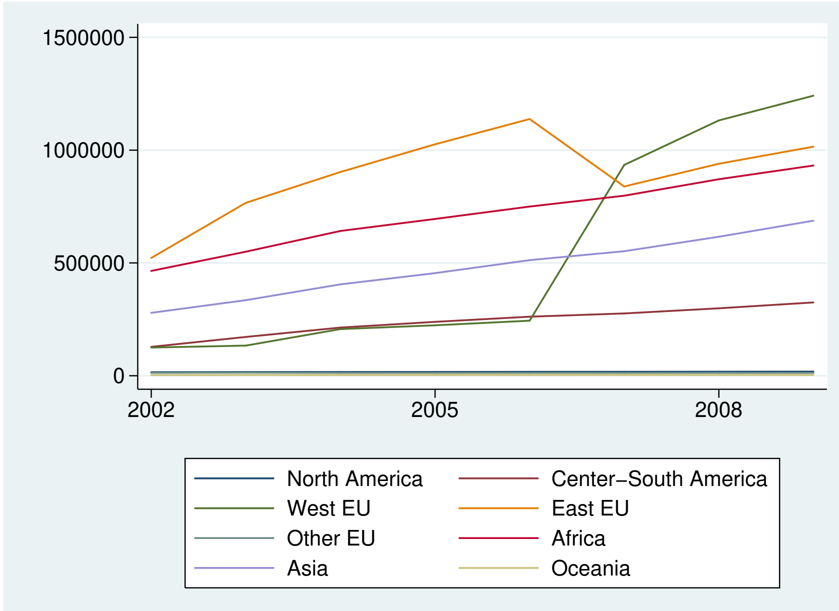

Figure 1: Resident Immigrants. Source: elaboration from ISTAT data

Figure 2: Simulation: impact of the actual flow of immigration on the growth of skill-specific wages.

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