Migration, Production Structure and Exports*

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Abstract

In a two-sector model we assume that production is performed with one mobile factor and two sector-specific CES labor composites of *simple* and *complex* tasks. Migrants and natives have different productivity when performing tasks. An inflow of migrants induces production restructuring in favor of the simple-task intensive sector (Rybczynski effect). Owners of the freely mobile factor gain from immigration.

We assess the effect of migrants' inflows on the production and export structure of the Italian provinces (NUTS3) in 1995-2006. When assuming that (a subset of) the service sector is relatively complex-task intensive with respect to manufacturing, the model is confirmed by the data. Although the investigated time span is very short, the effect is small but statistically significant: a doubling in the ratio of foreign-born residents to the province population induces a 4% increase in manufactures' value added with respect to services' value added. The same pattern is confirmed in the export structure and is much stronger – doubling the migrants' population share induces a 17% increase in the relative value added of low-tech exports (with respect to high-tech exports). These effects disappear statistically when considering an increase in foreign-born populations drawn from countries more similar to Italy (in terms of GDP per capita and educational attainment).

Keywords: Specific Factor Model, Productive Tasks, Rybczynski Effect, International Migration.

JEL Classification Codes: F22, C25.

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1 Introduction

In the last decades industrialized economies in North America and in Europe (Continental and UK) have been the destination of many migrants coming from neighbor countries – like Mexico for the US, or North Africa and Eastern Europe for the European Union (EU) – and from more distant origins – for instance, China and South-East Asia.

The incidence of foreign-born population on natives has almost doubled on average starting in 1990 (not counting undocumented migration), but with many different patterns among the various destination countries.

When investigating the effects on the receivers, economists have been mainly interested in labor market issues (see Okkerse, 2008, for a recent review). There is still an intense debate on the reaction of wages and natives' unemployment rates when the labor force increases due to immigration. In the US there is now a large consensus that only the low-educated segment of the labor market may be affected.[1] In Europe the effect is even more mitigated.[2]

Our work focuses on another issue, that is the effect of immigration on the production structure in terms of sectorial recomposition.

According to the traditional theories of international trade, immigration can be considered as an increase in factor endowments that can give rise to different adjustments on the production side. The most relevant are the changes in production techniques or, alternatively, the changes in the production mix, also known as the Rybczynski effect.

As an attempt to link labor economics and international trade theory in the economic analysis of migration, we borrow from the recent literature in tasks and offshoring (see, for instance, Grossman and Rossi-Hansberg, 2008) that highlights the importance of *labor services* (or *tasks*) when considering the labor market. As natives and foreign-born are assumed to have different relative productivity in performing simple versus complex tasks, immigration is

[1] Among the many articles on the subject, Borjas (2003) and Borjas and Katz (2007) found a significative effect on US wages, whereas Card (2007) does not confirm this finding. Ottaviano and Peri (2012) challenge the traditional approach by pointing at the imperfect substitution between natives and migrants in the detailed and fine segments (or cells) of the labor market.

[2] See D'Amuri and Peri (2011) and D'Amuri and Peri (2012). They considered all segments of the European labor markets and not only the low-educated one, as in many other studies on the US.

a comparative statics exercise that changes the relative endowment of the economy in terms of labor services and requires a change in the production structure under some given conditions.

Previous studies that investigated the change in factor endowments implied by migration reached various conclusions in different frameworks.

Hanson and Slaughter (2002) considered the local effect in the US states between 1980 and 1990, whereas Gandal et al. (2004) analyzed the particular case of the sudden inflow of migrants from the former Soviet Union in Israel in 1990. Although the two cases are different in terms of types of immigration – typically low-skilled Mexicans in the formers case, but high-skilled Russians in the latter – the authors conclude for a more relevant role of the changes in production techniques rather than the change in the production mix.[3]

Recent studies also emphasize the *type of change* in production techniques; in particular, whether there is an increase or a decrease in the capital-to-labor ratio. Accetturo et al. (2012) conclude for an increase in the ratio when using Italian manufacturing data at the firm level, whereas Lewis (2011) finds a tendency to slow the adoption of automated techniques in US metropolitan areas where migration has been more intense.

Card and Lewis (2007) and Card (2007) find effects on the production structure, but claim that this occurs within sectors (or within firms) rather than between sectors.[4]

In this paper we offer an additional contribution to this debate by building our analysis on the framework of labor tasks that has been used so far exclusively to look for the wage and the employment effects of immigration.[5] Let us recall the contribution by Peri and Sparber (2009) who also considered natives or foreign-born as individuals with different relative productivity in performing simple and complex tasks, but considered immigration only for its effects on a segment of the US labor market.

Although the structure proposed by Peri and Sparber (2009) (and the following papers) is

[3]They relate their results to the debate on skill-biased technological change (STBC) in the US, or *imported* STBC in the case of Israel.

[4]Instead, Bettin et al. (2012) find evidence of production recomposition in favor of low-skilled manufacturing when using firm-level data for the case of Italy in 2001-2003.

[5]As mentioned above, these effects have been found statistically significant but not very strong, at least in the European case – D'Amuri and Peri (2012) report a 0.7 percent increase in native wages when the percentage of migrants over total population doubles.

innovative, we deem that a similar framework could be used to investigate whether immigration have affected the production structure of economies, like Italy, that experienced sudden increases in the foreign-born population. In our framework, this could be done still considering redistribution and wage effects.

Hence, the contribution of this paper is twofold.

First, we propose a *two-sector* version of the task-based model initially proposed by Peri and Sparber (2009) that resembles the traditional *sector-specific* model of international trade – see Jones (1971), or Feenstra (2004, p.72). Besides the mobile (across-sector) factor, production in each sector requires *specific bundles of tasks* (named *specific factors* in the Jones model), where the specificity is due to the different productivity that each labor service has in each sector: simple (complex) tasks are relatively more productive in, say, the manufacturing (service) sector.

As a result, the production side of the economy resembles a traditional Heckscher-Ohlin-Vanek (HOV) framework, but with an explicit role for labor services. We assume that *relative* output prices are given as in a small open economy and the equilibrium variable becomes the *relative* production of the two sectors.

On the labor supply side, natives and migrants are assumed heterogeneous in terms of relative individual productivity when performing labor services. Similarly to Peri and Sparber (2009), migrants are *relatively* more productive when performing simple tasks; therefore, since they are willing to supply relatively more simple than complex tasks, the inflow of new migrants causes an increase in the *relative* supply of simple labor services in the overall economy.

Differently from Peri and Sparber (2009), since output prices are given, the relative wage of complex-to-simple tasks is given. Hence, the inflow of new migrants causes an adjustment in the production structure in favor to the simple-task intensive sector rather than on the relative wage of simple-to-complex tasks.

However, this does not hinder possible distributional effects. The assumption of constant relative output prices implies that the relative wage of simple-to-complex tasks remains constant. But the real and nominal wage of the so-called *mobile* factor can change and actually rises as a consequence of immigration. Hence, our framework encompasses the increase in wage dispersion that have been observed in many industrialized countries.

The second contribution of this paper is empirical as we test our model using Italian data. In fact, when focusing on receiving developed countries, Italy stands out as an interesting setting. Immigration has been very rapid, notwithstanding the absence of colonial ties with the origin countries. From 1995 to 2006 (our sample period) immigration in Italy has increased by a factor of three. Moreover, the immigration has been very diverse in terms of origin countries and both our theoretical and empirical model will take account of these characteristics.

The effect of this shock on the production structure of the economy is identified by the local presence of migrants. More precisely, we used the data set of foreign-born work permits at the provincial level (NUTS3) starting in the mid-1990s, i.e. the years where the migration presence has become more relevant for the Italian economy.

Many other studies have used regional data within the same country in order to evaluate the effect of migration on wages and concerns about the use of regional data have been raised following the remark by Borjas et al. (1996). This concern is less important in our case where the production structure can vary substantially among the regions of the same country.

Our main empirical findings are two and are encouraging according to the reduced-form estimation of our theoretical model.

First, an increase in immigration rates (i.e. percentage of foreign-born on the total population of the province) raises the relative weight of the simple-task intensive sector, identified as manufacturing and construction. In terms of value added, a doubling of foreign-born presence in percentage terms causes an increase in the value added of manufacturing and construction relative to services by 4 percent.

We ought to notice that, although the time span we consider is quite short to observe changes in the production structure within an HOV model, our results are all significant, although the impact is small.

Second, all migrants are not the same and their productivity may not be that different when considering foreign-born individuals who are more similar to natives. We exploited the large variety in the origins of the immigrants who arrived in Italy in the last two decades and considered the country of origin as a possible indicator of this difference – in terms of GDP per capita or in terms of percentage of migrants in Italy with primary, secondary or third educational degree.

When dividing countries in terciles – low, medium and high GDP per-capita origin countries, or origin countries with a prevalence of migrant in Italy with primary, secondary or tertiary education – our results are even more robust. Indeed, the increase in relative value added of the simple-task intensive sector is still significant and stronger when considering only more diverse migrants (i.e. coming from low-income countries or mainly low-educated). Instead, when considering more similar foreign-born populations (i.e. coming from high-income countries or mainly with a third educational degree), the effect is not significant anymore.

Results are confirmed and even stronger in magnitude when considering low-tech versus high-tech exports. The relative increase in the value added of low-tech exports is 17 percent for a doubling of foreign-born percentage over the total population. No effects are found when considering an increase in migrants from countries with high GDP per capita or origins of more highly educated migrants.

A typical well-known problem when searching for the effect of migration to the production structure, as well as on wages, is the possible reverse causality. Our model makes no exception. In our case we opted for a dynamic system-GMM method. We refer to Sections 5 and 6 for a thorough discussion on the advantages of this estimation method and the related results we obtain.

The remaining sections of the paper are organized as follows. In the Section 2 we present some characteristics of the immigration into Italy by pointing out why this is an interesting setting to study the effect of migration on the production structure. Moreover, we provide some new evidence on the task content of the sectorial dichotomy between simple-task and complex-task intensive sectors. The theoretical framework is illustrated in Section 3 where we derive the comparative statics for the increase in the foreign-born population. The data we use are discussed in Section 4, whereas Sections 5 and 6 present respectively the econometric issues related to our estimation and the empirical results with some robustness checks. Section 7 concludes with a discussion on the interpretation of the results. Three appendices illustrate the derivation of the task content of sectors, an extension of the theoretical model and some robustness checks for the empirical part.

2 Italy: An Interesting Natural Experiment

Italy has been known for many decades as a departure rather than a destination country. Indeed, Italian emigration has been one of the most massive in history, especially before the First World War (in 1913 the emigration rate was 18,7 per 1,000 residents), and continued quite intensively till the beginning of the 1970s. In the mid-Seventies the emigration rate drastically decreased, net immigration rates became positive although very small till the beginning of the 1990s when the phenomenon picked up.

Migration in Italy has been characterized by two relevant facts. First, it has been a very rapid phenomenon. Second, due to absence of strong colonial links, migration into Italy has been highly diversified in terms of origin countries, more than in any other European country (currently 189 nationalities are present on the Italian territory).

Non-native presence has tripled in slightly more than a decade. Foreign-born individuals increased from 1.4 million in 2002 to 4.6 million in 2011, which equals 7.6% of the Italian population.

Figure 1 reports the rising stock of foreign-born presence in 1995-2006 as measured by the number of residence permits, which are the data we use in this paper.

The increase is not smooth and the sudden changes are referred to the effects of three main amnesties that occurred during the period 1995-2006. The amnesties came together with new migration laws: (a) a first amnesty occurred in 1992 after the first relevant change in the immigration law (citizenship requirements were also extended to 10 years of residence from the original 5 years); around 250 thousands regularized migrants; (b) the second amnesty occurred in 1998 with the introduction of a new migration law (so called Turco-Napolitano law); migrant's residence permits were not strictly linked to labor contracts and expulsions with deportation of the illegal migrants back to their origin country were excluded (unless there were bilateral agreements, as in the case of Albania); around 200 thousand regularized migrants; (c) the third amnesty occurred in 2002 together with a stricter law (the Bossi-Fini law), which required the pre-existence of a labor contract to enter and stay in the country; around 640 thousand regularized migrants.[6]

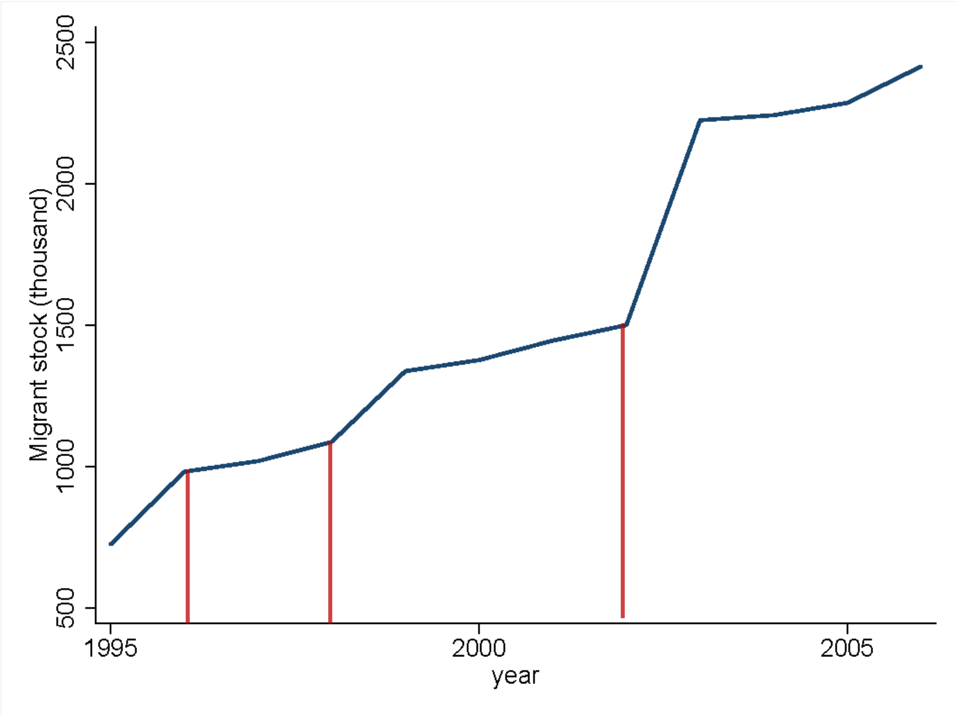


Figure 1: The Stock of Residence Permits in Italy 1995-2006 (Source: Italian Ministry of the Interior and ISTAT).

When investigating more thoroughly this rapid increase in foreign presence, two characteristics ought to be noticed: first, the quick change in the wide composition of migration by country of origin; second, the uneven geographical localization.

Regarding the origin of foreign-born, most migrants were coming from richer countries in 1995, whereas in 2006 the stock composition completely changed. Figure 2a reports the composition of migrants by ranking countries of origin with GDP per capita (in year 1995), more prcisely, by grouping countries in terms of terciles of GDP per-capita.

[6]In the empirical part the jumps in the series that occurred around the amnesties are treated with proper econometric methods.

Figure 2b shows that the 1995 distribution is slightly skewed towards *richer* origin countries: 1/3 of the migrants were arriving from economies with high per-capita GDP, which was bigger than the percentage for origins from low per-capita GDP. This picture is reversed starting in 2000 and even more drastically in 2006. In 2006 over 90% of foreigners with regular residence permits in Italy were born in countries with less than 8,000 US$ per capita.

The second important characteristic is the geographical uneven distribution of migrants in Italy. Migrants tend to settle down where pull factors – like favorable conditions of the labor market, availability of public services, network linkages with previous migrants of the same or similar nationalities – are stronger. From this point of view, the dual characteristic of the Italian economy explains very well why the overall majority of migrants locates in Center or Northern Italy (see Figure 2b).

Hence, given the wide variation of countries of origin and high variability in migrants' location, we deem that the Italian case offers a double type of variability to study the effects of migrants' arrivals and presence on the economic structure, i.e. the sector composition and weights.

Furthermore, Figure 3 reports the sectorial distribution of migrants and natives for the years 2005 and 2006.[7] Foreign-born are proportionally more represented in the industrial sector and especially in construction; although still relevant, migrants' employment share in the different types of services is lower than in the case of natives.

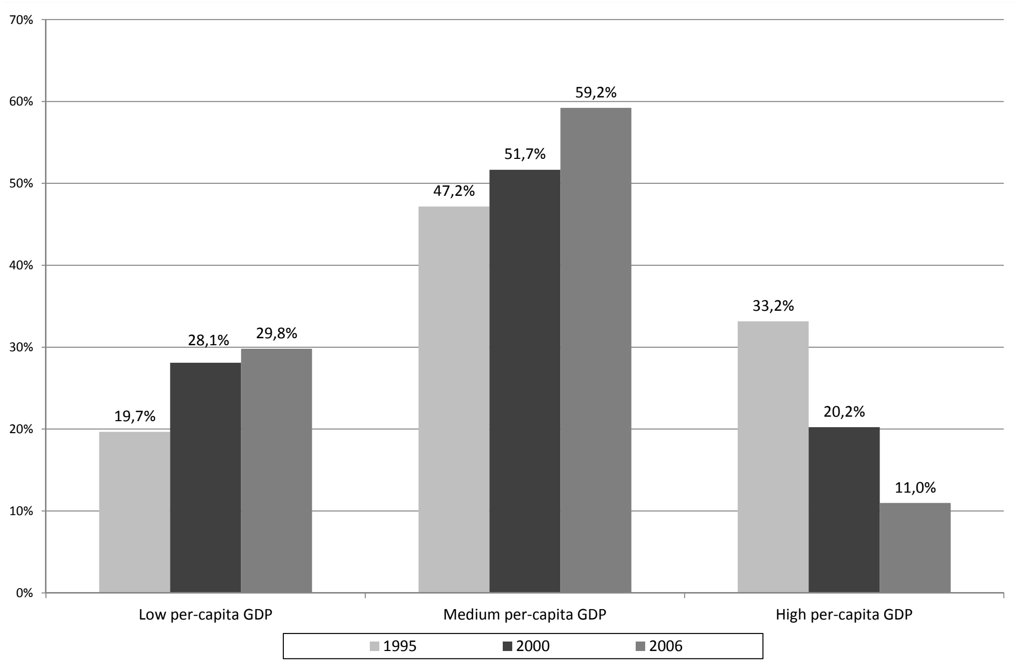
In the same Figure 3 we also report the relative weight of each sector in total Italian GDP. As presented below, according to our theoretical framework some sectors will not be considered in our empirical model. This is not relevant for our analysis since the disregarded sectors are not intensive in terms of migrants' employment or are negligible for total GDP (e.g. the Agriculture sector).

The definition of intensiveness in terms of simple or complex tasks could be heuristic and based on common wisdom, especially when considering large sectorial aggregations as in our case while using detailed local data.

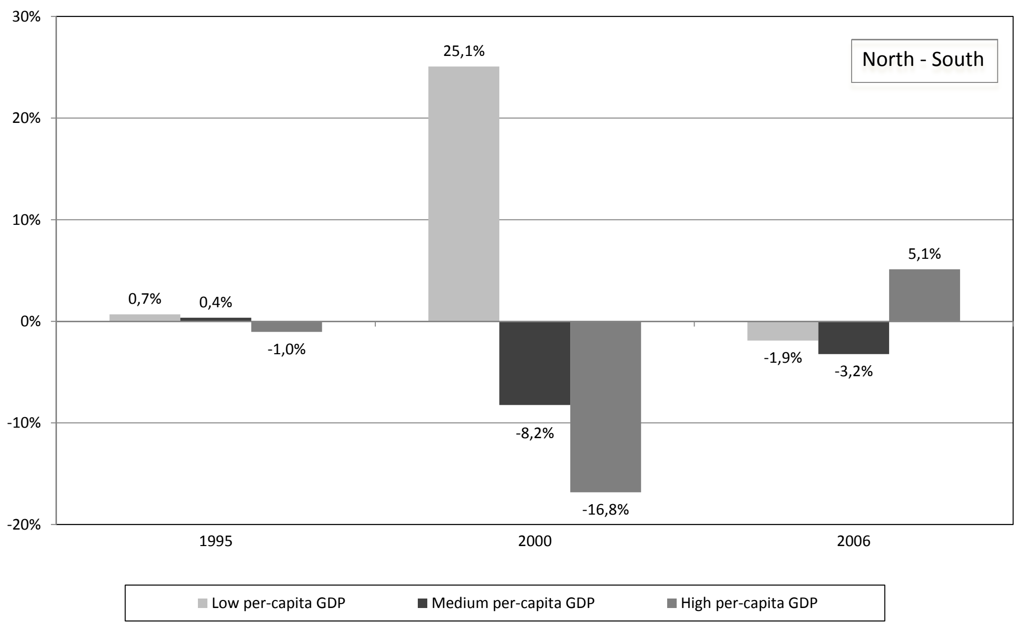
[7] The years 2005 and 2006 are the first two years for which these statistics are available for Italy and are the only two overlapping years with our sample. Averages of these two years are reported in the Figure 3.

Figure 2: Distribution of migrants' origin countries by GDP per capita (in terciles; source: Italian Ministry of the Interior and ISTAT).

(a) Italy



(b) Difference in the distribution according to the final location in Italy (North vs. South)



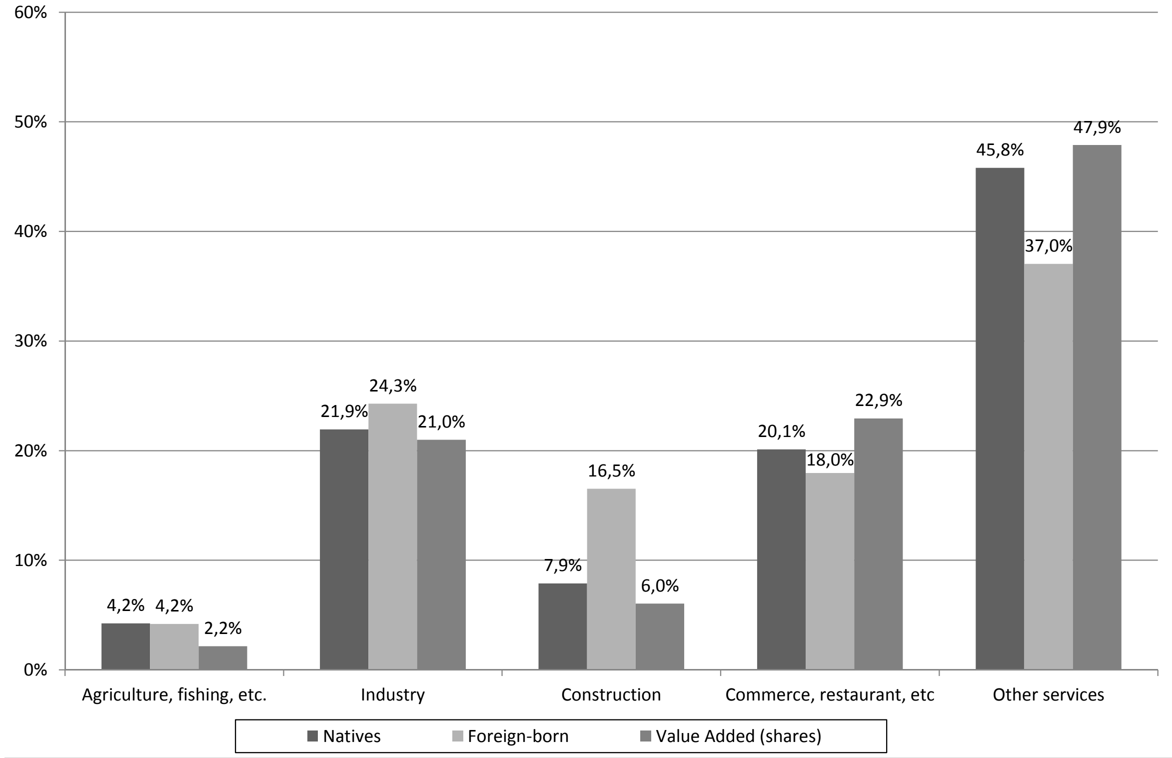


Figure 3: Employment distribution of natives and foreign-born in Italy in the main sectors; sectors' shares of value added (average 2005-06; source: Italian Institute of Statistics, ISTAT).

Based on the computations shown in D'Amuri and Peri (2012) for the task content of the different occupations (see their Tables A2 and A3), we obtained the simple/non-simple content of our two major sectors (i.e. industry plus constructions and services) by weighing the task content of each occupation with the employment in each sector. The task content is represented by the (average) percentile of employment performing that type of task less intensively. For instance, in Figure 4 the score 44 for Industry in the first group of histograms (Complex tasks) means that 44 percent of all the workers in the economy was performing complex tasks less intensively than in Industry. Hence, the higher the percentile, the more intensive that sector is in that particular task. The ratio complex-to-simple tasks is represented in the last group on the right-hand-side.

Figure 4 reports our computations (see Appendix A for the sources, data and derivations). Industry/Manufacturing (including constructions) has a complex-to-simple ratio lower than the one for the total economy and of the Service sector. As it is explained in Section 4, we will use a stricter definition of complex-task intensive sector by excluding personal and household services from the large Service sector definition. This means that the complex-task intensity would be even stronger than the one represented in Figure 4.

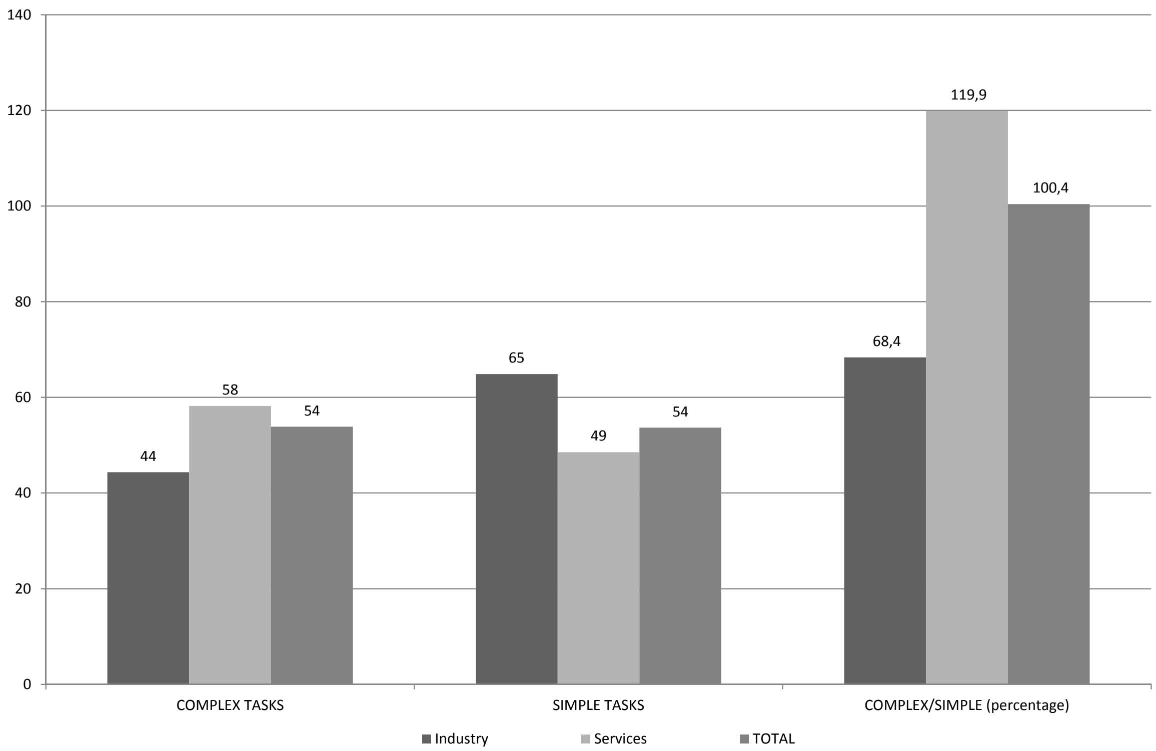


Figure 4: A Measure of Average Task Complexity by Sector in 2005 (Source: Own Computation, see Appendix A).

A further discussion on the data is reported in Section 4.

3 Theoretical Framework

Let us consider two sectors, manufacturing (M) and services (V), and assume that the two production functions are well-behaved Cobb-Douglas:

$$Y_j = A_j H_j^{(1-\alpha)} N_j^{\alpha}$$

Output Y_j in each sector $j = M, V$ is produced with two different inputs: *(a)* the factor H, which is freely mobile between the two sectors, and *(b)* the specific factor N_j, which is characterized by a sector-specific composition of *labor services*. The setup is similar to the Ricardo-Viner specific-factor model – see Jones (1971), or Feenstra (2004) (p.72). The elasticity of output to the mobile factor H is the same; the two sectors differ because of the TFP parameter A_j and the different composition of the factor N_j as discussed below.

The mobile factor H can be traditionally interpreted as capital, but it can be any type of production factor that is in fixed supply in our market (being the province in our case), but that can be used by both sectors, i.e. land, a general type of labor, public services, etc.[8]

The demand for H in each sector is given by its marginal productivity:

$$\frac{\partial Y_j}{\partial H_j} = \alpha \left(\frac{N_j}{H_j}\right)^{1-\alpha}$$

Given the sector mobility, arbitrage implies that the nominal remuneration of H be equal in the two sectors; hence:

$$\left(\frac{H_M}{H_V}\right) = \left(\frac{p_M}{p_V}\right)^{\frac{1}{1-\alpha}} \frac{N_M}{N_V}$$

where p_j, $j = M, V$, is the output price of sector j.

As a consequence, the relative production is simply a function of the relative output price and the relative specific-factors supply:

$$\frac{Y_M}{Y_V} = \left(\frac{p_M}{p_V}\right)^{\frac{\alpha}{1-\alpha}} \frac{N_M}{N_V} \tag{1}$$

Let us assume for now that the relative price is fixed since, for instance, it is given from abroad (we assume a small-open province or region or economy).

Let us name W_H the nominal "wage" of the mobile factor H, and W_j for $j = M, V$ the nominal "wages" of the two specific factors. From the Cobb-Douglas characteristics:

$$p_j = A W_H^{\alpha} W_j^{1-\alpha}$$

for $j = M, V$, where $A \equiv \left[\left(\frac{\alpha}{1-\alpha}\right)^{1-\alpha} + \left(\frac{\alpha}{1-\alpha}\right)^{-\alpha}\right]$.

Therefore:

[8] Peri and Sparber (2009) consider a CES production function in one-sector model where one of the two intermediate services corresponds to the amount of high education workers and may be similar to our specific factor.

$$\frac{W_M}{W_V} = \left(\frac{p_M}{p_V}\right)^{\frac{1}{1-\alpha}} \tag{2}$$

Hence, a *given* relative output price implies a *given* relative "wage" of the specific factors.[9]

Another important consequence of (1) (and given relative prices) is that the dynamics of relative output is fully determined by the relative quantity of the two specific factors, which are composite indexes of labor services (or labor tasks).

The composite factor N_j is a sector-specific input because of its composition in terms of labor services. We consider two different types of labor services: *simple* manual tasks (S) and *complex* (abstract, communication intensive) tasks (C). The labor services are then combined differently in the two sectors via a CES aggregation as follows:

$$N_j = \left[\beta_j S_j^{\frac{\sigma-1}{\sigma}} + (1-\beta_j) C_j^{\frac{\sigma-1}{\sigma}}\right]^{\frac{\sigma}{\sigma-1}} \tag{3}$$

where the coefficient β_j represents the relative productivity of *simple* to *complex* tasks and we assume that simple tasks S are relatively more productive in the M sector, i.e. $\beta_M > \beta_V$. The elasticity of substitution between tasks is equal to σ and does not change between the two sectors.

Then:

$$\frac{N_M}{N_V} = \left[\frac{\beta_M S_M^{\frac{\sigma-1}{\sigma}} + (1-\beta_M) C_M^{\frac{\sigma-1}{\sigma}}}{\beta_V S_V^{\frac{\sigma-1}{\sigma}} + (1-\beta_V) C_V^{\frac{\sigma-1}{\sigma}}}\right]^{\frac{\sigma}{\sigma-1}} =$$

$$= \frac{S_M}{S_V}\left[\frac{\beta_M + (1-\beta_M) c_M^{\frac{\sigma-1}{\sigma}}}{\beta_V + (1-\beta_V) c_V^{\frac{\sigma-1}{\sigma}}}\right]^{\frac{\sigma}{\sigma-1}} \tag{4}$$

where $c_j \equiv \frac{C_j}{S_j}$ for $j = M, V$.

Equation (4) shows that the relative quantity of the two specific factors depends on the two ratios c_M and c_V, and on the ratio $\frac{S_M}{S_V}$. Ultimately, also relative output depends on the

[9]It is impossible to give empirical evidence on the provincial relative prices. However, in terms of wages, we provide evidence of the absence of a specific dynamics of relative wages. In Appendix C, Table 12 shows that all year dummies are not statistically significant.

same three ratios.

Roadmap

In this model labor services could *travel* between the two sectors via workers (whose relative *task* supply is defined later) and there exist one single market for complex tasks and one for simple tasks. In other words, the specificity of the factors N_M and N_V depends only on the relative productivity of the two tasks in the two sectors. Hence, the two specific factors N_M and N_V are labor task composites and the equilibrium quantities of each specific labor composite in each sector is determined by the equilibrium values of each labor task from each sector.

As shown below, the relative price of labor services is linked to the relative wage in the two sectors and, ultimately, by the relative price of output. As cleared up below, the relative demand for labor services in each sector depends only on the relative wage. When the relative wage is given (as in our case because we assume given relative output price), then the relative supply of *total* labor services is given, as well as the two relative demands of labor services *from each sector*. Given the relative wage of tasks and given both the functional forms of the task supply and of the M and V demand for tasks, the only variable to be determined is the relative weight of each sector, i.e. the ratio $\frac{S_M}{S_V}$ and ultimately the output ratio. Any exercise of comparative statics will have a direct effect on the relative output ratio.

3.1 The relative wage of tasks

From the CES characteristics, the "wage" of each composite factor is the following:

$$W_j = \left[\beta_j W_S^{1-\sigma} + (1-\beta_j) W_C^{1-\sigma}\right]^{\frac{1}{1-\sigma}}$$

for $j = M, V$. Let us define $\omega \equiv \frac{W_C}{W_S}$. So:

$$\frac{W_M}{W_V} = \left[\frac{\beta_M + (1-\beta_M)\omega^{1-\sigma}}{\beta_V + (1-\beta_V)\omega^{1-\sigma}}\right]^{\frac{1}{1-\sigma}}$$

Let us define $W \equiv \left(\frac{W_M}{W_V}\right)^{\sigma-1}$ and $\widetilde{\omega} \equiv \omega^{\sigma-1}$. Hence:

$$W = \frac{\beta_V \widetilde{\omega} + (1-\beta_V)}{\beta_M \widetilde{\omega} + (1-\beta_M)}$$

and this implies:

$$\widetilde{\omega} = \frac{(1-\beta_M)W - (1-\beta_V)}{\beta_V - W\beta_M} \tag{5}$$

As expected, when the relative price of output is given, then not only the relative "wage" of the two specific composite factors is given, but also the relative "wage" of the two types of labor services that form the composite labor factors.

Moreover, the relative wage $\omega \equiv \frac{W_C}{W_S}$ decreases when W increases, hence when $\frac{p_M}{p_V}$ increases.[10]

3.2 Relative demand for tasks

Workers are assumed to freely move between the two sectors, which implies that labor services are freely-mobile between the two sectors since they *travel* with workers.[11]

It is easy to obtain the *sectorial* relative demand for complex tasks as a function of relative task wages, $\omega \equiv \frac{W_C}{W_S}$:

$$\frac{C_j}{S_j} = \left(\frac{1-\beta_j}{\beta_j}\right)^{\sigma} \omega^{-\sigma} \tag{6}$$

[10] A final observation on the determination of the relative wage ω concerns the condition of economically meaningful value, i.e. for $\omega > 0$. In order for ω to take a positive value, we need a condition on the relative wage of the composite factors, which implies a condition on the relative output price:

$$\frac{\beta_V}{\beta_M} < \left(\frac{W_M}{W_V}\right)^{\sigma-1} < \frac{1-\beta_V}{1-\beta_M}$$

or

$$\frac{\beta_V}{\beta_M} < \left(\frac{p_M}{p_V}\right)^{\frac{\sigma-1}{1-\alpha}} < \frac{1-\beta_V}{1-\beta_M}$$

where, we recall, $\beta_M > \beta_V$

[11] We ought to notice that our estimated model is based on local labor market (using data at the provincial level); so, this latter hypothesis translates into a plausible "free workers mobility within the province".

Since $\beta_M > \beta_V$ for any given relative task wage, the service sector is always complex-task intensive with respect to the manufacturing sector:[12] $\frac{C_V}{S_V} > \frac{C_M}{S_M}$.

The *total* relative demand for complex tasks is then:

$$\left(\frac{C}{S}\right)^d = s_M \left(\frac{C_M}{S_M}\right)^d + (1 - s_M)\left(\frac{C_V}{S_V}\right)^d =$$

$$= \left[\frac{s}{s+1}\left(\frac{1-\beta_M}{\beta_M}\right)^\sigma + \frac{1}{s+1}\left(\frac{1-\beta_V}{\beta_V}\right)^\sigma\right]\omega^{-\sigma} \tag{7}$$

where $s_M = \frac{S_M}{S_M+S_V} = \frac{\frac{S_M}{S_V}}{\frac{S_M}{S_V}+1} = \frac{s}{s+1}$ is the weight of the demand for simple tasks from the M sector and increases when $s = \frac{S_M}{S_V}$ increases.

3.3 Relative supply of tasks

By following Peri and Sparber (2009), let us consider two types of individuals $k = D, F$ respectively for native (D) and for foreign-born (F). Each individual is endowed with 1 unit of labor and has to decide how to optimally allocate it between simple and complex tasks. Being l_k the fraction of labor unit devoted to simple tasks, then $s_k = (l_k)^\delta \chi_k$ is the amount of simple services that individual k can provide – where χ_k is a measure of productivity in simple tasks by k and $0 < \delta < 1$.[13] Hence, the total wage generated is given by $(l_k)^\delta \chi_k W_S$. Similarly, the remaining fraction of labor unit devoted to complex services generates the wage $c_k W_C \equiv (1 - l_k)^\delta \kappa_k W_C$, where κ_k is a measure of the ability in complex services by individual k.

Hence, the total wage of individual k from the allocation of its labor unit is the following:

$$\mathcal{W}_k = (l_k)^\delta \chi_k W_S + (1 - l_k)^\delta \kappa_k W_C = s_k W_S + c_k W_C \tag{8}$$

Let us assume that natives are relatively more productive in complex tasks:[14] $\frac{\kappa_D}{\chi_D} \equiv \pi_D >$

[12] We have absence of *task-intensity reversal.*

[13] As explained in Peri and Sparber (2009), the restriction on the δ parameter captures the decreasing abilities in the tasks and avoid full specialization.

[14] Peri and Sparber (2009) introduce also a parameter that may capture wage discrimination between natives

$\pi_F \equiv \frac{\kappa_F}{\chi_F}$.

Wage maximization determines the optimal allocation of the labor unit and the relative k-individual supply of tasks is the following:

$$\frac{c_k}{s_k} = \left(\frac{W_C}{W_S}\right)^{\frac{\delta}{1-\delta}} (\pi_k)^{\frac{1}{1-\delta}} \tag{9}$$

for $k = F, D$. Not surprisingly, for the same relative wage a native individual D supplies relatively more complex tasks and this is due to the fact that natives are relatively more productive in complex tasks.

We obtain the relative supply of tasks by weighing with the fraction of foreign-born supply of manual services:

$$\frac{C}{S} \equiv \frac{C_F + C_D}{S_F + S_D} \equiv \frac{S_F}{S_F + S_D}\frac{C_F}{S_F} + \left(1 - \frac{S_F}{S_F + S_D}\right)\frac{C_D}{S_D} = \phi(f)\frac{c_F}{s_F} + [1 - \phi(f)]\frac{c_D}{s_D} =$$

$$= \left\{\phi(f)\,(\pi_F)^{\frac{1}{1-\delta}} + [1 - \phi(f)]\,(\pi_D)^{\frac{1}{1-\delta}}\right\}\left(\frac{W_C}{W_S}\right)^{\frac{\delta}{1-\delta}} \tag{10}$$

where $f = \frac{L_F}{L_F + L_D}$ is the fraction of *foreign-born residents*; $0 < \phi(\cdot) < 1$ is monotonically increasing, $\phi(0) = 0$ and $\phi(1) = 1$.

When f increases there is a recomposition effect in favor of simple labor services and for any given relative wage there is a decrease in the relative supply of complex-to-simple tasks; formally $\frac{\partial \frac{C}{S}}{\partial f} < 0$.

and foreign-born, as shown by the literature on wage differentials. However, this parameter is not relevant for the solution of our model and can be omitted. D'Amuri and Peri (2012) reformulate the optimization problem as utility maximization and assume that simple services are disliked relatively more by natives. They model it as a fraction $0 < d_k < 1$ that decreases the positive effect on utility of income that comes from manual services. For sake of simplicity, we omit also these *dislike* terms. They would only increase the number of parameters without any further insight on our proposition.

3.4 Equilibrium

Equilibrium in the markets for tasks is obtained in relative terms by considering the demand and supply of complex-to-simple labor services and the relative wage of complex-to-simple labor services.

As shown in Section 3.2, when the output price ratio is given at p^*, the relative wage of the specific factors is given, as well as the relative wage of labor services $\omega \equiv \frac{W_C}{W_S} = \omega^* = \left[\frac{(1-\beta_M)(p^*)^{\frac{\sigma-1}{1-\alpha}}-(1-\beta_V)}{\beta_V-(p^*)^{\frac{\sigma-1}{1-\alpha}}\beta_M}\right]^{\frac{1}{\sigma-1}}$ — see equations (2) and (5). Therefore, the relative supply $\frac{C}{S}$ from equation (10) is determined:

$$\left(\frac{C}{S}\right)^* = \Xi\left(\underset{-}{f}\,;\underset{+}{\pi_D}\,,\underset{+}{\pi_F}\right)(\omega^*)^{\frac{\delta}{1-\delta}} \tag{11}$$

In equilibrium total relative supply is equal to total relative demand, as given from equation (7):

$$\Xi\left(f;\pi_D,\pi_F\right)(\omega^*)^{\frac{\delta}{1-\delta}} = \left[\frac{s}{s+1}\left(\frac{1-\beta_M}{\beta_M}\right)^\sigma + \frac{1}{s+1}\left(\frac{1-\beta_V}{\beta_V}\right)^\sigma\right](\omega^*)^{-\sigma}$$

where the unknown is the relative weight s, i.e. the relative weight of the M sector:

$$s \equiv \frac{S_M}{S_V} = \frac{c_V(\omega^*) - c(\omega^*;f;\pi_D,\pi_F)}{c(\omega^*;f;\pi_D,\pi_F) - c_M(\omega^*)} \tag{12}$$

where

$$c(\omega^*;f;\pi_D,\pi_F) \equiv \Xi(f;\pi_D,\pi_F)(\omega^*)^{\frac{\delta}{1-\delta}}$$

$$c_j(\omega^*) \equiv \left(\frac{1-\beta_j}{\beta_j}\right)^\sigma (\omega^*)^{-\sigma} \qquad \text{for} j = M, V$$

3.5 Increase in Foreign-Born Residents

Let us consider an increase in the fraction f of foreign-born residents.

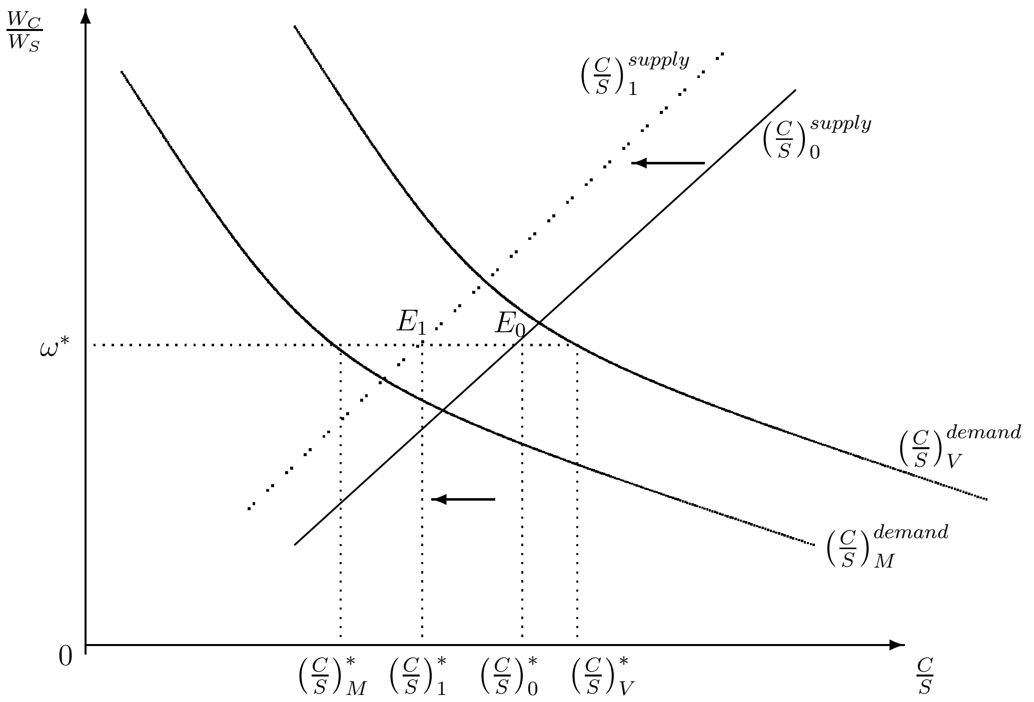


Figure 5: Effect of the increase in f in the complex-to-simple-tasks ratios.

Equation (11) shows that when f rises the *relative* supply of overall complex tasks lowers.

Since the relative wage does not change, then the relative demand must decrease of the same amount.

The two sectorial relative demand for complex-to-simple labor services depends only on the relative wage of tasks that does not change. Hence, the only reduction in total relative demand can occur via a *recomposition* of the total demand that occurs by an increase in the weight to the less complex-task intensive sector, i.e. the M sector.

Formally, it is easy to see in equation (12) that when $c(\omega^*; f, \cdot)$ lowers because there is an increase in f and ω^* does not change – hence, letting constant c_V and c_M – then the s ratio increases. Consequently, the sector-specific composite factors and the output ratio change in favor of the simple-task-intensive sector, i.e. both $\frac{N_M}{N_V}$ and $\frac{Y_M}{Y_V}$ rise when f increases.

Graphically, the increase in f is represented in Figure 5 by an upward shift in the relative supply of tasks. The equilibrium moves from E_0 to E_1 with a contraction in the overall complex-to-simple-tasks ratio from $\left(\frac{C}{S}\right)_0^*$ to $\left(\frac{C}{S}\right)_1^*$. Since the wage ratio remains constant, the

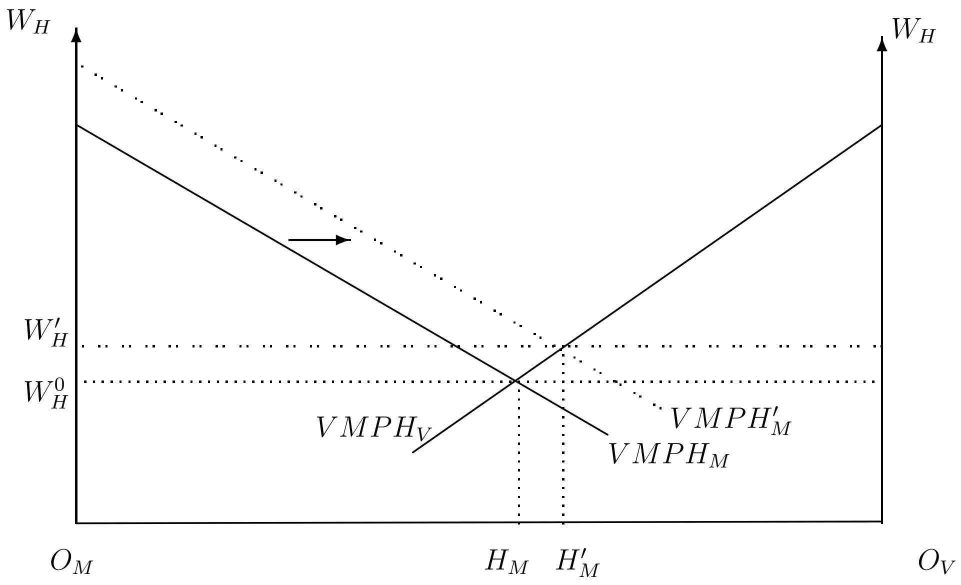


Figure 6: Effect of the increase in the f in the market of the "mobile" factor H.

relative demand for tasks in the two sectors are also constant and equals to $\left(\frac{C}{S}\right)^*_M$ and $\left(\frac{C}{S}\right)^*_V$. The decrease in the overall relative demand for tasks is then possible only by means of a larger weight to the M sector, i.e. the sector with the lower requirement of complex-to-simple-task ratio at the current relative wage.

3.6 Redistribution and Welfare

The inflow of foreign-born residents has an effect also in the market of the (within-area) mobile factor H. In particular, the rise in f induces an increase in the relative demand for the mobile factor H from sector M. As shown in Figure 6, the upward shift from $VMPH_M$ to $VMPH'_M$ implies that employment of the mobile factor in sector M increases – H_M rises. Since the quantity of mobile factor is given, employment of this factor must decrease in the V sector – H_V lowers.

Overall, the inflow of migrants represents an increase in resources that alters the quantities in the specific factors. Given the constant returns to scale technology in both sectors, the mobile factor becomes scarcer and its nominal "wage" increases. In Figure 6 the upward shift in the $VMPH_M$ schedule causes also the rise from W^0_H to W'_H.

Hence, although the hypothesis of constant output relative prices implies a constant ratio in the relative wage for the specific composite factors of the two sectors, the model can still envisage a redistribution effect. Indeed, the mobile factor H becomes scarcer and its remuneration increases not only in nominal and real terms, but also in relative terms with respect to the remuneration of the specific factors.

This is a well-known effect in the traditional specific-factor model. In our framework there is a redistribution effect in favor of the mobile factor, which gains from migration.

When measuring welfare as directly proportional to the wage,[15] it is easy to show that total welfare in the economy increases since the wage of the mobile factor H increases, natives are not affected and the new foreign-born residents are likely to gain a higher wage than at the origin.

3.7 Final Considerations

To conclude, differently from the one-sector model of Peri and Sparber (2009) and D'Amuri and Peri (2012) the adjustment in the model works via a sectorial recomposition in favor of the simple-task-intensive sector and not via an increase in the relative wage of tasks.

However, although we assume that relative prices of manufacturing to services is constant and, as a consequence, also the relative remunerations of tasks, our model encompasses also a redistribution effect which works in favor of the mobile factor.

In the Appendix B we extend the model to multiple nationalities of foreign-born that we also consider in the estimation.

4 Data and Descriptive Statistics

The main objective of this paper is to analyze the impact of migration[16] on the production and the export structure of the Italian economy over the period of more intense and significant

[15]In fact D'Amuri and Peri (2012) consider a very similar optimization problem as utility maximization.

[16]We refer here to migration as measured by stock of foreign-born individuals. No data on pure flows are available in Italy at the disaggregated level; hence, when we address "flows" we are actually using stock variations.

increase in foreign-born presence, 1995-2006.

The analysis is conducted at the level of *Province*, i.e. NUTS3.[17]

We deem *Province* as the finest geographical entity to investigate the migration effects and this choice is justified by two main reasons. First, detailed data on residence permits, including origin countries, are not available at a finer level than the *Province*. Second, the fact of being well-confined areas allows us to avoid the size effect of the Modifiable Area Unit Problem (see Briant et al. (2010) on the issue).[18]

Regarding migration, we use data on residence permits (see the Figure 1 above) in 1995-2006.[19] Detailed measures of residence permits can go back to 1992, but we use 1995 as the starting date since previous years were not reliable and less representative of the migration phenomenon due to low numbers, especially when considering data at the provincial level. Due to the EU Eastern enlargement in 2004-2007, the requirement for residence and work permits has been levied for some relevant nationalities (like migrants from Romania and Poland) and they are aggregated to all the other EU non-Italian citizens as of 2007-2008. So, we considered 2006 as the ending year of our study.

In Section 2 we have already underlined the two main characteristics of the Italian immigration: rapidity and cultural diversity.

Data on the local production and export structures are publicly available on a yearly base from the ISTAT. In details, production data are aggregated value added for six macro-sectors: agriculture, construction, manufactures, retail and professional services – i.e. logistics, ICT etc. – financial services, household services. While our series of manufactures coincides with the aggregate originally reported by ISTAT to which we add constructions,[20] our definition

[17]The number of *Province* increases over the sample period due to the creation of new provinces. We use data that consistently refer to the initial 1995 distribution with 103 entities. We recall that the 103 Italian provinces have an average size of km^2 2,800 with a coefficient of variation at 0.17. They are 57 times tinier than American states and more than 200 times smaller than the Canadian provinces. They are also smaller and more regular in size with respect to French metropolitan *départements* and Spanish provinces.

[18]This same geographical entity is used in Bratti et al. (2012) for an analysis of the pro-trade effect of migration and in Jayet et al. (2010) to study the network effect on Italian migration.

[19]They slightly differ from the data on population registers since minors are not counted separately and are included in the residence permits of their custodians. Data on residence permits are released by ISTAT (Italian National Institute of Statistics), but they refer to data from the Ministry of the Interior through their local offices (*Questure*).

[20]From Figure 3 we notice that the construction sector is important because the employment share of

of *services* includes retail and professional services, financial services, but excludes household services in order to consider a subset that could plausibly be considered as *complex-task intensive*.

Export data are till obtained from ISTAT and are flows which are obtained by using the Italian version of NACE rev2.

Our dataset for production covers the period from 1995 to 2006, while sectoral export series starts from 1997. In Table 1 we report some general characteristics of the provinces, including some general infrastructure indexes that may be important to control for the local economic environment.

Table 1: Summary Statistics

variable	mean	sd	min	p25	p50	p75	max
VA_{man}/VA_{serv}	0.49	0.23	0.10	0.29	0.48	0.63	1.24
Migrants (per 1000 inhab.)	23.79	17.63	0.30	10.17	18.43	34.06	98.10
Density (per sq-km)	243.47	329.01	22.99	103.68	172.08	258.14	2639.63
Graduate (per 1000 inhab.)	2.35	3.37	0.00	0.00	0.70	3.79	22.01
Airports (runaway km)	29.28	76.33	0.00	0.00	0.00	29.94	637.33
Highways (km)	24.99	20.82	0.00	10.06	23.00	34.37	94.09

Note: $Serv/Manuf$ represents the service sector value added over manufactures, $Migrants$ reports the number of foreign born residents over the overall population (1000 inhabitants); *Density* is the number of residents by squared km, *Graduates* is the number of college graduates over the population; *Airports* and $Highways$ are measured as the runaway/road extension per squared km. All the variables are referred to the province level.

5 Econometric Strategy

We estimate the causal impact of an inflows of migrants in province i at time t – measured by a change in the ratio of the foreign presence to the total province population – on the relative value added of manufacturing over services.

Many other studies have used regional data within the same country in order to evaluate the effect of migration on wages.[21] Concerns about the use of regional data have been raised

foreign-born is particularly relevant, although the total weight in GDP is lower than 10 percent. Estimation results not including the construction sector are similar to the ones presented below and are available from the authors upon request.

[21]See, for instance, Glitz (2012) for Germany and González and Ortega (2011) for Spain.

following the remark by Borjas et al. (1996) that regional variability of wages within the same country could be too low since there may be a lot of co-variation due to nation-wide effects.

This concern is less important in our case where the production structure can vary among the regions of the same country. Moreover, a possible (but very unlikely) nation-wide effect may work against our possible findings.

According to our model, an inflow of migrants generates an overall positive effect on the relative value added of manufacturing. A variation in the migrants-to-natives population ratio is assumed as a reliable indicator for the changes in the composition of relative tasks supply. This effect should be more intense when the new migrants are more *diverse* from natives in terms of relative productivity and hence the workers' distribution in terms of relative task productivity with respect to natives is more severely spread. Therefore, we want to investigate not only the overall effect of migrants' inflows, but also the separate effect of *different types* of migrants arriving in the Italian provinces – i.e. a change in the relative task supply referred not only to Equation (10), but also to Equation (16) as reported in Appendix B.

We use the logarithm of migrants-to-native population ratio in province i at time t, $Migr/Pop_{it}$, as our covariate of interest and specify the general econometric model as follows:

$$(VA_{man}/VA_{serv})_{it} = \beta_0 + \beta_1 Migr/Pop_{it} +$$

$$+ \textit{other covariates} + \textit{fixed and time effects} + \epsilon_{it} \tag{13}$$

Our dependent variable of interest $(VA_{man}/VA_{serv})_{it}$ is the ratio of the value added in manufacturing to the value added in service sectors in province i and time t.

Among the fixed effects and some of the covariates we must include variables taking into account that some provinces may show natural or historical advantages that may affect the relative value added by raising time invariant unobserved heterogeneity (Combes et al., 2011).

The time effect represents time-specific factors that can influence the provincial value-added distribution, i.e. macroeconomic cycles, national political elections, national labor market reforms etc.

In order to estimate β_1 consistently, we need to address several econometric issues.

First, relative valued added is a structural variable and is very persistent over time – i.e. $E(\epsilon_{it} \mid \epsilon_{it-1})$ is considerably different from zero (Bond, 2002). Estimation of a static model may not be suitable (Cassette et al., 2012), instead a dynamic specification of our reduced form is more appropriate:

$$(VA_{man}/VA_{serv})_{it} = \beta_0 + \rho(VA_{man}/VA_{serv})_{it-1} + \beta_1 Migr/Pop_{it} +$$

$$+ \boldsymbol{X}'_{it}\boldsymbol{\beta}_k + \eta_i + \nu_t + \epsilon_{it} \tag{14}$$

where $\boldsymbol{X}'_{it}$ is the vector of the other control variables, η_i is a provincial fixed effect controlling for unobserved time-invariant heterogeneity and ν_t is a time-specific fixed effect.

Second, as usually reported in the economic literature on migration, the covariate representing migrants' presence and location may not be orthogonal to innovations in the relative value added and there is simultaneous equation bias. Many reasons have been proposed. Among those, migrants' location choices are not random; the drivers for these choices – e.g. network effects, economic magnet effects, etc. – vary over time and we need some kind of instrument to exploit the variation from these effects to relative value added.

Given the model in (14), it seems reasonable to employ a System-GMM estimator *à la* Blundel and Bond in order to consistently estimate β_1 overcoming also the problem of simultaneous equation bias. Such estimator provides several advantages.

First, it allows discussions over the identifying assumptions and a number of useful tests for exogeneity; moreover, it is quite robust to different hypotheses on the functional form.

Second, endogeneity issues can be addressed by using the same method and including a set of instruments Z_{it}. In particular, Z_{it} includes two-year lags of the potentially endogenous covariates, namely the lagged dependent variable and the migrants-to-native population ratio.

The vector $\boldsymbol{X}_{it}$ contains a full set of controls for each province i at time t, namely the level of migrants (as a measure of time-varying attractiveness of the province by migrants),[22] the degree of urbanization (as residents per squared kilometer), the average education level of the population in the province (as the number of college graduates over the total population) and two measures on the quality of the province infrastructure (specifically the presence of airports and/or highways).

Over the period 1995-2006 there were three major amnesties which had a considerable impact on the migrant distribution. However, as typical for any such regularization, the actual presence of migrants dates to some periods back before they appear in the official statistics. Hence, when including the incidence of illegal migration, the profile of the time series would become smoother, but the trend would not change. In order to control for that policy change we have included, in Z_{it}, an *amnesty* dummy variable – which takes the value of one when the policy was implemented, i.e. in 1996, 1998 and 2002 – interacted with the growth rate in residence permits of the province i.

Finally, as an additional exercise to check for robustness of our results, we have also tested the theoretical model for the export structure. Intuitively, if a change of labor force composition in terms of heterogeneous individuals affects the relative supply of tasks in favor of simple tasks and, as a consequence, the production structure has changed, then we expect a similar outcome also on export composition.

A consolidated branch of the empirical literature has highlighted the positive effect of migrants on bilateral trade – see for instance Rauch (2001) and Rauch and Trindade (2002).

While the aforementioned channels have been deeply scrutinized, less attention has been paid to the sectoral export composition.

In this latter estimation model we define a new dependent variable as the ratio of low- to high-tech exports at a province level, being this ratio positively influenced by the relative simple tasks and hence positively related to the migrants' weight in the province population:

[22] In defining GMM structure we consider as potentially endogenous such variable, but in this case we restrict the set of instruments only to the equation in levels.

$$(EXP_{low-tech}/EXP_{high-tech})_{it} = \beta_0 + \rho(EXP_{low-tech}/EXP_{high-tech})_{it-1} + \beta_1 Migr/Pop_{it} +$$

$$+ \boldsymbol{X}'_{it}\boldsymbol{\beta}_k + \eta_i + \nu_t + \epsilon_{it} \qquad (15)$$

6 Estimation Results

In Table 2 we report the results for the dynamic specification (14). Along with our main covariate of interest, *Migr/Pop*, the estimated equation contains controls for the degree of urbanization, education composition and infrastructure endowment of each province i at time t along with a control for the overall level of migrants in the province.

In column (1) of Table 2, according to the theoretical model, the fraction f is measured with the ratio of the overall number of foreign born residents in the province to the total provincial population, i.e. *Migr/Pop* in the Table. The estimated coefficient is statistically significant and positive, as predicted in Section 3.

This does not imply that the other sector is somehow penalized in the level. Indeed, in the regression we have also included the *level* of migrants in the province, i.e. the variable *Migr* (still in log), and the estimated coefficient is negative and marginally significant, hence indicating that the increase in migrants by itself does not lower the relative value added of services. Our interpretation of this result is that, when considering the total number of migrants, its increase has a positive effect also on household services, which are excluded in our definition of "services", but that may benefit natives who are relatively more productive in high-value-added services. Hence, when including the *level* of migrants, and not simply their ratio to the total population, we have an indirect positive effect on high-value-added services.[23]

[23] Estimation without this covariate gives similar, but smaller estimated coefficients for the incidence of migrants over the total population. The result is still significant, but we need to enlarge the matrix of instruments.

Table 2: Baseline Regression and Migrants Grouped according to GDP per capita of their country of origin – dependent variable: $\ln(VA_{man}/VA_{serv})$

VARIABLES				
	(1)	(2)	(3)	(4)
$\ln(VA_{man}/VA_{serv})_{t-1}$	0.943***	0.956***	0.940***	0.975***
	(0.031)	(0.034)	(0.029)	(0.037)
ln *Migr/Pop*	0.043**			
	(0.019)			
ln *Migr/Pop (low GDPpc)*		0.023*		
		(0.013)		
ln *Migr/Pop (medium GDPpc)*			0.032**	
			(0.016)	
ln *Migr/Pop (high GDPpc)*				-0.013
				(0.010)
ln *Migr*	-0.034**	-0.018*	-0.015	-0.002
	(0.014)	(0.011)	(0.011)	(0.013)
Density	0.015*	0.009	0.005	0.000
	(0.008)	(0.007)	(0.006)	(0.008)
Graduate	2.060	1.167	0.857	1.093
	(1.348)	(0.994)	(0.947)	(1.078)
Highways	-0.002	-0.001	-0.003	0.003
	(0.004)	(0.003)	(0.004)	(0.002)
Airports	-0.002	-0.001	-0.003	-0.001
	(0.003)	(0.003)	(0.003)	(0.003)
Constant	0.377***	0.225**	0.241*	-0.071
	(0.140)	(0.103)	(0.124)	(0.124)
Observations	1,133	1,133	1,133	1,133
Number of ID	103	103	103	103
AR(1) p-value	0	0	0	0
AR(2) p-value	0.514	0.514	0.578	0.529
Hansen p-value	0.147	0.174	0.178	0.134
Kleibergen-Paap (LM)	279.512	246.817	239.148	234.913
Instruments	65	65	65	65

Robust SE in parentheses: $*\quad p < 0.1$, $**\quad p < 0.05$, $***\quad p < 0.01$. All regressions contain time dummies. In all the regressions the estimated model employs two-year lag on (VA_{man}/VA_{serv}), and ln *Migr/Pop* as instruments (for the latter only the level is included); while for ln *Migr* the set of internal instruments spans from 2 to 4 lags. *PolicyDummy* is included in the set of exogenous instruments as well.

The robustness of our regression is evaluated with the classic tests after IV estimations. The Hansen-J test ensures that the instruments are not correlated with the residuals for all our estimations. To check for weak identification we include the Kleimbergen-Paap rank F-test for our instrumental variable estimations. Given the dynamic specification we need to employ an Arellano-Bond test, to prove that the residuals of the first-difference equations are not second-order correlated. An accurate choice of the instrument solves the problem of instrument proliferation (Roodman, 2009) and the number of instruments that we have used does not weaken the Hansen test statistic.

We have assumed that the economic structure is slowly changing and therefore empirically a dynamic model with the lagged dependent variable is the most appropriate. Our estimates show that the first-order autoregression coefficient is very close to unity. Hence, we decided to check for the presence of a unit root.

When using the Im-Peasaran-Shin test the unit root could be excluded.[24]

6.1 The Effect of Differentiated Migration

In order to check whether the composition of migration at the province level plays a role in affecting the local production, we disaggregate foreign-born residents in province i and time t into three classes according to the characteristics of their origin countries.

We have noticed that Italian immigration is characterized by a multitude of migrants in terms of their countries of origin (189 nationalities in our sample period) and we deem as interesting to exploit this additional variability of our sample. In particular, we assume that some characteristics of the countries of origin may approximate migrants' characteristics in terms of relative productivity when performing simple rather than complex tasks.

The theoretical model has shown that: the more similar the foreign-born residents to natives in terms of relative productivity while performing simple-to-complex tasks, the smaller the impact of a change in f to the local production structure. However, we do not observe

[24] Moreover, since the number of instrument is relatively high with respect to the number of provinces we also test if the GMM estimator suffers from finite sample problems. All the results are reported in Appendix C.

task productivity of each worker; so, a possible rough proxy can be represented by the level of development of the origin country, as approximated by GDP per capita.

We are aware that GDP per capita is a very rough proxy. Hence, we use it simply to rank the origin countries and create three classes of migrants with low, medium and high complex-to-simple-task productivity depending on their origin. By assuming that natives have a high relative productivity, the largest effect on the relative value added of manufacturing is expected when considering the migrants coming from countries with low per-capita GDP.

Indeed, the positive effect of migrants on the relative value added of manufacturing is magnified when we consider the composition by nationality of the foreign-born residents. In columns (2) to (4) of Table 2 we present the results associated with the percentages of the three different classes of migrants. More precisely, in *Migr/Pop (low GDPpc)* we consider only the migrants from the low-income countries, in *Migr/Pop (medium GDPpc)* only those from middle-income origins, and in *Migr/Pop (high GDPpc)* those from high-income countries. As predicted by the theoretical model and proposed in Equation (17), the response of the local production structure in favor of manufacturing to a change in the migrants' composition is higher, the more different is the relative task productivity between natives and migrants when imputed by differences in GDP per capita.

When looking at the magnitude of the point estimates, the a priori of the model is confirmed since the effect of an increase in the stock of migrants coming from low-income countries – hence, migrants assumed to have the highest *relative* productivity in simple-to-complex tasks with respect to natives – is stronger with respect to the effect of an increase in the other two classes of migrants – assumed to be characterized by medium and low productivity in relative simple tasks and which are the excluded groups in column (2). The point estimates associated with our variable of interest is 0.043 in this case. Instead, when we refer only to foreign-born residents from the high-income origin countries – see column (4) – the effect is no longer statistically different from zero, meaning that for such kind of migrants the effect on relative value added is not different from the excluded groups (coming from medium- and low-income countries).[25] [26]

Furthermore, we employ a different classification of foreign-born residents according to their imputed schooling attainment. In particular, we use the information obtained by Docquier et al. (2008), who classify foreign-born residents in OECD countries by nationality and schooling attainment.[27] For each province i we consider the share of *low-educated* foreign workers aggregating the stock of migrants according to the source country share of primary school attainment.[28] Figure 7 shows that, as expected, the two variables – GDP per capita and education attainment of the origin country of the migrants in Italy – are highly correlated.

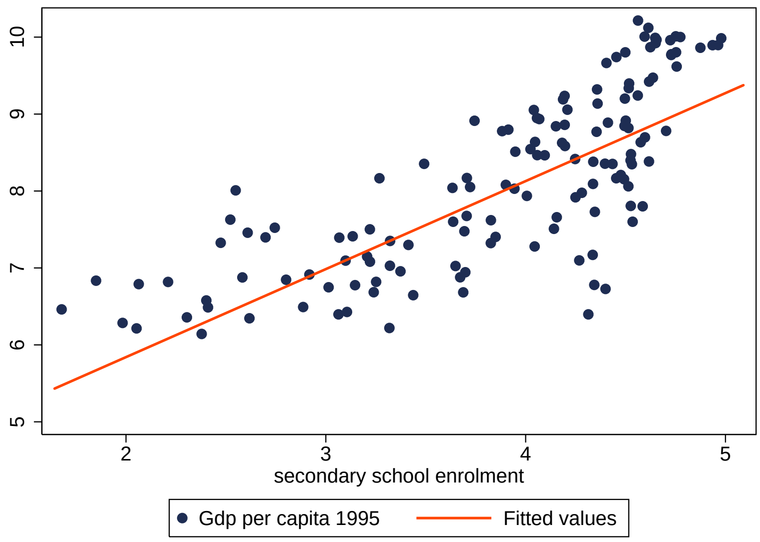


Figure 7: Correlation between per-capita GDP and level of schooling. (Source:)

[25]We consider each group in a separated regression with the aim of being more parsimonious and to avoid that the number of instruments raises too much. Such a concern is motivated by the structure of our panel, which reports only 103 different individuals – Italian Provinces, given the fact that the number of elements in the estimated variance matrix is quadratic in the instrument count (as in T), a relatively finite sample, as ours, may lack adequate information to estimate large matrix.

[26]Given our identification strategy, which considers each group in a separated regression, the coefficient associated with the regression in column (3) is not informative since it relies on the exclusion of the tails of our distribution, which are likely to compensate with each other and with reverse effects on the value-added ratio.

[27]Specifically, the stock (and rates) of migration inflows for each OECD country are provided by the level of schooling and gender for 195 source countries in 1990 and 2000.

[28]In such a way we do not exclude any nationality in building our education-specific variable, but we consider only the fraction of residents with a specific school attainment. Of course in doing so we implicitly assume that, by nationality, the distribution of migrants along the education attainment does not change province by province, but it is uniform over Italy, similarly to the previous case when we considered nationalities by the GDP per-capita.

Table 3 reports the estimates of education-specific regressions using the Docquier et al. (2008) classification. As we can see from column (1), the coefficient associated with foreign workers with only primary education *Migr/Pop (Primary Ed)* – hence, migrants assumed to have the highest *relative* productivity in simple tasks – is highest on the relative manufacturing value added with respect to the excluded group (secondary and tertiary education); instead, in column (3) the one associated to the tertiary-educated migrants *Migr/Pop (Tertiary Ed)* is similar in magnitude but only marginally different from zero.

Table 3: Regressions with Migrants Grouped according to Education Attainment of their Country of Origin – Dependent Variable: $\ln(VA_{man}/VA_{serv})$

VARIABLES	(1)	(2)	(3)
$\ln(VA_{man}/VA_{serv})_{t-1}$	0.951***	0.929***	0.966***
	(0.028)	(0.038)	(0.034)
ln *Migr/Pop (Primary Ed)*	0.032**		
	(0.015)		
ln *Migr/Pop (Secondary Ed)*		0.055**	
		(0.024)	
ln *Migr/Pop (Tertiary Ed)*			0.038*
			(0.021)
ln *Migr*	-0.022**	-0.047***	-0.040**
	(0.010)	(0.018)	(0.016)
Density	0.009	0.022**	0.018**
	(0.007)	(0.011)	(0.008)
Graduates	1.583	2.232	2.429
	(1.103)	(1.553)	(1.612)
Highways	-0.002	-0.003	0.001
	(0.004)	(0.005)	(0.004)
Airports	-0.002	-0.002	-0.000
	(0.003)	(0.003)	(0.003)
Constant	0.286***	0.558***	0.479**
	(0.109)	(0.205)	(0.210)
Observations	1,133	1,133	1,133
Number of ID	103	103	103
AR(1) p-value	0	0	0
AR(2) p-value	0.565	0.501	0.449
Hansen p-value	0.114	0.160	0.191
Kleibergen-Paap (LM)	282.047	272.693	252.677
Instruments 65	65	65	

Robust SE in parentheses: $*\quad p < 0.1$, $**\quad p < 0.05$, $***\quad p < 0.01$. All regressions contain time dummies. In all the regressions the estimated model employs two-year lag on (VA_{man}/VA_{serv}), and ln *Migr/Pop* as instruments (for the latter only the level is included); while for ln *Migr* the set of internal instruments spans from 2 to 4 lags. *PolicyDummy* is included in the set of exogenous instruments as well.

The different estimates of the sub-groups between Table 2 and Table 3 may trigger two possible interpretations.

First, column (3) of Table 3 shows a positive impact of tertiary educated migrants on manufacturing rather than on services. A similar increase in tertiary-educated natives would very likely induce an increase in relative valued added of services rather than that of manufacturing. This may indicate some form of under-employment or *brain waste* of the migrants, which is well-known in the literature.

Second, the coefficient of the group with highest education attainment is small but significantly different from zero (0.038 in column 3 of Table 3), whereas the same coefficient is not significant when the same *best* group of migrants is obtained by using the highest 33% GDP per capita (-0.013 in column 3 of Table 2). This latter result is more in line with our model.

Hence, when believing in our model, migrants are employed in different tasks according to their relative productivities; since they are not directly observable, employment is decided with the signal provided by their countries of origin. When firms have to assign migrants to complex tasks and use the country of origin of the migrants as an identification of their characteristics, then it is the level of wealth of the country of origin, proxied by GDP per capita, that seems to count the most, rather than the country's level of school attainment.

For instance, an inflow of migrants from the Philippines – a country with a low GDP per capita, but with a relatively high school attainment – does not increase the relative value added in services because the Philippines are considered a low-income country and migrants from there are not considered capable and productive in complex tasks. Instead, they are assigned to simple tasks by increasing relative value added in manufacturing according to the results in Table 3.

Our general results are confirmed also when we consider the ratio between low to high technology exports as the dependent variable[29] – see Table 4. In this case the magnitude of the effect is much stronger when we consider only those workers which are more likely to provide simpler tasks with respect to natives, as in column (2) of Table 4.

[29] As relatively higher technology export industries we consider chemicals and rubber, pharmaceutical products, computers and electronic devices.

Table 4: Export Regression with Migrants Grouped according to GDP per capita of their country of origin – Dependent Variable: $\ln(EXP_{low}/EXP_{high})_t$

VARIABLES	(1)	(2)	(3)	(4)
$\ln(EXP_{low}/EXP_{high})_{t-1}$	0.915***	0.893***	0.918***	0.881***
	(0.032)	(0.036)	(0.028)	(0.040)
ln *Migr/Pop*	0.168*			
	(0.088)			
ln *Migr/Pop (low GDPpc)*		0.153**		
		(0.068)		
ln *Migr/Pop (medium GDPpc)*			0.039	
			(0.113)	
ln *Migr/Pop (high GDPpc)*				0.073
				(0.058)
ln *Migr*	-0.180	-0.241**	-0.053	-0.146**
	(0.115)	(0.113)	(0.122)	(0.072)
Density	0.091	0.128**	0.027	0.067
	(0.063)	(0.065)	(0.068)	(0.042)
Graduates	6.751	6.332	3.663	3.294
	(4.844)	(5.715)	(6.606)	(3.973)
Highways	0.013	0.028	0.006	0.015
	(0.015)	(0.021)	(0.012)	(0.017)
Airports	0.011	0.013	-0.000	0.013
	(0.013)	(0.017)	(0.012)	(0.010)
Constant	1.889*	2.405**	0.614	1.570**
	(1.040)	(1.036)	(1.236)	(0.794)
Observations	927	927	927	927
Number of ID	103	103	103	103
AR(1) p-value	0.0163	0.0158	0.0163	0.0157
AR(2) p-value	0.215	0.209	0.217	0.212
Hansen p-value	0.339	0.180	0.176	0.850
Kleibergen-Paap (LM)	264.41	212.088	223.339	162.462
Instruments	67	67	67	67

Robust SE in parentheses: $*\ \ p < 0.1$, $**\ \ p < 0.05$, $***\ \ p < 0.01$. All regressions contain time dummies. In all the regressions the estimated model employs two-year lag on (EXP_{low}/EXP_{high}), and ln *Migr/Pop* as instruments (for the latter only the level is included); while for ln *Migr* the set of internal instruments spans from 2 to 4 lags. *PolicyDummy* is included in the set of exogenous instruments as well.

Similar results hold when we classify foreign-born residents according to the level of schooling, as in Table 5. In column (1) we report the point estimates for the migrants with the primary level of education with respect to all the other foreign born. Again the impact is very strong, while the same coefficient considering only the highly-educated fraction of migrants is not statistically significant.

Table 5: Export Regression with Migrants Grouped according to Education Attainment of their Country of Origin – Dependent Variable: $\ln(EXP_{low}/EXP_{high})_t$

VARIABLES	(1)	(2)	(3)
$\ln(EXP_{low}/EXP_{high})_{t-1}$	0.916***	0.912***	0.917***
	(0.031)	(0.034)	(0.030)
ln *Migr/Pop (Primary Ed)*	0.172**		
	(0.077)		
ln *Migr/Pop (Secondary Ed)*		0.156*	
		(0.088)	
ln *Migr/Pop (Tertiary Ed)*			0.099
			(0.104)
ln *Migr*	-0.182*	-0.179	-0.140
	(0.094)	(0.121)	(0.149)
Density	0.088*	0.095	0.070
	(0.052)	(0.067)	(0.074)
Graduate	8.301*	6.013	3.845
	(4.915)	(4.670)	(4.717)
Highways	0.013	0.010	0.012
	(0.014)	(0.015)	(0.016)
Airports	0.009	0.012	0.009
	(0.011)	(0.015)	(0.015)
Constant	2.038**	2.000*	1.578
	(0.913)	(1.161)	(1.524)
Observations	927	927	927
Number of ID	103	103	103
AR(1) p-value	0.0160	0.0166	0.0160
AR(2) p-value	0.214	0.215	0.215
Hansen p-value	0.372	0.380	0.482
Kleibergen-Paap (LM)	264.825	260.510	218.213
Instruments	67	67	67

Robust SE in parentheses: $*\ p < 0.1$, $**\ p < 0.05$, $***\ p < 0.01$. All regressions contain time dummies. In all the regressions the estimated model employs two-year lag on (EXP_{low}/EXP_{high}), and ln *Migr/Pop* as instruments (for the latter only the level is included); while for ln *Migr* the set of internal instruments spans from 2 to 4 lags. *PolicyDummy* is included in the set of exogenous instruments as well.

7 Concluding remarks

We have proposed a simple two-sector model with a common input (i.e. the mobile factor) and sector-specific inputs which are bundles of productive tasks. Tasks are supplied by heterogeneous workers – natives and foreign-born residents – who differ in terms of relative task productivity (besides an additional cost in doing simple tasks).

A reduced form can be obtained relating the relative output of the two sectors and the relative abundance of the two types of residents when assuming constant relative output prices. This relationship resembles the traditional Rybczynski equation.

The model is tested for Italy, i.e. a peculiar case where immigration has been rapid and very diverse. More exactly, we used the 103 Italian provinces in the period 1995-2006 and evaluated the impact of the increase in the foreign-born presence on the relative value added of manufactures to services. By assuming that foreign-born residents had a comparative advantage in simple tasks and that manufactures are intensive in simple rather than complex tasks, we should observe a significant effect on the average provincial production structure in favor of manufacturing where immigration has been more intense.

Moreover, foreign-born residents are not all the same and we may find heterogeneity also among them. Italy is a very interesting case since its immigration has been highly diverse in terms of nationalities (189 nationalities). We split the foreign-born residents in different subgroups according the the level of GDP per capita and according to the education attainment of the different nationalities that arrived in Italy.

Our model is empirically confirmed since migrants coming from countries with lower GDP per capita or characterized by nationalities with lowest education attainment show a significantly higher effect on manufactures – i.e. the simple-task-intensive sector – rather than the other foreign-born residents.

Quantitatively, our estimates show that *ceteris paribus* when doubling the presence of migrants over the total population induces a significant, although small, switch towards manufactures – equivalent to 4.3% relative increase in manufactures with respect to services. Same result is obtained when considering migrants from countries with lowest GDP per capita or simply primary-educated migrants – when the assignment is done according to the distribution of education by nationality. Instead, a statistically insignificant effect is found for migrants coming from countries with high GDP per capita (according to their nationality).

The results are confirmed also on exports by distinguishing high-tech (i.e. complex-task intensive) and low-tech (i.e. simple-task intensive) exports. In this case the effect is much stronger: doubling the incidence of foreign-born residents in the total population of the province increases on average low-tech export relative value added by 16.8%; the increase is 15.3% when considering only migrants from countries with low GDP per capita and 17.2% when considering primary-educated migrants.

References

Accetturo, A., Bugamelli, M., and Lamorgese, A. (2012). Welcome to the machine: firms' reaction to low-skilled immigration. Temi di discussione (Economic working papers) 846, Bank of Italy, Economic Research and International Relations Area.

Bettin, G., Turco, A. L., and Maggioni, D. (2012). A firm-level perspective on migration. Development Working Papers 328, Centro Studi Luca d'Agliano, University of Milano.

Bond, S. (2002). Dynamic panel data models: a guide to microdata methods and practice. Cemmap working papers, Centre for Microdata Methods and Practice, Institute for Fiscal Studies.

Borjas, G. J. (2003). The labor demand curve is downward sloping: Reexamining the impact of immigration on the labor market. *The Quarterly Journal of Economics*, 118(4):1335–1374.

Borjas, G. J., Freeman, R. B., and Katz, L. (1996). Searching for the effect of immigration on the labor market. *American Economic Review*, 86(2):246–51.

Borjas, G. J. and Katz, L. F. (2007). *The Evolution of the Mexican-Born Workforce in the United States*, pages 13–56. University of Chicago Press.

Bratti, M., De Benedictis, L., and Santoni, G. (2012). On the pro-trade effects of immigrants. IZA Discussion Papers 6628, Institute for the Study of Labor (IZA).

Briant, A., Combes, P.-P., and Lafourcade, M. (2010). Dots to boxes: Do the size and shape of spatial units jeopardize economic geography estimations? *Journal of Urban Economics*, 67:287–302.

Card, D. (2007). How Immigration Affects U.S. Cities. *CReAM Discussion Paper*, (11).

Card, D. and Lewis, E. G. (2007). The diffusion of mexican immigrants during the 1990s: Explanations and impacts. In *Mexican Immigration to the United States*, NBER Chapters, pages 193–228. National Bureau of Economic Research, Inc.

Cassette, A., Di Porto, E., and Foremny, D. (2012). Strategic fiscal interaction across borders: Evidence from french and german local governments along the rhine valley. *Journal of Urban Economics*, 72(1):17–30.

Combes, P.-P., Duranton, G., and Gobillon, L. (2011). The identification of agglomeration economies. *Journal of Economic Geography*, 11(2).

D'Amuri, F. and Peri, G. (2011). Immigration, jobs and employment protection: Evidence from europe. NBER Working Papers 17139, National Bureau of Economic Research, Inc.

D'Amuri, F. and Peri, G. (2012). Immigration, jobs and employment protection: evidence from europe before and during the great recession. Temi di discussione (Economic working papers) 886, Bank of Italy, Economic Research and International Relations Area.

Docquier, F., Lowell, B. L., and Marfouk, A. (2008). A gendered assessment of the brain drain. Policy Research Working Paper Series 4613, The World Bank.

Feenstra, R. (2004). *Advanced International Trade: Theory and Evidence*. Princeton University Press.

Gandal, N., Hanson, G. H., and Slaughter, M. J. (2004). Technology, trade, and adjustment to immigration in israel. *European Economic Review*, 48(2):403–428.

Glitz, A. (2012). The labor market impact of immigration: A quasi-experiment exploiting immigrant location rules in germany. *Journal of Labor Economics*, 30(1):pp. 175–213.

González, L. and Ortega, F. (2011). How do very open economies adjust to large immigration flows? evidence from spanish regions. *Labour Economics*, 18(1):57–70.

Grossman, G. M. and Rossi-Hansberg, E. (2008). Trading tasks: A simple theory of offshoring. *American Economic Review*, 98(5):1978–97.

Hanson, G. H. and Slaughter, M. J. (2002). Labor-market adjustment in open economies: Evidence from us states. *Journal of International Economics*, 57(1):3–29.

Jayet, H., Ukrayinchuck, N., and DeArcangelis, G. (2010). The location of immigrants in italy : Disentangling networks and local effects. *Annales d'Economie et de Statistique*, (97-98):329–350.

Jones, R. W. (1971). A three factor model in theory, trade and history. In J. Bhagwati, R. Jones, R. M. and Vanek, J., editors, *Trade, Balance of Payments and Growth*. Amsterdam – North Holland.

Lewis, E. (2011). Immigration, skill mix, and capital skill complementarity. *The Quarterly Journal of Economics*, 126(2):1029–1069.

Okkerse, L. (2008). How to measure labour market effects of immigration: A review. *Journal of Economic Surveys*, 22(1):1–30.

Ottaviano, G. I. P. and Peri, G. (2012). Rethinking the effect of immigration on wages. *Journal of the European Economic Association*, 10(1):152–197.

Peri, G. and Sparber, C. (2009). Task specialization, immigration, and wages. *American Economic Journal: Applied Economics*, 1(3):135–69.

Rauch, J. E. (2001). Business and Social Networks in International Trade. *Journal of Economic Literature*, 39(4):1177–1203.

Rauch, J. E. and Trindade, V. (2002). Ethnic chinese networks in international trade. *The Review of Economics and Statistics*, 84(1):116–130.

Roodman, D. (2009). How to do xtabond2: An introduction to difference and system gmm in stata. *Stata Journal*, 9(1):86–136.

A Computation of Sectors' Task Complexity

The construction of Figure 4 is based on the Tables below.

Table 6 is based on Table A3 in D'Amuri and Peri (2012) where the authors proposed a grouping of tasks for occupations. Besides the column rank, the *score* represents the percentile of workers performing less intensively that task. For instance, the first number 80 for Corporate Manager regarding Mental Tasks means that 80 percent of all workers is performing manual tasks less intensively than Corporate Managers.

In the last two columns we aggregate simple and non-simple/complex tasks by taking simple averages of the tasks in each group. Moreover, we compute simple averages for the 8 main groups of occupations (*Corporate Mangers*, *Intellectual Occupations*, *Technical Occupations*, *Operative Occupations*, *Occupations Relative to Sales and Services*, *Specialized Workers*, *Conductors of Plants and Machinery Operators* and *Unskilled Workers*).

For these 8 main groups we have data on the number of employees for each sector, as reported in Table 7. In order to obtain the aggregate score for each of the two sectors and the total economy, we weighted each one of the 8 occupation scores of Table 6 by the percentage of each type of occupation in the sector. For instance, *Intellectual Professions* with a score 70 for complex tasks have been included in the total computation of complex tasks with a weight equal to about 3 percent for Industry and 13.9 percent for Services, being 3 and 13.9 the percentages of workers reported doing *Intellectual Professions* respectively in Industry and Services.

Besides all the possible measurement errors that occur with the simple averaging, we ought to remind all the caution that were also reported in D'Amuri and Peri (2012). First of all, the scores (as percentiles) are all referred to the US labor market for the year 2000.

Table 6: Regrouping Skill Contents of Occupations

	SIMPLE TASKS				COMPLEX/MENTAL TASKS						AGGREGATED TASKS	
	MANUAL		ROUTINE		MENTAL		COMUNICATIVE		COMPLEX		SIMPLE TASKS	NON-SIMPLE TASKS
	score	rank	score	rank	score	rank	score	rank	score	rank	Average Score	Average Score
Corporate managers	27	18	47	13	80	3	79	5	83	3	**37**	**80.7**
Physical, mathematical and engineering professionals	34	15	34	17	85	1	56	10	63	9	34	68.0
Life science and health associate professionals	63	8	82	4	72	7	81	4	71	6	72.5	74.7
Other professionals	34	14	42	14	61	9	67	8	74	5	38	67.3
Intellectual Occupations											**48.2**	**70**
Physical, mathematical and engineering associate prof.	36	13	39	16	77	5	48	13	61	10	37.5	62.0
Life science and health associate professionals	63	8	82	4	72	7	81	4	71	6	72.5	74.7
Technical Occupations											**55**	**68.3**
Office clerks	29	17	33	18	47	13	59	9	44	14	31	50.0
Customer service clerks	29	16	19	20	77	4	81	3	46	13	24	68.0
Operative Occupations											**27.5**	**59**
Personal and protective service workers	59	10	51	11	50	12	51	12	54	11	55	51.7
Models, salesperson and demonstrators	18	19	15	21	59	10	77	6	66	8	16.5	67.3
Occupations relative to sales and services											**35.8**	**59.5**
Extraction and building trades workers	62	9	90	1	57	11	55	11	80	4	76	64.0
Metal, machinery and related tradework	84	3	75	7	42	15	19	19	30	17	79.5	30.3
Precision, handicraft, craft printing and related trade workers	68	6	64	10	35	18	26	15	35	16	66	32.0
Other craft and related trade workers	74	5	83	3	18	21	9	21	22	21	78.5	16.3
Specialized Workers											**75**	**35.7**
Stationary plant and related operators	65	7	86	2	27	19	23	18	40	15	75.5	30.0
Machine operators and assemblers	82	4	77	5	36	17	16	20	30	18	79.5	27.3
Drivers and mobile plant operators	88	1	69	9	38	16	24	16	28	20	78.5	30.0
Conductors of plants and machinery operators											**77.8**	**29.1**
Drivers and mobile plant operators	55	11	42	15	25	20	35	14	28	19	48.5	29.3
Laborers in mining, construction,manufacturing and transport	87	2	73	8	46	14	24	17	49	12	80	39.7
Unskilled Workers											**64.3**	**34.5**

Source: D'Amuri and Peri (2012, Table A3); our computations for the last two columns (simple averages of groups of occupations)

Table 7: Employment by occupation and by sector in 2005 (thousands)

	Industry	Services	TOTAL (no Agriculture)	TOTAL
Corporate managers	296.5	630.5	**927.0**	**1040.5**
Intellectual Professions	182.9	2043.4	**2226.3**	**2230.8**
Technical Professions	923.5	3473.1	**4396.6**	**4418.7**
Operative Professions	573.0	1987.5	**2560.5**	**2581.1**
Professions relative to sales and services	173.1	3345.2	**3518.3**	**3532.4**
Specialized Workers	2915.5	933.1	**3848.7**	**4300.2**
Conductors of plants and machinery operators	1354.4	677.2	**2031.6**	**2071.0**
Unskilled Workers	274.7	1637.7	**1912.4**	**2129.6**
TOTAL	6693.7	14727.7	**21421.4**	**22304.2**

Source: ISTAT and ISFOL Elaborations on Labor Force Survey (2007).

B Immigration of Different Types of Individuals

Let us assume that foreign-born residents are not homogeneous, but they differ in terms of relative productivity in complex tasks. For simplicity, let us assume that there are two types of foreign-born residents (1 and 2) and that: $\frac{\kappa_D}{\chi_D} > \frac{\kappa_F^1}{\chi_F^1} > \frac{\kappa_F^2}{\chi_F^2}$. By assuming no differences in the "dislike" parameter d_F between the two groups, from equation (9) it is easy to rank their individual relative task supply: $\frac{c_k^1}{s_k^1} > \frac{c_k^2}{s_k^2}$

Then the average relative supply of the overall foreign-born is the following:

$$\frac{C_F}{S_F} \equiv \frac{S_F^2}{S_F^2 + S_F^2}\frac{C_F^2}{S_F^2} + \left(1 - \frac{S_F^2}{S_F^2 + S_F^2}\right)\frac{C_F^1}{S_F^1} = \lambda(g)\frac{c_F^2}{s_F^2} + [1 - \lambda(g)]\frac{c_F^1}{s_F^1}$$

where $g = \frac{L_F^2}{L_F^1 + L_F^2}$ and L_F^i is equal to the number of foreign-born residents of type $i = 1, 2$ and the $\lambda(\cdot)$ function has the characteristics of the $\phi(\cdot)$ function: $\lambda(0) = 0$, $\lambda(1) = 1$, $0 < \lambda(\cdot) < 1$ and is monotonically increasing.

The overall supply is therefore:

$$\frac{C}{S} \equiv \frac{S_F}{S_F + S_D}\frac{C_F}{S_F} + \left(1 - \frac{S_F}{S_F + S_D}\right)\frac{C_D}{S_D} = \phi(f)\frac{c_F}{s_F} + [1 - \phi(f)]\frac{c_D}{s_D} =$$

$$= \phi(f)\lambda(g)\frac{c_F^2}{s_F^2} + \phi(f)[1 - \lambda(g)]\frac{c_F^1}{s_F^1} + [1 - \phi(f)]\frac{c_D}{s_D} \qquad (16)$$

An increase in g, i.e. in the fraction of less productive migrants in complex tasks, for a given f, lowers the relative supply of complex tasks more since the composition effect gives more weight to the migrants who are relatively less productive in complex tasks.

The same effects occurs in the market for the mobile factor H. Hence, the complete relationship between the relative output of manufacture-to-services is the following:

$$\left(\frac{Y_M}{Y_V}(f,g)\right) = \left(\frac{H_M}{H_V}\underset{+}{(f}\ ,\ \underset{+}{g)}\right)^{(1-\alpha)}\left(\frac{N_M}{N_V}\underset{+}{(f}\ ,\ \underset{+}{g)}\right)^{\alpha} \tag{17}$$

C Other Robustness Checks for the Estimation

A number of robustness checks for the main empirical specifications of our model are reported in this Appendix.

First, given the fact that the number of elements in the matrix of instruments grows quadratically in the time dimension, we want to be sure that the sample we are using contains adequate information for estimation. In order to exclude that our estimation is affected by the so called "small sample bias" problem, we exploit the fact that estimating a dynamic model with OLS will produce an upward bias, while if using an FE estimator it will generate a downward bias. We use the coefficients estimated via OLS and an FE model as upper and lower bounds for our preferred estimator (GMM-sys). As reported in Table 8 and Table 9, the autoregressive coefficient obtained through GMM-sys actually lies in the interval defined by the OLS and the FE estimates hence confirming that our sample contains enough information to ensure estimator consistency, in both value added and export regressions.

Second, given the autoregressive form of our model and the fact that the estimated autoregressive coefficient for value added dependent variable (VA_{man}/VA_{serv}) is very close to one, an issue of unit roots may arise. Table 10 reports the results for the different versions of the Im-Peasaran-Shin unit-root test and no presence of unit roots seemed to be statistically significant. The same test is reported – see Table 11 – for the dependent variable based on export flows $\ln(EXP_{low}/EXP_{high})$ bringing similar results.

Finally, in Table 12 we provide a test of one assumption of the model, namely the fact

Table 8: Coefficient boundaries for dynamic panel estimation: Value Added

VARIABLES	(1)	(2)	(3)
$\ln(VA_{man}/VA_{serv})_{t-1}$	0.979***	0.948***	0.768***
	(0.005)	(0.037)	(0.030)
ln *Migr/Pop*	0.002	0.038	-0.097
	(0.004)	(0.024)	(0.093)
ln *Migr*	-0.001	-0.041**	0.090
	(0.002)	(0.017)	(0.090)
Constant	0.014	0.511**	-1.318
	(0.031)	(0.214)	(1.179)
Observations	1,133	1,133	1,133
R-squared	0.981		0.711
Number of ID		103	103
AR(1) p-value		0	
AR(2) p-value		0.508	
Hansen p-value		0.0911	
Instruments		61	

Robust SE in parenthesis $*p < 0.1, **p < 0.05, ***p < 0.01$. All regressions contain time dummies. Columns (2) reports the GMM-sys results the estimated model employs two year lag on (VA_{man}/VA_{serv}) and $lmig_{it}$ as instruments (for the latter only level equation is included); while for lMN_{it} the set of internal instruments spans from 2 to 4 lags. *PolicyDummy* is included in the set of exogenous instruments as well.

Table 9: Coefficient boundaries for dynamic panel estimation: Exports

VARIABLES	(1)	(2)	(3)
$\ln(EXP_{low}/EXP_{high})_{t-1}$	0.951***	0.931***	0.548***
	(0.015)	(0.028)	(0.054)
ln *Migr/Pop*	0.009	0.066*	-1.679***
	(0.021)	(0.040)	(0.575)
ln *Migr*	0.002	-0.027	1.625***
	(0.014)	(0.070)	(0.538)
Constant	0.086	0.570	-20.639***
	(0.183)	(0.745)	(7.055)
Observations	1,133	1,133	1,133
R-squared	0.935		0.325
Number of ID		103	103
AR(1) p-value		0.0161	
AR(2) p-value		0.216	
Hansen p-value		0.550	
Instruments		63	

Robust SE in parenthesis $*p < 0.1, **p < 0.05, ***p < 0.01$. All regressions contain time dummies. Columns (2) reports the GMM-sys results the estimated model employs two year lag on (EXP_{low}/EXP_{high}) and $lmig_{it}$ as instruments (for the latter only level equation is included); while for lMN_{it} the set of internal instruments spans from 2 to 4 lags. *PolicyDummy* is included in the set of exogenous instruments as well.

that the relative wage of manufacturing to services is constant by Provinces due to constant relative output prices manufacturing/services. Since there are no data on wages at the Province level (NUTS-3) we are obliged to test it at the Region level (NUTS-2). Data source is the Survey on Household Income and Wealth (SHIW), carried out by the Bank of Italy every two years and gathering data on the incomes and savings of households. The dependent variable is constructed as the ratio between manufactures to service wages by individuals, then aggregated at regional level. We use five waves of the survey, from 1998 to 2006. Interestingly, the coefficients of all year dummy variables are not statistically significant, meaning that the distribution of regional relative wages does not change over time and not invalidating our hypothesis.

Table 10: Im-Pesaran-Shin unit-root test for (VA_{man}/VA_{serv})

			Fixed-N exact critical values		
	Statistic	p-value	1%	5%	10%
t-bar	-2.142		-2.390	-2.320	-2.290
t-tilde-bar	-1.794				
Z-t-tilde-bar	-6.776	0.000			

AR parameter: Panel-specific; included Panel means and Time trend.

Table 11: Im-Pesaran-Shin unit-root test for $\ln(EXP_{high}/EXP_{low})$

			Fixed-N exact critical values		
	Statistic	p-value	1%	5%	10%
t-bar	-2.434		-2.420	-2.340	-2.300
t-tilde-bar	-1.702				
Z-t-tilde-bar	-6.031	0.000			

AR parameter: Panel-specific; included Panel means and Time trend.

Table 12: Robustness check: Relative Wages – Region Specific

	$\ln(Wage_{man}/Wage_{serv})_t$	
$Year2000$	0.016	0.016
	(0.074)	(0.071)
$Year2002$	0.077	0.067
	(0.064)	(0.055)
$Year2004$	0.116*	0.116**
	(0.061)	(0.056)
$Year2006$	0.049	0.058
	(0.062)	(0.056)
Constant	-0.384***	-0.347***
	(0.040)	(0.068)
Region Dummy	No	Yes
Number of Obs	100	100
R-squared	0.038	0.403

Robust SE in parentheses: $*p < 0.1, **p < 0.05, ***p < 0.01$. Dependent variable is the relative wage of Manufactuers over Services; due to data availability it is computed at Region level (NUTS2) every two year.