DIPARTIMENTO DI SCIENZE SOCIALI
ED ECONOMICHE

SAPIENZA
UNIVERSITÀ DI ROMA

ISSN 2385-2755
Working papers
(Dipartimento di scienze sociali ed economiche)
[online]

WORKING PAPERS SERIES
DIPARTIMENTO DI
SCIENZE SOCIALI ED ECONOMICHE
n. 1/2014

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CF 80209930587 - P.IVA 02133771002

Immigration and Manufacturing In Italy. Evidence from the 2000s*

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May 2014

Abstract

This paper tests the effect of an increase in the migration rate on manufacturing firms' performance at the local level. The model is estimated for the Italian economy during the recent years of rapid and varied migration (a threefold increase in the 1995-2006 and the presence of 189 nationalities). Firm performance is measured with common indexes (sales per worker and production per worker) at the firm level and then aggregated at different levels. In particular, we construct measures for both a representative (average) province-sector firm and a representative (average) province firm. By means of the sector data we are able to estimate the impact of migrants on high- and low-tech sectors, both in the level and in relative terms. We also consider migrants heterogeneity (in terms of characteristics of nationalities) in order to approximate the effect of high- and low-skill migrants.

Our results show that migrants' presence in the province positively affects firm's performance: a doubling of the migration ratio to provincial population raises sales per worker by 9-12 per cent on average. However, this increase is unevenly distributed and favors low-tech versus high-tech sectors. On the labor supply side, an increase in proxied relatively low-skill migrants favors low-tech sectors.

Keywords: Firm Performance, Sector Analysis, Rybczynski Effect, International Migration.

JEL Classification Codes: F22, C25.

*We would like to thank Carlo Altomonte, Giulia Bettin, Paolo Giordani, Hubert Jayet, Fabio Mariani, Peter Neary, Gianmarco Ottaviano, Diego Puga, Cristina Tealdi and participants at the workshop "Production, R&D and Knowledge Offshoring: Economic Analyses and Policy Implications" and at various seminars. We kindly acknowledge financial support from Sapienza University of Rome (Ateneo Grant). The authors declare that they have no relevant or material financial interests that relate to the research described in this paper. The usual disclaimers apply.

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1 Introduction

The weight of foreign-born population on natives in developed countries has almost doubled on average starting in 1990, but with many different patterns among the various destination countries. Countries with a colonial past, for instance, showed a clear bias in the direction of their colonial ties.

When investigating the effects on destination countries, the public opinion has been mainly concerned on the impact in the domestic labor markets. Economists have been debating for almost two decades on the reaction of wages and natives' unemployment rates when the labor force increases due to immigration (see Okkerse, 2008, for a recent review).

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 due to institutional differences with respect to North America.[2]

Given the small change in wages, especially in case of Europe, then an ensuing question would be: what has been the effect of such a relevant inflow of new labor force?

If wages are not highly affected and the unemployment rate does not change that much, common wisdom would point to a change in production. In a one-sector model we would simply observe an increase in output, but in a two-sector model we should consider also possible recomposition effects.

In this paper the focus is on the effect of immigration on both firms' performance and the production structure of Italian manufacturing.

Did migrants' presence at the local level have an effect on the performance of manufacturing firms in the same area? Were all manufacturing sectors affected in the same way? In the theory of international trade the answer to this latter question is no since the Rybczynski theorem claims that, under the hypothesis of sticky wages, sectors whose production utilizes more

[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 (2014). They considered all segments of the European labor markets and not only the low-educated one, as in many other studies on the US.

intensively the labor services offered by migrants increase production relatively more than the other sectors.

We build upon this intuition and we contribute empirically to the debate in two ways. First, we want to uncover the effect of migrants' presence on the average performance of firms residing in the same area and in different sectors. Our a-priori is that the resource increase due to migration is not evenly distributed. Second, when we strictly consider the *relative* performance of firms in sectors that would use migrants more or less intensively, we expect to obtain a significant impact of the migration rate in favor of more labor-intensive sectors.

Previous studies that investigated the change in factor endowments implied by immigration and have considered two possible effects when wages are not affected, as in our case.

First, migration may induce firms to switch to techniques that are more complementary to the characteristics of the new labor force. For instance, 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 former 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] Along the same line, Lewis (2004) analyzed the large inflow of Cuban migrants in Miami through the Mariel boatlift and reached similar conclusions on the rate of technology adoption (i.e., towards less computer-based techniques in Miami with respect to similar cities in the US) rather than an effect in the industry mix.

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.

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

Second, immigration may cause an effect in the production structure, but at a highly disaggregated level. 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. 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, but only for the years 2001-2003.

More recent work has focused on the the composition of the labor force, which generally implies that migration increases the ratio of low-skilled to high-skilled workers.[4] As recalled above, most contributions, like Peri and Sparber (2009) or D'Amuri and Peri (2014), are more interested in the effect of migration in the relative wage and use a one-sector model as a reference.

Besides the US and overall Europe, there have been recent studies on other specific countries. González and Ortega (2011) consider the case of Spain, which has some similarities to the Italian case because of the rapid and intense inflow of immigrants (from 4.8% to 10.8% of the population between 2001 and 2006). They find that the adjustment has occurred mainly in production techniques with firms located in the high-immigration regions employing relatively more unskilled labor than firms located in similar low-migration regions. Dustmann and Glitz (2014) analyze the case of Germany with firm-level data and distinguish the effects of migration depending on whether we consider a traded or a nontraded sector. In the latter case, they find an effect on factor prices, whereas in traded sectors the adjustment occurs on both the output mix and the change in techniques, but mainly through the latter with firms taking advantage of the greater availability of low-skilled labor. The other important contribution by Dustmann and Glitz (2014) is the effect on the dynamics of entry and exit of heterogeneous firms as a consequence of the labor supply shock caused by immigration.

Finally, very recent work has been focusing also on the effect of migration on firm productivity – e.g. Peri (2012) – and on innovation – e.g. Hunt and Gauthier-Loiselle (2010) and Kerr and Lincoln (2010). In some ways our estimates on the effect of migration on different

[4]The excellent survey in Lewis (2013) shows the mathematical conditions required in the production function to marginalize the effect on capital and concentrate on the ratio low- to high-skilled labor as emphasized in the recent literature, e.g. Ottaviano and Peri (2012).

measures of firm performance could be related to the former strand of literature.

Our investigation is performed for the Italian economy in the 2000s, which have been the years of the more intense immigration flows.

In this scenario Italy represents a particular case where the increase has been very intense and highly varied in terms of origin countries. Indeed, the presence of non native residents in Italy[5] has risen from 1.3 million in 2002 to 4.4 million in 2013 and in terms of percentage of the total resident population has increased by more than a factor of three (from 2.3 per cent in 2002 to 7.4 per cent in 2013). Moreover, the immigration has been very diverse in terms of origin countries with the presence of more than 180 nationalities since 2005.

In this paper we exploit the territorial distribution of migrants and the economic structure of the most relevant firms residing in that same province. In particular, we evaluate the contribution of migration presence in the province to two different measures of firm performance. First, we estimate the effect of the provincial migration rate (i.e. the ratio of the number of migrants to the total province population) on some performance measures of both the average province firm and the average province-sector firm, i.e. with the detail of the sector where it operates. We dichotomize sectors between high-tech and low-tech sectors and evaluate whether migration has favored the latter ones by assuming that migration has relatively increased the endowment of low-skilled labor and that high-tech (low-tech) sectors are high-skill (low-skill) labor intensive.

Second, we look for a distinction among the different types of migrants. When dividing migrants' origin countries in terciles – origin countries of migrants prevalently with primary, secondary or tertiary education – our results are further confirmed. Indeed, an increase of the solely portion of migrants that could be considered relatively low-skilled has a significant effect on the performance of average province firms in the relatively low-tech manufacturing sectors.

Many other studies have used regional data within the same country in order to evaluate

[5]We define as *non native resident in Italy* an individual residing in Italy, but not holding the Italian citizenship. The term *non native resident* is used hereafter interchangeably with *migrant*.

the effect of migration on wages and some concerns have been raised about the use of regional data following the remark by Borjas et al. (1996), i.e. the fact that the use of regional data may show an attenuated variation due to a dominant national effect. This concern is less important in our case where the production structure and firms' performance can vary substantially among the regions of the same country.

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 delayed effect and include migration presence with a lag of five years, which could be quite plausible given the typical gradual effect of migration on firm performance and the slow moving feature of the production structure. In this way we avoid that part of reverse causality that could be attributed to simultaneity.

The main findings confirm our a-priori and firm performance is differently affected depending on the sector where firms operate. It significantly rises in typically labor-intensive sectors by 8-13 per cent for a doubling of the migrants' presence (like Textiles and Furniture). It affects positively but not significantly capital-intensive sectors (like Chemicals and Machinery) and also negatively, although non significantly, some others (Electronics). Moreover, a proxy of differently-skilled migrants points towards the correct intuition that low-tech sectors take higher advantage from more low-skilled migrants. Finally, given the high weight of labor-intensive industries in Italy, it is not surprising that there is a greater impact on firms' performance by low-skill migrants (i.e. with imputed lower levels of school attainment).

The remaining sections of the paper are organized as follows. Section 2 presents general characteristics of the migration phenomenon in Italy in the last two decades. A general description of the data used for our empirical evidence is found in Section 3. The econometric models implemented in this work are reported in Section 4, whereas Section 5 illustrates our results by distinguishing between general effects on firms' performance and effects on the relative (low- versus high-tech) production structure. We also estimate the differential effect of high- and low-skill migrants by using the information on their origin countries in order to see whether there is a differential effect on firm's performance and on the sector composition.

Section 6 concludes.

2 Migrants' Characteristics and Sectoral Employment in Italy

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 out-migration rate was 18.7 per 1,000 residents), and continued quite intensively till the beginning of the 1970s. In the mid-Seventies the out-migration 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 stylized 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. However, the increase has not been smooth, as Figure 1 shows, since three main amnesties occurred during the period 1995-2006.[6]

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 non natives, the percentage of migrants coming from developed countries was not negligible in the 1990s (almost 30 per cent), whereas in the 2000s the stock

[6]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.

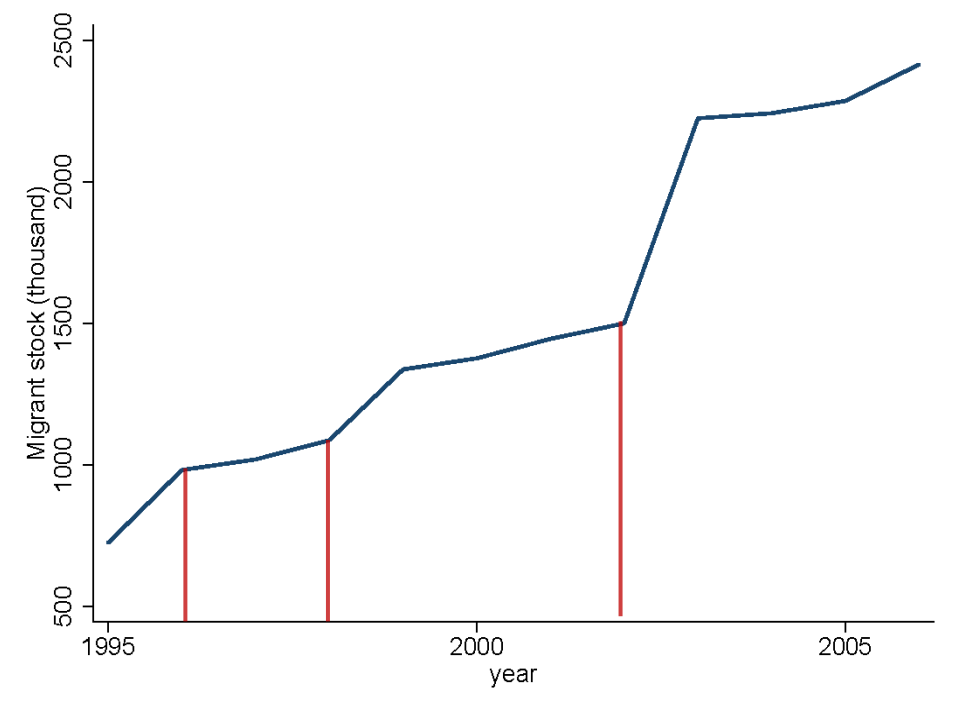

Figure 1: The Stock of Residence Permits in Italy 1995-2006 (Source: Italian Ministry of the Interior and ISTAT).

composition radically changed and over 90 per cent of migrants originated from less developed or emerging economies.

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.[7] 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. At the beginning of 2013 only 14 per cent migrants were residing in Southern Italy, although experiencing the highest growth rate in 2012 (+12 per cent).

Hence, given the wide variation in the origin countries and high variability in migrants' location, we deem that the Italian case offers a double variability that is very useful to study the effects of migrants' arrivals and presence on the economic structure and firms' performance.

Finally, Figure 2 reports the sectorial employment distribution of migrants and natives for

[7]See, for instance, Jayet et al. (2010).

the years 2005 and 2006.[8] Non natives 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 2 we report the relative weight of each sector in total Italian GDP.

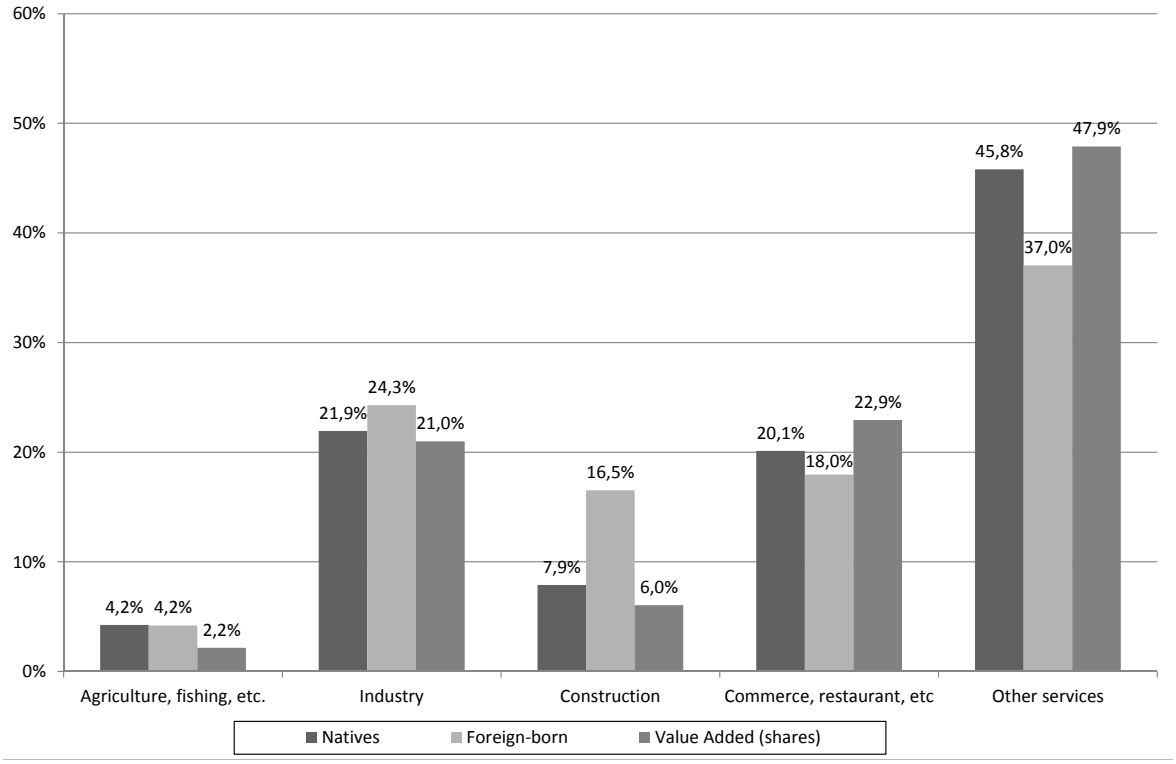

Figure 2: Employment distribution of natives and non natives in Italy in the main sectors; sectors' shares of value added (average 2005-06; source: Italian Institute of Statistics, ISTAT).

3 Data and Descriptive Statistics

Firm level data are obtained from the AIDA dataset, provided by Bureau Van Dijk. Raw data contain balance-sheet information of Italian manufacturing firms. In particular, we use the version of the dataset reporting only statutory financial statements, the so-called *bilancio civilistico* which reports the firm level annual balance sheets prior to consolidation for multi-plant firms.[9]

[8]The years 2005 and 2006 are the first two years for which these statistics are available for Italy. The figures reported on the histograms are 2005-2006 averages .

[9]It is worth noting that plant-level balance-sheet data are not available, focusing only on pre-consolidation data we are at least partially able to control for multi-plant firms, whose incidence is relatively small in Italy.

After controlling for possible measurement errors – excluding firms with implausible (negative or missing) figures for value added, sales and number of workers – and for possible outliers – keeping only firms that remain at least tree years in the sample – we end up with an unbalanced panel of 63,252 firms, over the period 2001-2010. Table 1 reports the sectoral decomposition of the total observations in our AIDA sample for whole period.

Concerning the geographical representativeness of the manufacturing sector, we have compared the regional distribution of firms in our sample in the year 2010 against the population of manufacturing firms in Italy, as provided in the official dataset ASIA by the Italian Institute of Statistics at NUTS2 level, and the correlation is 95 per cent.[10]

Table 1: Sectoral composition: Firm level observations

NACE code	Industry	Freq.	Percent.
24,25	Basic Metals	76,232	21.97
28	Machinery and Equipment	46,828	13.49
13,14,15	Textiles, wearing, leather	40,451	11.66
20,21,22	Chemicals	35,708	10.29
10,11,12	Food, Beverages and tobacco	30,202	8.7
26,27	Electronics	28,339	8.17
16,17,18	Paper, Printing, Wood	26,904	7.75
23	Non-metallic mineral products	19,978	5.76
33	Other Manufacturing	16,645	4.8
31	Furniture	14,739	4.25
29,30	Transports and equip.	9,821	2.83
19	Coke and Petroleum	1,211	0.35
	Totals	347,058	100

Sectors are coded according to NACE rev.2 classification at 2-digit level.

Using firm-level data allows us to recover the production structure at the local level and to test for the effect of migrants' presence on both firms' performance and production shifts among sectors – what we called a Rybczynski effect. Namely, we have aggregated firms' values according to technological intensity classification provided by Eurostat.[11] As relatively high-technology sectors we consider: Chemicals and Pharmaceutical (NACE 20,21), Computers (NACE 26), Electrical equipment, Machinery and Motor vehicles (NACE 27, 28, 29), Transport equipment (NACE 30 - excluding 301), Medical and dental instruments (NACE 325) and

[10]Results available from the authors upon requests.

[11]The classification is taken from the Statistics on high-tech industry and knowledge-intensive services for a detailed description see `http://epp.eurostat.ec.europa.eu/cache/ITY_SDDS/en/htec_esms.htm`

Weapons (NACE 254). The other industries are considered as relatively low technology.

Data on migrants' presence at the province level (NUTS3) are the official residence permits (*Permessi di Soggiorno*) and are provided by Italian Institute of Statistics (although originally gathered by the Italian Ministry of Interior).

Other controls at the province level are: density (population per squared kilometer), the overall GDP per worker and a measure of infrastructure endowments (extension of airports runaways). All these data come from the Italian Institute of Statistics. Table 2 reports the descriptive statistics for our main variables of interest.

Table 2: Descriptive Statistics: main variables

Variable	Obs	mean	sd	min	p25	p50	p75	max
Value Added (1,000, Euro)	347058	3329	19565	1	451	912	2291	4856264
Production (1,000, Euro)	347058	15330	133841	7	1715	3720	9761	21700000
Workers (#)	347058	53	238	2	10	19	44	27783
Age	347058	20	14	1	9	18	27	137
Density	994	245	334	36	104	172	259	2640
$GDP_{per\ worker}$ (1,000, Euro)	994	45	6	29	42	45	50	61
Airports (Runaways)	994	29	77	0	0	0	30	637

Note that *Density* is measured as inhabitants per squared kilometer, GDP per worker is the overall province value added divided by the total number of workers, while *Airports* measures the extent of runways per Km^2 and (all are measured at province by year level) Source: Italian Institute of Statistics. Value Added, Production, age and Workers are derived from firm level data. Source: bureau Van Dijk Aida.

Finally, one important assumption to evaluate a significant effect on the production structure (the Rybczynski effect) is that relative wages are not affected by the new inflow of labor force. In Table 3 we provide a test for the fact that wages are relatively sticky. We consider the relative wage of manufacturing to services and since there are no data on wages at the province level (NUTS3), we are obliged to rise up at the region level (NUTS2). The 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 incomes and savings of households. The dependent variable is constructed as the ratio of manufactures to service wages by individuals, then aggregated at regional level. We use five waves of the survey, from 1995 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, hence not invalidating our

hypothesis of sticky wages.

In general, it is well-known that Italian wages are sticky (se, for instance, **?**). Regarding the period under investigation, Figure 3 reports the mean wage dynamics for manufacturing and service sectors in 1995-2006. The figure shows that wages in the two industries increased steadily and at a similar pace. The cumulated increase over a ten years period was around 27%, i.e. an average yearly 2.7% which is not different from the average inflation rate.

Table 3: Descriptives: Wages Dynamics – Region Specific

	(1)	(2)
	$\ln(Wage_{man}/Wage_{serv})_t$	
$Year:$ 1998	-0.018	-0.011
	(0.055)	(0.047)
$Year:$ 2000	-0.001	0.005
	(0.073)	(0.064)
$Year:$ 2002	0.059	0.056
	(0.062)	(0.046)
$Year:$ 2004	0.099	0.105**
	(0.060)	(0.047)
$Year:$ 2006	0.031	0.049
	(0.061)	(0.048)
Constant	-0.367***	-0.489***
	(0.038)	(0.184)
Region Dummy	No	Yes
Number of Obs	116	116
R-squared	0.037	0.412

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

4 Economic Intuition and Econometric Modeling

The main objective of this paper is to evaluate the effect of the rapid and varied immigration flows in the Italian provinces on firms' performance and on the production structure. We consider the institutional and socio-economic characteristics of the Italian labor and product markets pointing to sticky wages (see evidence in Section 3) and by a very low labor mobility across provinces (see Mocetti and Porello, 2010).

We are interested in the effect of migration on different measures of productivity by using firm-level data as described in Section 3 using two different approaches.

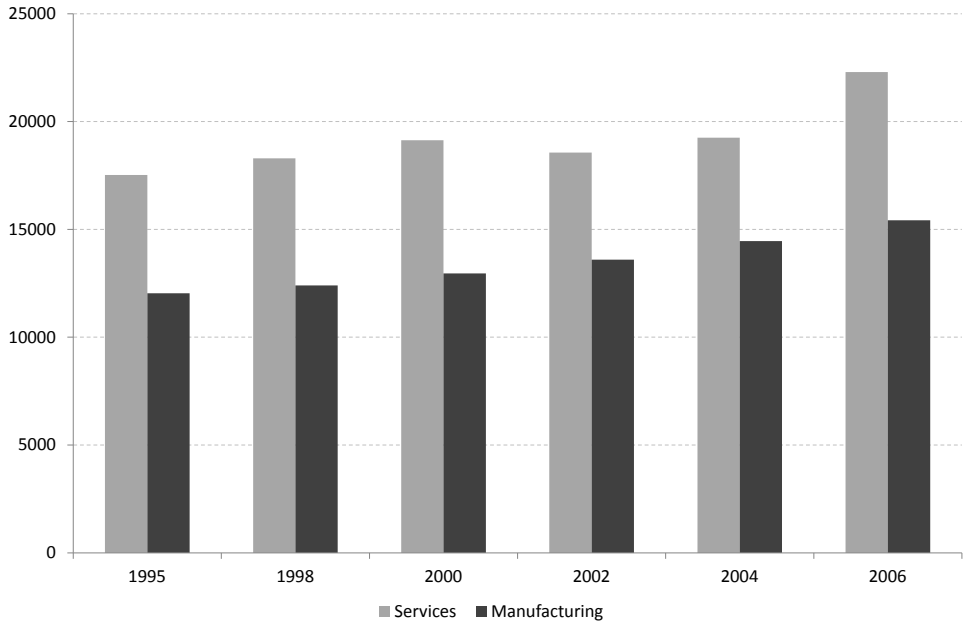

Figure 3: Nominal wage dynamic for manufacturing and service sectors. Source Bank of Italy (SHIW). Values are in Euro.

The *first* econometric model is based on an aggregation of individual-firm data at the level of sector and province. More precisely, the equation to estimate is the following:

$$y_{jst} = \alpha_0 + \beta_1 \ln(Mig/Pop)_{jt-5} + \gamma_k \mathbf{\Gamma}'_{jst} + \beta_k \mathbf{\Pi}'_{jt-5} + \delta_{st} + \delta_j + \epsilon_{jst} \quad (1)$$

where y_{jst} is our measure of firm i performance in province j, sector s and time t;[12] $\mathbf{\Gamma}'$ is a vector of controls for (average) firm characteristics at province level: $\ln(age)$ is the geometric average of firm age; $\ln(age)^2$, is the geometric average of firm age squared; to control for firm size distribution we use four dummy variables based on the quintile of the production distribution by sectoral aggregate, province and year (the dummy for the bottom 20% of the distribution is excluded and the other dummies can be interpreted as deviations from the reference group). $\mathbf{\Pi}'$ is a vector of province level controls: $\ln(GDP/worker)$ as the log of the province level GDP per worker; $\ln(Pop/Km2)$ is the log of province inhabitants per squared

[12]During the analysis we use mainly $\ln(sales/workers)$, whereas $\ln(production/workers)$ is employed for robustness check and results on this latter dependent variable are available upon request.

kilometers; *Airports* measures the runaways per province squared kilometer and Highways reports the Km of highways every 1000km of routes, by province. Our main variable of interest is $\ln(Mig/Pop)_{jt-5}$ representing the log(Migrants/population); δ_j is a set of province fixed effects, while δ_{st} refers to sector-time dummies.

Our variable of interest, i.e. the incidence of migrants over the province population, is lagged five years assuming that the presence of migrants takes some time to affect the slow-moving dependent variable. As an important byproduct of this choice, the five-year distance to the dependent variable is deemed to be sufficient to avoid the simultaneous-equation bias. Also the province controls are introduced with a five-year lag.

The *second* econometric model looks for the effects of the migrants' presence at a more aggregate level by using a sort of *representative provincial firm*.

For this purpose we follow a two-stage procedure like in Brunello and Cappellari (2008). In the first stage we use firm-level data and obtain a province-representative measure of firm performance – name it y_{jt} – as the predicted value of the province-time factor when conditioning on relevant firm-level information so as to take into account firms' heterogeneity (see Section 5.2 below). In the second stage the predicted value is used as the dependent variable on which to estimate the effect of migration.

The second-stage equation to estimate becomes as follow:

$$y_{jt} = \alpha_0 + \beta_1 \ln(Mig/Pop)_{jt-5} + \gamma_k \mathbf{\Gamma}'_{jt} + \beta_k \mathbf{\Pi}'_{jt-5} + \delta_t + \delta_j + \epsilon_{jt} \tag{2}$$

where $\mathbf{\Gamma}'_{jt}$ contains the province average values of the same variables in $\mathbf{\Gamma}'_{jst}$ described above.

Finally, we consider that the Rybczynski original formulation is based on a two-sector model where the effects of changes in endowments cause a recomposition on the production structure. Hence, we estimate a *third* model where the dependent variable represents the *relative* performance of two aggregated sectors.

In particular, as detailed out in Section 5.4 below, we use the high/low-tech breakdown of sectors as explained in Section 3 and construct *relative sales per worker* between low-tech and

high-tech sectors – name it $y_{jt}^{Low/High}$.

The equation of the third model to estimate is then:

$$y_{jt}^{Low/High} = \alpha_0 + \beta_1 \ln(Mig/Pop)_{jt-5} + \gamma_k \mathbf{\Gamma'}_{jt} + \beta_k \mathbf{\Pi'}_{jt-5} + \delta_t + \delta_j + \epsilon_{jt} \tag{3}$$

Moreover, we attempt to evaluate the effect of different types of migrants on the same measures of firm's performance and on the production structure. This is described below in both Sections 5.3 and 5.4 where the variable of interest on migration is refined relatively to a possible distinction between high- and low-skill migrants.

5 Estimation Results

In this Section we report the final results and the intermediate steps for the three models (1)–(3). In the last two sections we also consider the different impact of heterogeneous migrants on firms' and sectors' performance.

5.1 Evidence at the Sector-Province Level

Estimation of Equation (1) is presented in Table 4. The nine columns of each table report the estimated coefficients for the main manufacturing sectors as defined in Section 3. The number of observations changes due to the fact that in some province and years not all the sectors are represented. The goodness of fit is never below 0.5.

The impact of migration on firm's performance (i.e. sales/workers) is reported in the first line. We notice that the effect is always positive (apart from Electronics) while the magnitude and significance is variable across sectors.

The overall impact is non negligible pointing to an increase between 7.6 (Textiles) and 12.5 (Basic Metals) per cent in the ratio of sales to workers for a doubling of the ratio of migrants to the population of the province where the firm resides (lagged by five years). As reported in Section 2, the total migrant population has increased threefold both in absolute

and in relative terms to the total population during this period; therefore, a doubling of the migrants' incidence is not a rare events in many Italian provinces during the period that we consider.

The control variables, when significant, have the expected signs with few exceptions. Noteworthy *Size* dummies are always positive and strongly significant, with an increasing magnitude for all the sectors, indicating that an higher share of large firms is associated with greater sales per worker. Moreover the Crisis$^{t\geq 2008}$ dummy is also statistically significant and negative in all regression confirming a not negligible demand shocks after the financial crisis of late 2007.

5.2 Province-Level Evidence

Following Brunello and Cappellari (2008), we want to exploit the information at the firm-level data to obtain a representative province-level measure of firms' performance by conditioning on the firms' characteristics and considering the high degree of firms' heterogeneity at all levels.

The first-stage regression is then the following:

$$y_{ijst} = \gamma_k \mathbf{\Gamma}'_{ijst} + \gamma_s + \gamma_{jt} + \epsilon_{ijst} \tag{4}$$

where y_{jst} is the $\ln(sales/workers)$ for firm i in province j, sector s and time t; $\mathbf{\Gamma}'_{ijst}$ is a vector of controls at the firm level that includes: (the log of) firm age and its squared value, a set of dummies for firm size quintile based on production level by year and sector (excluded reference group: first quintile, i.e. bottom 20%). Sector dummies[13] are represented by γ_s, whereas estimates of the province-time dummy coefficients γ_{jt} are the important output of this first stage; ϵ_{ijst} is the random error.[14]

Results of this first-stage regression are reported in Table 5 (with exclusion of the dummy coefficients) where we report results for two measures of firm performance – i.e. sales/workers

[13]Sector dummies are referred to 2-digit Ateco2007 (NACE rev 2).
[14]We do not include the constant to avoid dropping one γ_{jt} dummy.

Table 4: Estimation for Main Manufacturing Sectors with Firm-Level Data. Dependent Variable: Sales/Worker

VARIABLES	(1) Food and Bev.	(2) Textiles	(3) Furniture	(4) Chemicals	(5) Electronics	(6) Metal Prod.	(7) Machinery	(8) Transports	(9) Others
$\ln(Mig/Pop)_{jt-5}$	0.088**	0.076*	0.130**	0.083	-0.051	0.125**	0.127	0.075	0.061*
	(0.042)	(0.043)	(0.050)	(0.084)	(0.071)	(0.049)	(0.079)	(0.087)	(0.033)
$\ln(age)$	-0.272	-0.183	-0.058	0.036	0.118	0.441	-0.066	0.598**	0.010
	(0.175)	(0.223)	(0.214)	(0.382)	(0.244)	(0.269)	(0.133)	(0.294)	(0.164)
$\ln(age)^2$	0.072*	0.041	-0.019	-0.043	-0.001	-0.057	-0.027	-0.173**	-0.021
	(0.040)	(0.048)	(0.048)	(0.092)	(0.065)	(0.064)	(0.033)	(0.068)	(0.037)
Size: 2^{nd} quintile	0.501***	0.300*	0.352**	0.359**	0.048	0.155*	0.066	0.230*	0.297**
	(0.159)	(0.169)	(0.152)	(0.178)	(0.132)	(0.088)	(0.072)	(0.120)	(0.129)
Size: 3^{rd} quintile	0.775***	0.320**	0.511***	0.269	0.166	0.191	0.219**	0.464**	0.621***
	(0.214)	(0.140)	(0.140)	(0.300)	(0.232)	(0.129)	(0.110)	(0.208)	(0.114)
Size: 4^{th} quintile	1.027***	0.516***	0.768***	0.460**	0.191	0.614***	0.452***	0.660**	0.854***
	(0.158)	(0.155)	(0.126)	(0.226)	(0.302)	(0.160)	(0.161)	(0.270)	(0.146)
Size: 5^{th} quintile	0.904***	0.684***	1.284***	0.628*	0.827*	0.545***	0.702***	0.848***	0.873***
	(0.204)	(0.179)	(0.172)	(0.329)	(0.448)	(0.159)	(0.197)	(0.235)	(0.161)
$\ln(GDP/W)_{jt-5}$	-0.477***	0.332*	0.257	0.777**	-0.657	0.685**	-0.082	0.299	-0.080
	(0.149)	(0.181)	(0.251)	(0.299)	(0.405)	(0.271)	(0.292)	(0.347)	(0.155)
$\ln(Pop/Km2)_{jt-5}$	1.462**	1.241**	1.189**	1.352	1.847*	-0.238	-1.007	-0.378	0.285
	(0.557)	(0.570)	(0.599)	(1.311)	(1.109)	(0.891)	(0.920)	(1.194)	(0.554)
$AirPorts_{jt-5}^{Km2}$	0.065	0.070	0.048**	0.037	0.044	0.048**	0.038	0.028	0.021
	(0.041)	(0.057)	(0.022)	(0.042)	(0.072)	(0.024)	(0.026)	(0.035)	(0.014)
$\text{Crisis}^{t\geq 2008}$	-0.095***	-0.139***	-0.199***	-0.146***	-0.010	-0.133***	-0.138***	-0.120**	-0.094***
	(0.035)	(0.028)	(0.021)	(0.039)	(0.050)	(0.036)	(0.039)	(0.053)	(0.021)
Constant	2.449	1.833	6.482***	-1.406	5.649	10.632	20.314***	11.409**	11.352***
	(4.539)	(3.943)	(2.268)	(10.248)	(4.583)	(6.572)	(7.273)	(5.252)	(2.149)
Observations	993	978	986	932	879	947	823	846	994
R-squared	0.705	0.611	0.707	0.500	0.689	0.660	0.649	0.666	0.727

Standard errors, in parentheses, are clustered at province level, *, **, *** statistically significant at the 10, 5 and 1 percent level, respectively. All regressions include province and time dummies, not reported. Sectors are coded according to NACE rev.2 classification at 2-digit level: Food & Beverages (NACE 10, 11, 12), Furniture (NACE 31), Chemicals (NACE 20, 21, 22), Electronics (NACE 26, 27), Metal Prod. (NACE 24, 25), Machinery (NACE 28), Transports (NACE 29, 30), Others (NACE 16, 17, 18, 32, 33).

Table 5: First-Stage Regression

	(1)	(2)
Dep. Vars	*Sales/W*	*Prod/W*
Age (of the firm)	0.188***	0.171***
	(0.010)	(0.009)
Age^2	-0.062***	-0.059***
	(0.002)	(0.002)
Size: 2^{nd} quintile	0.254***	0.251***
	(0.005)	(0.005)
Size: 3^{rd} quintile	0.440***	0.436***
	(0.006)	(0.006)
Size: 4^{th} quintile	0.602***	0.599***
	(0.007)	(0.007)
Size: 5^{th} quintile	0.865***	0.866***
	(0.008)	(0.008)
Observations	347,058	347,058
R-squared	0.997	0.997

Standard errors clustered at firm level in parentheses, *, **, *** statistically significant at the 10, 5 and 1 percent level, respectively. All regressions include province by time and sectoral dummies, not reported. Regression do not include constant.

(*Sales/W*) and production/workers (*Prod/W*) – although our main analysis is done on *Sales/W*. The coefficients are all highly significant and the goodness of fit is very high.

Let us define $y_{jt} \equiv \widehat{\gamma_{jt}}$ as the estimated province-time effect in stage one, which represents our representative measure of *Sales/W* at the *province level* and becomes the dependent variable in Equation (2). Estimation of Equation (2) is performed by using weighted least square, since our dependent variable is estimated. We use the inverse of the standard errors as weights (see Brunello and Cappellari (2008)).[15] Standard errors are clustered at the province level.

Table 6 reports the estimates of Equation (2) when considering *Sales/W* as our measure of firm performance.[16] Moreover, we report the results when interacting the control variables with a *Crisis dummy* that takes value of 1 for the period 2008-2010. Standard errors are clustered at the province level and the time trend is included in one case.

[15]Results are also confirmed using non-weighted OLS with either province clustering or bootstrap for the standard errors. They are available from the authors upon request.

[16]There is no much difference when considering *Prod/W*. Results are available from the authors.

Table 6: Estimation for the Province-Representative Firms.

Dep. Var	(1)	(2)	(3)	(4)
y_{jt}		$Sales/W$		
ln(Migrants/pop)$_{jt-5}$	0.093***	0.106***	0.109***	0.119***
	(0.013)	(0.015)	(0.022)	(0.023)
ln(GDP/W)$_{jt-5}$			0.270***	0.235**
			(0.096)	(0.099)
ln(pop/Km2)$_{jt-5}$			0.512	0.421
			(0.328)	(0.390)
ln(Airports)$^{Km2}_{jt-5}$			0.043**	0.043**
			(0.018)	(0.019)
Crisis$^{t\geq 2008}$			-0.140***	-0.148***
			(0.011)	(0.013)
Crisis$*(Migrants/pop)_{jt-5}$				-0.013
				(0.014)
Crisis$*ln(GDP/W)_{jt-5}$				0.130*
				(0.069)
Crisis$*ln(pop/Km2)_{jt-5}$				0.008
				(0.009)
Crisis$*ln(Airports)^{Km2}_{jt-5}$				0.001
				(0.003)
Constant	12.494***	25.913***	9.400***	8.267***
	(0.052)	(4.035)	(1.244)	(2.954)
Time Trend	No	Yes	No	No
Observations	994	994	994	994
R-squared	0.199	0.211	0.700	0.702

Standard errors clustered at Province Level. *, **, *** statistically significant at the 10, 5 and 1 percent level, respectively. All regressions include province dummies, not reported.

Results show no rejection at the 95 per cent confidence level for the hypothesis of an effect of migration. Quantitatively, doubling the presence of migrants over the province population is associated to an increase of 9-12 per cent on sales per worker. Noteworthy, the elasticity of sales to migrants is in line with the one found in Bratti et al. (2014) using Italian province export data (sales on foreign markets) over the same period 2002-2010.[17] General statistics confirm the acceptable goodness of fit (always higher than 0.7 when including the control variables). For all the control variables we always reject the null hypothesis of zero value, except for population density.

It is interesting to evaluate the effect of the Great Recession starting in 2008 with a strong and significant negative effect on average (sales/worker), but without any significant effect on all the other variables.

5.3 The Effect of Migrants' Heterogeneity

Migrants are not all the same and their economic contribution to the destination country can change along different dimensions. Taking into account migrants' heterogeneity is then particularly important for the case of Italy where so many nationalities are present (see Section 2).

Indeed, the nationality can be a proxy for different abilities of a migrant, both in terms of skills and in terms of productivity when performing various tasks. For instance, coming from Romania, hence talking a native latin-derived language with ease in learning Italian, may be a proxy of higher productivity in tasks that require communication abilities in comparison with individuals coming from China.[18]

In this paper we elaborate on a measure of average level of education by nationality. In particular, we use the information in Docquier et al. (2008), who classify foreign-born residents in OECD countries by nationality and schooling attainment.[19] For each province j we consider

[17] In the baseline regression Bratti et al. (2014) found an elasticity of exports to migrants of 0.128.

[18] The role of language proximity and ability in acquiring the host-country language has been investigated in the literature and may involve human capital considerations that are however beyond the scope of this paper.

[19] 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.

the share of *primary-educated* foreign workers aggregating the stock of migrants according to the source country share of primary school attainment and we do the same for *secondary-educated* and *tertiary-educated* foreign workers.

In Table 7 we report the estimation of Equation (2) as in Section 5.2, but separating distinct migration rates for three subgroups of migrants.[20] In particular, in the three columns we report the effect of the incidence of migrants with different degrees of school attainment.

All the coefficients of interest are significant (at the 99 per cent probability level) and show a decreasing effect in magnitude when increasing the level of school attainment. More precisely, doubling our proxy of the migration rate for primary-educated migrants increases the province-representative firm's sales per worker by almost 12%, whereas doubling the tertiary-education migration rate the increase is no higher than 6.2% and this difference is highly significant.

This may indicate that the local production systems in manufacturing do not benefit in the same way by the increase in the presence of *more skilled* migrants. This is further investigated in Section 5.4.

The goodness of fit of the model remains high (never below 0.69) and the control variables have all the expected sign when significant.

The crisis dummy has a highly significant negative effect on the average value of *Sales/W*.

5.4 Effects on the Relative Performance of High- to Low-Tech Sectors

The final exercise is to evaluate the impact of migration on the *relative performance* of high- and low-tech sectors according to the classification presented in Section 3.

The dependent variable is then the relative performance of low-tech sectors with respect to high-tech sectors. We obtain this measure by refining the two-stage procedure of Section 5.2.

In particular, our new first stage is the following:

[20] Results with *Prod/W* as a dependent variable are very similar and are available upon request.

Table 7: Aggregate Estimation for the Province Representative-Firm Data and Migrants' Heterogeneity. Dependent Variable: Estimated Sales per Worker.

Dep. Var:	(1)	(2)	(3)
y_{jt}		$Sales/W$	
$\ln(\text{Mig/pop})^{Primary}_{jt-5}$	0.119***		
	(0.022)		
$\ln(\text{Mig/pop})^{Secondary}_{jt-5}$		0.109***	
		(0.022)	
$\ln(\text{Mig/pop})^{Tertiary}_{jt-5}$			0.062***
			(0.020)
$\ln(\text{GDP/W})_{jt-5}$	0.257***	0.248**	0.395***
	(0.093)	(0.100)	(0.098)
$\ln(\text{pop/Km2})_{jt-5}$	0.427	0.528	0.747**
	(0.331)	(0.327)	(0.316)
$\ln(\text{Airports})^{Km2}_{jt-5}$	0.042**	0.044**	0.046***
	(0.018)	(0.019)	(0.017)
$\text{Crisis}^{t\geq 2008}$	-0.137***	-0.145***	-0.132***
	(0.010)	(0.011)	(0.011)
Constant	8.226***	9.536***	7.940***
	(2.577)	(1.266)	(1.169)
Observations	994	994	994
R-squared	0.703	0.701	0.690

Standard errors clustered at Province Level *, **, *** statistically significant at the 10, 5 and 1 percent level, respectively. All regressions include province dummies, not reported.

$$y_{ijst} = \gamma_k \mathbf{\Gamma}'_{ijst} + \gamma_{jt} * \gamma_{is^{Low}} + \gamma_s + \epsilon_{ijst} \tag{5}$$

where the dependent variable is the log of *sales per worker* and all the covariates are the same as in Equation (4); the only difference is the insertion of the dummy $\gamma_{is^{Low}}$ that identifies the low-tech firms.[21]

Similarly to Section 5.2, the first-stage output of interest for the subsequent analysis is the estimate of $\gamma_{jt} * \gamma_{is^{Low}}$. We define $y^{Low/High}_{jt} \equiv \widehat{\gamma_{jt} * \gamma_{is^{Low}}}$ and this is our measure of low-to-high-tech *relative sales per worker* that we use to estimate Equation (3) from Section 4.[22] As

[21]Since identification is province by year we consider only those cells with at least 10 firms in both high- and low-tech industries. Note that in the AIDA database firms do not change both sectors and province overtime; hence, although firm-specific the dummy $\gamma_{is^{Low}}$ does not contain the province j and the time t subscript.

[22]The analysis has been carried out also for the other dependent variable *relative production per worker*. Results are very similar and available upon request.

in Section 5.2, we use weighted least squares where the weights are obtained from the inverse of the standard errors of the first stage.

Results show the expected effect: an increase in the weight of migrants in the population tends to relatively favor low-tech versus high-tech sectors. Table 8 reports our results: the first column reports the effect of the total migration rate, whereas we show the effects of the different types of migrants in the last three columns.

All the coefficients are highly significant at the common significance levels. The total migration rate has the expected positive effect on relative sales per worker of low-tech sectors and it is higher with respect to the baseline specification. However, the magnitude of the effect is significantly different when considering primary-educated migrants with respect to tertiary-educated ones. More precisely, doubling the ratio of primary-educated migrants raises the low-tech sectors' sales per worker by 17.6% more than the high-tech sectors; the same doubling of tertiary-educated migrants has a 10.2% relative rise in low-tech sectors.

The goodness of fit is higher than 0.72 for all specifications and the other control variables have the expected sign.

Table 8: Estimation for the Relative (Low-Tech vs High-Tech) Sales per Worker.

Dep. Var: $\widehat{\delta_{jt} * \delta_s^{Low}}$	(1)	(2)	(3)	(4)
		$Sales/W$		
$\ln(\text{Mig/pop})_{jt-5}$	0.164***			
	(0.039)			
$\ln(\text{Mig/pop})_{jt-5}^{Primary}$		0.176***		
		(0.041)		
$\ln(\text{Mig/pop})_{jt-5}^{Secondary}$			0.153***	
			(0.036)	
$\ln(\text{Mig/pop})_{jt-5}^{Tertiary}$				0.102***
				(0.034)
$\ln(\text{GDP/W})_{jt-5}$	-0.455**	-0.466**	-0.464**	-0.300
	(0.210)	(0.210)	(0.206)	(0.202)
$\ln(\text{pop/Km2})_{jt-5}$	0.477	0.345	0.538	0.816
	(0.643)	(0.627)	(0.661)	(0.677)
$\ln(\text{Airports})_{jt-5}^{Km2}$	0.058*	0.057*	0.060*	0.061**
	(0.030)	(0.029)	(0.031)	(0.028)
$\text{Crisis}^{t\geq 2008}$	-0.103***	-0.099***	-0.108***	-0.093***
	(0.022)	(0.021)	(0.023)	(0.023)
Constant	7.208***	7.934***	7.128***	5.247**
	(2.005)	(1.975)	(2.097)	(2.084)
Observations	987	987	987	987
R-squared	0.730	0.732	0.729	0.724

Standard errors clustered at Province Level *, **, *** statistically significant at the 10, 5 and 1 percent level, respectively. All regressions include province dummies, not reported. Regression are weighted using the inverse of the standard error of first stage estimation for $\widehat{\gamma_{jt} * \gamma_s^{Low}}$.

6 Concluding remarks

We have proposed a simple empirical model to uncover the possible lagged effect of migration on different measures of firm's performance at the sector-province level and at the province level. We presented results on the level and then distinguishing between high- and low-tech sectors.

When migrants' presence rises in the province, we obtain a general increase in the performance of the average local firm. But the effect is uneven among the sectors. A significant effect is found for the relatively low-tech sectors. This is confirmed also when considering the relative performance of low- to high-tech sectors.

Moreover, non native residents are not all the same. Italy is a very interesting case since its immigration has been highly diverse in terms of nationalities (189 nationalities). We split the non natives in different subgroups according to the education attainment of the different nationalities in order to approximate the different levels of human capital.

An increase in the rate of migrants coming from countries with a higher presence in Italy of low-educated migrants does favor low-tech sectors relatively more with respect to high-tech ones. This is consistent with the old intuition of the Rybczynski theorem of international trade under the plausible assumption that low-tech sectors use production techniques that are intense in low-skill migrants.

Quantitatively, our estimates show that *ceteris paribus* when doubling the presence of migrants over the total population this induces a significant increase in the general performance of average provincial firms – in the order of 9-12 per cent in sales per worker.

Some caveats of our analysis are important to highlight. First, as shown in Figure 1, the rise in non native presence has not been smooth over the years because of the amnesties that occurred since the mid-90s. A further analysis should take into consideration these jumps in the time series.

Secondly, the presence of illegal migrants should be acknowledged. The same jumps in the stock of migrants pinpoint to the non-negligible quantity of this phenomenon. Data on illegal migration are very difficult to obtain, especially at the detailed geographical level needed for

our analysis. We could only infer that some of the variability in our dependent variables cannot be explained by the sole legal migrant ratio. However, illegal migrants are more subject to the phenomenon of brain waste (i.e. under-utilization of their human capital, see for instance Coniglio et al. (2009)) and we can guess that their omission from the analysis would downward bias especially the effect of low-skill migrants.

In conclusion, the increase in the weight of migrants is associated to an increase in general firms' performance. However, this increase is not even and tend to favor low-tech sectors with respect to high-tech sectors.

This evidence should be important in guiding next reforms in the migration law in Italy.

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