Immigrants and Firms' outcomes: Evidence from France *

Cristina Mitaritonna (CEPII)† Gianluca Orefice (CEPII)‡

Giovanni Peri (University of California, Davis)§

October 2, 2014

Abstract

In this paper we analyze the impact of an increase in local supply of immigrants on several firm's outcomes allowing heterogeneous cost of hiring immigrants across firms. Using micro-level data on French manufacturing firms 1995-2005, we show that a supply-driven increase in foreign born workers, who were prevalently skilled, in a French department, increased the revenues per workers and total factor productivity of firms in that department. We also find that this effect was significantly stronger for firms with initially low levels of foreign employment, whose share of immigrants grew faster. The positive productivity effect of immigrants was also associated with faster growth of capital, stronger specialization of natives in communication tasks, larger exports of the firms and higher native wages.

Key Words: Immigrants, Firms, Productivity, Heterogeneity, Export.

JEL Codes: F22, E25, J61.

*We are grateful to participants of CEPII seminar 2012, CEPII-PSE workshop 2013 and ETSG Munich 2014. We thank Matthieu Crozet, Lionel Fontagné and Thierry Mayer for helpful comments. Customs data and DADS database were acceded at CEPII. This work benefited from a State aid managed by the National Agency for Research, through the program Investissements devenir with the following reference: ANR-10-EQPX-17 (Remote Access to data CASD).

†CEPII, 113 rue de Grenelle 75007 Paris. Email: cristina.mitaritonna@cepii.fr.

‡CEPII, 113 rue de Grenelle 75007 Paris. Email: gianluca.orefice@cepii.fr. Corresponding Author (phone: +33 (0)1 53 68 5571).

§Department of Economics UC Davis, One shield Avenue, Davis CA 95616. Email: gperi@ucdavis.edu

1 Introduction

In many industrialized countries entrepreneurs and employers are among the strong supporters of more open immigration policies.[1] This may be because immigration helps to keep wage of workers low cutting their costs. Alternatively it may be because immigrants supply skills complementary to those of natives and allow for efficient specialization, and higher firm productivity, especially if they are highly skilled (e.g. Docquier et al 2014, Peri et al. forthcoming). This paper, using French firm-level data, analyzes the effect of immigration on firm-level revenues and productivity during the decade 1995-2005. Some recent papers have found indirect evidence that local availability of immigrants may benefit productivity. Specialization of immigrants in tasks complementary to those performed by natives (Peri and Sparber, 2009) may increase the productivity and revenue per worker of firms. On the other hand there is evidence that highly skilled foreign individuals, especially if working in science and technology, contribute substantially to the innovative output and productivity of a region or a city (Kerr and Lincoln, 2010, Peri et al, forthcoming). There is however scant direct empirical evidence on the impact of immigrants on firms' productivity and revenues due to limited data availability. Moreover, when analyzing the impact of immigration at the firm level, one has to account for the vast firm heterogeneity and for the fact that changes of immigrant supply are a local labor market phenomenon and not a firm-specific phenomenon. Indeed, different firms may respond in different ways to changes in the local immigrant supply, but one has also to acknowledge that the presence of immigrants in a firm may be correlated with (and explained by) differences across them (in productivity and industrial specialization) and hence it cannot be considered as changing exogenously.

Our approach in this paper is to use new data on French manufacturing firms and an identification strategy based on local "area" (French Departments) variation in the supply of immigrants and firm-specific response to such changes, due to firm heterogeneity. The differential response of firms in hiring immigrants can be interpreted as driven by differential cost of hiring. The data have several advantages, in that they allow us to construct multiple outcomes at the firm level (value added per worker, productivity, export, average wages, capital) in a genuine panel of firms, that can be followed over the period 1995-2005.[2] However they also have some limitations, in that they allow us to identify foreign-born individuals in firms and their occupation but not their country of origin or their education. Hence we consider foreign-born workers as one group, which we show to be highly skilled in aggregate, and we instrument their local change in supply with a shift-share instrument based on pre-existing immigrants' location and aggregate flows, *à* la Altonji and Card (1991). We are aware of the limitation of this instrument and hence we check that at least it is uncorrelated with initial (1995) economic

[1] As an example, in March 2013 tech industry groups (such as IT Industry Council, the Silicon Valley Leadership, and others) in a letter addressed to President Obama (full text here: http://fr.scribd.com/doc/130388692/Tech-CEO-letter) argued for the need of immigration reforms that would allow the entry of more high-skilled immigrants (H1-B visa).

[2] Because of data availability for firms' TFP and value added in 1995, our estimation sample restricts to the period 1996-2005. See the data section for more details.

conditions across French Departments that could correlate with economic growth and we control for several firm-level characteristics.

We show, based on aggregate statistics relative to their occupational distribution, that the net immigrant inflow in France during this period was skill-intensive. The employment of foreign-born, increased much more in occupations with high cognitive and analytical content (based on the O*NET definitions) than in those with high manual content. Moreover, the share of immigrants with high school diploma (or lower) decreased over the period from 74% in 1995 to 58% in 2005 and those with more than 3-year university diploma grew from 9% to 14% of the foreign population. Hence, the finding of this paper, should be interpreted as documenting the effect of skill-intensive immigration inflows on firms outcomes. Let us also notice that while the initial stock of immigrants as of 1995 (in large part from North Africa) was not very skilled, and largely concentrated in manual type of occupations, the net change between 1995 and 2005, that provides identification to our analysis, was much more skill-intensive and fueled by immigration from Eastern and Western European countries.

After presenting some stylized facts about immigration in France between 1995 and 2005 and its distribution across skill groups and French departments, we sketch a simple model that features firms with a distribution of unit costs of hiring immigrants and includes a simple productive complementarity between (less skilled) natives and (more skilled) immigrants. Firms can potentially access two technologies, one employing only natives and one employing both native and immigrants, paying a cost to hire them but benefiting from their complementarity with natives. Such a model produces an important differentiation between firms hiring immigrants and firms not hiring them. The model produces several predictions on the effects of an increase in the immigrant supply (accompanied by a decrease in their wages) on firms' share of immigrants and revenue per worker. Intuitively, the model shows that those firms that did not hire immigrants at the beginning of the period of analysis (as their hiring cost were too high) realized the largest gains if the increase in supply pushed wages of immigrants below their "hiring" threshold. The model suggests that there is a cost threshold, depending on the wage of immigrants, and firms with costs lower than such a threshold will hire immigrants (rather than only natives) and they realize larger surplus. When the supply of immigrants increases at the local level, some firms are pushed below the threshold and hire immigrants for the first time realizing the largest productivity gains. In general all firms hiring immigrants increase their surplus as immigrant supply increases, but the largest effect will be for those with initially low shares of immigrants.

Our empirical approach then shows that a supply-driven increase in immigration in a department raises the share of immigrants hired by firms as well as the share of firms hiring immigrants. Confirming the predictions of our simple model we find that the largest increase in immigrants as share of employment is for the subset of firms that had initially no immigrants (or a very small share of immigrants) and ended the period with some immigrants. Then we show that firms with low (or zero) initial shares of immigrants experienced the largest positive productivity effects associated to hiring immigrants. These results are consistent with the cost-reducing role of immigrants combined with a heterogeneous cost of hiring them across firms. We also explore whether other outcomes, related to the productivity of firms, were affected by hiring immigrants. We identify significant positive effects on exports and on the level of capital used by firms. Even for these outcomes, in most cases, the strongest effect is for firms starting with no immigrants. These additional results are consistent with the idea that the productivity gains are driven by skill-complementarieties and skill-capital complementarity from immigration. Improved export performance is also a result of that. We also show that there is no evidence of a decline in native wages in the firm as consequence of immigration. Rather, as a consequence of higher productivity, native wages increase. These effects are consistent with our model and are not consistent with a scenario in which native and immigrants are substitute in production as in that case productivity should not be affected, capital intensity should decline and native wages should decline.

The rest of the paper is organized as follows. Section 2 puts this paper in the context of the existing literature. Section 3 sketches a simple model and derives some testable implications. Section 4 discusses the empirical specifications and the identification strategy and limitations. Section 5 presents the data and the summary statistics. Section 6 describes and comments on the estimates of the effects of immigration on firm outcomes. Section 7 concludes the paper.

2 Literature Review

While there is an abundance of studies about the effect of immigrants on the labor market outcome of natives ranging from the national level (e.g. Borjas 2003, Borjas and Katz 2007, Ottaviano and Peri 2012) to the area studies (such as Card 2001, 2009) and using data from several different countries [3] (see also the recent literature reviews by Longhi et al (2005) and Kerr and Kerr (2011)), much less is known about the firm-level effect of immigrants. Some aggregate studies suggest interesting mechanisms through which immigrants may be absorbed within firms, by adjusting the task specialization of workers (Peri and Sparber 2009, Ottaviano Peri and Wright 2013) only few recent studies tackle this issue with actual firm level data.

Malchow-Moller, Munch and Skaksen (2012) using Danish firms data find that immigrants strongly substitute for natives within the single firm. Differently Martins, Piracha and Varejao (2012) on Portuguese data find no effect of immigrants on the employment of natives at the firm level. These studies focus only on the wage and employment effect of immigrants. Importantly, however, these studies do not distinguish between an increase in immigrant supply at the regional level and at the firm level. While one can identify an exogenous shock (driven by aggregate country-specific flows) of immigrants into an area, it is very hard to think that the increase in the

[3] Some countries are particularly studied such as Germany (De New and Zimmermann 1994) and the UK (Dustmann, Fabbri and Preston 2005). A recent paper looking at the labor market effect of immigrant in France is Edo (2013) .

share of immigrants at the firm level is simply "supply-driven" and not correlated, that is, with observable and unobservable characteristics of the firm. Spelling out the details of how the share of foreign-born employment in a firm is related to the local labor market supply and how it is related to firm's choice and characteristics is crucial for a correct identification and it is not done in the papers listed above. Similarly Hatzigeorgiou and Lodefalk (2011), and Hiller (2013) analyze the effect of immigrants on the firm-level export, relying on a simple reduced-form empirical specification that correlate firm-immigrants and firm exports.

Recent studies suggest that immigrants may produce a change in the local supply of specific skills, as they are often concentrated in some specific jobs. Productivity gains from immigration have been found across US states by Peri (2012). That paper shows that one cause for those productivity gains from immigration was the specialization of native workers into communication-intensive tasks in which they have a comparative advantage and which are complementary to tasks performed by immigrant workers. More recently Peri et al (forthcoming) have emphasized that highly skilled immigrants in STEM jobs may increase productivity of US cities, especially for college educated workers. Only few very recent studies (e.g. Trax et al 2013) began to analyze the correlation between skilled immigrants and firm productivity.

Very little attention has been devoted in the literature to the fact that a large share of firms does not hire any immigrant even in regions with very large immigrant presence. For instance, about 40% of firms do not hire any immigrant in our sample. On the other hand some firms hire a very large share of immigrants. Immigrants, that is, just as exports (e.g. Bernard and Jensen 1999), are distributed very unevenly across firms. In our sample, in 2005, 10% of the French firms employed 88% of the total migrant workforce. This suggests that there may be heterogeneous costs associated with hiring immigrants as well as benefits that accrue to the firm if it hires immigrants up to a certain scale. It makes sense to think that these costs may be related to the fact that information about immigrant workers is harder to read by firms and that integrating immigrants in production may require some basic arrangements (e.g. to improve communication) that some firms do not have in place. On the other hand for firms that have low cost of hiring immigrants, (because they are better connected into their information network), the access to their skills may generate productivity gains. The presence of fixed costs and firm heterogeneity has been very much at the centre of the recent models of international trade (Melitz 2003, Bernard et al 2003). A large share of the manufacturing firms do not trade abroad, only larger and more productive firms do and the productivity effects of trade openness is in large part that of selecting higher productivity firms by increasing their advantage. Our paper moves some steps in the direction of thinking about immigration within the context of firms with heterogeneous costs of hiring immigrants. Namely we combine the idea of complementarity between natives and immigrants at the firm level, especially due to their different skill distribution (e.g. Ottaviano and Peri, 2012) with the presence of heterogeneous costs of hiring immigrants at the firm level. Both the theoretical and empirical literature in the area of immigration and the firm are in their infancy. A recent paper by Haas and Lucht (2013) uses a general equilibrium model with heterogeneous firms (Melitz 2003) where migrants imperfectly substitute for native workers and firms differ for their productivity levels; simulation results show that: (i) natives over migrants wage ratio increases with the immigrants share in the firm; (ii) firm productivity increases with the immigrants share in the firm. Trax et al (2013), mentioned above, is one of the few examples, to our knowledge, of empirical analysis of the impact of the country-of-birth diversity on plant productivity. Certainly with the increased availability of firm-level data it will become more common to focus on the theoretical and empirical analysis of immigration and the firm. This paper begins to think more rigorously about theoretical and empirical approaches.

3 Theoretical Framework

This section provides a simple intuition, based on a partial equilibrium model, of the impact of a decrease in the cost of immigrants (due to an increase in their local supply) on firms' immigrant share in employment, and on their revenue per worker. The model combines two key ingredients: complementarity between natives and immigrants (that we justify below by documenting the different skill and occupational distribution of natives and immigrants) and the existence of heterogeneous unit costs of hiring immigrants across firms. Along this cost distribution we identify a "threshold firm" separating a set of firms hiring and a set of firms not hiring immigrants. These ingredients deliver some key empirical implications. We formalize them in the simplest way possible, aware that this is not the only possible rationalization of some of the empirical regularities we test. Still the model sketched here is consistent with some important stylized facts an is useful to organize some empirical findings .

Consider a fixed number of firms in a region (sector-region) producing a homogeneous good y using local workers who can be native (indicated as n) or immigrant (indicated as m). The simplest version of the model is obtained when these firms are homogeneous in their technological productivity indicated by the parameter θ. They face, however, a heterogeneous unit cost of hiring immigrants. Those workers are harder to hire or train because of visa, language and screening issues and different firms have different experience/exposure to them and hence different efficiency in dealing with those costs. For instance, while domestic employers may have good information about the ability of native workers, they do not have perfect information about the ability of immigrant workers. But some firms, because of networks or connections have better information than others. Hence the unit cost of hiring immigrants, f_i, is assumed to be firm-specific. In order to obtain analytical solutions for our qualitative results we assume that firms' hiring costs are distributed uniformly along the interval $[0, \Theta]$. Once hired, immigrants are used as an additional input in production and we assume that they are complementary to natives. Such complementarity can be driven by their different education levels[4],

[4] In our sample, foreign born are - on average - relatively more educated than natives. Over the period 1995-2005 the ratio between

different production skills or different specialization (foreign-born tend to take more technical jobs and less communication-intensive ones, e.g. Peri and Sparber, 2011). The production function below accommodate any degree of imperfect substitutability between natives and immigrants, depending on the value of the elasticity σ. Hence the production function of firm i is:

$$\begin{aligned} y_i &= \theta \left(n_i^{\sigma} + m_i^{\sigma}\right)^{\frac{1}{\sigma}} \text{ if } m_i > 0 \qquad (1)\\ y_i &= \theta n_i \text{ if } m_i = 0 \end{aligned}$$

The terms n_i and m_i are the input of Natives and Immigrants in production of firm i. The term θ captures total factor productivity. The parameter $\sigma < 1$ is a production parameter determining the elasticity of substitution between immigrants and natives. With only two factors in production the increase in one factor's price decreases its demand and increases the demand for the other unless they are perfect substitutes ($\sigma = \infty$). As described above, in order to hire immigrants, and use the production function with two factors, a firm has to pay f_i per unit of output, capturing screening, processing or information costs, that exist for immigrants and not for natives and vary across firms.

Firms take the wage of natives, w_N and immigrants w_M as given and determined in the local labor market (partial equilibrium approach) and they minimize the cost of production. Assuming good y as the numeraire, the unit cost minimization subject to the production function in (1) yields a unit cost equal to:

$$\begin{aligned} \frac{\widetilde{w}}{\theta} + f_i &= \frac{\left(w_N^{\frac{\sigma}{\sigma-1}} + w_M^{\frac{\sigma}{\sigma-1}}\right)^{\frac{\sigma-1}{\sigma}}}{\theta} + f_i \text{ if } m_i > 0 \qquad (2)\\ \frac{w_N}{\theta} \text{ if } m_i &= 0 \end{aligned}$$

where $\widetilde{w}$ is the geometric average of the wage cost for natives and immigrants which is the solution to the unit cost minimization problem of the firm when it has access to both types of worker[5]. Hence let us define the threshold cost as:

$$\overline{f} = \frac{w_N - \widetilde{w}}{\theta} \qquad (3)$$

Then, for firms whose hiring costs f_i are smaller than the threshold $\overline{f}$ the unit cost of production is minimized

tertiary educated immigrants (over the rest of immigrants) increased by 6.1 percentage points, while the same ratio increased only by 3.9 percentage points for natives. We thank Ahmed Tritah and Joachim Jarreau for providing us such aggregated statistics based on the *Enquete Annuelle* by the INSEE.

[5]The problem is : $\min_{n_i, m_i} \left(w_N n_i + w_M m_i\right)$ subject to $\theta \left(n_i^{\sigma} + m_i^{\sigma}\right)^{\frac{1}{\sigma}} = 1$.

by using the option of employing immigrants too and hence they hire immigrants. Notice that for any firm to hire immigrants we need $w_N > \widetilde{w}$ which implies that immigrant wages should be lower than native wages (a condition that we will test in the data in section 5.3). Moreover the threshold is a decreasing function of w_M. As w_M decreases for given w_N, so does the unit cost $\widetilde{w}$ and hence the threshold increases and more firms hire immigrants. For those firms that hire immigrants the solution to the minimization problem above, also implies that the optimal ratio $\frac{m_i}{n_i}$is equal to $\left(\frac{w_M}{w_N}\right)^{\frac{1}{\sigma-1}}$ so that the optimal share of foreign-born in employment, $(sh\_for)_i^*$ for firm i is:

$$(sh\_for)_i^* = \frac{m_i}{m_i+n_i} = \frac{\left(\frac{w_M}{w_N}\right)^{\frac{1}{\sigma-1}}}{1+\left(\frac{w_M}{w_N}\right)^{\frac{1}{\sigma-1}}} \text{ if } f_i < \overline{f} \tag{4}$$
$$(sh\_for)_i^* = 0 \text{ if } f \geq \overline{f}$$

The first part of condition (4) implies that in this simple model the share of immigrants $(sh\_for)_i^*$ increases as the wage of immigrants decreases for given wage of natives (recall that $\sigma < 1$). Moreover also the share of firms hiring immigrants, $sh_{(imm>0)}$which equals $\overline{f}/F$ increases as the wage of immigrants decreases for given wage of natives

If native workers are perfectly mobile across firms and have no market power, their wages are pinned down by their productivity in the firms with no immigrants and hence $w_N = \theta$. Hence, firms producing with the one-factor technology (natives only) have 0 profits. We also assume that immigrants are mobile across firms and have no market power, and hence they are paid their marginal productivity. Hence the profits of firms using both types of workers, per unit of output, will be: $\pi_i = p_i - (\frac{\widetilde{w}}{\theta}) - f_i$. Substituting $p_i = 1$ (numeraire) and $w_N = \theta$ which implies $\widetilde{w} = \theta(1-\overline{f})$ we can write the profit for firm i we get:

$$\pi_i = \overline{f} - f_i. \tag{5}$$

Expression (5) shows that the firm with costs of hiring immigrants exactly equal to $\overline{f}$ will have 0 profits (as those hiring only natives). Our simple model generates profits per unit of output that increase linearly as the unit costs of hiring immigrants decrease. Firms that are more efficient in hiring immigrants (low f_i) will enjoy larger unit profits and employ a positive share $(sh\_for)_i^*$ of immigrants. Notice also that in our simple model profit per unit of output in a firm is a measure of revenue net of cost per unit of output.

From conditions (4)-(5) we obtain the following predictions.

- Prediction 1: A decrease in w_M (due to an increase in the supply of foreign-born in the region) will decrease $\widetilde{w}$ and hence it will increase the threshold (straightforward from equation 3) and and hence the share of firms in the region hiring a positive number of immigrants, $sh_{(imm>0)}$ will increase.

- Prediction 2: A decrease in w_M will also increase the share of immigrants hired by each firm with positive immigrant share (see condition 4) as $(sh\_for)_i^*$ depends negatively on the ratio $\frac{w_M}{w_N}$. This effect is larger for those marginal firms with originally no immigrants. They will go from 0 to $(sh\_for)_i^*$ while the other firms will experience a marginal increase in $(sh\_for)_i^*$.

- Prediction 3: A decrease in w_M will increase the profits per unit of output of firms that hire immigrants (see expression 5). The profit per unit of output are revenues net of costs and represents the surplus of each firm hiring immigrants,

- Prediction 4: This effect will be stronger for firms that move from 0 immigrants to positive values will also experience a substantial increase in their surplus from an initial value of 0.

While our model is partial equilibrium and very simple it provides some predictions that are straightforward consequences of the complementarity between native and immigrants and of the existence of a fixed costs in hiring immigrants, which is heterogeneous across firms. In our empirical analysis we will test the impact of an exogenous increase in the local supply of immigrants which reduces their wages on surplus and performance of a firm.

First, we will check whether, as predicted in the model above, a positive immigration shock increases the share of immigrants in some firms, decreases the share of firms with no immigrants, and has the largest effect on firms with initially zero (or extremely low) shares of immigrants (Prediction 1-2). Then we check whether the increased supply of immigrants in a region increases the value added per worker (surplus) of firms and whether this effect is stronger for firms with initially very few (zero) immigrants. Finally, departing from the letter of the model, but keeping the spirit, we test whether other features of production often associated with higher value added per worker are also responding to the inflow of immigrants such as capital intensity and the export of the firms both in terms of values sold (intensive margin) and number of markets (extensive margin).

4 Empirical Framework

Our empirical strategy tests the predictions of our simple model. The empirical specifications, however, are quite general and go well beyond the model as we test the effect of immigration on outcomes not included in the theoretical analysis but linked to value added per worker. The goal of the empirical analysis is to help us understand the response of firms' outcomes to inflows of immigrants in the local labor market. In particular we set up an empirical model that, controlling for firm heterogeneity, analyzes the response of firm outcomes to local immigration shocks. We also allows firms that initially had very few (or zero) immigrants to respond to these shocks in different way than the rest. The rationale for this heterogeneous effect is that firms with very few immigrants, after a positive labor supply shock in the region, can afford the cost for hiring them and move to the "better" technology that employs a mix between native and immigrants. Notice that while in the model we assumed that the two types of technology have the same total factor productivity (θ) so that the only gain in moving to the immigrant-hiring technology is represented by the savings in unit costs, in reality the switch to that technology can also imply higher productivity $\theta_I > \theta_N$ because of specialization (Peri and Sparber 2009), or due to positive externalities from more skilled immigrants (Moretti 2004, Peri et al 2014). This may imply a further boost to revenues per worker. Hence we will test the effect of immigration on value added per worker as well as on total factor productivity of the firm.

Our framework allows us to emphasize that the area-level change in immigrants, appropriately instrumented, can be considered as a supply shock, exogenous to the firm. However the change in the firms' employment share of immigrants is the result of an interaction between this shock and the characteristics of the firm (heterogeneous cost of hiring immigrants). Hence, different departments provide variation in the intensity of the supply-shock while different firms within the department provide heterogeneous responses to it. The few previous studies on the impact of immigrants at the firm level (e.g. Malchow-Moller, Munch and Skaksen, (2012), Martins, Piracha and Varejao (2012)) have combined the heterogeneity of firm responses and the variation of immigrant shock across localities by analyzing the response of firm outcomes to changes in the firm's employment share of immigrants. This may confound the intensity of the local shock with the type of firms on which the shock has the strongest effect.

The trade literature has also related export shocks to wage (productivity) effects in the firm. In that context (e.g. Hummels et al 2013) it makes sense to consider a firm-specific export (or import) shock, because the differences in export/import markets of firms make them differentially vulnerable to the growth of those markets, even for firms located in the same area. To the contrary as immigration shocks are changes in the local availability of immigrant workers they are common to all establishments in a labor market. Then individual firms can respond differently according to their differential cost of hiring immigrants (as shown in the model) and this is what we allow.

Our baseline empirical model is as follows:

$$(y)_{i,s,d,t} = \phi_i + \phi_{s,T} + \phi_{r,T} + \beta_1 \left(s_{d,t}^{IMMI}\right) + \beta_2 (s_{d,t}^{IMMI})_{d,t} * I_i \left(fs_{i,1995}^{IMMI} \leq p\right) + \beta_3 X_{i,t} + \varepsilon_{i,t} \quad (6)$$

Where i indicates the firm and $(y)_{i,s,d,t}$ represents an outcome relative to firm i in sector s, department d and year t. Our sample includes the universe of manufacturing firms in France[6] between 1995 and 2005 hence the

[6]As described in the data section, we however rely on manufacturing firms with at least 20 employees, i.e. firms for which we have balance sheet data from EAE.

index t takes values between 1995 and 2005. The term ϕ_i indicates a set of firm fixed effects, meant to capture all the unobserved firm specific factors affecting the outcomes of firms [7] (its ownership, management, and brand characteristics). The terms $\phi_{s,T}$ and $\phi_{r,T}$ are respectively sector-by-period and region-by-period fixed effects (one region is the union of 4-5 departments according to the French administration) and are meant to control for unobserved region and sector specific (time variant) variables at a frequency of T years where $T = 2$[8]. In particualr they could capture local agglomeration effect or sector-specific technological changes. Those effects are more demanding than region and sector time trends but less than region-year and sector-year effects. As one period lasts two years those fixed effects fully absorb any change in French labour market legislation and/or sector technologies that evolves slowly.[9] The reason we are unable to introduce region-year effects is that they absorb most of the variation of our instrument, making IV estimation too weak. We will partially obviate to that by showing several robustness checks about these fixed effects (see Appendix table A7).

The term $X_{i,t}$ captures a set of firm-specific time-varying controls including the head-quarter dummy (being one if the firm is the head-quarter of a group), a foreign affiliate dummy (being one if the firm is an affiliate of a foreign multinational firms) and the firm age. The explanatory variables of interest are $s_{d,t}^{IMMI}$ that measures the share of immigrant population at time t in the district d, where the firm is located [10], and the interaction between that variable and the dummy $I_i\left(fs_{i,1995}^{IMMI} \leq p\right)$ which is equal to 1 if $fs_{i,1995}^{IMMI}$, the share of immigrants in firm i as of 1995, was below or equal to a threshold p at the beginning of the period, in 1995. We consider alternatively a threshold p equal to 0, identifying firms with no immigrants in 1995, or p equal to the median value in the firm distribution, identifying firms with few immigrants in 1995. The change of immigrant share $s_{d,t}^{IMMI}$ captures the district-level change in immigrants, while the dummy $I_i\left(fs_{i,1995}^{IMMI} \leq p\right)$ allows firms that initially have a low share (or no) immigrants to respond differently in their outcome, to such a shock. $\varepsilon_{i,t}$ is a random error not correlated with the dependent variables.

We analyze six outcomes, $(y)_{i,t}$ at the firm level. They are the share of foreign-born in employment, the logarithm of value added per worker, the log of total factor productivity (TFP), the logarithm of the capital stock, an index of specialization of natives in communication-intensive occupations and the logarithm of exports. The model illustrated in section 3 predicts that firms with no (few) immigrants in 1995, would increase their share significantly more than firms that already had lot of them (effect of fixed costs) if the supply of immigrant moves those firms from above to below the threshold cost. Those firms will also experience larger increase in

[7] In our sample each firm belongs to a specific department-sector over the entire period. For multi-plant firms operating in several sectors and regions, we keep the sector and the department of the biggest plant (in terms of total number of workers)

[8] Two-year period fixed effects means that we have a dummy variable for a given region (or sector) every two years. We run several robustness checks by changing the duration of the period and results hold. See appendix table A7 for TFP estimation results using respectively three and five year lasting period definition.

[9] One important shock in the French labor market might be represented by the EU enlargement toward Easter countries in 2004 (free mobility of workers within EU). Although our period fixed effects control for this shock, France implemented the free mobility of people from Eastern countries only in 2008, so out of our sample.

[10] We consider the 93 non-overseas departments of France for which we have data on 1990 stock of migrants by the INSEE Population Census (needed to compute our instrumental variable). Thus the explanatory variable of interest, takes 1023 different values (93 departments by eleven years).

value added per worker, and, in the case in which the productivity of the technology with immigrants is higher ($\theta_I > \theta_N$), they would experience higher productivity gains, and possibly higher values of other productivity related outcomes (exports, native wages). These predictions of the model would imply a positive and significant β_1 and β_2 coefficients for all of the outcome variables described above. We run specification 6 on all firms that have at least one immigrant by the last year of observation to distinguish the overall effect of an increase in immigrant supply from the specific effect on firms with low (or no) initial presence of immigrants.[11] Then, as robustness check, we run the same equation as in (6) on the full sample of firms.

4.1 Identification issues and Instrumental Variables

Estimating equation (6) using least square methods, even as we include fixed effects for firm-specific, region-period and sector-period specific unobservable variables, leaves open the possibility that some omitted local conditions may affect simultaneously the demand of immigrants and the productivity/labor demand of firms. District-specific yearly shocks, not observable to the researcher, may drive a positive correlation between the residual of the productivity equation, $\varepsilon_{i,t}$ and the explanatory variable $s_{d,t}^{IMMI}$. In our setting the omitted variable concern seems more severe than the reverse causality problem as the unobserved productivity shocks of an individual firm, do not have a significant impact on the district's economic outcome which is much larger. In order to identify the part of the change in the immigration share at the district level that is driven by supply changes rather than by local productivity shocks we use the shift-share instrument based on initial spatial distribution of immigrants. Pioneered by Altonji and Card (1991) and then used in several studies since, (such as Card (2001), Card (2009), Peri and Sparber (2009), Lewis (2013) among others) this approach is based on the idea that new immigrants tend to move to the same area (French department in this case) where previous immigrants from the same country of origin already live and have established a community[12]. This is because they know of opportunities in those location from the network of immigrants and because they enjoy the amenities of living with their co-nationals. These reasons to co-locate are driven by preference and information and not by demand shocks. Hence, we use immigrants in each French department as share of total immigrants in 1990 (from INSEE Population Census), and we then apply the growth rate in the total number of immigrants in each year proportionally to that share obtaining an imputed number of immigrants in each department, which we call $\widehat{IMMI}_{d,t}$ and is calculated as follows:

$$\widehat{IMMI}_{d,t} = \frac{IMMI_{d,1990}}{IMMI_{France,1990}} * IMMI_{France,t}. \tag{7}$$

[11] As a robustness check we use a different sample composed by firms that have at some point hired one immigrant. Results, available under request, do not change.

[12] In our data we have no info on the country of origin of migrants to compute the country-specific imputed number of migrants, hence we implement the instrument for their aggregate.

$IMMI_{France,t}$ is the stock of foreign-born individuals working in France at time t in the manufacturing and service sector. These data are obtained from DADS data (see section 5.1 below). Notice that we include the total stock of migrants working in both service and manufacturing sectors, while we focus on manufacturing firms only in estimating equation (6). This improves the exogeneity of our instrument as manufacturing-specific shocks in a region should not affect the aggregate flows. As a robustness check (reported in column 7 of tables 5-10) we use the total stock of migrants in France (which includes also non-working migrant population) at time t from OECD data. This is available only after 2001. We then computed the imputed share of immigrants in the department as follows:

$$\widehat{s_{d,t}^{IMMI}} = \frac{\widehat{IMMI}_{d,t}}{\widehat{IMMI}_{d,t} + Natives_{d,1995}} \tag{8}$$

In the imputed variable (8) the population growth of natives in the department (which is also potentially endogenous) does not enter as native population, in the computation of the share, is fixed at year 1995. The instrument captures the idea that departments with a large initial share of immigrants (as of 1990) are likely to attract a larger share of the *new* immigrants because of network effect and family reunion of migrants from year 1996 (as described in the next section, we estimate equation 6 on the period 1996-2005). The implicit assumption is that the distribution of immigrants in 1990 across departments is uncorrelated (or weakly correlated) with the distribution of demand shocks in the department from 1996 on, once we have controlled for firm fixed effects and region and sector-by-period fixed effects. The potential concerns for this type of instrument is that the 1990 distribution of immigrants across department is correlated with some economic conditions that affect subsequent growth of productivity and employment. To mitigate these concerns in section 5.4 we test that the instruments are not correlated with initial economic conditions of the departments. Unfortunately we cannot test (due to lack of data) that they are uncorrelated with their trend preceding 1995. While we should be cautious in interpreting the results, our strategy and instruments are standard in this literature and the robustness and consistency of our findings is reassuring.

5 Data and preliminary correlations

5.1 Sources and summary statistics

In constructing firm-level variables we merged several data sources. First, the DADS (Declaration Annuelle des Donnetes Sociales) database consists of administrative files based on mandatory reports on the employees' earnings and characteristics made by French firms to the Fiscal Administration. DADS data contain yearly information about the structure of employment for each establishment in France[13]. Each single observation in this dataset corresponds to a unique establishment-year. At the establishment level DADS provides information on the geographical location and the industry of the establishment, as well as the identification number for the establishment (SIRET) and for the parent enterprise (SIREN). In terms of employees characteristics, we have information on the gender, age, place of birth (native vs. foreigners), total gross and net earnings during the year, number of hours worked and occupation (both at two-digit CS and four-digit PCS-ESE classification). Individual employees are not linked across years but establishments are, hence we can construct the characteristics of employees by firm (SIREN) each year. In order to define the skill of workers, we use information on their occupation. We then combine measures from the O*NET database that associates the intensity of a number of skills to each occupation in the Standard Occupational Classification (SOC). Cross-walking this classification with the occupational structure provided by the DADS (by merging both into the 1988 International Standard Classification of Occupations, ISCO -88)[14] we can construct an indicator of the complexity and communication-intensity of tasks performed by workers to show how immigrants are specialized in relatively complex jobs and native in communication-intensive ones. We follow Peri and Sparber (2009), and we focus on the dichotomy between communication and manual tasks, to classify jobs along the communication-intensity spectrum[15] (see Appendix table A9 for details on occupation classification). Once we have associated our communication and manual intensity measure to an occupation, we construct the measure of communication/manual intensity for native workers at the firm level. To construct the variables on firm outcomes we also use two additional data sources that covers the whole manufacturing sector. The trade variables used are from the Custom dataset, which provides records of all the French firms exporting goods during the period 1995-2005. Exports - quantity in tons and values in Euros - are available by firm, year, product (identified by an 8 digit code corresponding to the NC8 nomenclature) and the country of destination[16]. The other source we use is the Annual Business survey (EAE). It gives us balance-sheet data information (e.g. value-added, sales, value of the assets included in the capital stock , use of intermediate goods) necessary to compute revenues per worker, capital and total factor productivity. EAE data are available for the period 1995-2007. Matching all these sources together, using the SIREN identification number, we got an unbalanced panel dataset over the period 1995-2005.[17] However, some

[13]This database includes different units organized by year and region (12 years- 24 regions) which implies that 288 separate databases with more than 50 millions of observations by year were merged.

[14]For a detailed description of the procedure adopted to merge occupations and calculate the occupation-specific skill intensity see the Appendix A.3.

[15]For the definition of manual skills we average 19 O*NET variables capturing an occupation movement, coordination and strength requirements. For the communication intensity index we average 4 O*NET variables considering oral and written expression and comprehension. For the cognitive task we use 10 O*NET variables capturing the analytical skills used.

[16]For the number of products exported one needs to account for the fact that the product nomenclature changes over time during the period considered. To avoid the problem of mistaking a change in code for a change in product we harmonized the product nomenclature in the dataset, expressing all export and imports at the HS6 1996 revision.

[17]A standard concern in firm level (unbalanced) panel is that we observe only surviving firms. In our framework, the arrival of new immigrants in the department might change the toughness of competition among firms in the same area implying a survivor bias in our estimation. To check for this potential bias, we re-estimate all our regressions on a balanced dataset including firms which are present over the entire period. Results do not change. As a sample of this robustness check, in table A8 we show results on TFP using balanced database.

of the variables needed to compute the TFP measure (and per capita value added) have missing information in 1995, for this reason our estimation sample in tables 4-11 (and A4-A8) is restricted to the period 1996-2005. See appendix section A1 for further details on data coverage. Finally the data about the immigrant and the native population in each department each year are from (department-year) aggregation of DADS individual data. Thus we obtain the total number of immigrant and native workers in the department in the year t. The share of immigrants across department in 1990 (used to build our instrument) come from INSEE Population Census. The summary statistics of the outcome variables and of the share of foreign-born at the firm level are reported in Table 1.[18]

5.2 Immigrants skills and their distribution

Let us describe more in detail some characteristics of immigrant workers in France in order to corroborate the idea that their net inflow was relatively skilled and unevenly distributed across departments, during the 1995-2005 period. First, Table 2 shows that, while immigrants in low complexity occupations (measured as low value of the complexity/manual O*NET index of the occupation) constituted a larger share of total hours worked than immigrants in high complexity occupations as of 1995, their inflow between 1995 and 2005 was much larger among the high-complexity than among the low-complexity group. The table shows that the top 10 occupation by complexity index increased the percentage of immigrants in total hours worked by 9.7 percentage points, while the share of hours worked by migrants among low complexity occupations increased only by 2.6 percentage points. Similarly, distinguishing production (blue collar) and non production (white collar) manufacturing workers, the first group's share of immigrants increased by only 2.5 p.p. during the decade 1995-2005 while the second group increased by 9.3 p.p. Figure 1, shows the percentage composition of immigrants in France (form the IEB dataset) from 1980 to 2010, by schooling degree. While the largest group is that of primary educated immigrants, their share has been declining fast, especially in the most recent 15 years, while college educated immigrants have been growing fast (the top share in the bar chart) immigrants. Finally, over the period 1995-2005 the share of immigrants with high school diploma (or lower) decreased from 74% in 1995 to 58% in 2005. Consistently, the share of immigrants with at least a three-year university diploma went from 9% in 1995 to 14% in 2005[19]. It is therefore fair to characterize the immigrant net flow into French manufacturing during the 1995-2005 period as skill-intensive.

A second interesting feature of the inflow of immigrants in France is their very uneven cross-regional distribution. First, the considered period is one of significant increase in the foreign-born population in France (from about 6% in 1995 to 12% in 2005 of the population). Second, different regions had very different exposure to immigrants. Some regions (as Champagne-Ardenne and Lorraine) maintained a low exposure to migration

[18]The correlation matrix among the variables is reported as Appendix Table A1.
[19]The educational composition of immigrannts is also showed in table A3 of the Appendix.

over the entire period; while other regions consistently increased their exposure to migration over time. As an example, the region Nord-Pas-de-Calais had an immigrants share equal to 6.3% in 1995 and that became equal to 16% in 2005 (with an average yearly growth rate by 25%). Other regions simply reinforced their immigrants exposure over the period; for example Ile-de-France and Rhone-Alpes already had relatively high immigrants shares in 1995 (respectively 10% and 9.6%) which increased significantly by the end of the period (to, respectively 21% and 18% in 2005)[20].

5.3 Preliminary correlations

Let us describe here some simple correlations existing in the data that are consistent with what we would expect based on the simple model that we described in section 3. First, that model predicts that firms with initially higher share of immigrants have lower costs of hiring them and hence should have higher revenue per worker. In our data the correlation between firm immigrants' share in 1996[21] and value added per worker, controlling for sector and region fixed effect was 0.121 with a standard error of 0.053. Hence in the first year of our data we did observe the positive correlation implied by our model. Second, our model predicts that firms hire immigrants, even if they have the same productivity as natives, because of their lower wage (unit cost). Several papers (reviewed in Kerr and Kerr 2011) document that immigrants are paid less than native workers with similar characteristics. In our data, averaging the wage of immigrants and the wage of natives by French department we find that immigrants had lower wages and often the difference was in the order of 20-25%[22].Third, we calculated the correlation between the change in immigrants share and the change in relative native-immigrant wages across departments over years. This correlation reveals an important mechanism through which an increase in immigrant supply would reduce the wage of immigrants relative to natives, revealing imperfect substitutability between the two groups and making immigrants less expensive to hire. We find that this correlation is negative, although imprecisely estimated and not very significant. An increase in immigrants by one percentage of employment would reduce their relative wages by 8.4 percent relative to natives, but the standard error of the estimate is also equal to 8.7. Hence, we take this correlation as suggesting, together with the lower wage of immigrants relative to natives, that when their supply increases firms with costs below a threshold would consider profitable to hire immigrants. These basic correlations are consistent with the working of the basic mechanisms illustrated in our model.

[20]Data on share of foreign population in 1995 and 2005 for all regionss are shown in Table A2 of the Appendix.
[21]Remember we have not data on value added per capita in 1995
[22]Figure A1 in the appendix shows the scatterplot of native versus immigrant log wages by department in 1995. We notice that all points are above the 45 degree line indicating larger hourly wages for natives than for immigrants.

5.4 Instrument validity

Before presenting the empirical results we show some evidence, albeit indirect, of the validity of the instrument exclusion restriction. In constructing our IV we assumed that the distribution of immigrants in year 1990 was orthogonal to subsequent productivity and labor demand shock at the local level. This is a strong assumption. Income and productivity shocks that are specific to departments and persistent over time may have affected the stock of immigrants in 1990 and may be correlated to their flows after 1996. To find some reassurance that the instrument constructed this way is not correlated with pre-existing economic patterns across districts we consider the correlation across districts between our instrument, namely the change in the imputed immigrants over the period 1995-2005[23] and the firm's economic outcomes in the departments that we will analyze in the empirical section as of 1995 (TFP, Specialization in communication/Manual Tasks by natives, Capital and Trade). The issue is whether our instrument is correlated with the pre-existing performance of firms across districts[24]. Table 3 shows the OLS correlation across districts of imputed change in immigrants and 1995 economic outcomes and, reassuringly, it finds no significant correlation with pre-existing average economic outcomes. While we are unable to assess the correlation of the instrument with unobserved pre-determined factors, it is reassuring to know that there is no correlation with the pre-period observable economic outcomes. The inclusion in the regression of firm fixed effects and region (industry)-period specific fixed effects also helps to clean the residual from unobserved changes to the department economic performance.

The power of the instrument, expressed by the F-statistics of the first stage will be shown at the bottom of each regression Table from 4 to 11. As we will notice the F-stat is very high, often around 70 (or 40 in case joint F-stat) and never even close to the threshold of 10, usually used as rule of thumb value for triggering concerns of weak instruments. In estimating the interaction term in equations (6) we also address the issue of endogeneity of the interacted variables by using the imputed share of immigrants in the department interacted with the relevant dummy for the presence of migrants in the firm as of 1995.

6 The Effects of Immigration on Firms

Tables 4 to 11 show the estimated parameters on the explanatory variables of interest for specifications (6) using two samples of firms. The first sample, in columns 1-4, includes only firms having at least one immigrant by the last period of observation; this is useful since the effect of local migration shocks is supposed to be restricted to those firms having at least one immigrant. The second sample, columns 5-6, is the full sample of firms in our dataset, it is intended as a robustness check here.

[23] Computed as $s_{d,2005}^{\widehat{IMMI}} - s_{d,1995}^{\widehat{IMMI}}$

[24] A more accurate test would be obtained by regressing the before-1995 trend in our outcome variables on the after-1995 trend of our instrument. Unfortunately we do not have information on French firms outcome before 1995.

Tables 4 to 11 share a very similar structure, and they simply differ because of the outcome variable that they consider. We will describe the main features of the tables when describing Tables 4 and 5 and then we will comment on the corresponding parameter estimates for each Table in the following subsections. As described in section 5.1, the estimation sample in Tables 4-11 (and A4-A8) covers the period 1996-2005 (because of data unavailability for TFP and value added in 1995). Nevertheless, we use year 1995 to compute the dummy $I_i\left(fs_{i,1995}^{IMMI} \leq p\right)$ as in equation (6).

6.1 Firm's Share of Immigrants in Employment

In Table 4 we show how the increased share of immigrants in the district population translates into local firms hiring more of them. The dependent variable in specifications (1)-(4) is the immigrant share in the employment of the firm and the unit of observations are firm-years. In the first column, specification (1), we report the coefficient on the district share of immigrants from a specification that includes the fixed effects and the control variables (as in equation 6) but it does not include the interaction with the dummies. The estimates are obtained using least squares. The second column shows the same coefficient estimated using 2SLS with the imputed share of immigrants described above as instrument. Then in column (3) we show the key coefficients in the full specification including the interaction between the share of immigrants in the department and the dummy equal to one if the firm had no immigrants in 1995. In column (4) rather than interacting with a dummy denoting exactly no immigrants in 1995 we interact with one capturing firms with few immigrants, namely below the median value of firms immigrants share in 1995 (which was equal to 2.3 percentage points of employment). In all cases the sample used for the regression includes firms that had at least one immigrant by the last period of observation as those firms that never had immigrants do not contribute to identify these effects. The standard errors are clustered by district level in each specification in order to account for the correlation of errors across firms and over time within a geographic department. These regressions are meant to establish whether firms with initially no (or few) immigrants responded to the exogenous changes in the local immigrant supply differently than other firms. With no costs of hiring immigrants, and a firm-level network, one should expect that new immigrants are hired across firms in proportion of existing ones. This would imply larger share growth in firms with larger initial share, and hence a negative coefficient on the interaction effect. The model presented above, instead, predicts the opposite effect. With initial costs and an optimal combination native-immigrants for production, some firms will move from 0 to the optimal share, when supply increases and the cost of immigrants decreases, showing larger increase than firms already employing immigrants.

We see that, because of the power of the instrument, the 2SLS estimates are precise and significant in column (2) to (5). In specification (2) they are also larger than the OLS estimates (specification 1) revealing the potential existence of a measurement error bias stronger than the endogeneity bias. More interestingly, we find that the effect of an increase in immigrants by one percentage point of the population in the department translates into an increase in the share of immigrants in firms by 0.95 percentage points on average, (column 2). When separating firms with initially 0 immigrants we find that those, experienced an extra effect from District immigration by almost 0.83 percentage points on their immigrant share. Firms with no initial immigrant employed increased their immigrants by 1.6 percentage points of employment for each increase of immigrants by one percentage point in the district population. For firms already hiring immigrants that increase was only 0.78 percentage points. Hence, the coefficients show that while all firms that hire immigrants respond to a higher share of immigrants in the population by increasing their share in employment, firms that initially had no immigrants (or few of them) respond significantly more. Column (4) shows that the differential response of firm with very few immigrants in 1995. Similarly to the case of initially 0 immigrants firms with few immigrants have a response three times larger (sum of main and interaction coefficient) than the response of firms with larger immigrant shares in 1995. In column (5) we replicate this last specification but using the instrument based on OECD data on migrants stock, and results do not change. Specifications (1)-(5) test propositions 2 of Section (3). Those results establish that while firms increase their share of immigrants when more of them are available in the district, the firms with initially no immigrants seem to adjust their share more significantly. This is consistent with the existence of an optimal native/immigrant ratio in the firm and costs of first hiring immigrants, as illustrated by our simple model. In order to test proposition (1) we want to see whether in districts with increasing supply of immigrants, the share of firms with non-zero immigrant in employment also increases. In specification (6) of Table 4 we do this in a regression that still uses the firm-level structure. The dependent variable is a dummy equal to 0 if the firm has no immigrants and equal to 1 if the firms move to a positive share of immigrants (i.e dummy equal to one if no immigrants at time $t-1$ and some immigrants - at least one - at time t). The positive and significant effect of the share of district immigrants on this variable implies higher probability that a firm begins hiring immigrants in districts with higher immigration rates. Regression in column (7) tests directly proposition 1 at the department level. Using the share of firms with non-zero immigrants in employment calculated for a department we regress that on the share of immigrants in the workforce. Again there is clear support for the idea that a larger local supply of immigrant increases the share of firms that hire them.

6.2 Firms' Value Added and TFP growth

A main prediction of our model is the positive effect of immigration on value added per worker (Prediction 4 in section 3). This effect is driven by the adoption of less costly technologies that exploit native-immigrants complementarities when the last type of workers become more easily available. We also emphasized that the use of more specialized two-factor technology may produce higher TFP if the productivity of this technology is higher than the productivity of the technology using natives only. We test these predictions in Tables 5 and 6 of the paper that share the exact same structure. We calculate value added per worker by subtracting total costs from total revenues of the firm (obtained from their balances sheets) and dividing by number of workers in the firm. We also compute the TFP of firms using the Olley and Pakes (1996) - OP from now on - approach, which accounts for the endogeneity in the use of inputs and hence is more reliable than using simple OLS. We also used, as a robustness check, TFP calculated following the Levinsohn and Petrin (2003) - LP - approach. The results using this second method of calculating the TFP are reported in Table A4, while a detailed description of OP and LP approach is in the Appendix section A2.[25]

Table 5 shows the estimated effects of district immigration on firm value added per worker and Table 6 on firm TFP. Specifications (1) and (2) show the average effect, estimated in OLS and using 2SLS, respectively. Increased immigration in the district is associated with faster value added per worker growth and faster TFP growth, in particular when we focus on the 2SLS estimates. The effect estimated using 2SLS is significantly larger than the OLS effect and significant both for value added and TFP. Endogeneity concerns, that would attenuate the IV estimate, therefore, do not seem to play a role in the estimation of these effects on firm productivity. The estimates of column 2 imply that increase in the immigrants as percentage of employment in the district by 10 points (which is roughly the average growth of immigrants in French manufacturing between 1995 and 2005), would correspond to a 3.9 log point increases in value added per worker and 1.7 log point increases in the TFP of the average firm in the district (corresponding to about 3.9 and 1.7 percent respectively). Columns (3) and (4) in Tables 5 and 6 show that the effect on value added per worker and on TFP is stronger for firms with initially no immigrants (3) or with a very small share of immigrants (4). The interaction term, in fact has a positive coefficient. The effects, however, are significantly positive only on TFP due to the large standard error in the estimates for value added. Using the estimates in column (4) a firm with initial immigrants share below the median will experience a TFP increase of 0.86 log points for each increase in the immigrant population in the district by 10 percentage points of employment. The effect would be equal to 1.2% but not significant on value added per worker. This effects are linked to the fact that these firms hire the immigrants, and they hire them at a faster pace than other firms in the district (as shown in Table 4 above) hence profiting from cost-reduction, as well as from TFP growth.

In order to confirm the crucial role of hiring immigrants for realizing the productivity gains in a district we consider in specification 5-7 all firms, not only those with some immigrants. The overall average effect in column 5 is still positive on both value added per worker and TFP. More importantly the specification as (6) in which we include the interaction with dummies corresponding to few initial immigrants (specification 6) confirm the results obtained in column (4), restricted to the sample of firms with at least one immigrant by the end of

[25]The OP approach consists of a semi-parametric estimator using investment by firm to proxy for unobserved productivity shocks. This allows to solve the simultaneity problem between inputs and output. The OP procedure also defines an exit rule to solve for the selection issue in TFP estimation. Since OP relies on investments to proxy for productivity shock (with investment increasing in productivity), only observations with positive investment values could be used. See appendix section A.2 for further details on TFP calculation.

the period. Firms hiring immigrants realize the complementarity in production with a particularly significant positive effect, especially on TFP. While the extra-positive effect on value added per worker (Table 5 column 7) seems to be of similar magnitude as for TFP the standard error is larger. Finally, in the last column (7) we replicate the same specification but using the IV based on the stock of migrants by OECD (robustness check) and results do not change. We still find positive and significant effects on TFP and similarly positive but not significant effect on value added per worker (because of larger imprecision of the estimates).

6.3 Capital growth

The significant increase in productivity at the firm level identified in the previous section is likely to drive (and be correlated to) other changes in firms' outcomes. In particular while there is no capital factor in our model, if we think that immigrants are skilled workers, they may exhibit strong complementary with physical capital too (e.g. Krusell et al 2000). If this is the case then we should also observe growth of the firm's capital stock associated to larger inflow of immigrants. On the other hand if immigration is only a shift in supply of labor to the firm then capital may not respond to it immediately and the capital/labor ratio at the firm's level should decrease. Moreover if firms switch to a different production function that is immigrant-intensive this may imply also a change in capital intensity (besides a change in TFP). Lewis (2011) finds that in high immigration areas firms are associated with slower growth in capital-labor ratio (although in his sample immigration is unskill-intensive). It is interesting therefore, to see whether in our case the impact on TFP corresponds to a similar impact on the physical capital intensity of the firm.

Table 7 shows the estimates of specifications similar to those in the previous tables, when the dependent variable is the logarithm of capital value, calculated as total gross capital stock of the firm (deflated by a price index). As we estimate specifications with firm fixed effects the identifying variation is constituted by differences within firm over time. The coefficients tell us whether larger immigration shares in the district stimulate higher net investment in the firm. Column (1) and (2) show a positive and significant effect on the capital of the average firm. The 2SLS estimate implies that an increase of immigrant percentage in employment by 10 points increases the capital stock in the average firm by 8.6%. The effect is larger (in percentage terms) than the effect on productivity. Firm accompany the hiring of immigrants with significant capital investments. Columns (3) and (4) confirm also that the effect of district immigration on capital investment is significantly stronger for those firms with initially no immigrant, or with small initial share of immigrants (below the median). Their elasticity of response to district immigration is about three times bigger than the response of the other firms. These effects are significant when considering only firms with at least one immigrant by the end of period (specifications 3-4) and when including all firms (specification 5-6). Results do not change when we use the OECD data based instrumental variable in column (7), which also imply restricting the attention to the period

2001-2005.

Measures of the capital stock and of its value can be imprecise. Hence, as a robustness check, In Table A5 of the appendix we use a much coarser, but easier to collect, measure of the capital stock of a firm, namely the number of plants that the firm operates. The results are perfectly in line with those of Table 7. The impact of immigration within the district on the logarithm of the number of plants that a firm operates, interacting as usual the explanatory variable with the firm initial share of immigrants. We find that the average effect on the number of firms' plants is positive and it is essentially fully driven by those firm starting in 1995 with 0 or below-median share of immigrants (columns 3 and 4). Overall these results show that immigration affects the total value of capital as well as the number of plants that a firm operates. These findings are clearly complementary to what Lewis (2011) finds for the United States. There, prevalently low skilled immigration was associated to the adoption of unskilled-intensive technology and less mechanization. Here prevalently skilled immigration seems to be associated with increased capital intensity, higher TFP and increased opportunity for operating new plants.

6.4 Specialization of native workers

Another margin of potential response to immigration at the firm level is the productive specialization of native workers. The complementarity with immigrants may come from their overall high education level. However it may be strengthened by their preferential specialization in some productive tasks. Several papers suggest that less educated immigrants are intensively employed in manual tasks, possibly because their comparative disadvantage in language skills (Lewis 2013). On the other hand highly educated immigrants may specialize in more technical/analytical skills and less in language/communication skills and they may push natives into those more communication-intensive occupations as suggested by Peri and Sparber (2011). It is therefore interesting to analyze whether the specialization response of natives within firms is also a margin of adjustment for the firm. Following Peri and Sparber (2009) we construct and index of communication-intensity for the occupations of natives in the firm. The idea is that, as they do not have the same command of the language, foreign skilled employees will take more technical occupations and will push natives into language and communication intensive ones. The index we build is the ratio of the communication and the manual-intensity intensity index (in logs) for native employees in a firm. This index takes high values if natives are more concentrated in occupations that use intensively communication skills (such as sales jobs, secretarial types of jobs and usually white collar ones) relative to manual skills (machine operators, laborers or blue collar jobs).

The index, therefore, is obtained exploiting the occupational distribution of natives in a firm. A positive change in this index reveals occupational mobility of workers towards jobs that use more communication-intensive skills and away from manual-intensive skills. Table 8 shows the estimated coefficients using the index as dependent variable. The 2SLS estimates (Column 2) point to a positive effect of the district immigration on the communication-intensive specialization of natives in the firm. This effect is confirmed in all subsequent specifications. However we do not find a stronger effect for firms initially hiring no immigrants or few immigrants. The interactions effects in specifications (3), (4), (6) and (7) have an insignificant coefficient revealing no differential effect in specialization of the firms with larger increase in immigrant share (initially with low share of immigrants). This indicates that in most firms in districts with high immigration inflows native workers moved towards more communication intensive jobs, but this was a general response, not specific to firms that hires a particularly large number of immigrants. If the competition between natives and immigrants is an attribute of the whole labor market it makes sense to have native workers respond in similar way in all firms. After all the marginal productivity of a skill, if workers are mobile across firms, is affected throughout the market. Individual firms may have different productivity effects and still native workers may be affected in a similar way across firms. This, as we will see is mirrored in the analysis of the wage effects of immigrants on local natives.

6.5 Firms' Export growth

The productivity gains from immigration shown before could also affect the export performances of firms in the manufacturing sector. A large body of empirical literature (beginning with Bernard and Jensen 1999) has emphasized that more productive firms are those that access international market and export. Moreover firms that export in more than one international market are the most productive ones (as they are able to cover the fixed cost of entry in several foreign markets). At the same time several papers have analyzed the connection between immigration and exports at the national and regional level (see Felbermayr, Grossman and Kohler 2012 for a recent review) emphasizing how immigrants may reduce the fixed cost of exporting. Only few papers, however, have looked at the firm-level connection between the immigration and export (Hiller 2013 and Hatzigeorgiou and Lodefalk 2011 show this effect using Danish and Swedish data respectively). Most studies find that immigrants have a trade-creation effects on regions and firms and interpret this as the result of reducing fixed costs of trading with the country of origin of immigrants (e.g. Peri and Requena 2010). In a firm level (trade) framework, if the trade creation effect of immigrants were due to only the reduced fixed cost to export (i.e. supplementary information on destination countries provided by immigrants), we would observe only a positive effect of immigrants on the extensive margins (number of markets) and a null effect on the intensive margin (since the intensive margin is affected only by changes in variable trade cost and productivity). In this section, by analyzing the effect of immigrants on total volume of trade and on the extensive margin of trade (foreign markets) we shed some light on the channels through which immigrants boost trade.

As we do not have information on the country of origin of immigrant workers we cannot properly test the information channel, likely to be a bilateral relation driving the pro-trade effect of immigration. However we can still test whether immigration affects the value of export and the number of export markets for the firm. In Table 9 we report estimation results when the logarithm of the total value of exports by the firm is the dependent variable (intensive margin). In Table 10 we consider the logarithm of the number of export markets of the firm (extensive margin) as outcome. Very interestingly, in Table 9 the 2SLS estimated effects of district immigrants on firm export is large and significant. An increase of immigrants by 10 percentage points of the local population increases exports of the firm in the district by 13.7%. Hence in districts with growing immigrants community, firms that hire them experience a clear increase in the volume of exports. This effect is magnified for firms initially at 0 or below the median immigrants employment (positive and significant coefficient for the interacted variable in columns 3 and 4). These results are robust across other specifications in columns (5) and (6) and are consisten with productivity increases due to hiring immigrants.

The results of Table 10 are similar. While the aggregate effect on export could be driven by a simple increase in trade flows, in Table 10 we analyze whether immigration increases also the number of foreign markets served by the firm. If we think that immigrants, besides affecting productivity, reduce the fixed costs of exporting in new markets this second effect should be positive. The positive and significant effect of immigration on the number of export market found in specification (2) of Table 10 is particularly strong. It is also entirely due to those firms with initially no immigrants (column 3) or few immigrants (column 4) that hire them as a consequence of their increased supply. As immigrants arrive in the district, firms can open up new export markets and those that hire more immigrants (likely from different countries) may open up more markets. This can be the combined effect of higher productivity and of lower fixed costs of accessing export markets. Overall the effects on export are consistent with those on productivity and show that immigration in the district affects firms' export performance, especially those firms that increase significantly their share of immigrants from 0 or low levels. Immigrants increase the value of their exports and the number of their foreign markets[26].

6.6 Native Wages

So far we have not even considered the variable on which most of the existing studies of immigration effects focus: the wages of native workers. All the previous results, indicate higher productivity, higher capital intensity and more language-intensive specialization of natives as consequence of immigrants. These adjustments should result in higher wages for natives. In a framework similar to that of the previous tables we consider the logarithm of wages to native workers as dependent variable and we report the estimated coefficients in Table 11. Wages are measured at the firm level and hence their changes combine changes in wages of individuals and potential changes in the composition of workers in the firm. First, keep in mind that a key mechanism operating in

[26]Table A6 in the appendix shows similar results as Table 10, using the number of exported varieties (rather than the number of foreign markets). Immigrants also increase the variety of goods exported by a firm.

reducing the firm's costs when hiring immigrants is their complementarity to natives and potential productivity improvements. Both mechanisms should produce positive wage effects for natives. Moreover, if the market for native and immigrant workers is the whole district, and not a single firm (as in our model), the wage effect should be common to all workers, independently from the type of firm as natives equalize wages by moving across firms. The results of Table 11 are consistent with this interpretation (and with results described in section 5.4). An increase in the immigrant share in the district seems to have a strong positive effect on the average wage of natives in local firms. An increase of immigrants by 10 percentage points of employment is associated with an increase in native wages in the firm by 5.4% (column 2 of Table 11). Moreover the effect on native wages in firms hiring few immigrants at the beginning of the period (column 3 and 5) does not seem to be significantly different. These effect may be due in part to a selection of skilled natives in firms with immigrants and may combine different wage effects for workers of different skill levels. Still a firm-based analysis of the effect of high skilled immigration on native wages show a positive and significant overall effect.

7 Conclusion

This paper uses French firm level data to study the effect of immigration on a set of firms specific outcomes, related to the firms' productivity. In particular - for the first time in the literature according to our knowledge - we study the heterogeneity of firms in responding to exogenous labor supply shocks due to immigration.

A strong empirical regularity emerging from the analysis is that firms in district receiving a large inflow of immigrants experience productivity gains, faster investments, specialization of natives in communication intensive occupations and faster export growth. Using enclave-driven instrument to proxy the supply-driven inflow of immigrants our analysis confirms that these effects are compatible with a causal interpretation. More interestingly, we find that firms initially hiring a low share of immigrants are those that increase more their share of immigrants following an inflow in the district. Those are also the firms experiencing the largest productivity and revenue growth, and the largest growth in capital and in exports. We also find that wage and specialization effect of immigrants on natives are common within the labor market and not firm-specific. This evidence is compatible with a simple model in which firms have heterogeneous costs of hiring immigrants and immigrants are complementary to natives and may be combined with natives in a more efficient production method. When migrants' labor supply increases, some firms begin employing them in production, benefit from lower costs, and move towards hiring the optimal share of immigrants which is higher the lower is their wage. As firms with initially no immigrants turn out to be among the less productive ones (because of the cost of hiring immigrants), immigration stimulated productivity growth for firms lagging behind. Hence it was particularly beneficial for under-performing firms. Immigration may induce some convergence in the productivity levels of firms that hire them, which is an aspect never considered or analyzed by the literature.

Altonji, j. and D. Card, (1991) "The Effects of Immigration on the Labor Market Outcomes of Less-skilled Natives", NBER Chapters, in Immigration, Trade and the Labor Market, pp. 201-234.

Bernard, Andrew B. and Bradford Jensen, J., (1999). "Exceptional exporter performance: cause, effect, or both?," *Journal of International Economics*, Elsevier, vol. 47(1), pages 1-25, February.

Bernard Andrew B., Jonathan Eaton, J. Bradford Jensen and Samuel Kortum, (2003). "Plants and Productivity in International Trade," *American Economic Review*, American Economic Association, vol. 93(4), pages 1268-1290, September.

Borjas, G. (2003) "The Labor Demand Curve is Downward Sloping: Reexamining the impact of Immigration on the Labor Market", *Quarterly Journal of Economics*, 118(4): 1335-74.

Borjas, G. and L.F. Katz (2007) "The Evolution of the Mexican-Born Workforce in the United States", in Mexican Immigration to the United State, ed. G. Borjas, 13-56. University of Chicago Press.

Card, D. (2001) "Immigrants Inflows, Native Outflow, and the local Labor Market Impacts of higher immigration.", *Journal of Labor Economics*, 19(1):22-64.

Card D. (2009) "Immigration and Inequality", American Economic Review, Papers and Proceedings, 99(2): 1-21.

De New, J.P and K.F. Zimmermann (1994) "Native Wage Impacts of Foreign Labor: A Random Effects Panel Analysis" *Journal of Population Economics*, 7(2):177-92.

Docquier F. , C. Ozden and G. Peri (2014)"The Labour Market Effects of Immigration and Emigration in OECD Countries". *The Economic Journal*. doi: 10.1111/ecoj.12077.

Dustmann, C., F. Fabbri and I. Preston (2005) "The Impact of Immigration on the British Labour Market" *Economic Journal*, 115(507): F324-F341.

Edo, A. (2013) "The Impact of Immigration on Native Wages and Employment", CES working paper 13-64.

Felbermayr, Gabriel, Grossmann, Volker and Kohler, Wilhelm, (2012). "Migration, International Trade and Capital Formation: Cause or Effect?," IZA Discussion Papers 6975, Institute for the Study of Labor (IZA).

Haas, A. and M. Lucht (2013) "Heterogeneous Firms and Imperfect Substitution: The Productivity Effect of Migrants" Norface Discussion Paper Series 2013019, Norface Research Programme on Migration, Department of Economics, University College London.

Hatzigeorgiou, A. and M. Lodefalk (2011) "Trade and Migration: Firm-Level Evidence", Working Papers 2011:6, Orebro University.

Hiller, S. (2013) "Does immigrant employment matter for export sales? Evidence from Denmark", *Review of World Economics*, 149(2):369-394.

Hummels, D., R. Jorgensen, J.Munch and C. Xiang (2013) "The Wage Effects of Offshoring: Evidence from Danish Matched Worker-Firm Data", American Economic Review (forthcoming)

Kerr S.P. and W.R. Kerr (2011) "Economic Impacts of Immigration: A Survey" Finnish Economic Papers, vol. 24(1), pages 1-32.

Kerr S.P. and W.F. Lincoln (2010) "The Supply Side of Innovation: H-1B Visa Reform and the U.S. Ethnic Invention", Journal of Labor Economics, vol.28(3), pp. 473-508.

Krusell Per, Lee E. Ohanian, Jose-Victor Rios-Rull and Giovanni L. Violante, 2000. "Capital-Skill Complementarity and Inequality: A Macroeconomic Analysis," *Econometrica*, Econometric Society, Econometric Society, vol. 68(5), pages 1029-1054, September.

Levinsohn, J. and A. Petrin (2003) "Estimating production functions using inputs to control for unobservables", Review of Economic Studies, 70(2):317-341.

Lewis, E. (2011) "Immigration, Skill Mix, and Capital Skill Complementarity", The Quarterly Journal of Economics, 126(2):1029-1069.

Lewis, E. (2013) "Immigration and Production Technology", Annual Review of Economics vol.5, Forthcoming, August 2013.

Longhi S., P. Nijkamp and J. Poot (2005) ”A Meta-Analytic Assessment of the Effect of Immigration on Wages” Journal of Economic Surveys, vol. 19(3), pages 451-477, 07.

Malchow-Moller N., J.R. Munch and J.R. Skaksen (2012) ”Do Immigrants Affect Firm-Specific Wages?” Scandinavian Journal of Economics, vol. 114(4):1267-1295.

Martins, P.S., Piracha, M. and J. Varejao (2012) ”Do Immigrants Displace Native Workers? Evidence from Matched Panel Data” IZA Discussion Papers 6644, Institute for the Study of Labor (IZA).

Melitz, M. (2003) ”The Impact of Trade on Intra-Industry Reallocations and Aggregate Industry Productivity” Econometrica, 71(6):1695-1725.

Moretti E. (2004) ”Workers' Education Spillovers and Productivity: evidence from Plant-Level Production Functions”, in American Economic Review, vol.94 (3).

Olley, S.G. and A. Pakes (1996) ”The dynamics of productivity in the telecommunications equipment industry”, Econometrica, 64(6):1263-1297.

Ottaviano, G. and G. Peri (2012) ”Rethinking the Effects of Immigration on Wages”, Journal of the European Economic Association, 10(1):152-197.

Ottaviano, G., Peri, G. and G. Wright (2013) ”Immigration, Offshoring and the American jobs”, forthcoming American Economic Review.

Peri, G. (2012) ”The Effect of Immigration on Productivity: Evidence from U.S. States” Review of Economics and Statistics, 94(1):348-358.

Peri, G. and C. Sparber (2009) ”Task Specialization, Immigration, and Wages”, American Economic Journal: Applied Economics, 1(3):135-69.

Peri G. and C, Sparber (2011) ”Highly-Educated Immigrants and Native Occupational Choice” Industrial

Relations, Vol. 50, No. 3.

Peri, G. and F. Requena (2010) ”The trade creation effect of immigrants: Testing the theory on the remarkable case of Spain”, Canadian Journal of Economics, 49(4):1433-1459.

Peri G., K. Shih and C. Sparber (2014) “STEM workers, H1B visas and productivity in US cities” forthcoming, *Journal of Labor Economics*.

Trax M, S. Brunow and J. Sudekum (2013) ”Cultural Diversity and Plant-Level Productivity” mimeo University of Duisenburg-Hessen.

Tables

Table 1
Summary statistics for firm-year observations

Variable	***Observations***	***Mean***	***Std Dev.***	***Min***	***Max***
Ln (Employment of natives)	136252	4.30	0.97	0	11.05
Ln(Wage of natives) – per hour worked	136244	2.35	0.32	1.00	12.62
Ln(per capita value added)	108181	3.46	0.52	-2.19	10.44
Ln(TFP) OP	105174	1.77	0.19	-0.15	2.58
Ln(TFP) LP	104084	2.11	3.22	-11.2	13.95
Ln(Communication /Manual)	175025	0.31	0.37	-0.02	2.68
Ln(Capital)	123533	3.20	1.11	-6.52	10.98
Ln(Total Export Value)	98508	13.28	2.66	0	22.86
Ln(Number of export varieties)	156073	2.62	1.59	0	5.16
Ln(Number of export markets)	156073	1.82	1.24	0	5.16
Share of foreign-born	137122	0.06	0.12	0	1

Note: individual observations are firms by year in France over the period 1995-2005. TFP data cover the period 1996-2005. The sources of the data are several and they are described in the text section 5.1 and A.1.

Table 2
Share of total hours worked by foreign-born individuals in France within the Manufacturing sector

Occupation Type	Share of hours worked by foreign-born		
	1995	2005	Change 1995-2005
Skilled (top 5 cognitive/manual occupation)	0.046	0.165	0.119
Unskilled (bottom 5 cognitive/manual occupation)	0.093	0.119	0.016
Skilled (top 10 cognitive/manual occupation)	0.038	0.135	0.097
Unskilled (bottom 10 cognitive/manual occupation)	0.089	0.115	0.026
Non-production workers	0.038	0.131	0.093
Production workers	0.093	0.118	0.025

Note: Authors' calculation on DADS dataset. Production workers are those of occupation groups CS 62, 63, 64, 65, 67, 68 and 69 (manual skilled workers, handlers, storage and transport workers, agricultural workers, industrial skilled workers, motor-vehicle drivers, unskilled manual workers and unskilled industrial workers). Other occupations groups are considered as non-production workers. Top 10 occupation by cognitive/manual complexity are: government officials, engineers and technical managers, business and administration professionals, commercial managers, professors and scientists professions, administrative workers in private sector, teachers, information professions, administrative workers and technicians. Bottom 10 occupation by cognitive/manual complexity are: police and military, personal services workers, manual skilled workers, skilled handlers, storage and transport workers, foremen, agricultural workers, industrial skilled workers, motor-vehicle drivers, unskilled manual workers and unskilled industrial workers.

Table 3
Correlation of the IV (imputed immigrant change 1995-05) with economic outcomes across districts in 1995

	Change in Imputed Immigrant share 1995-2005
Firms Outcome in the starting year:	(1)
TFP as OP	0.022
	(0.093)
Ln(communication/manual)	-0.280
	(0.177)
Ln(capital)	0.424
	(1.051)
Tot Trade	0.161
	(1.852)
Number of traded varieties	0.163
	(0.909)
Observations	93

Note: Each row represents the result from a univariate regression having as dependent variable the change of the imputed departmental share of immigrant over the period 1995-2005 (period 1996-2005 for TFP regression because of data availability) and as explanatory variable the average economic value listed in the table for the district firms in 1995.

Table 4
Immigration in the District and Firm's immigrants share.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Dep. Var : Immigrants as share of firm employment					Dep var : dummy for going from 0 to >0 immigrant employment	Dep. Var : share of firm with non-zero immigrants in the department
Immigrant share in Department	0.356***	0.951***	0.780***	0.561***	0.721***	0.669***	2.100***
	(0.054)	(0.140)	(0.130)	(0.123)	(0.168)	(0.079)	(0.538)
(Immigrant share in Department) x (initial firm share=0)			0.837*** (0.208)				
(Immigrant share in Department) x initial firm share<=median)				1.027*** (0.173)	0.783*** (0.162)		
Method of Estimation	OLS	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS
Sample	Firm with at least one migrant by the last period of observation					All firms	All departments
Observations	74865	73704	73704	73704	30305	118490	1026
First stage coefficients :							
Imputed Immi sh.		0.288***	0.291***	0.295***	3.906***	0.283***	0.056***
Imputed Immi sh. x Firm zero immi			0.275***				
Imputed Immi sh. x Firm below 50th mig				0.272***	2.353***		
F-stat of first stage		72.48				79.16	83.37
Joint F-stat (Kleibergen-Paap F statistic)			39.28	37.93	19.73		

Note: Columns (1) – (6) always include region-by-period, sector-by-period and firm fixed effects and the other firm level control variables.
Column (5) shows results using the imputed share of migrants based on the stock of migrants provided by OECD (data only 2001-2005)
Column (7) is departmental level regression with year FE included. Standard errors are always clustered at the department level.
*, **, *** indicate significance at the 10, 5 and 1% confidence level

Table 5
Immigration in the District and Firm's per worker value added

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Dep. Var : Log of Value added per worker						
Immigrant share in Department	0.052	0.390***	0.383***	0.342**	0.531***	0.472***	0.940***
	(0.077)	(0.119)	(0.134)	(0.150)	(0.116)	(0.132)	(0.239)
(Immigrant share in Department) X (dummy zero initial immi share)			0.024 (0.282)				
(Immigrant share in Department) X (dummy below median initial immi share)				0.129 (0.212)		0.200 (0.145)	0.079 (0.210)
Method of Estimation	OLS	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS
Sample	Firm with at least one migrant by the last period of observation				All Firms		
Observations	68263	66931	66931	66931	106082	106082	43715
First stage coefficients :							
Imputed Immi sh.		0.288***	0.290***	0.295***	0.282***	0.290***	3.803***
Imputed Immi sh. x Firm zero immi			0.273***				
Imputed Immi sh. x Firm below 50th mig				0.272***		0.271***	2.362***
F-stat of first stage		73.94			80.80		
Joint F-stat (Kleibergen-Paap F statistic)			41.63	39.97		40.51	24.42

Note: Columns (1)-(7) always include region-by-period, sector-by-period, firm fixed effects and firm level control variables described in the text.
Column (7) shows results using the imputed share of migrants based on the stock of migrants provided by OECD (data only 2001-2005)
Standard errors are clustered at the department level. The period considered is 1996-2005. The unit of observation is one establishment in one year.
*, **, *** indicate significance at the 10, 5 and 1% confidence level.

Table 6
Immigration in the District and Firm's TFP

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Dep. Var : TFP calculated using Olley and Pakes method						
Immigrant share in Department	0.055***	0.179***	0.145***	0.147***	0.178***	0.142***	0.153***
	(0.009)	(0.026)	(0.024)	(0.027)	(0.022)	(0.025)	(0.035)
(Immigrant share in Department) X (dummy zero initial immi share)			0.173*** (0.047)				
(Immigrant share in Department) X (dummy below median initial immi share)				0.086*** (0.032)		0.072** (0.030)	0.073** (0.034)
Method of Estimation	OLS	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS
Sample	Firm with at least one migrant by the last period of observation				All Firms		
Observations	66472	65180	65180	65180	103074	103074	42417
First stage coefficients :							
Imputed Immi sh.		0.288***	0.290***	0.295***	0.282***	0.290***	3.787***
Imputed Immi sh. x Firm zero immi			0.274***				
Imputed Immi sh. x Firm below 50th mig				0.272***		0.271***	2.323***
F-stat of first stage		73.93			80.81		
Joint F-stat (Kleibergen-Paap F statistic)			41.64	40.03		40.55	25.59

Note: Columns (1)-(7) always include region-by-period, sector-by-period, firm fixed effects and firm level control variables described in the text.
Column (7) shows results using the imputed share of migrants based on the stock of migrants provided by OECD (data only 2001-2005)
Standard errors are clustered at the department level. The period considered is 1996-2005. The unit of observation is one establishment in one year.
*, **, *** indicate significance at the 10, 5 and 1% confidence level.

Table 7
Immigration in the District and Firm's Capital Stock

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Dep. Var : Ln(capital)						
Immigrant share in Department	0.270***	0.862***	0.582***	0.493***	0.784***	0.485***	0.841***
	(0.060)	(0.125)	(0.127)	(0.132)	(0.121)	(0.131)	(0.135)
(Immigrant share in Department) X (dummy zero initial immi share)			1.366*** (0.374)				
(Immigrant share in Department) X (dummy below median initial immi share)				0.974*** (0.293)		0.594*** (0.194)	0.920*** (0.273)
Method of Estimation	OLS	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS
Sample	Firm with at least one migrant by the last period of observation				All Firms		
Observations	74433	73274	73275	73275	117763	117763	48372
First stage coefficients :							
Imputed Immi sh.		0.289***	0.291***	0.295***	0.283***	0.291***	3.809***
Imputed Immi sh. x Firm zero immi			0.276***				
Imputed Immi sh. x Firm below 50^{th} mig				0.273***		0.273***	2.378***
F-stat of first stage		72.80					
Joint F-stat (Kleibergen-Paap F statistic)			39.53	38.22		38.61	24.53

Note: Columns (1)-(7) always include region-by-period, sector-by-period, firm fixed effects and firm level control variables described in the text.
Column (7) shows results using the imputed share of migrants based on the stock of migrants provided by OECD (data only 2001-2005)
Standard errors are clustered at the department level. The period considered is 1996-2005. The unit of observation is one establishment in one year.
*, **, *** indicate significance at the 10, 5 and 1% confidence level.

Table 8
Immigration in the District and Native's communication intensity in the Firm

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Dep. Var : Ln(communication/manual)						
Immigrant share in Department	0.028	0.137***	0.148***	0.093*	0.071**	0.089*	0.208***
	(0.031)	(0.033)	(0.046)	(0.051)	(0.032)	(0.050)	(0.064)
(Immigrant share in Department) X (dummy zero initial immi share)			-0.057 (0.127)				
(Immigrant share in Department) X (dummy below median initial immi share)				0.101 (0.114)		-0.035 (0.080)	0.117 (0.086)
Method of Estimation	OLS	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS
Sample	Firm with at least one migrant by the last period of observation				All Firms		
Observations	59917	57748	57748	57748	89689	89689	45980
First stage coefficients :							
Imputed Immi sh.		0.291***	0.294***	0.299***	0.286***	0.296***	3.827***
Imputed Immi sh. x Firm zero immi			0.279***				
Imputed Immi sh. x Firm below 50th mig				0.275***		0.276***	2.383***
F-stat of first stage		72.63			80.00		
Joint F-stat (Kleibergen-Paap F statistic)			42.02	38.97		39.36	24.30

Note: Columns (1)-(7) always include region-by-period, sector-by-period, firm fixed effects and firm level control variables described in the text.
Column (7) shows results using the imputed share of migrants based on the stock of migrants provided by OECD (data only 2001-2005)
Standard errors are clustered at the department level. The period considered is 1996-2005. The unit of observation is one establishment in one year.
*, **, *** indicate significance at the 10, 5 and 1% confidence level.

Table 9
Immigration in the District and Firm's Value of Exports

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
			Dep. Var : Ln(export)				
Immigrant share in Department	0.100	1.377**	0.764**	0.877**	1.294***	0.909**	0.311
	(0.173)	(0.327)	(0.358)	(0.417)	(0.273)	(0.367)	(0.466)
(Immigrant share in Department) x (dummy zero initial immi share)			3.310*** (0.878)				
(Immigrant share in Department) x (dummy below median initial immi share)				1.346** (0.653)		0.818* (0.471)	0.789 (0.677)
Method of Estimation	OLS	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS
Sample	Firm with at least one migrant by the last period of observation				All Firms		
Observations	59054	57790	57790	57790	85689	85689	35955
First stage coefficients :							
Imputed Immi sh.		0.288***	0.290***	0.295***	0.284***	0.292***	3.813***
Imputed Immi sh. x Firm zero immi			0.277***				
Imputed Immi sh. x Firm below 50^{th} mig				0.273***	78.81	0.274***	2.360***
F-stat of first stage		71.97					
Joint F-stat (Kleibergen-Paap F statistic)			42.99	38.97		40.46	22.58

Note: Columns (1)-(7) always include region-by-period, sector-by-period, firm fixed effects and firm level control variables described in the text.
Column (7) shows results using the imputed share of migrants based on the stock of migrants provided by OECD (data only 2001-2005)
Standard errors are clustered at the department level. The period considered is 1996-2005. The unit of observation is one establishment in one year.
*, **, *** indicate significance at the 10, 5 and 1% confidence level.

Table 10
Immigration in the District and Firm's extensive margin of Exports

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Dep. Var : Ln(number of served markets)						
Immigrant share in Department	0.070	0.442***	0.136	0.074	0.488***	0.141	0.102
	(0.062)	(0.136)	(0.153)	(0.161)	(0.123)	(0.147)	(0.163)
(Immigrant share in Department) x (dummy zero initial immi share)			1.661*** (0.382)				
(Immigrant share in Department) x (dummy below median initial immi share)				0.993*** (0.273)		0.738*** (0.220)	0.677*** (0.289)
Method of Estimation	OLS	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS
Sample	Firm with at least one migrant by the last period of observation				All Firms		
Observations	59190	57923	57923	57923	86006	86006	35857
First stage coefficients :							
Imputed Immi sh.		0.289***	0.290***	0.296***	0.284***	0.292***	3.822***
Imputed Immi sh. x Firm zero immi			0.276***				
Imputed Immi sh. x Firm below 50^{th} mig				0.272***		0.272***	2.357***
F-stat of first stage		71.92			78.84		
Joint F-stat (Kleibergen-Paap F statistic)			42.51	39.04		40.28	22.62

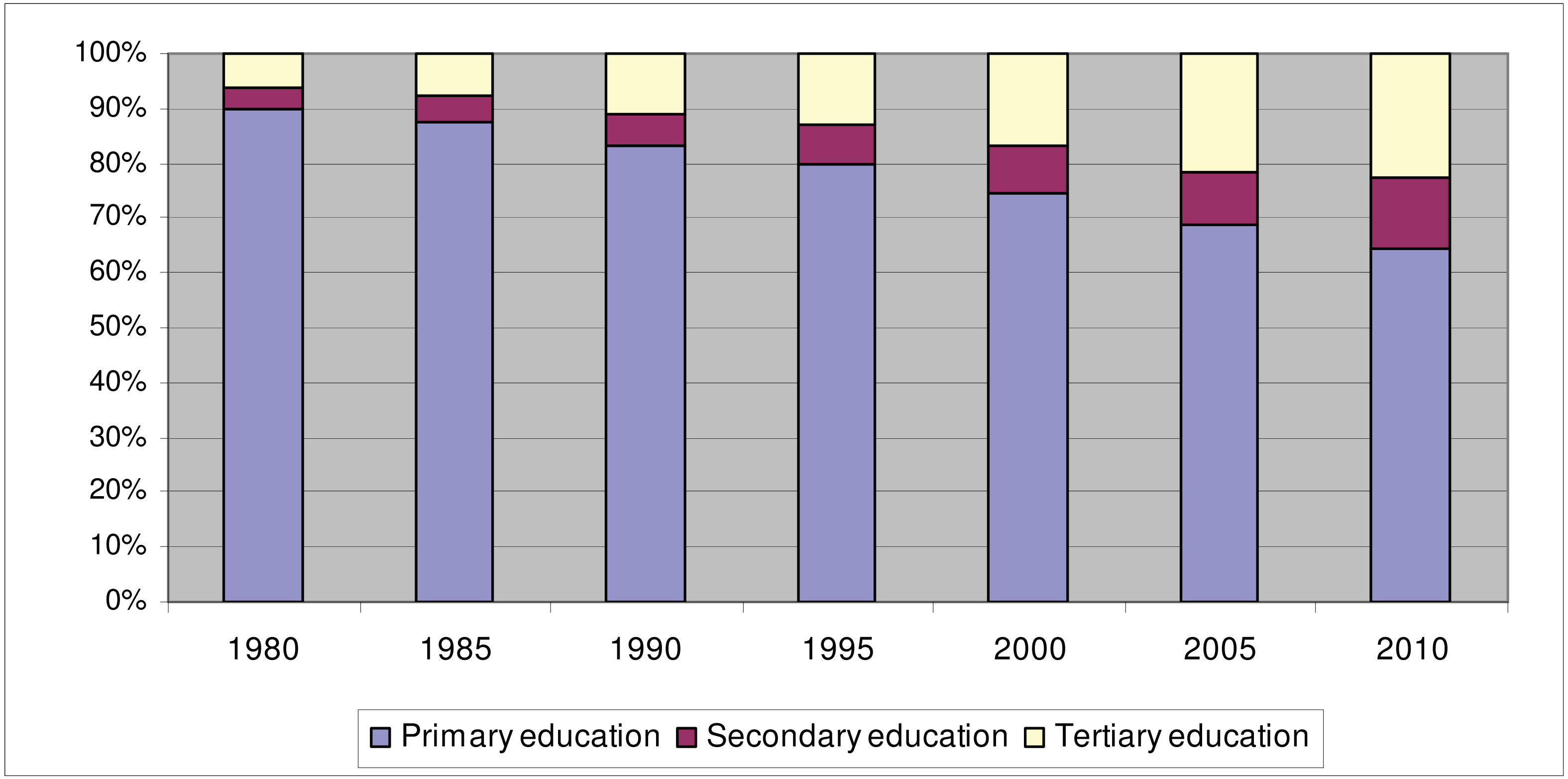
Note: Columns (1)-(7) always include region-by-period, sector-by-period, firm fixed effects and firm level control variables described in the text.
Column (7) shows results using the imputed share of migrants based on the stock of migrants provided by OECD (data only 2001-2005)
Standard errors are clustered at the department level. The period considered is 1996-2005. The unit of observation is one establishment in one year.
*, **, *** indicate significance at the 10, 5 and 1% confidence level.

Table 11
Immigration in the District and Native workers' wage in the firm

	(1)	(2)	(3)	(4)	(5)	(6)
	Dep. Var : ln(wage of natives)					
Immigrant share in Department	0.197****	0.542***	0.516***	0.531***	0.493***	0.657***
	(0.030)	(0.072)	(0.084)	(0.062)	(0.069)	(0.113)
(Immigrant share in Department) x (dummy below median initial immi share)			0.068 (0.113)		0.076 (0.078)	-0.075 (0.145)
Method of Estimation	OLS	2SLS	2SLS	2SLS	2SLS	2SLS
Sample	Firm with at least one migrant by the last period of observation			All Firms		
Observations	74238	73078	73078	117799	117799	48097
First stage coefficients :						
Imputed Immi sh.		0.288***	0.295***	0.283***	0.291***	3.755***
Imputed Immi sh. x Firm below 50^{th} mig			0.270***		0.272***	2.342***
F-stat of first stage		71.94		79.08		
Joint F-stat (Kleibergen-Paap F statistic)			38.63		37.99	24.69

Note: Columns (1)-(6) always include region-by-period, sector-by-period, firm fixed effects and firm level control variables described in the text. Column (6) shows results using the imputed share of migrants based on the stock of migrants provided by OECD (data only 2001-2005). Standard errors are clustered at the department level. The period considered is 1996-2005. The unit of observation is one establishment in one year. *, **, *** indicate significance at the 10, 5 and 1% confidence level.

Figure 1:
Foreign-born in France, percentage of total by Education category (Primary, secondary and tertiary)



Source: IAB Brain Drain Dataset.

Immigrants and Firms'productivity: Evidence from France

Appendix

Cristina Mitaritonna (CEPII)*   Gianluca Orefice (CEPII)†
Giovanni Peri (University of California, Davis)‡

October 2, 2014

*CEPII, 113 rue de Grenelle 75007 Paris. Email: cristina.mitaritonna@cepii.fr.
†CEPII, 113 rue de Grenelle 75007 Paris. Email: gianluca.orefice@cepii.fr. Corresponding Author.
‡Department of Economics UC Davis, One shield Avenue, Davis CA 95616. Email: gperi@ucdavis.edu

Appendix A1: Sample description.

A crucial issue to be clarified is the representativeness of the sample with respect to the initial data source. Our main dataset (containing info on the employment structure of French plants) is the DADS dataset, which is exhaustive and includes all the French establishments (plants) in the period 1995-2005. Notice that one firm may appear many times, depending on the number of establishments she holds and also on the sector where she operates. In the period 1995-2005, the DADS contains 13.922.675 observations (triplet plant-sector-year), among these 1.546.871 observations belong to the Manufacturing sector,[1] 12.344.653 to the service sector and the remaining to the primary sector. Because of data availability in balance sheet info, we focus on manufacturing sector only. Thus, when we collapse the 1.546.871 manufacturing observations by counting only once all the multi-sector plants (establishments in more than one sub-sector of the industry sector) we end up with 1.534.582 observations (plant-year).

Since the EAE dataset (containing balance sheet data) does not include the agro-industry sector, we have to exclude from the remaining DADS data also those plants belonging to the agro-industry sector.[2] Then the number of plant-year observations reduces to 1.065.076.

After the merge between the DADS, Custom data and EAE datasets, we hold information for 218.895 plant-year in the manufacturing sector,[3] which are those plants belonging to those firms having more than 20 employees (EAE provides info only for firms bigger than 20 employees). Finally the sample reduces to 160.367 observations if we include the TFP variable, which is available only over the period 1996-2005.

The huge drop in the number of plants (from original DADS to our final sample) is not surprising, because, by data availability constraint (EAE), we get rid of the many individual, micro and small enterprises in France. So it becomes important to clarify the representativeness of our final sample of firms in terms of the share over total employment in France (or number of hours worked). In terms of employment (number of employees), our final dataset covers the 64% of the total French employment (in manufacturing sector in the period 1996-2005); while in terms of total hours worked our final sample represents the 66% of the total.

As a final step, since our main dependent variables (TFP, Capital and export variables) are at firm level, we need to collapse plant level information (SIRET id number) at firm level (SIREN id number). Then we end up with 136244 firm-year combinations.

[1] According to the Naf 2-digit classification, the manufacturing sector includes activities from code 10 to 34
[2] Code 10 and code 11 according to the Naf 2 classification
[3] Activities from code 12 to 34 of the Naf 2 classification

Appendix A2: Estimating TFP (total factor productivity)

Let's define a Cobb-Douglas production function as follows:

$$y_{jt} = \beta_0 + \beta_l L_{it} + \beta_k K_{it} + \omega_{it} + \epsilon_{it}$$

where y_{it} is the log of output (value added or revenue) of firm i at time t (year in our data). We use value added to proxy output. As we do not observe physical output, we divide the value added by the Producer price index, 1995 prices at the NAF 2 digit level, and then we take the log (from Insee).

L_{it} and K_{it} are the log of inputs - labor and capital, respectively. The average number of employees during the year is used as a proxy for labour. For capital we used the value of tangible assets at the beginning of the period, deflated by the Real fixed capital stock, 1995 prices (from Euklems, http://www.euklems.net/).

ω_{it} represents unobserved (for the econometrician) inputs that are known to the firm when it decides capital and labour. We refer to ω_{it} as Total Factor Productivity (TFP). ϵ_{it} is the error term. Now if ω_{it} affects the choice of inputs, this leads to a simultaneity problem in the estimations of both β_l and β_k, and thus a biased estimation of TFP.

To solve this problem, Olley and Pakes (1996) propose a semiparametric estimation method, derived from a theoretical model, showing the condition under which an investment proxy controls for correlation between input levels and the unobserved productivity shock. Olley and Pakes (1996) propose a firm-level competition model where firms have idiosyncratic efficiencies and face the same market structure and factor prices. Profits are a function of capital K_{it}, efficiency ω_{it} , factor prices and other firms. ω_{it} follows a first-order Markov process:

$$\omega_{it} = E[\omega_{it}|\omega_{i(t-1)}] + \nu_{it} = h(\omega_{i(t-1)} + \nu_{it})$$

where ν_{it} is uncorrelated with K_{it}, but not necessarily with L_{it}. The model compares for each firm, the value of continuing to produce with the value of liquidation. If firm continues in operation, chose labour and investment, knowing current efficiency ω_{it}). Investment choice at time t , I_{it}, gives the capital stock in the next period:

$$K_{i(t+1)} = (1 - \delta)K_{it} + I_{it}$$

which means that time is needed to build physical capital. Investment is chosen at time t, but it is not productive until period $t + 1$. The solution of the model generates two firm decision rules. First, the firm stops producing when its efficiency level falls below a given threshold (which increases monotonically with the capital stock). Second, if the firm does not exit, investment is a function of of current state variables.

$$I_{it} = I_t(K_{it}, \omega_{it}),$$

Assuming monotonicity in the function $I_t(.)$ we can invert and obtain the unobservable productivity as a function of two observed inputs, capital and investment:

$$\omega_{it} = g_t(I_{it}, K_{it}).$$

We can re-express the the Cobb-Douglas production function in logs, in the value added case, as:

$$y_{it} = \beta_l L_{it} + \phi_{it}(K_{it}, I_{it}) + \epsilon_{it}$$

where

$$\phi_{it}(K_{it}, I_{it}) = \beta_0 + \beta_k K_{it} + g_t(I_{it}, K_{it})$$

and

$$E(\epsilon_{it}|L_{it}, K_{it}, I_{it}) = 0$$

The first stage of the Olley and Pakes routine substitutes a third-order polynomial approximation in k_{it} and i_{it} in place of ϕ_{it} and estimates β_l. In the second stage the coefficient β_k is identified as follows. Estimated values for $\widehat{\phi}_{it}$ are computed as

$$\widehat{\phi}_{it} = \widehat{y}_{it} - \widehat{\beta}_l L_{it}.$$

For a candidate value β_k^* we obtain a prediction (upon a constant) of $\widehat{\omega}_{it}$ where

$$\widehat{\omega}_{it} = \widehat{\phi}_{it} - \beta_k^* K_{it}.$$

Assuming that productivity follows a first-order Markov process, $E[\omega_{it}|\omega_{i(t-1)}]$ is given by predicted values from regression:

$$\widehat{\omega}_{it} = \gamma_0 + \gamma_1 \widehat{\omega}_{i(t-1)} + \gamma_2 \widehat{\omega}_{i(t-2)}^2 + \gamma_3 \widehat{\omega}_{i(t-3)}^3 + \epsilon_{it}$$

to which we can refer to $\widehat{E}[\omega_{it}|\omega_{i(t-1)}]$. The estimate of β_k is defined as a solution to the minimization of:

$$min_{\beta_k^*} \sum (y_{it} - \widehat{\beta}_l L_{it} - \beta_k^* K_{it} - \widehat{E}[\omega_{it}|\omega_{i(t-1)}])^2$$

Finally using $\widehat{\beta}_l$ and $\widehat{\beta}$, TFP is estimated as a residual of the Cobb-Douglas production function. Levinsohn and Petrin (2003) have extended the Olley and Pakes (1996) approach to contexts where data on capital investment presents significant censoring at zero investment. They propose a two-stage estimation, using intermediate materials as a proxy for the unobserved productivity shock. In the paper we have approssimated intermediate inputs by the cost of materials, deflated by the Intermediate inputs price index, 1995 prices (from Euklems). Intermediate inputs m_{it} are expressed as a function of capital stock K_{it} and productivity ω_{it} :

$$m_{it} = m_t(K_{it}, \omega_{it}),$$

Assuming monotonicity in the function $m_t(.)$ we can invert and obtain the unobservable productivity as a function of two observed inputs, capital and intermediates:

$$\omega_{it} = g_t(m_{it}, K_{it}).$$

The LP routine is then processed in the same way than the OP routine,described above. All in all Levinsohn and Petrin (2003) allow to retain more observations than the Olley and Pakes (1996) estimation, because typically firms report a positive use of inputs, and as a consequence, the monotonicity condition is more likely to hold for intermediates than for investments.

Appendix A3: Complexity measures by occupation

In order to measure the complexity of tasks covered by native workers, we computed indices of communication, cognitive and manual complexity for each of the occupations covered by native workers among French firms. To this end, we use the 2010 version of O*NET dataset which includes measures of the importance, on a scale from 0 to 100, of more than 200 worker and occupational characteristics (e.g. finger dexterity, oral expression, thinking creatively, operating machines) in about 974 tasks, based on the six-digit Standard Occupational Classification (SOC) classification. We follow Peri and Sparber (2009), and we focus on the dichotomy communication versus manual tasks, as our index of how complex a task is. For the definition of manual skills we average 19 O*NET variables capturing an occupation "Movement and strength" requirements. For the communication intensity index we average 4 O*NET variables considering oral and written expression and comprehension (see Table A9). The complexity index by occupation is simply the measure of the Communication intensity of the occupation itself or its ratio over the manual complexity.

As an alternative indicator to proxy tasks-complexity we also use the dichotomy cognitive versus manual tasks. For the cognitive task we use 10 O*NET variables, as in Table A9. Once we have calculated our complexity measure by task, we construct the measure of complexity of occupations at the firm level using the DADS dataset. Unfortunately the two data sources are not directly comparable; some concordance problems exist. While O*NET data set uses six- SOC codes , in the DADS the variable occupation follows the four-digit Professions et Categories Socioprofessionnelles des Emplois Salaries d'entreprise (PCS-ESE) nomenclature. Matching the two datasets requires putting both of them in a common nomenclature, that is the 1988 International Standard Classification of Occupations (ISCO -88). This causes other concordance issues. Firstly, correspondence tables exist only between the six-digit SOC 2007 and 4-digit ISCO-88 and between the four-digit PCS-ESE 2003 and the three-digit ISCO -88. Secondly, the PCS-ESE nomenclature has been revised twice during the period 1982-2007. These two points imply harmonizing all the PCS-ESE codes within the DADS dataset, reporting all them at the four-digit PCS-ESE 2003 version. Moreover when attributing at each four-digit PCS-ESE 2003 code a "Complexity index"we reduce the information originally contained in the O*NET database. We are obliged to compute an average of the "Complexity index"at the three-digit ISCO-88 occupation codes, which means having a "Complexity index" for 130 PCS-ESE codes compared to the 414 original ones.

ONLINE APPENDIX TABLES

Table A1
Correlation matrix

	N. of natives	Wage natives	Ln(pc VA)	TFP OP	TFP LP	Comm/ manual	Cogni/ manual	Capital (ln)	Capital Intensity	Total value of exports	Number of export varieties	Number of Export markets	Immi Share
N. of natives	1												
Wage natives	0.22	1											
Ln(pc value added)	0.07	0.36	1										
TFP OP	0.80	0.27	0.35	1									
TFP LP	0.11	0.01	0.04	0.14	1								
Comm/manual comp.	0.04	0.28	0.17	0.07	-0.04	1							
Capital	0.74	0.25	0.35	0.79	0.16	-0.03	-0.03	1					
Total value of exports	0.56	0.24	0.28	0.64	0.12	0.09	0.10	0.57	0.30	1			
Number of export varieties	0.49	0.20	0.28	0.55	0.05	0.25	0.24	0.42	0.13	0.80	1		
Number of Export markets	0.46	0.22	0.20	0.51	0.07	0.24	0.23	0.42	0.16	0.78	0.92	1	
Immi Share	-0.17	-0.03	-0.01	-0.02	0.05	-0.00	-0.00	0.01	-0.04	0.03	0.01	0.00	1

Table A2
Share of immigrants across French regions in 1995, 2005 and average growth rate over the period 2005-1995

	Share of immigrant over native workers in 1995	*Share of immigrant over native workers in 2005*	*Average yearly growth rate in region immigrant share (2005-1995)*
Region			
Île-de-France	0.099	0.217	0.073
Champagne-Ardenne	0.078	0.077	-0.012
Picardie	0.057	0.076	0.020
Haute-Normandie	0.055	0.083	0.065
Centre	0.076	0.127	0.047
Basse-Normandie	0.023	0.042	0.131
Bourgogne	0.078	0.128	0.069
Nord - Pas-de-Calais	0.063	0.159	0.249
Lorraine	0.075	0.089	0.010
Alsace	0.093	0.143	0.034
Franche-Comté	0.086	0.123	0.018
Pays de la Loire	0.030	0.095	0.144
Bretagne	0.027	0.110	0.727
Poitou-Charentes	0.032	0.142	0.314
Aquitaine	0.048	0.153	0.211
Midi-Pyrénées	0.044	0.139	0.404
Limousin	0.028	0.061	0.135
Rhône-Alpes	0.096	0.187	0.103
Auvergne	0.072	0.101	0.053
Languedoc-Roussillon	0.040	0.110	0.191
Provence-Alpes-Côte d'Azur	0.058	0.215	0.193
Mean	*0.059*	*0.123*	*0.154*

Source: Authors' calculations on DADS data.

Table A3
Share of migrants by education attainment 1995-2005.

	1995	***2005***
Share of immigrants with high school diploma (or lower)	74.49	58.08
Share of immigrants with more than high school diploma	25.51	41.92
Share of immigrants with more than 3-year university diploma	9.11	13.85

Source: INSEE, *Enquete Annuelle.* We thank Ahmed Tritah and Joachim Jarreau for providing us this aggregated statistics.

Table A4
Immigration in the District and Firm's productivity Levinsohn Petrin TFP estimation

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Dep. Var : TFP calculated using Levinsohn and Petrin method						
Immigrant share in Department	0.222***	0.352***	0.220	0.086	0.410***	0.077	0.439*
	(0.064)	(0.133)	(0.139)	(0.181)	(0.123)	(0.173)	(0.228)
(Immigrant share in Department) x (dummy zero initial immi share)			0.653* (0.367)				
(Immigrant share in Department) x (dummy below median initial immi share)				0.637** (0.315)		0.666*** (0.227)	0.768** (0.328)
Method of Estimation	OLS	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS
Sample	Firm with at least one migrant by the last period of observation				All Firms		
Observations	65868	64561	64561	64561	101952	101952	41891
First stage coefficients :							
Imputed Immi sh.		0.288***	0.290***	0.295***	0.282***	0.290***	3.798***
Imputed Immi sh. x Firm zero immi			0.274***				
Imputed Immi sh. x Firm below 50th mig				0.272***		0.271***	2.365***
F-stat of first stage		73.80			80.74		
Joint F-stat (Kleibergen-Paap F statistic)			41.25	39.65		40.55	24.37

Note: Columns (1)-(7) always include region-by-period, sector-by-period, firm fixed effects and firm level control variables described in the text.
Column (7) shows results using the imputed share of migrants based on the stock of migrants provided by OECD (data only 2001-2005)
Standard errors are clustered at the department level. The period considered is 1996-2005. The unit of observation is one establishment in one year.
*, **, *** indicate significance at the 10, 5 and 1% confidence level.

Table A5
Immigration in the District and Firm's number of plants

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Dep. Var : Ln(number of plants by firm)						
Immigrant share in Department	-0.008	0.139***	0.018	-0.001	0.075**	-0.020	-0.077
	(0.032)	(0.051)	(0.068)	(0.067)	(0.036)	(0.054)	(0.065)
(Immigrant share in Department) x (dummy zero initial immi share)			0.593*** (0.176)				
(Immigrant share in Department) x (dummy below median initial immi share)				0.370*** (0.122)		0.190** (0.083)	0.290*** (0.108)
Method of Estimation	OLS	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS
Sample	Firm with at least one migrant by the last period of observation				All Firms		
Observations	74865	73704	73704	73704	118490	118490	48554
First stage coefficients :							
Imputed Immi sh.		0.288***	0.291***	0.295***	0.283***	0.291***	3.806***
Imputed Immi sh. x Firm zero immi			0.275***				
Imputed Immi sh. x Firm below 50th mig				0.272***		0.273***	2.375***
F-stat of first stage		72.48			79.10		
Joint F-stat (Kleibergen-Paap F statistic)			39.28	37.95		38.37	24.54

Note: Columns (1)-(7) always include region-by-period, sector-by-period, firm fixed effects and firm level control variables described in the text.
Column (7) shows results using the imputed share of migrants based on the stock of migrants provided by OECD (data only 2001-2005)
Standard errors are clustered at the department level. The period considered is 1996-2005. The unit of observation is one establishment in one year.
*, **, *** indicate significance at the 10, 5 and 1% confidence level.

Table A6
Immigration in the District and Firm's number of exported varieties

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
				Dep. Var : Ln(number of varieties)			
Immigrant share in Department	-0.018	0.328**	-0.021	-0.063	0.390***	-0.058	0.081
	(0.076)	(0.167)	(0.202)	(0.210)	(0.151)	(0.201)	(0.221)
(Immigrant share in Department) x (dummy zero initial immi share)			1.903*** (0.471)				
(Immigrant share in Department) x (dummy below median initial immi share)				1.056*** (0.337)		0.953*** (0.293)	1.100*** (0.377)
Method of Estimation	OLS	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS
Sample	Firm with at least one migrant by the last period of observation				All Firms		
Observations	59190	57923	57923	57923	86006	86006	35857
First stage coefficients :							
Imputed Immi sh.		0.289***	0.290***	0.296***	0.284***	0.292***	3.822***
Imputed Immi sh. x Firm zero immi			0.276***				
Imputed Immi sh. x Firm below 50th mig				0.272***		0.273***	2.357***
F-stat of first stage		71.92			78.84		
Joint F-stat (Kleibergen-Paap F statistic)			42.51	39.04		40.28	22.62

Note: Columns (1)-(7) always include region-by-period, sector-by-period, firm fixed effects and firm level control variables described in the text.
Column (7) shows results using the imputed share of migrants based on the stock of migrants provided by OECD (data only 2001-2005)
Standard errors are clustered at the department level. The period considered is 1996-2005. The unit of observation is one establishment in one year.
*, **, *** indicate significance at the 10, 5 and 1% confidence level.

Table A7
Immigration in the District and Firm's TFP. Robustness using different definition of period

	(1)	(2)	(3)	(4)	(5)	(6)
	Dep. Var : *TFP calculated using Olley and Pakes method*					
Immigrant share in Department	0.132***	0.117***	0.116***	0.321***	0.284***	0.287***
	(0.023)	(0.024)	(0.025)	(0.038)	(0.038)	(0.043)
(Immigrant share in Department) x (dummy zero initial immi share)		0.174*** (0.046)			0.181*** (0.053)	
(Immigrant share in Department) x (dummy below median initial immi share)			0.092*** (0.030)			0.089** (0.040)
Method of Estimation	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS
Sample	Firm with at least one migrant by the last period of observation					
Observations	65180	65180	65180	65180	65180	65180
Period Definition	3 years	3 years	3 years	5 years	5 years	5 years
First stage coefficients :						
Imputed Immi sh.	0.256***	0.258***	0.261***	0.287***	0.289***	0.293***
Imputed Immi sh. x Firm zero immi		0.274***			0.273***	
Imputed Immi sh. x Firm below 50^{th} mig			0.271***			0.272***
F-stat of first stage	67.64			74.43		
Joint F-stat (Kleibergen-Paap F statistic)		34.37	33.79		43.47	36.18

Note: Columns (1)-(6) always include region-by-period, sector-by-period, firm fixed effects and firm level control variables described in the text. Standard errors are clustered at the department level. The period considered is 1996-2005. The unit of observation is one establishment in one year. *, **, *** indicate significance at the 10, 5 and 1% confidence level.

Table A8
Immigration in the District and Firm's TFP. Robustness using balanced dataset

	(1)	(2)	(3)	(4)	(5)	(6)
	Dep. Var : *TFP calculated using Olley and Pakes method*					
Immigrant share in Department	0.128***	0.096***	0.093***	0.135***	0.091***	0.101***
	(0.018)	(0.019)	(0.022)	(0.018)	(0.019)	(0.021)
(Immigrant share in Department) x (dummy zero initial immi share)		0.173*** (0.044)			0.136*** (0.034)	
(Immigrant share in Department) x (dummy below median initial immi share)			0.094*** (0.028)			0.069*** (0.026)
Method of Estimation	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS
Sample	Firm with at least one migrant by the last period of observation			All Firms		
Observations	42543	42543	42543	65809	65809	65809
First stage coefficients :						
Imputed Immi sh.	0.288***	0.292***	0.296***	0.283***	0.290***	0.293***
Imputed Immi sh. x Firm zero immi		0.277***			0.275***	
Imputed Immi sh. x Firm below 50^{th} mig			0.278***			0.277***
F-stat of first stage	78.10			84.61		
Joint F-stat (Kleibergen-Paap F statistic)		47.11	46.08		40.98	42.85

Note: Columns (1)-(6) always include region-by-period, sector-by-period, firm fixed effects and firm level control variables described in the text. Standard errors are clustered at the department level. The period considered is 1996-2005. The unit of observation is one establishment in one year. *, **, *** indicate significance at the 10, 5 and 1% confidence level.

Table A9
Complexity measures and O*Net variables

Measures	**O*NET Variables**
Manual Instensity	Arm-Hand Steadiness, Manual Dexterity, Finger Dexterity, Control Precision, Multilimb Coordination, Response Orientation, Rate Control, Reaction Time, Wrist-Finger Speed, Speed of Limb Movement, Static Strength, Explosive Strength, Dynamic Strength, Trunk Strength, Stamina, Extent Flexibility, Dynamic Flexibility, Gross Body Coordination, Gross Body Equilibrium
Communication Intensity	Oral Comprehension, Written Comprehension, Oral Expression, Written Expression
Cognitive Intensity	Fluency of Ideas, Originality, Problem Sensitivity, Deductive Reasoning, Inductive Reasoning, Information Ordering, Category Flexibility, Mathematical Reasoning, Number Facility, Memorization

Figure A1
Native and immigrant log wages in 1995
French departments