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ABSTRACT

In this paper we analyze the impact of an increase in the local supply of immigrants on firms' outcomes, allowing for heterogeneous effects across firms according to their initial productivity. Using micro-level data on French manufacturing firms spanning the period 1995-2005, we show that a supply-driven increase in the share of foreign-born workers in a French department (a small geographic area) increased the total factor productivity of firms in that department. Immigrants were prevalently highly educated and this effect is consistent with a positive complementarity and spillover effects from their skills. We also find this effect to be significantly stronger for firms with low initial productivity and small size. The positive productivity effect of immigrants was also associated with faster growth of capital, larger exports and higher wages for natives. Highly skilled natives were pushed towards firms that did not hire too many immigrants spreading positive productivity effects to those firms too. Because of stronger effects on smaller and initially less productive firms, the aggregate effects of immigrants at the department level on average productivity and employment was small.

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A online appendix is available at http://www.nber.org/data-appendix/w22852

1 Introduction

This paper estimates the effect of immigration on firm-level productivity, capital investments, employment and exports using French firm data in the period 1995-2005. We also analyze how these effects where different across firms depending on their initial productivity and size and how immigration affected employment flows of natives across firms and firm creation and destruction. Recent papers have found indirect evidence that immigrants benefits firms' productivity. Specialization of natives and immigrants in different and complementary tasks (Peri and Sparber, 2009) may increase production efficiency and labor productivity at the local level. Highly skilled foreign individuals, especially those in science and technology fields, contribute to innovation and increase the productivity of a region or a city (Kerr and Lincoln, 2010, Peri et al, 2015). There is, however, scant direct evidence of the impact of immigrants on firms' productivity and employment due to limited data availability and identification issues at the firm level. When analyzing the impact of immigration at the firm level, one has to account for the heterogeneity that drives differences in firm-specific responses to a local change in immigrant supply. Thus, simply analyzing the correlation between immigrant workers' share and performance of firms is likely to be uninformative of the effect of the first on the second.

New data on French manufacturing firms and an identification strategy based on country-of-origin-driven variation in the supply of immigrants across geographic areas (French Departments) allow us to focus on firm-specific effects of an increase in immigrants. In particular, with our data, we can construct multiple outcomes at the firm level in a panel of individual firms that can be followed over time.[1] Merging them with Census data we can also construct an instrument for the local change in supply of immigrants using a shift-share method based on the pre-existing immigrants' location at the level of a French "*départments*" (local areas) interacted with changes in the aggregate inflows of immigrants by country of origin. The increased immigration from the European Union during the decade, driven by introduction of free mobility in 1992, provide an interesting event to study. Our identification method is not new, as it builds on a traditional instrument proposed by Altonji and Card (1991) and then Card (2001). However, the increased immigrant flows post 1992 and validity checks that we perform to ensure that such an instrument is uncorrelated with pre-1992 economic conditions and trends across French Departments, put our application on reasonably solid ground. We also control for several time-varying, firm-level characteristics, and for firm fixed effects to reduce the concerns of lingering endogeneity and omitted variable bias.

Firm-level data allow us to analyze the effect of immigration in the context of firms with heterogeneous initial productivity. We ask the crucial question whether immigration has a different impact on the initially more productive or on the less productive firms. Hence, we estimate a response to immigrants that can depend

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

on firm's initial productivity (which is highly correlated with its size and probability of exporting). If the inflow of immigrants helps firms that are initially less productive, it can also help native workers in those firms, preventing job destruction and encouraging growth. This would appear as aggregate complementarity with native workers (as in Ottaviano and Peri, 2012). In this case immigration would be beneficial in particular for firms lagging behind in the productivity distribution. The importance of studying the heterogeneous effect of immigration across firms' characteristics is supported by firm-level stylized facts showing that not all French firms employed immigrant workers as of 1995, and that the share of immigrants hired exhibits a large variation across firms and is correlated with the variation of other firm characteristics (see section 3.2).

We also document that, based on aggregate statistics relative to their occupational distribution, the net immigrant inflow in France during the 1995-2005 period was skill-intensive (see section 3.2). The employment of foreign-born workers increased significantly more in occupations with high cognitive and analytical content than in those with high manual content. The share of immigrants with a high school diploma (or lower) decreased over that period from 74% in 1995 to 58% in 2005, while those with more than a 3-year university diploma grew in percentage from 9% to 14% of the foreign population. Moreover, from Labor Force Survey data we know that the share of immigrants in the group of tertiary educated increased from 5.7% to 7.1% over the period 1995-2005. Hence their net inflow had a relatively larger share of college educated than in the native population. As mentioned above, the increase in immigrants was mainly driven by EU citizens and a large share of those was college educated. The findings of this paper should be interpreted as documenting the effects of high-skilled immigrants on outcomes of manufacturing firms.

This paper introduces two main novelties with respect to the existing literature. First, we focus on firm-level outcomes and we only exploit within-firm variation when assessing the impact of a variation of immigration supply in the local labor market on these outcomes. Second, we allow heterogeneity in initial firm productivity to affect the response to immigration and we interact the local supply change in immigrants with the initial productivity of firms to estimate the consequences of such heterogeneity (we also consider firms' size and immigrant share as proxies for initial productivity).

We first show that a supply-driven increase in immigrants in an area pushes the average firm to hire immigrants. This is quite reasonable as larger supply of immigrants in the area will drive larger employment of immigrants. Interestingly, such an effect is stronger for the subset of firms that initially had low productivity levels. These firms were more likely to start hiring immigrants and hired more of them in the considered period. Then we show that firms with low initial productivity also experienced the largest positive productivity effects associated with immigration in the area. We also explore whether other outcomes, related to the productivity of firms, such as exit, domestic market share, export and capital investments 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 low levels of productivity and low share of immigrants. These additional results are consistent with the idea that the productivity gains may be in part driven by skill-capital and skill-technology complementarities within the firm that hired immigrants. We find no evidence of a decline in native wages as a consequence of hiring immigrants. Rather, as a consequence of higher productivity, native wages increased in the department. Interestingly, the composition of native workers across firms also changed as a consequence of immigration. Highly educated native workers were pushed into firms hiring fewer immigrants and contributed to increasing their wages. New immigrants had a small but significant effect in reducing firm exit and seem to increase the size of small firms relative to large firms. These differential effects and reallocation across firms imply a small aggregate effect at the department level as immigration spurs convergence of productivity and of the size of firms by stimulating small, initially less productive firms more than larger and initially more productive ones. Differently from a homogeneous effect on all firms, the heterogeneous firm-level effects aggregate to a modest regional effect.

The rest of the paper is organized as follows. Section 2 puts this paper in the context of the existing literature and introduces a simple framework to discuss the channels explored in the empirical analysis. Section 3 presents the data and stylized facts. Section 4 discusses the empirical specifications and the identification strategy and its limitations. Section 5 describes and comments on the estimates of the effects of immigration on firm outcomes. Section 6 concludes the paper.

2 Framework and Literature Review

There is an abundance of studies on the effect of immigrants on the labor market outcomes of natives. These studies analyze immigration at the national level (e.g. Borjas 2003, Borjas and Katz 2007, Ottaviano and Peri 2012) or at the local level (such as Card 2001, 2009), and they use data from several different countries[2] (see also the literature reviews by Longhi et al (2005), Kerr and Kerr (2011) and Lewis and Peri (2015)). Much less is known, however, about the firm-level effects of immigrants or about the inter-firm adjustments triggered by immigrants. This is in part due to the easier availability of labor market data (from census and population surveys) rather than firm-level data including information on the place of birth of individuals. Recently, aggregate studies suggest interesting mechanisms through which immigrants may be absorbed within firms, such as adjusting the task specialization of workers (Peri and Sparber 2009; Ottaviano, Peri and Wright 2013), modifying the adopted production techniques (e.g. Lewis 2011), promoting accumulation of physical

[2]Some countries such as Germany (De New and Zimmermann 1994) and the UK (Dustmann, Fabbri and Preston 2005) are particularly well studied. Recent papers study the labor market effect of migration by using individual level data from country-specific surveys. Edo and Toubal (2015), using individual level data for France, find that immigration decreases the wage of highly educated native workers by about 1% and contributes to an increase in the wage of low-skilled workers by 0.5%. Cohen-Goldner and Paserman (2011), using individual-level data for Israel, find a 10% increase in the share of immigrants decreases native wages by 1 to 3% in the short run, and has no effect in the medium-long run.

capital or expanding the number of establishments (Olney, 2013).

Only very recent studies have used firm-level data to study the effects of immigration. Malchow-Moller, Munch and Skaksen (2012), using data from Danish firms, find that immigrants substitute for natives within individual firms. Martins, Piracha and Varejao (2012) using 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 effects of immigrants and hence they extend the classical labor approach to firm-level data. Hatzigeorgiou and Lodefalk (2016) and Hiller (2013) consider more specific firm-level outcomes. They analyze the effect of immigrants on firm-level exports, relying on a reduced-form empirical specification that correlates firm-immigrants and firm exports. Ghosh et al. (2014) and Doran et al. (2014) study the effect of a reduction in the annual H-1B cap (skilled immigrant visas) in the US on firm-specific outcomes (i.e. innovation, productivity, revenues and profits). The first paper analyzes the impact of restricting the H-1B number on the outcome of all large US firms, the second uses a smaller sample but exploits the randomness of a lottery allocation of . Ghosh et al. (2014) find a significant reduction in size and productivity for firms that heavily depend on foreign H-1B workers following the enforcement of a lower H-1B quota. The second paper does not find any impact on innovation at the firm level from hiring fewer H-1B employees. Let us emphasize that an important difference between our study and those using visa growth in the US is the free mobility of EU workers that constituted the bulk of new foreign-born individuals in our sample. In the US, firms previously hiring workers are at a relative advantage for hiring more, when the quota increases, as they are familiar with laws and procedures. In France, EU citizens were easily available to firms, when barrier to mobility were removed. This fact may contribute to the explanation of the finding that less productive firms hired more immigrants during the considered period and it is an important difference between our analysis and the research on visa workers.

Our analysis is focused on the impact of immigrants on firm-specific outcomes. We aim at first quantifying the effect of an exogenous increase of immigrants in a labor market on firms' productivity (and on other productivity related firms' outcomes). Then we also study whether the effect of immigration is heterogeneous across firms with different levels of initial productivity (or initial size). Finally we analyze other margins of adjustment, such as firm exit and native mobility and selection across firms in response to local immigration. While the change in immigrant workers' availability pertains to the local labor market, different firms may respond differently to it and important outcomes such as productivity, capital investments and exports may be affected. Recent studies (e.g. Peri 2011, Peri and Sparber 2009) suggest immigrants are often concentrated in specific jobs and in specific production tasks. Different firms may be subject to productivity gains according to their exposure to these jobs and their internal organization of productive tasks. More recently, Peri et al. (2015) have emphasized that highly skilled immigrants in STEM jobs may increase productivity of US cities, especially for college educated workers. Brunow et al (2015) began to analyze the correlation between cultural

diversity of workplace (as diversification of foreign employees in the firm) and firm productivity. A recent paper by Haas and Lucht (2013) uses a general equilibrium model with heterogeneous firms (as in Melitz 2003) where migrants imperfectly substitute for native workers and firms differ in their productivity levels and it shows, via simulation results, that firm productivity increases with the immigrants' share in the firm.

To capture the variety of channels through which immigration may affect productivity and natives' wages in heterogeneous firms we consider the production function of a generic firm i within a labor market. We indicate with $s = \frac{F}{N+F}$ the share of foreign-born workers in that labor market, where N and F indicate the employment of natives and foreign-born respectively. Firms can adjust their technology and efficiency responding to the native/immigrant composition of the labor force so that firm-specific productivity may depend on (s), via externalities. The presence of more immigrants may also increase the number of foreign workers hired by the firm (f_i), and it may also generate productivity gains (through specialization, complementarity and optimal task allocation) that may vary across firms. We allow for immigrants and natives to be imperfect substitutes in a CES production function (as in Ottaviano and Peri 2012, or Docquier, Ozden and Peri 2014) and we allow firms to benefit from migrant's externalities within the region. We represent this using the following production function for firm i :

$$Y_i = A_i(s)(\beta f_i^{\frac{\sigma-1}{\sigma}} + (1-\beta)n_i^{\frac{\sigma-1}{\sigma}})^{\frac{\sigma}{\sigma-1}} \tag{1}$$

In equation (1) we are assuming that hired immigrants f_i and natives n_i are combined into output (Y_i) with an elasticity of substitution equal to $\sigma > 1$ so that the productivity of native workers may depend on immigrants through complementarities. Immigrants have a specific productivity β that may differ from that of natives $(1-\beta)$. The productivity of the firm also depends, however, on the proportion of immigrants in the local labor market, s, through skill spillovers and externalities. While the CES component allows a positive wage and labor productivity effect of immigrants on natives within the firm through complementarity, the productivity effect may extend to the whole area either because of skill externalities (Docquier et al, 2014), technology adoption (Lewis 2013) or efficiency reasons (Peri 2012) and it may vary across firms (hence the subscript i). Dividing equation (1) by $(n_i + f_i)$ implies that output per worker, y_i, and hence labor productivity of firm i, depends on the share of immigrants in the firm, $s_{\ i}$ and in the region s as follows:

$$y_i = \frac{Y_i}{n_i + f_i} = A_i(s)(\beta s_i^{\frac{\sigma-1}{\sigma}} + (1-\beta)(1-s_i)^{\frac{\sigma-1}{\sigma}})^{\frac{\sigma}{\sigma-1}} \tag{2}$$

The first term, $A_i(s)$ captures the effect of the share of immigrants, through potential externalities, on the productivity of firm i. The intensity of this externality can be different across firms. The second term, in brackets, captures the within-firm complementarity effect between immigrants and natives. It impacts the

average labor productivity of a firm and it has an internal maximum (between 0 and 1) which is a value of s_i corresponding to the "optimal" combination of immigrants and natives. This optimum is larger the larger is β, the relative productivity of immigrants. For equal productivity of immigrants and natives, ($\beta = 0.5$) the second term is maximized at $s_i = 0.5$. Hence, for similar productivity of immigrants and natives, an increase in the share of immigrants in the firm will likely increase labor productivity in a firm through this channel at levels of s_i smaller than 0.5 which is the case for most of the considered firms. At higher value of s_i the contribution of that term can become negligible or even negative.[3]

The average productivity effect of immigrants in a local labor market (in our case a French department) will be the weighted average productivity of each firm, y_i, with weights equal to the size of firms in terms of workers $x_i = \frac{n_i+f_i}{N+F}$. Hence:

$$y = \sum_{i \in Firms} x_i y_i = \sum_{i \in Firms} x_i(s) y_i(s) \tag{3}$$

The notation above emphasizes that not just the productivity of individual firms, y_i but their relative size, $x_i(s)$, can be affected by the percentage of immigrants in the local labor market. Both the productivity and the size of a firm may vary in response to changes in the local share of immigrants in different ways. Individual firms hiring more immigrants may benefit from their internal complementarity with natives, or from externalities due to spillovers effects. Firm creation and destruction (entry and exit) can also be induced by the presence of immigrants. The reallocation of natives may also affect relative size of firms.

Influential models of international trade (such as Melitz 2003, Bernard et al. 2003) have emphasized that the opening to international market competition produces a selection of firms and affects the creation and destruction of those. Opening to trade will affect firms differently depending on their initial productivity. The local inflow of immigrants can also generate differential productivity effects across firms that may depend on their initial productivity, specialization and hiring of immigrants. Hence equation (3) allows for possible effects of immigrants on firm size (and on firm survival) that may vary across the initial distribution of firms.

Our empirical analysis investigates, first, equation (2) at the firm level. In particular, we analyze how a change in the local share of immigrants over time affects the productivity of firms, allowing different effects along the initial productivity distribution. In particular, considering the variation over time of a linear version of equation (2) we can write:

$$\Delta y_i = y_i^a \Delta s + y_i^b \Delta s_i \tag{4}$$

[3]The wage of native workers in firm i is given by the following expression $w_{ni} = A_i(s)(1-s)^{-\frac{1}{\sigma}}(\beta s_i^{\frac{\sigma-1}{\sigma}} + (1-\beta)(1-s_i)^{\frac{\sigma-1}{\sigma}})^{\frac{1}{\sigma-1}}$. The extra-term $(1-s)^{-\frac{1}{\sigma}}$ shows how the complementarity between immigrant and native workers affects native wages positively and more strongly than average productivity in the firm.

In (4) the operator Δ captures the change over time. The term $y_i^a \Delta s$ captures the firm-specific change triggered by a change in the share of local immigrants, due to externalities and the term $y_i^b \Delta s_i$ captures the change in productivity in a firm due to increased share of its own immigrant workforce, due to complementarity. Hence $y_i^a$and y_i^b are partial derivatives of firm productivity with respect to the immigrant externality and complementarity effect, respectively. We are interested in analyzing how the effects vary depending on firm's initial heterogeneity. What expression (4) makes also clear is that even firms not directly hiring immigrants may be affected by their inflow in the local economy as their productivity may depend on s through local externalities, as shown in the first term $y_i^a \Delta s$. To analyze the heterogeneous productivity effects we will use different measures and proxies of initial productivity levels (initial TFP, initial size, initial share of immigrants) interacted with the change in local labor markets' immigrant shares .

The estimated impact of immigrants on individual firm productivity is only part of the total effect immigration can have on average local productivity. Besides affecting the productivity of existing firms increases in immigration can change their relative size, by pushing labor towards or away from firms that hire more immigrants. By changing the competition environment it may also affect the creation/destruction of firms and the selection of natives among them. Hence, decomposing the effect of a change in s on the average local area productivity expressed by (3), gives the following equation:

$$\Delta y = \sum_{i \in \Delta Firms} x_i^{new}(s) y_i^{new}(s) + \sum_{i \in Firms} \Delta x_i(s) * y_i(s) + \sum_{i \in Firms} x_i(s) * \Delta y_i(s) \tag{5}$$

The decomposition emphasizes that there are three potential channels affecting the local productivity effect of immigrants. Beginning from the third term we will analyze how the change in immigrant share in a labor market area affects individual firm productivity and how this effect differs across firms (as illustrated by equation 4); this is the focus of our firm-level analysis which studies productivity effects allowing different forms of heterogeneity. Then, the first term on the right hand side of equation (5), captures the effect on creation and destruction of firms ($\Delta Firms$) due to an increase in s. Immigration can change the firm landscape by helping new firm creation or affecting survival of existing firms. We will also analyze in detail the impact of immigrants on these two margins. Finally the second term in equation (5) captures the effect of immigration in reallocating workers across existing firms, through changing the relative size of firms, (Δx_i). Depending on whether firms use technologies that complement immigrant skills more or less intensely, some may grow while others may shrink in response to immigrants. By capturing the change in relative size of firms this term suggests that also the selection of native workers (e.g. by skills) across firms may change and we will analyze this source of heterogeneity and potential spillovers.

The main goal of this paper is identifying an exogenous shock related to the inflow of foreign born workers and analyzing the average and the differential impact on firm productivity, on firm creation, destruction and

on the reallocation of native workers across firms. The framework above acknowledges the existence of several potential channels through which immigration can impact productivity and hence local employment/wages within and across firms. We also analyze the impact on size, capital investment and exports that are important outcomes at the firm level, and are related to their productivity performance. This framework is much richer than the one used traditionally to analyze the labor market effect of immigrants which constraints many of the above effects to be zero and only analyzes aggregate impact on employment and wages.

3 Data and stylized facts

3.1 Sources and summary statistics

Let us begin with a description of the data and some important stylized facts. In constructing firm-level variables we merged several data sources. First, the Declaration Annuelle des Donnetes Sociales (DADS) database consists of administrative files based on mandatory reports on employees' earnings and characteristics. DADS data contain yearly information about the structure of employment for each establishment in France.[4] Each single observation in this dataset corresponds to a unique establishment-year combination. At the establishment level, DADS provides information on geographic location and industry, as well as the identification number for the establishment (SIRET) and the parent enterprise (SIREN). In terms of employee characteristics, we have information on the gender, age, place of birth (native vs. foreigners), total yearly gross and net earnings, number of hours worked and occupation (both at two-digit CS and four-digit PCS-ESE classification), but not educational attainment. Individual employees are not linked across years, but establishments are, hence, we can construct the characteristics of the average employees in a firm (SIREN) for each year.

To construct the variables on firm outcomes we also use two additional data sources that cover 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 1995-2005 period. Exports – quantified in tons and valued in Euros – are available by firm, year, product (identified by an 8 digit code corresponding to the NC8 nomenclature) and the country of destination.[5] 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 domestic market share, capital and total factor productivity. EAE data are available for firms with more than 20 employees over the period 1995-2007. Matching all these sources together, using the SIREN identification number, we obtain an unbalanced panel dataset of firms over the 1995-

[4]This database includes different units organized by year and region (12 years, 24 regions) which implies 288 separate databases with more than 50 million observations per year were merged.

[5]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.

2005 period.[6] However, some of the variables needed to compute the TFP measure have missing information in 1995; for this reason our estimation sample in tables 5-12 (and A3-A9) is restricted to the period 1996-2005. See appendix section A1 for further details on data coverage. Finally, the data about the immigrant and native populations 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 year t. The share of immigrants across departments 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.

3.2 Immigrants Skills and Firm heterogeneity

During the 1995-2005 period, the net inflow of immigrants in France was highly skilled and unevenly distributed across departments. We do not have information on the education of workers in the DADS data, so in order to characterize the skill content of French immigration in the 1995-2005 we rely on the complexity and communication-intensity of the tasks performed by workers (we follow Peri and Sparber (2009) and focus on the dichotomy between communication and manual tasks to classify jobs along the communication-intensity spectrum). To do so we combine measures from the O*NET database that associate the intensity of several skills to each occupation in the Standard Occupational Classification (SOC) - cross-walking this classification with the occupational structure provided by the DADS.[7] First, table 2 shows that immigrant inflow between 1995 and 2005 was much larger among the high-complexity than the low-complexity group of occupations. The table shows the top 10 occupations by complexity index increased the percentage of immigrants in total hours worked by 9.7 percentage points, while the share of hours worked by immigrants among low complexity occupations increased only 2.6 percentage points (p.p.). 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 1995-2005 period, while the second group increased by 9.3 p.p. Figure 1 shows the percentage composition of immigrants in France (from the IEB dataset) from 1980 to 2010 by schooling degree. The largest group is primary-educated immigrants, but their share has been declining fast, especially over the past 15 years. Immigration of college-educated people, however, has been increasing rapidly (the top share in the bar chart). Finally, over the 1995-2005 period, the share of immigrants with a high school diploma (or lower) decreased from 74% in 1995 to 58% in 2005. The share of immigrants with at least a three-year university diploma went from

[6] A standard concern in firm-level (unbalanced) panels is 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 A6 we show results on TFP using a balanced database.

[7] By merging both into the 1988 International Standard Classification of Occupations, ISCO-88.

9% in 1995 to 14% in 2005[8]. Using Labor Force Survey data we could also compute the share of immigrants (over total population) by education attainment. The share of immigrants in the group of tertiary educated population increased from 5.7% to 7.1% over the period 1995-2005. Differently, the share of immigrants in the group of unskilled population (with less than 3-year university diploma) decreased by 1 percentage point (from 6.7% to 5.6%). Overall, it is fair to characterize the net flow of immigrants 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 a significant increase in the foreign-born population in France (from about 6% of the population in 1995 to 12% in 2005). Second, different regions had very different exposure to immigrants. Some regions (such as Champagne-Ardenne and Lorraine) maintained a low exposure to immigration over the entire period; other regions experienced increasing exposure to immigrants over time. As an example, the population percentage of immigrants in the Nord-Pas-de-Calais region increased from 6.3 points in 1995 to 16 points in 2005 (with an average yearly growth rate by 25%). Other regions simply increased the already-high share of immigrants over the same period. For example, in 1995 the Ile-de-France and Rhone-Alpes regions already had relatively large immigrant shares of 10% and 9.6%, respectively, that increased significantly to 21% and 18% in 2005, respectively.[9]

Just as historical reasons produced large variation in the presence of immigrants across areas, the data show a very large variation in the presence of foreign-born workers across firms. In 1996[10] 36% of all French firms did not employ any immigrant workers. The share of firms with 0 immigrants varies a lot across department. As an example, in Seine Saint-Denis and Val d'Oise only 12% of all firms did not employ immigrants in 1996, while 78% of firms did not employ immigrants in Nierre and Haute Marne. Only in the South-East department of Haute-Garonne did all firms employ at least one immigrant worker. The share of firms that do not hire immigrants is negatively and significantly correlated with the share of immigrants in the department, as shown in figure 2. However there are some firms with no immigrants even in departments with large share of immigrants. The large variation of immigrant share across firms is correlated to other firm characteristics. This underscores the importance of controlling for firm characteristics and also the need for a sharper identification strategy not based on the correlation between share of immigrants and productivity levels across firms. Table 3 shows the linear correlation coefficients across French manufacturing firms between immigrants and productivity proxies in year 1996. Each row of the table uses the variable listed in the first column as dependent in a regression, on region and sector fixed effects and on either the immigrant share in the firm employment (column 1), or on a dummy equal to one for having no immigrants and zero otherwise (column 2). The dependent variables are

[8]The education composition of immigrants is also displayed in table A2 of the Appendix.

[9]Data on the share of foreign population in 1995 and 2005 for all regions are shown in table A1 of the Appendix, that is available online.

[10]The year 1996 is the initial year for our estimation sample.

TFP, domestic market share, capital per worker and exports (all in logs). The first two are measures of labor productivity, while the other two variables are positively correlated with it. The share of immigrants in the firm is significantly correlated with all the firm outcomes considered. While such correlation may or may not arise for causal reasons in our identification we will not use any of this cross sectional association to identify our effect, but we will let the firm heterogeneity drive differential response to exogenous local immigrant inflow.

4 Empirical Framework

The goal of the empirical analysis is to help us understand the response of firms' outcomes to inflows of immigrants in the local labor markets. In particular we set up an empirical model that, controlling for firm productive heterogeneity, analyzes the response of firm outcomes to local immigration shocks. We allow firms with low initial productivity to react differently to a positive shock in migrant labor supply. For this reason we allow firms that initially have TFP or total employment below the median or zero immigrant share to respond to local immigration shocks in a different way than the rest of firms. We focus on a simple distinction between firms below and above the median of average productivity (or size) to capture whether heterogeneous effects imply a reduction (positive additional effect below the median) or an increase (negative additional effect) in the productivity inequality across firms.[11] We also consider specifically firms that initially had zero immigrants to see if they respond to these shocks in different ways than the rest (in table 3 we show that firms without immigrants are among the less productive ones). If immigrants have an effect that is complementary to a firm's technology, and their presence allows the adoption of more efficient technologies, those firms may exhibit a particularly strong positive effect when they start hiring immigrants.

Area-level changes in immigrant share, appropriately instrumented, can be considered an exogenous supply shock for the firm. However, the size of the change in the firm's employment share of immigrants depends also on its own characteristics. Hence, variation of immigrants across departments represents supply-shock, while variation of firms' share of immigrants within the department provide evidence of heterogeneous responses. 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)) combined the cross-sectional variation due to firm-level hiring and the variation of immigrant supply across localities. This may confound variation in local supply with variation in firms' response to it. In our approach we will consider only exogenous area-level variation of immigrants as a supply shock. Additionally, we will use the firm-level variation within a department to understand differential firm response.

The trade literature has previously related export shocks to firm-level outcomes (such as productivity and

[11] We will also check with a finer partition of firms by quartiles of initial productivity to show that the effect of immigration is actually monotonic in initial productivity. See table A7.

wages). In that context (e.g. Hummels et al 2014), it makes sense to consider a firm-specific export (or import) shock because of the differential exposure of each firm to the growth of specific foreign markets. In our case, immigration shocks are more reasonably considered as changes in the local availability of immigrant workers and, as such, they are common to all establishments in a labor market. Then we allow individual firm to respond differently according to their differential initial productivity. Our baseline empirical model is as follows:

$$(y)_{i,s,d,t} = \phi_i + \phi_{s,T} + \phi_{r,T} + \beta_1 \left(s_{d,t}^{IMMI}\right) + \beta_2 (s_{d,t}^{IMMI})_{d,t} * I_i \left(k_{i,1996} \leq \underline{k}\right) + \beta_3 X_{i,t} + \varepsilon_{i,t} \quad (6)$$

The variable $(y)_{i,s,d,t}$ represents an outcome relative to firm i in sector s, department d and year t. Our sample includes the universe of French manufacturing firms with at least 20 employees between 1995 and 2005.[12] Hence, the index t takes values between 1995 and 2005. However, because of data unavailability for firm TFP in 1995, our estimation sample is restricted to the 1996-2005 period. 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. Since, in our sample, every firm belongs to a specific sector-department, firm fixed effects also capture department and sector-specific unobserved factors.[13] By introducing firm fixed effects we base our identification on differences with respect to firm-specific average over time (within estimator). This reflects the spirit of equation (4) that describes how changes in firm's productivity depends on the change in immigrant composition of the local labor force. 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 $T = 2$.[14] In particular, they could capture local agglomeration effects or sector-specific technologies that change over time.[15] As one period lasts two years, those fixed effects fully absorb changes in French labor market legislation and/or sector technologies that evolve slowly.[16]

The term $X_{i,t}$ captures a set of firm-specific time-varying controls, including a headquarter 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 firm) and the firm's age. The explanatory variables of interest are: (i) $s_{d,t}^{IMMI}$, the share of immigrant population at time t in the department d where the firm is located;[17] and (ii) the interaction of this

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

[13] 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 department of the biggest plant (in terms of total number of workers).

[14] Two-year period fixed effects imply 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. See Appendix table A5 for TFP estimation results using, respectively, three- and five-year period definitions for the fixed effects.

[15] The fixed effects we introduce are the most demanding, while still maintaining reasonable identification power in the IV estimation. The inclusion of region-by-year effects would render the instrument excessively weak. We will show several robustness checks with regards to these fixed effects in Appendix table A5.

[16] One important shock in the French labor market might be represented by the EU enlargement, having added Eastern 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 – outside our sample period.

[17] We consider 92 non-overseas departments of France for which we have data on the 1990 stock of migrants by the INSEE

variable with the dummy $I_i\left(k_{i,1996} \leq \underline{k}\right)$ that selects firms whose initial characteristic $k_{i,1996}$ was below a certain threshold. This variable aims at capturing the differential effect depending on initial firm characteristics.[18]

We adopt three different specifications depending on the choice of the initial characteristic. Such characteristic is meant to be correlated with initial productivity of the firm. Hence k represents alternatively, (i) the share of immigrants in firm i as of 1996 and in this case the threshold is 0; (ii) the TFP of firm i as of 1996 and in this case the threshold is the sample median and (iii) the total employment of firm i in 1996 and also in this case the threshold is the sample median. The change of immigrant share, $s_{d,t}^{IMMI}$, captures the exogenous department-level change in immigrant supply, and the dummy, $I_i\left(k_{i,1996} \leq \underline{k}\right)$, allows the outcomes of firms that initially have no immigrants or low productivity (or size) to respond differently to such a shock

We analyze several outcomes, $(y)_{i,t}$, at the firm level. They are the log of total factor productivity (TFP), the domestic market share (as further proxy of productivity), the logarithm of the capital stock, the exit probability of firms,[19] the number of plants per firm, the logarithm of exports, the number of served foreign markets, the wage of natives in the firms and the employment of native workers in the firm. All those variables (except exit probability) are positively correlated with productivity. Hence estimating a positive and significant β_1 and β_2 coefficients for those outcome variables implies that immigration promotes convergence of those outcomes across firms, stimulating initially less productive firms more than the rest. We estimate specification 6 on the full sample of firms.

4.1 Identification issues and Instrumental Variables

Estimating equation (6) using least squares methods, even if we include fixed effects for firm-specific, region-period and sector-period unobservable variables, leaves open the possibility that some omitted local conditions may affect the changes in demand of immigrants and the changes in productivity/labor demand of firms simultaneously. District-specific yearly shocks, not observable to the researcher may drive a positive correlation between the residual $\varepsilon_{i,t}$, in equation (6) and the explanatory variable, $s_{d,t}^{IMMI}$. In our setting, the omitted variable concern is more severe than the reverse causality problem, as the unobserved productivity shocks of an individual firm do not have a significant impact on the department's economic outcome, which is much larger. In order to identify the part of the change in the immigration share at the department level driven by supply-driven variation, rather than by local productivity shocks, we use a shift-share instrument based on the initial spatial distribution of immigrants. Pioneered by Altonji and Card (1991) and used in several studies since then

Population Census (needed to compute our instrumental variable). Thus, the explanatory variable of interest takes 1,012 different values (92 departments by eleven years).

[18] This implies that results would be restricted to firms that existed in 1996. To attenuate this limitation, we run two robustness checks. First, we take the sub-period 2000-2005 and use the 2000 as starting year (using firms existing in 2000). Second, we run equation 6 on a balanced panel with firms existing over the entire period 1996-2005 (no entry/exit). Results for both robustness checks are reported in the online Appendix table A6 and confirm our baseline estimation results.

[19] We thank anonymous referee for suggesting this interesting firm outcome.

(such as Card (2001), Card (2009), Peri and Sparber (2009), and Lewis (2013), among others), this approach is based on the fact that, because of information and preferences, new immigrants tend to move to the same area (French department) where previous immigrants from the same country already live. This is because they know of opportunities in those locations 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, not by demand shocks. Building on this idea we construct the imputed number of immigrants in district d, for each year $t = 1996 - 2005$, $\widehat{IMMI}_{d,t}$ as follows. For each country of origin, o, we distribute the total number of immigrants in France for that group in year t indicated as $\widetilde{IMMI}_{o,t}$ across departments, in proportion to the share of that national group in the district as of 1990. By summing across countries of origin we obtain such an imputed number of immigrants in each department:

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

This method uses the initial distribution of immigrants from each country across districts interacted with the aggregate inflow of immigrants by country of origin. District-specific labor demand changes between 1995 and 2005 should not be correlated with either term, as long as district-specific determinants of agglomeration of some immigrant communities in the years before 1995 are not strongly correlated with demand changes in the period 1996-2005. Since the only available data on total immigrants by country of origin in France are from the *Census*, we also impute the *yearly* number of immigrants by country of origin - $\widetilde{IMMI}_{o,t}$ - as follows:

$$\widetilde{IMMI}_{o,t} = \frac{IMMI_{France,o,t,Census}}{IMMI_{France,t,Census}} * IMMI_{France,t,DADS}. \tag{8}$$

the first term in equation (8) is the share of immigrants in France from a given origin o in census year t (based on Census data, INSEE). While the second term in equation (8), $IMMI_{France,t,DADS}$, is the stock of foreign-born individuals working in France at time t in the manufacturing plus service sectors and is obtained from DADS data - which also provide the exhaustive sample of workers that we use (see section 3.1). Notice that we include the total stock of migrants working in service and manufacturing sectors, while we include manufacturing firms only when estimating equation (6).[20] This increases the correlation of the instrument with the supply of immigrants as manufacturing-specific shocks in a region should not affect aggregate flows. We then imputed the share of immigrants in the department as follows:

$$\widehat{s^{IMMI}_{d,t}} = \frac{\widehat{IMMI}_{d,t}}{\widehat{IMMI}_{d,t} + Natives_{d,1995}} \tag{9}$$

[20] By focusing on the manufacturing sector, we also avoid any minimum wage issues (Salaire minimum interprofessionnel de croissance, SMIC). Indeed only in service sectors (as touristic services, hotels and food services) the average hourly wage is close to the minimum wage.

In expression (9) the native population is fixed at year 1995 so as to avoid spurious effects due to the potentially endogenous native population growth in the department over the 1996-2005 period. Internal mobility of native workers due to local demand shocks could introduce significant spurious bias in the instrument if one uses the contemporary (rather than initial) number of native individuals. 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 *new* immigrants coming from the same country of origin because of network effects. So different migration rates from different countries, driven by changing conditions in sending country or policy variations or changes in immigration costs (all factors likely to be unrelated to local demand shocks) have differential impact on French districts depending on the distribution of these migrants. The implicit assumption is that the distribution of immigrants across departments for each country of origin in 1990 were uncorrelated with the distribution of changes in labor demand shocks in the department, conditional on firm fixed effects and region-period and sector-period fixed effects. Some potential concern for this type of instrument may arise if the 1990 distribution of immigrants across department is correlated with some economic conditions that affects subsequent changes of productivity and employment in firms. To mitigate these concerns, we test whether the instrument is correlated with initial economic conditions of the departments in the next section. We cannot test (due to lack of data) whether they are uncorrelated with their trend preceding 1996; but we provide alternative tests supporting the validity of the exclusion restriction. However, the instruments we use here are commonly used in this literature and generally considered valid (i.e. uncorrelated with pre-1996 levels of economic activity). For these reasons we consider our estimates as informative on the causal role of immigrants on French firms. In the next sub-section we discuss in greater detail the validity of our instrumental variable.

4.2 Instrument validity

Before presenting the empirical results, we show evidence consistent with the validity of the exclusion restriction, which is crucial to our identification strategy. In constructing the IV we assumed the distribution of immigrants by origin country in year 1990 was orthogonal to subsequent productivity and labor demand shocks at the local level. This is a strong assumption. Past income and productivity shocks, specific to departments, may be persistent over time. This introduces the possibility that past income and productivity had an effect on the stock of immigrants in 1990, and, through this channel, the instrument may be spuriously correlated to current firm's outcomes. To find some reassurance that the instrument constructed this way is not correlated with preexisting economic patterns across departments, we calculate the correlation across departments between the instrument, namely the change in the imputed immigrants over the period 1996-2005,[21] and the average economic outcomes in the departments as of 1996 (TFP, domestic market share, capital and trade). Table 4 panel A shows the OLS

[21] Computed as $\widehat{s^{IMMI}_{d,2005}} - \widehat{s^{IMMI}_{d,1996}}$

correlation of imputed changes in immigrants and 1996 economic outcomes across departments. Reassuringly, we do not find any significant correlation between the instrument and the preexisting average economic outcomes. While this is a reasonable test, it does not rule out correlation of the instrument with pre-1996 trend in the outcomes. A more accurate test would be to regress the trend in our outcome variables before-1996 on the after-1996 trend of our instrument. While we do not have information on French firms' TFP before 1996 we perform two additional tests. First, we test the validity of our instruments, constructed for the second half of the period only (2000-2005) relative to trends of the first part of the period (1996-1999). A significant correlation of local shocks and immigration behavior over time could generate a correlation with pre-existing trends, casting doubt on the shift-share procedure.[22] Results reported in Table 4 panel B show that there is no statistically significant correlation between the pre-2000 trend in local outcomes and the post-2000 trend in the instrument.[23] As an alternative, instead of using trends in the outcome variables at the firm level, we check the correlation of instruments with pre-existing labor market trends, available for the 1982-1990 period from French Census data. Results reported in panel C of table 4 show that the instrument is not correlated with preexisting trend in local labor market (department) variables.

5 The Effects of Immigration on Firms

Tables 5 to 12 show the estimated parameters on the explanatory variables of interest for specification (6) using the full sample of firms in our dataset and different firm-level outcomes. These tables share a similar structure, while using different outcome variables. We will describe the main features of the tables when commenting on the estimates presented in table 5 and, even more in table 6 which introduces the main estimates relative to productivity. Then we will comment on the parameter estimates for each of the other tables in the following subsections that relate to different outcomes. As described in section 4, the estimation sample in tables 5-12 (and in the online Appendix tables A3-A9 which represent checks of robustness) covers the period 1996-2005. We use firm characteristics measured in year 1996 to compute the dummy $I_i\left(k_{i,1996} \leq \underline{k}\right)$ as in equation (6). The sample used for all regression includes all manufacturing firms. The standard errors are clustered at the department level in each specification so as to account for the correlation across firms and over time within a geographic area.

[22] We thank anonymous referee for suggesting this test.

[23] The only significant correlation is for domestic market share but only at 10% and with the opposite sign that an endogeneity argument would suggest. This is an accurate test for the exogeneity of the instrument after 2000. So, in Onlne Appenix Table A6 we show TFP baseline results for the sub-period 2000-2005. Results are qualitatively identical to the baseline estimations on the full sample.

5.1 Firm's hiring of Immigrants

In table 5 we show how the increased supply of immigrants in the department translates into local firms hiring them. In particular, in panel A, we analyze how likely are firms that employed no immigrants at the beginning of the considered period to begin hiring them in response to the increased supply. The dependent variable is a dummy equal to one if the firm increases the number of immigrants from 0 to a positive share during the considered year. The main effect –reported in row one of the table – captures how the probability of hiring the first immigrant by a local firm increases as the share of immigrants in the area rises by one percentage point. Then, the interaction terms in specifications (4)-(5) captures the additional effect for firms with initial productivity below the median (the coefficient reported in the second row) or the interaction with firms whose size was below the median in 1996 (the coefficient reported in the third row). In panel B of table 5 we also analyze whether department specific migration shocks affect the number of immigrants hired by the firm (in logarithms) and if this effect is stronger in firms with initial productivity (or size) below the median.

These regressions are meant to establish whether firms become more likely to hire immigrants (and hire more of them) when more immigrants are available as workers. What is more interesting is to analyze whether those firms with initially low productivity or small size responded to the exogenous inflow of immigrants differently than other firms. If firms are homogeneous in their response to newly available immigrant workers, and this is independent of their productivity or size, one should expect that new immigrants are hired across firms homogeneously or, possibly, in proportion to their size and productivity. This would imply probability of hiring across firms and number of newly hired constant or proportional to firm's size and productivity. Hence a negative or null coefficient should be estimated for the interaction effects shown in columns (4) and (5) of panel A and B of table 5. Alternatively, if smaller and less productive firms might be more inclined to start hiring immigrants because of stronger complementarity, cost-saving and skill externalities in production, then one would observe a positive effect on firms with initially lower productivity. In this case a larger supply of immigrants could generate a stronger increase in the share of immigrants for smaller, less productive firms who can be moving the new technologies, while firms with higher initial productivity will have smaller changes. Such scenario would imply positive estimates of the interaction coefficient of columns (4) and (5).

The first two columns of table 5 show the OLS estimates of the coefficient on the immigrant share of employment in the department. The specification in column (1) includes region and sector fixed effects as controls, while specification (2) also includes firm fixed effects. The 2SLS estimates, on which we focus, are presented in column (3), which also includes a more demanding set of fixed effects (region-by-period and sector-by-period) as well as controls for individual firm characteristics. In this specification we find that a one-percent-population increase in immigrants in a district translates into a 0.57% higher probability for the average firm to begin hiring immigrants (panel A); and to a 0.4% increase in the number of immigrants hired by the firm

(panel B). Controlling for firm fixed effects and instrumenting the inflow of immigrants produces a larger point estimate of this effect, relative to OLS estimates. This indicates the presence of omitted variable bias in the OLS specification attenuating the effect.

When separating firms with low initial productivity (below the median), we find that these firms experienced an extra boost from immigration, increasing their probability of hiring the first immigrant by a further 0.26% (column 4, Panel A) and showing a much larger percentage hiring of immigrants in initially less productive firms (Panel B). Column (5) shows the differential response related to initial size and reveals that firms initially smaller than the median in 1996 had a significantly higher probability of beginning to hire immigrants and a significantly larger (log) number of immigrants hired. Similar to the case of firms with low productivity, these smaller firms responded to larger local supply of immigrants by increasing more substantially the probability of a first foreign-born hire and the number of immigrants hired. We analyze in the next sections whether such a higher propensity to hire immigrants, for initially small and less productive firms, was also associated with larger estimated effects of immigrants on outcomes.

5.2 Firms' TFP growth

A main objective of this paper is studying the effect of immigration on the productivity of firms. Such effect can be positive if immigrants bring complementarity in production and/or if they create externalities by affecting the choice of efficient technologies or efficient specialization. However, it can be negative if immigrants crowd firms or other productive inputs. Previous papers (such as Ottaviano and Peri 2012 or Peri 2012) have analyzed potential productivity effects in aggregate (state or urban) economies, but the analysis of firm-level effects is still lacking. Table 6 shows the estimated effects of immigration, measured as the increase in the share of foreign-born in the area (department) by one percentage point of the population, on firm productivity measured as total factor productivity (TFP). We compute the TFP of firms assuming the production function is log-linear, and hence productivity can be calculated as a residual from a log regression. We use the Olley and Pakes (1996) approach (henceforth, OP), which accounts for the endogeneity in the use of inputs and improves on the reliability of OLS estimates.[24] A detailed description of the OP approach and of our calculations is in the Appendix section A2.[25]

In column (1) we show the average effect of immigration estimated using OLS and including only region

[24] As a robustness check we also compute the TFP using a CES aggregation of labor between immigrants and natives. By assuming an elasticity of substitution equal to ten – consistent with Ottaviano and Peri (2012) and Peri (2011) – the CES aggregation of labor is the following: $(Natives^{0.9} + (Immigrants * (ImmiWage/NativeWage))^{0.9})^{1.1}$. Estimation results using this approach are reported in table A6 columns (7) and (8). They are not too different from the simpler approach taken in the main text.

[25] The OP approach consists of a semi-parametric estimator using firm investment to proxy for unobserved productivity shocks. This allows a solution to 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 investment to proxy for productivity shocks (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.

and sector fixed effects and individual firm controls. Then in column (2) we add firm fixed effects to the previous specification. These estimations may suffer from two problems. First, there can be bias from several sources such as simultaneity, omitted variables and measurement error. If the correlation between omitted productivity-increasing variables and the inflow of immigrants is positive, the bias of OLS will be positive. Measurement error and omitted "productivity" variables negatively correlated with immigration would bias the OLS estimates downward instead. Second, in those specifications we do not allow for heterogeneous effects of immigrants across firms. As a consequence of potentially contrasting biases it is hard to predict the sign of the overall bias. Progressively including fixed effects and then using the IV estimation and, importantly, allowing for heterogeneous effects across firms, should reduce those biases. In particular we observe that the inclusion of firm fixed effects (from column 1 to column 2) increases the size of the estimated coefficient (i.e. the correlation between immigrant supply and firm TFP) from 0.11 to 0.14. This suggests that unobserved firm-level characteristics which are positively associated with productivity growth are also negatively correlated with the local share of immigrants. Hence, omitting them produces a downward bias in the correlation. At the same time, the effects of immigrants on firm productivity is revealed in columns (4)-(6) to be heterogeneous and, in particular, such an affect is stronger for initially less productive firms. Such heterogeneity may also contribute to the downward bias when it is not accounted for.

For these reasons, we move to 2SLS estimates and first show in column (3) the average effect, estimated including the full set of fixed effects as reported in equation 6. Increased immigration in the department is associated with faster TFP growth in firms: a ten-percent-of-employment increase in immigrants in the department (which is roughly the average overall growth rate of immigrants in French manufacturing between 1995 and 2005) corresponds to a 1.7 log point increase in TFP for the average firm in the department (corresponding to an increase of about 1.7 percent). More interesting are the estimates in column (4), (5) and (6) in Table 6. They show a stronger effect of immigrant share on TFP for firms that had no immigrants initially. The interaction term has a positive and significant coefficient. The estimates in column (5) also reveal that the stronger effect of immigrants corresponds to firms with a low initial TFP level (below the median). Those firms experienced an additional TFP increase of 3.6 log points for each ten-percent-of-employment increase in the immigrant population in the department, relative to firms with initially high productivity (above the median). As TFP may be measured with error, we alternatively consider initial size in terms of employment, commonly considered as an alternative measure of firms' success. In column (6), we show that firms with an initial employment level below the median experienced a TFP increase of 3.5 log points for each ten-percent-of-employment increase in the immigrant population in the department, while for firms initially above the median size the effect was only 0.5 log points per ten-percent-of-employment increase. While in this and subsequent specifications we include one dimension of heterogeneity at a time and emphasize that initial productivity, size and share of immigrants are

strongly (and positively) correlated, we also experimented with including two or three at a time. In general the partition according to initial productivity is the most relevant one in identifying different responses of immigrant share on productivity and other outcomes (these results are available upon request). To confirm that initial productivity is monotonic in determining the TFP response to immigration we also estimate interactions with a finer partition of firms by quartiles of initial productivity. The estimates can be found in the online Appendix table A7, and they reveal that the effect of migration is monotonically decreasing in initial productivity, with the strongest effect on firms with initial productivity below the 25^{th} percentile and significantly positive effects only for firms below the median.

The effect of immigrants in boosting productivity of initially smaller and less productive firms may depend on the fact that those are more willing to hire them, and to adopt technologies and specialization that benefit from immigrants' effects. This feature may also explain why in a simple OLS regression with few controls and no firm fixed effects (as in column 1 of table 6) one finds an attenuated correlation (if still positive) between immigrant inflow and firm productivity. Immigrants were more likely to flow to initially less productive firms, in the France manufacturing sector, which may have help those firms cut costs, restructure production and increase productivity more than large firms.

The last row of table 6 shows the Kleinbergen-Paap F-statistics that measures the power of the instruments. In the case of two endogenous variables, the immigrant share and its interaction with the initial characteristics dummy, we use two instruments: the imputed immigrant share described above and its interaction with the dummy. In table 7 we report detailed results for the first stage regressions of the 2SLS procedure. Our instrumental variables are always highly significant in explaining the endogenous share of immigrants in the department and its interactions with $I_i\left(k_{i,1996} \leq \underline{k}\right)$. The F-stat and the joint F-stat are always well above 10, implying the instruments are not weak. It can be noticed that the instrumental variables are highly relevant and that the main instrument is a strong predictor of the main variable (share of foreign-born), while the interacted instrument is a strong predictor of the interaction term.[26]

5.3 Other productivity-related outcomes

The measures of productivity (TFP) used in the previous section are obtained as the residual from a firm-level production function. Hence measurement error of inputs can affect it, sometimes substantially. In this section, we provide robustness checks of the previous results using "easier to measure" firm outcomes which are positively correlated with productivity. Firms' domestic market share is an alternative measure used in several papers (e.g. Blonigen et al. 2014) as higher productivity induces cost advantages and, hence, a larger share of sales

[26]To save space we do not report detailed first stage regressions results for the other firms' outcomes (available upon request). However specification (6) does not change across firms' outcomes and first stage might slightly change only because of missing observations.

and revenues for a firm in the domestic market. Specifically, we calculate domestic revenue for each firm (as total turnover minus exported value) and divide it by the total domestic revenue of all French firms. We report results of these estimations in Panel A (the upper part) of table 8. Results are consistent with those obtained using TFP estimations: a ten-percent-of-employment increase in immigrants in the department corresponds to a 2.8 percentage point increase in domestic market share when we estimate the effects using 2SLS controlling for the most demanding set of fixed effects. When considering the possibility of heterogeneous effects, according to initial size and productivity, most of the impact of immigrants accrues to initially smaller and less productive firms. The impact on market share is a 6.7 percentage point increase for firms with no immigrants in 1996 and it is about 8 percentage points for firms with low productivity or small size (below median) in 1996. The impact on firms above the median of productivity and size is not significant (see columns (5) and (6) in table 8 Panel A). As further robustness checks, reported in the online Appendix table A3, we use three other proxies for firm productivity as dependent variable: (i) value added per worker (see table A3 columns 1 and 2), (ii) TFP calculated following the Levinsohn and Petrin (2003) approach (see table A3 columns 3 and 4), and (iii) revenues per worker (see table A3 columns 5 and 6). Albeit with some differences, all three checks confirm a positive and significant average effect of immigrants and stronger effects on firms with initial productivity below the median.

In section 2 and within the framework of decomposition (5) we highlighted the possibility that immigration flows affect the entry/exit dynamics of firms. Indeed, a possible consequence of increased productivity and larger market share for a firm is the increased probability of surviving in the market. The exit of a firm from the market is rather easy to record and, while a rather "coarse" variable, it is precisely measured. So, if an increased supply of immigrants benefits firms in the form of higher productivity, this could also reduce their probability of exiting the market. We test this channel in Panel B of table 8 where the dependent variable is a dummy equal to one if the firm becomes inactive (conditional on being active for at least two years) and remains such for at least two years. While we do not know from our dataset the reason why a firm ceased its activities, we know that the database includes all firms in France and, hence, disappearance from the dataset implies cessation of activities. The result for this outcome is similar (with opposite sign) to those on productivity. However, the heterogeneity in this effect between smaller, less productive firms and larger firms is not as large as the heterogeneity in the productivity effects. Using the 2SLS estimates of column (3), we find a ten-percent-of-employment increase in immigrant workers in a department corresponds to a 6.7 percentage point reduction in the exit probability for the average firm. This effect is somewhat magnified for firms with employment level below the median in 1996 (see column 6), but the additional effect is small and the probability of exiting decreases only by 7.0-7.1 percentage points (rather than by 6.3). Firms that were relatively small and unproductive in 1996 experienced a stronger boost to their productivity growth as a consequence of a larger immigrant share. Their probability

of exiting the market also decreased when the inflow of immigrants was larger.[27]

The fact that exit and entry can be affected by immigration suggests that selection of firms may drive some of the productivity effect estimated previously. To check that this is not the case, we perform two checks. First take the sub-period 2000-2005 and use the 2000 as starting year selecting only firms already existing in 2000. Second, we estimate equation 6 on a balanced panel with firms existing over the entire period 1996-2005 (no entry/exit). Results for both robustness checks (reported in the online Appendix table A6) confirm our baseline estimation results. The productivity effects are similar on the whole sample or on the balanced panel revealing no bias produced by selective attrition.

5.3.1 Growth in Physical Capital

The significant increase in productivity at the firm level, identified in the previous section is likely to drive other changes in firms' outcomes. As a large part of the immigrant inflow experienced by these French firms was of highly skilled workers, their hiring may have promoted complementarity with physical capital, boosting investment and the adoption of new technologies (e.g. Krusell et al 2000). If this was the case, then we should also observe growth in the firm's physical capital stock associated with larger inflows of immigrants. On the other hand, if immigration was an unexpected shift in the supply of labor accompanied by slow and costly capital adjustment then firms might have experienced a decrease in the capital/labor ratio in the short run and small change in capital stock. Moreover, firms may adopt different production techniques in response to larger availability of skilled immigrants, and those can be more capital intensive. Lewis (2011) finds that in areas of large low-skilled immigration, firms experience slower growth in their capital-labor ratios. It is interesting, therefore, to see whether, in our case, the impact on TFP is accompanied by a similar impact on firm physical capital intensity.

Panel A of table 9 (the upper part of it) shows the estimates of specifications similar to those in the previous tables, when the dependent variable is the logarithm of capital value, calculated as the total value of the capital stock of the firm (deflated by its price index). The coefficients tell us whether larger immigration shares in the department stimulate higher net investment in the firm. Column (1) shows the OLS estimates with the more limited set of fixed effects and column (2) includes firm fixed effects as controls. Notice the importance of firm fixed effects to obtain in this case a significant effect of immigration on capital stock. Then in column (3) we show the positive and significant effect on the capital of the average firm using 2SLS: a ten-percent-of-employment increase of immigrants in the department increases the capital stock in the average firm by 8 percent. The elasticity is larger (in percentage terms) than for productivity. When firms hire more

[27] We also estimated the effect of migration on the entry rate of firms across departments. This effect cannot be analyzed with a firm-level regression but we, rather, used a department-level regression. The results suggests that migration can affect positively the entry rate of firms. However the coefficient is very imprecisely estimated and not statistically significant.

immigrants, they significantly increase their capital investment and their capital stock. Columns (4) - (6) confirm a significant effect of immigration on capital investment which is stronger for those firms with initially no immigrants, low productivity, or small size (below the median) in the initial year of 1996. The elasticity of response for smaller/less productive firms to department immigration is about three times greater than the response of other firms.

Measures of the value of the capital stock of firms can be imprecise and include all types of physical capital investments. As a robustness check, reported in Panel B of table 9, we use a coarser, but easier to collect, measure of firms' capital stock. Namely, we consider the number of plants that the firm operates. This number is often one and sometimes grows to two or three. The results are significantly weaker than those for the total stock of capital, as to be expected for a variable that changes irregularly and rarely. Overall, however, even the impact on this outcome is in line with the findings described above. The average effect on the number of firms' plants is positive and is essentially driven by those firms starting in 1996 with 0 immigrants (compare the estimates in columns 3 and 4). Overall, these results show that immigration positively affects the total value of capital as well as the number of plants a firm operates. These findings are clearly complementary to what Lewis (2011) finds for the United States. There, prevalently low skilled immigration was associated with 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.

5.3.2 Growth in Exports

The productivity gains from immigration shown in the previous sections could 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 serving international markets and exporting more. Moreover, firms that export in more than one international market are the most productive one. The fact that these firms are able to cover the fixed cost of entry in several foreign markets is an indicator of their high level of productivity. 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. Few papers have also looked at the firm-level connection between immigrants and exporting their products. Hiller (2013) and Hatzigeorgiou and Lodefalk (2016) show this connection using Danish and Swedish firm-level data, respectively. Most studies find that immigrants have a trade-creation effect on regions and firms and they interpret this as the result of reducing fixed costs of trading with the country of origin of immigrants (e.g. Peri and Requena (2010)). Immigrants play a key role in connecting firms to new export markets in the countries where they are from.

Firms hiring additional immigrants (from different countries) are more likely to enter additional export markets. Our previous analysis has found a positive productivity effect and, hence, combining higher productivity with lower trade costs we expect to also find a positive impact of immigrants on trade for our sample.

Estimates of the (logarithm of the) total value of exports are reported in table 10 Panel A. They show that the presence of immigrants in a department boosts the export sales of French firms (column 3). In particular, a ten-percent-of-employment increase in immigrants in a department increases the export sales of the average firm by 12.7 percent. This effect is, as those found above, mainly driven by firms with low initial productivity and small size (see columns 5 and 6) who at the beginning of the period did not hire immigrants (column 4). The effects on total exports are consistent with those on productivity.

The effect on total exports can be decomposed into the extensive and intensive margins of trade. In a standard trade model with heterogeneous firms, a reduction in the fixed cost of exporting, due to immigrant workers, may favor small and less productive firms in particular. Immigration, by reducing the fixed cost of exporting, helps less productive firms access additional markets and export more (Melitz (2003); Chaney (2008) and Crozet and Koening (2010)). Positive immigration shocks are thus expected to positively affect the extensive margin of firms depending on their initial productivity/size. We test this channel by estimating equation 6 on the number of export markets in which firms sell, which can be considered one of the "extensive margins" of export. In table 10 Panel B we find a strong positive effect of immigrants on the number of foreign markets (see column 3), which is entirely due to those firms with initially low productivity (column 5) and small size (column 6). As an alternative measure for the extensive margin of trade in table A4 columns (1)-(2), we use the number of exported varieties (computed as the number of HS-6 digit items exported by each firm) and also find a positive immigrant supply shock has a positive effect on the number of exported varieties, especially for firms with low initial productivity.

Trade models with heterogeneous firms do not provide clear predictions on the effects of a reduction in the fixed cost of export on the intensive margin of export (export per market). However, as shown above, immigration has a strong positive effect on the productivity of firms that might reflect in an increase in the intensive margin of export of firms. In table A3 columns (4)-(6), we estimate whether immigration also affects the average exported value per destination and per variety of exported good. In line with previous results on TFP (and domestic market share), we find an increase in immigrants in a department increases the average export per destination (and variety), with a particularly strong effect for those firms with initially zero migrants in production and for firms with low initial productivity.

5.3.3 Growth in Wages and Employment

The evidence presented so far suggests that increases in the supply of immigrants may have helped smaller and less productive firms improve, invest, and increase their productivity and exports. But did these same inflows hurt native workers?[28] Higher productivity, higher investment in physical capital intensity and lower exit probability should help existing workers in those firms, too. While it is possible that immigrant workers had a competition effect on natives, they may have also helped existing workers through those productivity channels. In a framework similar to that of the previous tables, we consider the logarithm of wages of native workers in firms and the number of native workers employed in the firm (in log units) as two additional outcomes measured at the firm level. We report the estimated coefficients in table 11, where we display in Panel A the wage effects and in Panel B the employment effects. Wages are measured at the firm level and hence combine changes in wages of individuals and potential changes in the composition of workers at the firm level so that selection can take place. What are the channels through which immigrants can affect native wages and employment in the firm? First, the estimated productivity improvement should produce positive wage effects for natives, however, technology and capital may complement natives to a different extent than immigrants if their skills are different. Moreover, a larger supply of immigrants can increase competition for some native workers in the local labor market and may induce native workers to change firms. The results of table 11 Panel A reveal interesting patterns. An increase in the immigrant share in the department seems to have a strong positive effect on the average wage of natives on average. This is consistent with the productivity effect. A ten-percent-of-employment increase in immigrants is associated with a 5% increase in native wages in the average firm (column 3 of table 11). However, the effect on native wages is not stronger in firms initially hiring fewer immigrants (columns 4) and, although still positive, is reduced in firms with low initial productivity (+4.2% in column 5 adding the main effect and interaction) or with small initial size (+3.7% in column 6). These results could be puzzling if one only considers the productivity effect of immigrants across firms. However, one has to account also for a composition effect. In particular if, in response to hiring immigrants, high skilled natives redirect their employment towards firms that do not hire many of them, one can observe an increase in the average skills of natives in firms with initially high productivity (and subsequent low hiring of immigrants). This would imply an increase in native wages which could be larger in firms hiring fewer immigrants as natives' composition became more skilled in those firms. Table 12 shows that this is exactly the case. Using a framework similar to that of previous tables, we show the estimated effect of migration on the share of natives white collar jobs (skilled jobs) relative to the total employment of a firm.[29] Consistently with our explanation, firms with initially low TFP experienced only a small increase in the share of native in white collar jobs; however, firms with high initial productivity

[28] Recent studies on the labor market effect of immigration using Labor Force Survey data for France show average null (slightly negative) impact of immigration on the wages and employment of native workers in the long run (Edo 2015; Edo and Toubal 2015).

[29] We use white collar jobs as a proxy for skilled workers since we have data on the occupation of workers but not on their education.

experienced larger and significant increases in the share of native workers in white collar jobs.

Interestingly, the mobility of highly skilled native workers towards firms that hire fewer immigrants (or none) may be an important channel of positive spillovers in a municipality. Firms that do not hire immigrants may experience part of the benefit via an increase in their skilled workforce. One can test the strength of this spillover by analyzing the change in productivity in firms that hire no immigrants in a municipality that experiences an increase in immigration. We show one way of assessing the pure externality effect (vis-a-vis the combined complementarity-externality) in table A8 of the online Appendix. We report the effect of immigration at the department level on two types of firms, both with 0 immigrants at the beginning of the period. The first type hires immigrants over the period (switchers), the second type never hire immigrants. As expected, firms that hire immigrants experience the highest TFP boost, value added increase and domestic share growth. However, also firms without immigrants benefit from immigration in terms of TFP, suggesting the positive spillover effects.

Table 11 shows also that initially smaller and less productive firms expand their employment of natives more than other firms (Panel B of table 11) and given their change in skill composition this employment growth must takes place mainly through inflow of less skilled. In columns (3) and (4) of Panel B, we find a null effect of immigration on the employment of natives in the average firm. However, this hides a heterogeneous effect: a ten-percent-of-employment increase in immigrants is associated with a 5% decrease in native employment in firms with high initial productivity and to a 2.2% increase in native employment for firms with low initial productivity (column 5). As allowed in decomposition (5) immigration might induce the reallocation and selection of workers across existing firms and thus change the relative size and skill composition of firms. In column (6) we show the same kind of evidence using initial size instead of productivity to differentiate firms. Firms with low initial productivity and small size are those that experience the most pronounced productivity boost from immigration and net job-creation, increasing both immigrant and native employment.

The employment and wage data are available for a larger sample that includes all small firms (including those with less than 20 workers) within the DADS dataset. Hence, in this case we can estimate a specification for all firms including small ones (for which we do not have balance sheet data from EAE). Column (7) of table 11 reports the results for the extended sample that includes all small firms. In this case, the average wage effect is similar to column (3), but the employment effect turns positive, consistent with the estimates of columns (5) and (6) showing positive employment effects for initially small firms.

5.4 Department level regressions

All specifications estimated in the previous sections focus on firm-level outcomes. The results strongly suggest productivity effects may be larger for initially less productive and smaller firms (table 6); these firms are also more likely to increase in size (table 11) but have fewer skilled natives (table 12) in response to immigrants.

Hence, from an aggregate point of view, the effects of immigrants may be more conducive to productivity (and size) convergence across firms than to net aggregate productivity growth. Another important effect can be net firm creation in the area (first term of the decomposition), which could magnify employment effects at the firm level. In this section, therefore, we analyze aggregate department-level outcomes to see which firm-level heterogeneous effects survive the aggregation. Results from panel regressions in which the units are "department-year" observations, in which we include year effects, are reported in table 13. All regressions use 2SLS estimation using the IV described above. Immigration has a positive, but not significant, effect on net firm creation in a department (column 1). Column 2 also shows a positive and not significant effect of immigration on total employment of natives in a department. The firm-level analysis suggested this effect may take place with a reallocation of workers from larger (less affected) to smaller (more affected) firms.[30] Then we estimate the effect of immigration on the total exports of firms by given department-year. Consistently with firm level estimation, immigration has a positive effect on exports.[31]

On the productivity side at the department level,[32] we find that immigration has a positive and significant effect on the average domestic market share and on value added – see columns (6) and (7) – and a positive, but not significant, effect on average TFP and aggregate capital stock. Coefficients on domestic market share and per capital value added are bigger, but not far from those estimated at the firm level (and reported in tables 8 and A3). Finally, we estimate the effects of an increase in the supply of immigrants' in a department on the wage gap between immigrant and native workers (computed as the ratio between average immigrant over native wage in each department). While improving productivity and opportunities may benefit all workers, the increased supply of immigrants can hurt their own wage opportunities relative to natives. We do find evidence of this effect in column (8).

6 Conclusion

Using French firm-level data, we are among the very few who have studied the effect of immigration on a set of firm-specific outcomes related to productivity. In particular – also new in the literature – we study how firms differ in responding to exogenous immigrant supply changes due to immigration depending on their initial productivity and size. A significant empirical regularity emerges from the analysis: firms in departments that experienced a large inflow of immigrants had productivity gains, faster investment and export growth, lower exit probability and larger employment growth than comparable firms in departments receiving lower immigration

[30] As a further robustness check for the local labor market impact of migration, we replicate our estimations using French Labor Force Survey at the region-year level. Results are reported in the online Appendix table A9. Consistently with results reported in table 13, we find null effect of immigration on both native workers and wage in the region.

[31] The point estimate cannot directly be compared with firm-level estimation because of a scale effect from aggregation.

[32] To avoid compositional effects in aggregation, we computed a within-department weighted average using the inverse of firm size and productivity in 1996 as weights.

inflows. Using an instrument that proxies the supply-driven inflow of immigrants by distributing new inflows proportionally to the location of historical immigrant groups, and including a very rich set of fixed effects to control for firm and region heterogeneity, our analysis confirms these effects are consistent with a causal interpretation. We also find that firms with low initial productivity and small size are those that increase their employment of immigrants more and experience the largest productivity growth and strongest capital and export growth in response to the local increase in immigrant supply.

This has promoted some convergence in size and productivity level across firms in France, as high immigration departments have experienced higher productivity growth of initially less productive firms. We speculate this may be due to the fact that smaller, less productive firms were more ready to hire immigrants in order to cut costs and/or adopt new technologies, improve specialization, and invest in capital and methods that complement the skills of immigrants. There is also suggestive evidence that the positive productivity effect may spill over to firm not hiring immigrants, partly through an increase of the highly skilled natives who work in those firms. The possibility that immigrants, by helping firms (grow and survive), also help native workers stay employed and productive in thriving firms, may be at the basis of the result that competition from immigrants does not seem to hurt the labor market opportunities of natives (see Lewis and Peri 2015 for a review). This paper offers a new angle to understand that effect on labor market.

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Tables

Table 1
Summary statistics for firm-year observations

Variable	*Observations*	*Mean*	*Std Dev.*	*Min*	*Max*
Employment of natives	119950	149.95	519.47	1	63229
Wage of natives (per hour worked)	119950	11.21	5.27	2.72	161.21
Per capita value added	107859	38.07	92.06	0	14594
TFP OP	104850	6.03	1.18	0.86	13.30
TFP LP	98572	255.6	652.2	0.000	3760
Domestic Market Share	118924	0.000	0.001	0.000	0.049
Capital	119950	10676	130147	0	$1.3*10^7$
Number of Plants	119950	1.72	4.21	1	236
Total Export Value	119950	$6.96*10^7$	$5.19*10^8$	0	$8.55*10^9$
Export value per destination	87701	$4.13*10^5$	$1.66*10^6$	0	$9.57*10^7$
Number of export varieties	119661	35.62	110.05	0	5183
Number of export markets	119661	10.21	15.61	0	174
Share of foreign-born	119950	0.05	0.09	0	0.99

Note: individual observations are firms by year in France over the period 1996-2005. The sources of the data are several and they are described in the text section 3.1 and A.1.

Table 2
Share of total hours worked by foreign-born individuals in France 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 between immigrants share and firms' outcome in 1996

Variable	*(1)*	*(2)*
TFP	0.069***	-0.113***
	(0.015)	(0.003)
Domestic Market Share	0.193*	-0.667***
	(0.103)	(0.015)
Employment	0.178**	-0.623***
	(0.086)	(0.018)
Capital Intensity	0.524***	-0.166***
	(0.073)	(0.018)
Exports	0.588***	-1.295***
	(0.236)	(0.056)
Per capita Revenues	0.152***	-0.060***
	(0.054)	(0.012)
Explanatory variable	Immigrant share in the firm	Dummy for zero immigrants in the firm
Additional Covariates	Region and Sector fixed effects	

Note: individual observations are manufacturing firms in France in 1996. The sources of the data are several and are described in the text section 3.1 and A.1.

Table 4
Correlation between the IV and economic outcomes in French districts

Panel A: *Firms' Outcome in the initial year*	***Change in Imputed Immigrant share 1996-2005***
TFP as OP	0.051
	(0.095)
Domestic Market Share (ln)	0.497
	(0.597)
Ln(capital)	0.371
	(0.599)
Tot Trade	1.625
	(1.628)
Number of traded varieties	1.168
	(0.826)
Panel B: *Change in firms outcomes, 1996-1999.*	***Change in Imputed Immigrant share 2000-2005***
TFP as OP	-0.052
	(0.035)
Domestic Market Share (ln)	-0.276*
	(0.156)
Ln(capital)	-0.355
	(0.335)
Tot Trade	-1.121
	(0.707)
Number of traded varieties	-0.379
	(0.349)
Panel C: *Change in local labour market characteristics (1982-1990)*	***Change in Imputed Immigrant share 1996-2005***
Average Wage	-1.457
	(1.289)
Average Wage Native Workers	-1.306
	(1.391)
Total Employment	0.023
	(0.364)
Total Employment Natives	-0.370
	(0.349)
Total Hours Worked	0.353
	(0.420)
Total Hours Worked by Natives	0.062
	(0.433)
Observations	92

Note: Each row represents the result from a univariate regression having as dependent variable the change of the imputed departmental share of immigrant and the change/level in the economic value listed at the top of each panel for the district as explanatory variable.

Table 5
Immigration in the District and Firm's hiring of immigrants

	(1)	(2)	(3)	(4)	(5)
Panel A. *Dep. Var : Dummy for going from 0 to >0 immigrant employment*					
Immigrant share in Department	0.110***	0.181***	0.576***	0.467***	0.406***
	(0.026)	(0.039)	(0.081)	(0.088)	(0.082)
(Immigrant share in Department) x initial TFP below median)				0.261***	
				(0.116)	
(Immigrant share in Department) x initial Employment below median)					0.376***
					(0.098)
Method of Estimation	OLS	OLS	2SLS	2SLS	2SLS
Observations	119486	119482	115492	98252	112599
F-stat of first stage			56.33		
Joint F-stat (Kleibergen-Paap F statistic)				27.44	26.43
Panel B. *Dep. Var : Number of immigrants in the firm (ln)*					
Immigrant share in Department	-0.474	0.093	0.424*	0.088	-0.051
	(0.426)	(0.090)	(0.295)	(0.299)	(0.247)
(Immigrant share in Department) x initial TFP below median)				1.154**	
				(0.542)	
(Immigrant share in Department) x initial Employment below median)					1.446***
					(0.423)
Method of Estimation	OLS	OLS	2SLS	2SLS	2SLS
Observations	75960	75960	74273	64348	72672
F-stat of first stage			54.05		
Joint F-stat (Kleibergen-Paap F statistic)				23.46	20.95

Note: Column (1) includes region and sector fixed effects and firm-level control variables (age and foreign-owned dummy). Column (2) includes region, sector and firm fixed effects and firm level control variables. Columns (3)-(5) include region-by-period, sector-by-period and firm fixed effects and firm level control variables. The period considered is 1996-2005. The unit of observation is one firm in one year. *, **, *** indicate significance at the 10, 5 and 1% confidence level. The standard errors are clustered at the department level

Table 6
Immigration in the District and Firm's TFP

	(1)	(2)	(3)	(4)	(5)	(6)
	Dep. Var : TFP calculation using Olley and Pakes Method					
Immigrant share in Department	0.110*** (0.039)	0.141*** (0.023)	0.171*** (0.026)	0.131*** (0.026)	0.014 (0.023)	0.055** (0.026)
(Immigrant share in Department) x (zero initial immi. share)				0.141*** (0.041)		
(Immigrant share in Department) x initial TFP below median)					0.360*** (0.058)	
(Immigrant share in Department) x initial Employment below median)						0.296*** (0.047)
Method of Estimation	OLS	OLS	2SLS	2SLS	2SLS	2SLS
Observations	104432	104432	100431	98056	95032	98056
F-stat of first stage			58.86			
Joint F-stat (Kleibergen-Paap F statistic)				28.58	27.92	27.29

Note: Column (1) includes region and sector fixed effects and firm level control variables. Column (2) includes region, sector and firm fixed effects and firm level control variables. Columns (3)-(6) include region-by-period, sector-by-period, firm fixed effects and firm level control variables described in the text. The period considered is 1996-2005. The unit of observation is one firm in one year. Standard errors are clustered at the department level. *, **, *** indicate significance at the 10, 5 and 1% confidence level.

Table 7
First Stage Results

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Dep Var :	Immigrant Share	Immigrant Share	Immigrant Share x Zero initial Immi sh	Immigrant Share	Immigrant Share x TFP below 50th.	Immigrant Share	Immigrant Share x Empl below 50th.
Imputed Immigrant share in Department	0.644*** (0.084)	0.614*** (0.081)	-0.022 (0.014)	0.630*** (0.082)	-0.027 (0.018)	0.638*** (0.083)	-0.030 (0.019)
(Immigrant share in Department) x (zero initial immi share)		0.099* (0.058)	0.779*** (0.124)				
(Immigrant share in Department) x initial TFP below median)				0.026 (0.022)	0.714*** (0.109)		
(Immigrant share in Department) x initial Employment below median)						0.011 (0.019)	0.708*** (0.106)
Observations	100431	98056	98056	95032	95032	98056	98056
F-stat of first stage	58.86	30.20	25.10	29.69	26.59	29.45	26.79
Joint F-stat (Kleibergen-Paap F statistic)		28.58		27.92		25.45	

Note: Columns (1)-(7) 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 firm in one year. *, **, *** indicate significance at the 10, 5 and 1% confidence level.

Table 8
Immigration in the District and Firm's Domestic market share and Exit probability

	(1)	(2)	(3)	(4)	(5)	(6)
Panel A. *Dep. Var : Domestic market share (ln)*						
Immigrant share in Department	0.955**	0.990***	0.276***	0.065	-0.061	-0.099
	(0.385)	(0.159)	(0.097)	(0.132)	(0.136)	(0.117)
(Immigrant share in Department) x (zero initial immi share)				0.667***		
				(0.247)		
(Immigrant share in Department) x initial TFP below median)					0.821***	
					(0.248)	
(Immigrant share in Department) x initial Employment below median)						0.881***
						(0.206)
Method of Estimation	OLS	OLS	2SLS	2SLS	2SLS	2SLS
Observations	118460	118460	114455	111609	97395	111609
F-stat of first stage			56.08			
Joint F-stat (Kleibergen-Paap F statistic)				27.02	27.43	26.44
Panel B. *Dep. Var : Dummy=1 if the firm exits the market*						
Immigrant share in Department	-0.201***	-0.310***	-0.673***	-0.675***	-0.650***	-0.631***
	(0.019)	(0.043)	(0.076)	(0.075)	(0.097)	(0.072)
(Immigrant share in Department) x (zero initial immi share)				0.022		
				(0.055)		
(Immigrant share in Department) x initial TFP below median)					-0.056	
					(0.088)	
(Immigrant share in Department) x initial Employment below median)						-0.074**
						(0.030)
Method of Estimation	OLS	OLS	2SLS	2SLS	2SLS	2SLS
Observations	154742	154742	151280	146040	135530	146040
F-stat of first stage			57.32			
Joint F-stat (Kleibergen-Paap F statistic)				29.16	25.67	28.29

Note: Column (1) includes region and sector fixed effects and firm level control variables. Column (2) includes region, sector, firm fixed effects and firm level control variables. Columns (3)-(6) include region-by-period, sector-by-period, firm fixed effects and firm level control variables described in the text. The period considered is 1996-2005. The unit of observation is one firm in one year. Estimations in panel B do not contain firm level controls as we do not have such information when the firm is not observed in DADS (we squared the dataset to compute the exit dummy). Standard errors are clustered at the department level. *, **, *** indicate significance at the 10, 5 and 1% confidence level.

Table 9
Immigration in the District and Firm's Capital Stock and Number of Plants

	(1)	(2)	(3)	(4)	(5)	(6)
Panel A. *Dep. Var : Log of physical capital*						
Immigrant share in Department	0.185 (0.325)	1.006*** (0.198)	0.806*** (0.131)	0.587*** (0.162)	0.435*** (0.166)	0.474*** (0.162)
(Immigrant share in Department) x (zero initial immi share)				0.638** (0.263)		
(Immigrant share in Department) x initial TFP below median)					0.808*** (0.198)	
(Immigrant share in Department) x initial Employment below median)						0.742*** (0.239)
Method of Estimation	OLS	OLS	2SLS	2SLS	2SLS	2SLS
Observations	118775	118775	114928	111928	98009	111928
F-stat of first stage			56.52			
Joint F-stat (Kleibergen-Paap F statistic)				27.28	27.48	26.46
Panel B. *Dep. Var : Log of number of plants per firm*						
Immigrant share in Department	0.096 (0.115)	0.071** (0.031)	0.091* (0.048)	-0.001 (0.069)	0.039 (0.089)	0.091 (0.093)
(Immigrant share in Department) x (zero initial immi share)				0.299*** (0.102)		
(Immigrant share in Department) x initial TFP below median)					0.122 (0.128)	
(Immigrant share in Department) x initial Employment below median)						0.017 (0.152)
Method of Estimation	OLS	OLS	2SLS	2SLS	2SLS	2SLS
Observations	119486	119486	115492	112599	98252	112599
F-stat of first stage			56.33			
Joint F-stat (Kleibergen-Paap F statistic)				27.12	27.44	26.43

Note: Column (1) includes region, sector fixed effects and firm level control variables. Column (2) includes region, sector, firm fixed effects and firm level control variables. Columns (3)-(6) always include region-by-period, sector-by-period, firm fixed effects and firm level control variables described in the text. The period considered is 1996-2005. The unit of observation is one firm in one year. Standard errors are clustered at the department level. *, **, *** indicate significance at the 10, 5 and 1% confidence level.

Table 10
Immigration in the District and Firm's Exports

	(1)	(2)	(3)	(4)	(5)	(6)
***Panel A**. Dep. Var : Log of exports*						
Immigrant share in Department	1.103*	0.661***	1.275***	0.854**	0.082	0.328
	(0.588)	(0.204)	(0.343)	(0.387)	(0.298)	(0.378)
(Immigrant share in Department) x (zero initial immi share)				1.524**		
				(0.648)		
(Immigrant share in Department) x initial TFP below median)					2.768***	
					(0.692)	
(Immigrant share in Department) x initial Employment below median)						2.721***
						(0.619)
Method of Estimation	OLS	OLS	2SLS	2SLS	2SLS	2SLS
Observations	87069	87069	83697	81901	75600	81901
F-stat of first stage			58.47			
Joint F-stat (Kleibergen-Paap F statistic)				27.14	28.43	27.70
***Panel B**. Dep. Var : Log of number of foreign markets*						
Immigrant share in Department	0.544*	0.269***	0.611***	0.400**	0.135	0.304*
	(0.296)	(0.061)	(0.147)	(0.177)	(0.129)	(0.175)
(Immigrant share in Department) x (zero initial immi share)				0.681**		
				(0.320)		
(Immigrant share in Department) x initial TFP below median)					1.108***	
					(0.279)	
(Immigrant share in Department) x initial Employment below median)						0.820***
						(0.249)
Method of Estimation	OLS	OLS	2SLS	2SLS	2SLS	2SLS
Observations	87408	87408	84009	82225	75882	82225
F-stat of first stage			58.47			
Joint F-stat (Kleibergen-Paap F statistic)				27.14	28.43	27.70

Note: Column (1) includes region, sector fixed effects and firm level control variables. Column (2) includes region, sector, firm fixed effects and firm level control variables. Columns (3)-(6) always include region-by-period, sector-by-period, firm fixed effects and firm level control variables described in the text. The period considered is 1996-2005. The unit of observation is one firm in one year. Standard errors are clustered at the department level. *, **, *** 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)	(7)
***Panel A**. Dep. Var : Log of wage of natives*							
Immigrant share in Department	0.596***	0.702***	0.488***	0.502***	0.561***	0.573***	0.523***
	(0.143)	(0.120)	(0.073)	(0.073)	(0.093)	(0.090)	(0.054)
(Immigrant share in Department) x (zero initial immi share)				-0.049			
				(0.070)			
(Immigrant share in Department) x initial TFP below median)					-0.137*		
					(0.076)		
(Immigrant share in Department) x initial Employment below median)						-0.198***	
						(0.076)	
Method of Estimation	OLS	OLS	2SLS	2SLS	2SLS	2SLS	2SLS
Observations	119486	119486	115492	112599	98252	112599	1185558
F-stat of first stage			56.33				84.22
Joint F-stat (Kleibergen-Paap F statistic)				27.12	27.44	26.43	
***Panel B**. Dep. Var : Log of native workers in the firm*							
Immigrant share in Department	-0.077	-0.237***	-0.118	-0.201	-0.490**	-0.760***	0.129***
	(0.228)	(0.057)	(0.123)	(0.164)	(0.194)	(0.204)	(0.046)
(Immigrant share in Department) x (zero initial immi share)				0.188			
				(0.183)			
(Immigrant share in Department) x initial TFP below median)					0.709***		
					(0.222)		
(Immigrant share in Department) x initial Employment below median)						1.417***	
						(0.227)	
Method of Estimation	OLS	OLS	2SLS	2SLS	2SLS	2SLS	2SLS
Observations	119486	119486	115492	112599	98252	112599	1185645
F-stat of first stage			56.33				84.22
Joint F-stat (Kleibergen-Paap F statistic)				27.12	27.44	26.43	

Note: Column (1) includes region, sector fixed effects and firm level control variables. Column (2) includes region, sector, firm fixed effects and firm level control variables. Columns (3)-(6) always include region-by-period, sector-by-period, firm fixed effects and firm level control variables described in the text. The period considered is 1996-2005. The unit of observation is one firm in one year. Standard errors are clustered at the department level. *, **, *** indicate significance at the 10, 5 and 1% confidence level. In column (7) we show regression results for the full sample of French firms, including firms with less than 20 employees (firms for which we do not have balance sheet information).

Table 12
Immigration in the District and Native White collar workers in the firm

	(1)	(2)	(3)	(4)	(5)	(6)
Dep. Var : White Collar Natives over total employment						
Immigrant share in Department	0.233*	0.132***	0.108***	0.138***	0.201***	0.198***
	(0.126)	(0.016)	(0.023)	(0.031)	(0.033)	(0.035)
(Immigrant share in Department) x (zero initial immi share)				-0.085**		
				(0.039)		
(Immigrant share in Department) x initial TFP below median)					-0.187***	
					(0.037)	
(Immigrant share in Department) x initial Employment below median)						-0.202***
						(0.047)
Method of Estimation	OLS	OLS	2SLS	2SLS	2SLS	2SLS
Observations	119486	119489	115492	112599	98252	112599
F-stat of first stage			56.32			
Joint F-stat (Kleibergen-Paap F statistic)				27.12	27.44	26.43

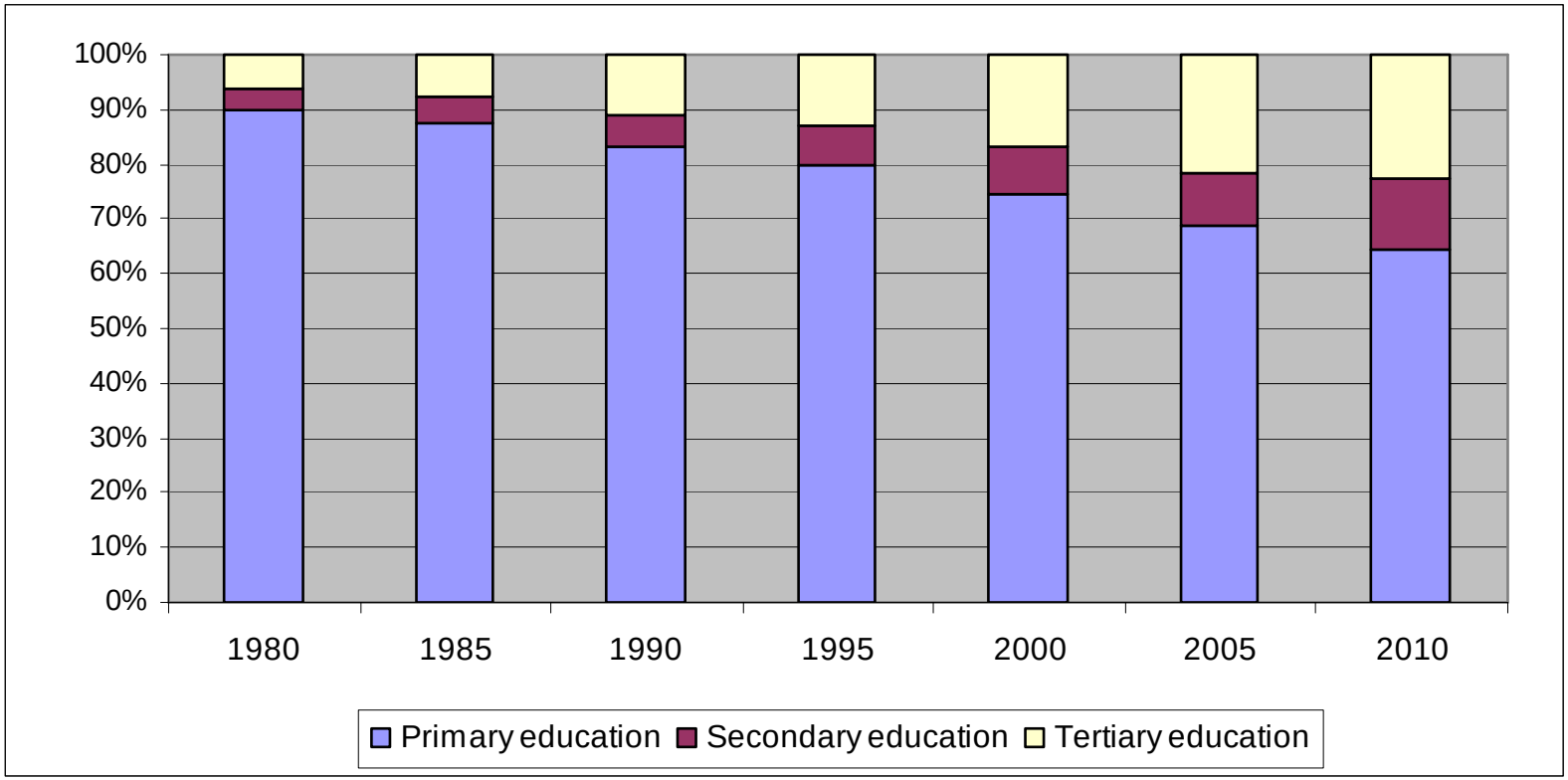
Note: Column (1) includes region, sector fixed effects and firm level control variables. Column (2) includes region, sector, firm fixed effects and firm level control variables. Columns (3)-(6) always include region-by-period, sector-by-period, firm fixed effects and firm level control variables described in the text. The period considered is 1996-2005. The unit of observation is one firm in one year. Standard errors are clustered at the department level. *, **, *** indicate significance at the 10, 5 and 1% confidence level..

Table 13
Immigration and District specific outcomes

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dep Var :	Number of firms	Employment of natives	Export	Capital	TFP	Domestic mkt share	Per capita Value Added	Wage Gap (immi/natives)
Immigrant share in Department	2.314	2.957	10.53**	0.885	0.046	1.383**	1.085***	-1.160*
	(2.010)	(3.020)	(0.429)	(0.930)	(0.098)	(0.613)	(0.388)	(0.592)
Method of Estimation	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS
Observations	1001	1001	996	996	910	1001	910	992
Sample	All Firms			All Firms				
Aggregation	Sum across firms in the same department			Weighted average across firms in the same department				
First stage coefficients :								
Imputed Immi sh.	0.294***	0.294***	0.293***	0.293***	0.289***	0.294***	0.289***	0.289***
F-stat of first stage	121	167	165	165	146	167	146	160

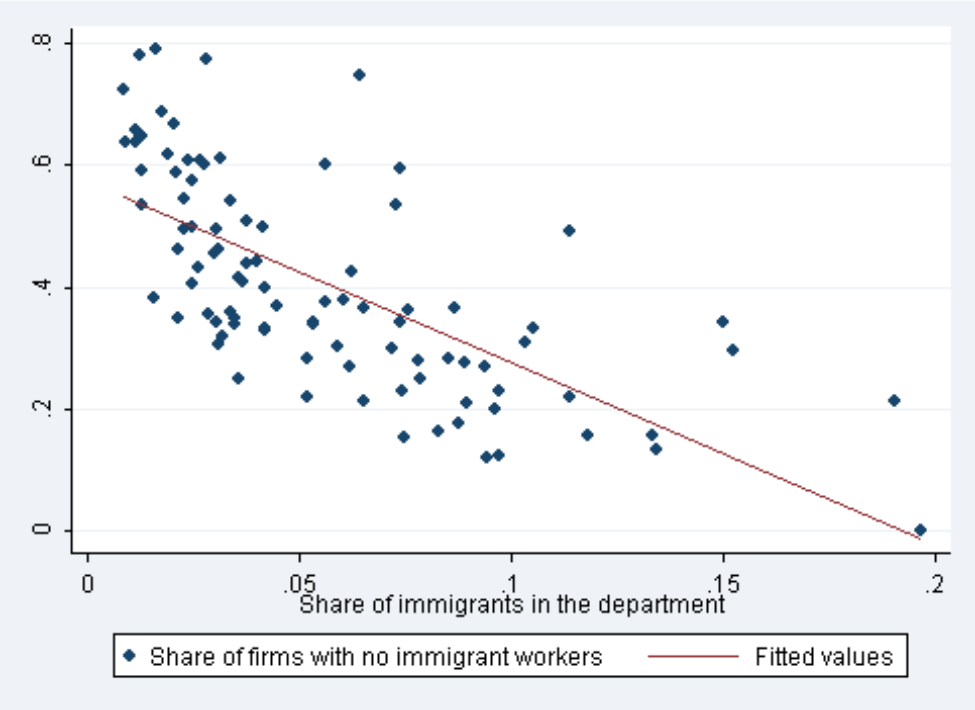
Note: Columns (1)-(8) include year fixed effects. The period considered is 1995-2005. The unit of observation is one department in one year. *, **, *** indicate significance at the 10, 5 and 1% confidence level.

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



Source: IAB Brain Drain Dataset.

Figure 2
Correlation between the share of firms with no immigrants and the immigrants share
French Departments, 1996



Note: Each point in the graph represents one department. The horizontal axis represents the share of immigrants in the population of the department while the vertical axis represents the share of firms with zero foreign employment among all firms.