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Immigrant Workers, Firm Export Performance and Import Competition *

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Abstract

This paper investigates whether the employment of immigrant workers affects the performance of firms in their export markets when they are facing an increase in import competition. Exploiting the surge of Chinese imports following its accession to the World Trade Organization and using a sample of French manufacturing exporters from 2002 to 2015, we find that an increase in the growth rate of Chinese imports in a market has a negative effect on both the survival probability of firms and the growth rate of sales on that market. This negative effect on firm performance is mitigated by the employment of immigrant workers.

Keywords: Firm, Heterogeneity, Immigrant workers, Import competition, Productivity

JEL Codes: F14 F22 F16

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1 Introduction

Labour migration has been increasing over the past decades reaching almost 5 percent of all workers worldwide in 2017 (ILO, 2018). Consequently, discussions on the effects of immigrant workers on the economy of the host country have been animating the economic debate. At the same time, the fall of trade barriers and increase in export opportunities as well as import competition has raised questions on the repercussions of a more globally intertwined economic environment for local firms and workers. This paper contributes to this discussion by investigating whether firms employing immigrant workers are affected differently by an increase in import competition in their export markets. To this end, we use a sample of French manufacturing firms that export at least once between 2002 and 2015, and we target two dimensions of firm export performance: the survival probability and the growth rate of sales in each export market served by a firm[1]. As an identifying exogenous shock, we exploit the accession of China to the World Trade Organization in 2001 that led to a dramatic increase in the level of import competition. While the so-called *China shock* has mostly been studied at the aggregate level (Autor et al., 2013; Shen and Silva, 2018; Balsvik et al., 2015; Malgouyres, 2017), a growing literature has been focusing on the effect of trade shocks on firm-level outcomes. An increase in import competition from China, or from low-wage countries more in general, has been found to have a negative impact on firm survival probability and employment growth (see Mion and Zhu 2013 or Bernard et al. 2006, among others), thus confirming the aggregate findings. However, the literature has also highlighted that firms adjust to increased competition along other dimensions. Namely, import competition has been found to induce skill-upgrading (Mion and Zhu, 2013) and innovation (Bloom et al., 2016), as well as a relocation of manufacturing activity towards more capital-intensive firms within an industry (Bernard et al., 2006).

France offers a particularly suitable context for the purpose of this study for two reasons. First, the share of total immigrant workers in the country is consistently higher than the European average. According to the UNCTAD Migration Database, in 2000 France hosted around 10% of immigrants while the EU15 average was around 8%. The European and the French share started converging only around 2015. Second, the impact of Chinese competition on French firms and thus on the French economy is substantial: Between 2002 and 2015, France has experienced a decrease of its market share in all of its major export destinations, while China has seen its market shares increase (Comtrade data). Moreover, Chinese imports represent a large part (up to two thirds) of the imports from low-wage countries by developed economies. See Martin and Mejean (2014) and Bernard et al. (2006) for France and the U.S. respectively.

We focus on firms' employment of immigrant workers as a determinant of their ability to face a trade shock. On the one hand, immigrant workers generate productivity gains within the firm boundaries. There are several reasons why immigrants may enhance productivity at the firm level. Mitaritonna et al. (2017) for French manufacturing firms and Ottaviano et al.

[1] In this paper, we define a market as an industry-destination combination.

(2018) for British service-producing firms show that an exogenous increase in the local labour supply of immigrants is associated with an increase in firm productivity. This result emphasises the fact that firm-specific productivity depends on the regional share of immigrants who convey country-specific knowledge. However, firm-level productivity gains also stem from the imperfect substitution between immigrant and native workers that leads to a more efficient allocation of tasks within and across firms (Foged and Peri, 2016; Ottaviano et al., 2013; Peri and Sparber, 2009), to firm adoption of different and possibly more efficient technologies (Lewis, 2011) and to innovation thanks to a broadened knowledge base (Kerr and Lincoln, 2010)[2]. On the other hand, immigrant workers can increase firm performance on the export market. It is now well established that immigrant workers possess a superior knowledge of foreign markets which lowers variable and fixed export costs for the firm (among others, see Ottaviano et al., 2018; Andrews et al., 2016; Hiller, 2013).

We start by presenting suggestive graphical evidence that the employment of immigrant workers is positively correlated with firm resilience to trade shocks, and we describe the theoretical framework that helps rationalise the empirical question of the paper. We then exploit the variation in the level of Chinese import penetration over time and across markets, and study how its effect on the survival probability and the growth rate of sales varies with the employment of immigrant workers. Our strategy aims at controlling for the endogenous relationship between the two measures of firm export performance and the employment of immigrant workers. Following existing studies, we instrument the employment of immigrant workers at the firm-level using the local supply of immigrants faced by firms.

We find that an increase in import competition from China negatively affects firm export performance in an industry-destination market. A one percentage point increase in the growth rate of Chinese imports lowers firm survival probability by 0.44 percentage points and the export sales growth rate by 0.58 percent when the firm employs no immigrant workers. This effect is, however, smaller for firms employing immigrant workers. The survival probability drops by 37 percentage points and the export sales growth rate by 49 percent when the firm employs one immigrant worker.

Additionally, in line with the literature, we provide evidence that the positive effect of immigrants is stronger for less productive firms. We also show that this mitigation effect is present, even after controlling for the fact that more productive firms better face an increase in import competition. This suggests that the mitigation effect of immigrant workers is only partly due to their productivity-enhancing effect. It is also consistent with the existing literature and the sug-

[2]It is to be noticed that ethnic fractionalisation has been found to exert an ambiguous effect on firm productivity. As pointed out by Trax et al. (2015), cultural diversity may enhance productivity through communication and knowledge spillovers but it may also have a negative effect if it induces social conflicts between employees or communication barriers that hamper buyer-supplier relationships. Using German firm-level data, the authors find that while the size of the group of immigrant employees has no significant impact on productivity, the diversification of the workforce in terms of citizenship increases total factor productivity.

gestive evidence we provide that immigrant workers improve the firm performance and resilience in the export markets thanks to their effect on export costs.

The contribution of this paper is twofold. First, it introduces a new dimension of analysis in the trade-migration literature. While the literature so far has been focusing on the sole effect of immigrants on the firm export performance, this paper discusses how two important aspects of globalisation, immigrant employment and import competition, interact and shape the resilience of firms in the export market. This piece of work therefore complement the existing literature by showing that immigrants not only foster trade, but also mitigate trade shocks that are potentially harmful for the economic stability and growth of a country. The paper most closely related to ours is a study by Mitaritonna et al. (2017). In this work, the authors highlight the effect of immigration on firm productivity and outcomes that are arguably related to productivity, such as export volume. Although our paper has the same flavor when claiming that the mitigation effect of immigrant workers is partly due to a productivity-enhancing effect, the focus of our study is fundamentally different. First, while the aforementioned study focuses on the sole role of immigrants on several firm-level outcomes, our paper shows how the two aspects of globalisation (immigration and import competition) interact in shaping the resilience of firms in their export market. Second, we show that the mitigation of immigrant employment on firm-level resilience on the export market is not only channelled through productivity.

Second, this paper contributes to the literature on the firm-level effects of an increase in Chinese import penetration. While the related literature mostly focuses on the impact at the aggregate level and for the domestic market, this paper contributes to the firm-level literature by exploring the heterogeneous responses of firms to the increase in Chinese import penetration faced in the export market. It does so by identifying a new firm-level determinant *i.e* the firm employment of immigrant workers.

The remainder of the paper is organised as follows. In Section 2, we describe the data we use for the analysis. In Section 3, we provide a set of facts on the relationship of interest and we discuss the underlying mechanisms evidenced by the literature. In Section 4, we detail our empirical strategy, while in Section 5 we present the results and analyse the extent to which immigrant workers improve firm resilience to trade shocks in the export market. Section 6 concludes.

2 Data

To investigate whether firms employing immigrant workers react differently to an increase in import competition in the foreign market, we combine three sources of administrative data on French firms from 2002 to 2015 using a unique firm identifier (the SIREN number). First, we use administrative data consisting of annual employee declarations by wage-paying establishments located on the French territory (*Déclarations Annuelles des Données Sociales*, DADS postes). This dataset contains information on the characteristics of the workers such as their adminis-

trative county of residence and work, wage, type of contract, citizenship (French *versus* foreign citizens) and place of birth (France *versus* foreign country). We do not observe the exact origin country of immigrants for either definition. In the remainder of the paper, we define an immigrant as a foreign citizen. We aggregate the data at the firm-year level to obtain the total number of employees and the number of French and immigrant workers.[3]

Second, we use balance-sheet data consisting of tax reports filled in by firms located in France (*Fichier de comptabilité unifié dans SUSE*, FICUS and *Fichier approché des résultats d'Esane*, FARE). We only keep firms whose main activity belongs to the manufacturing sector (divisions 10-33 of the NACE Rév. 2 classification) for the whole period in which they appear in the dataset. This dataset provides information on firm domestic sales, main industry, main administrative counties (French "départements"), value added, capital stock, total assets and other variables related to their balance sheet. The dataset does not contain information on firm linkages (such as their foreign affiliates).

Third, we use a dataset from the French customs that contains shipments in value and in volume by CPA6 product and origin/destination country. The dataset contains export flows at the firm-year-destination-product level. We use a time-invariant CPA6 code whose first four digits provide the main industry of the good exported by the firm (NACE rev. 2) in order to aggregate the data at the firm-year-destination-industry level.

In addition to the firm-level data, we use two publicly available sources of information. First, we use the 1990 French population census (*Données harmonisées des recensements de la population à partir de 1968*) which contains information on the stocks of native and immigrant populations (defined as foreign citizens) by 1-digit occupation codes and by administrative counties. Second, we use the Comtrade dataset that contains bilateral trade flows at the HS6 product level by origin and destination countries in U.S. dollars. Additional details on the data are provided in Appendix A.1.

We obtain a sample of 8,517,061 firm-industry-destination-year observations. It includes 59,903 unique firm identifiers (and 551,689 firm-year observations) which export at least once over the sample period. We focus our baseline analysis on exporting firms as only limited information on the industry of the domestic sales is available.[4] The sample includes both small and large firms in terms of profit, financial resources and employment, which is in line with the fact that the French economy is characterised by a high level of granularity. On average, firm probability to survive in one market from one year to another is 52%, and the midpoint growth rate of sales in one market is on average negative and amounts to -0.39. Another interesting fact is related to the persistence of immigrant employment over time within a firm: out of the 46.96%

[3] We start our analysis in 2002 because the individual identifier in the DADS Postes is available only from 2002 onward. Doing so, we are able to identify and keep only the main contract of an individual with several positions within the same firm in one year.

[4] For the domestic market, only the industry of main activity of the firm is available. Therefore it is not possible to identify all the industries in which a firm is active in the domestic market or whether the definition of the main activity comes from domestic or export sales, for exporters.

firm-year observations displaying a positive number of immigrant workers, about 91.44% of the firm-year observations display no change in their number of immigrant workers from one year to another.

We report a number of summary statistics in Appendix A.2, Table A.1. We split the sample into firm-year observations displaying a null employment of immigrants and those displaying a positive employment of immigrants. We observe that firms employing immigrant workers are significantly larger than other firms in all dimensions (revenue, assets, workforce, domestic sales, etc.). We then focus on the distribution of immigrant workers across firms in Appendix, Figure A.1. We see that among the 46.96% of firm-year observations that exhibit a positive employment of immigrant workers, 39.35% of them employ less than 5% of immigrant workers. We also report the distribution of the (log) number of immigrant employment which is also consistently skewed towards the left in Appendix, Figure A.2.

3 Motivation and Theoretical Underpinnings

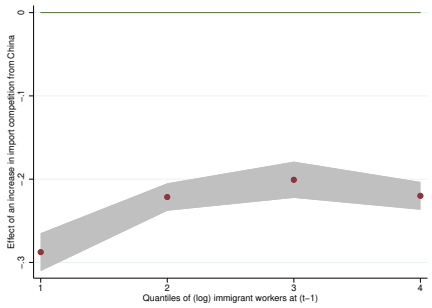
In this section, we describe the main relationship of interest as well as the theoretical literature that motivates our empirical analysis.

Employment of Immigrant Workers and Firm Resilience to Trade Shocks In Figure 1 we analyse the relationship between immigrant workers, import competition from China and the two measures of firm performance. On the left-hand side of Figure 1, we present graphically the set of interaction terms between quantiles of the (log) number of immigrant workers (plus one) at time $t-1$ and the change in Chinese import competition between time t and $t+1$, plotted against the firm survival probability at time t. The survival probability is a binary variable equal to one if a firm serves an industry-destination market at time t *and* $t+1$. This figure shows that the effect of import competition from China on the survival probability becomes less negative when the employment of immigrant workers increases.

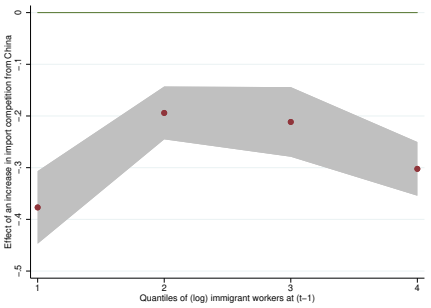
On the right-hand side of Figure 1, we show a similar graph for the growth rate of export sales. The growth rate is computed as the midpoint growth rate in order to account for zero export flows. The figure shows that the negative and significant effect of import competition decreases with immigrant employment (all points are above the first quantile that includes the observations with no employment of immigrant workers). All in all, this set of results provides suggestive evidence that the effect of import competition on the two measures of firm performance differs along the distribution of immigrant employment.

Figure 1: Immigrant Workers, Firm Export Performance and Chinese Import Competition

(a) Firm survival probability



(b) Firm Growth rate of export sales



Note: Regressions include the (log) size based on full-time employment and the initial level of firm TFP as controls as well as industry-year fixed effects. The grey area represents the 10% confidence interval. In both figures, the first quantile includes the observations with no employment of immigrant workers and accounts for 20% of the sample. The second quantile includes the observations displaying an employment of immigrant workers below the 40^{th} percentile. The third quantile includes the observations displaying an employment of immigrant workers between the 50^{th} and the 70^{th} percentile. The fourth quantile includes the observations displaying an employment of immigrant workers above the 70^{th} percentile.

Theoretical Underpinnings This paper aims at studying whether firms employing immigrant workers are more resilient to an increase in import competition in the export market. This relationship can be rationalised by means of a well-known partial equilibrium model where firms operate under monopolistic competition and optimise their export sales independently across export markets as in Melitz (2003). On each foreign market, each firm faces a non-negative demand function (such as the function used by Albornoz et al. 2012) which depends on a time-varying idiosyncratic shock related to foreign import competition. This shock can be interpreted as a demand shifter so that when import competition increases in one market, demand decreases for this same market (see the model by Vannoorenberghe, 2012).

In such a framework, two main assumptions can be made on the supply side to study the impact of immigration on firm resilience. First, the productivity of the firm can be related to its workforce composition. A CES aggregate that combines native and immigrant workers can account for the fact that immigrant workers increase productivity due to their imperfect substitutability with native workers, and that immigrants may affect productivity via knowledge externalities (see Mitaritonna et al., 2017, who provide a full description of the implication of this type of production function when the differentiated labour inputs are native and immigrant workers). Second, the fixed and variable export costs of the firms can be decreasing functions of the employment of immigrant workers as these workers lower informational barriers to trade (Marchal and Nedoncelle, 2019).

Based on these assumptions, it is possible to show that immigrant workers mitigate the drop in firm survival probability and growth rate of export sales following an increase in import competition in a foreign market. For simplicity, consider a firm that serves a unique foreign market at a given time. The firm either employs no immigrant worker or a positive number of immigrant workers. Its foreign sales are positive, but higher when it employs immigrants. Consider next that the firm is hit by an increase in import competition. At the extensive margin, the probability that the firm remains above its profitability threshold and survives is larger if the firm employs some immigrant workers. At the intensive margin, the sales growth rate of the firm drops, but the magnitude of the drop is smaller if the firm employs some immigrant workers. The reason is that the decrease in sales induced by an import competition shock affects more the small than the large firms. More intuitions are provided in Appendix A.3.

4 Empirical Strategy

4.1 Baseline Specification

Our motivating fact suggests that an increase in import competition decreases both the survival probability and the growth rate of sales in the export markets of the firm. However, this detrimental effect seems to be mitigated by the employment of immigrant workers. We test this hypothesis by means of the following econometric specification:

$$y_i = \beta_0 + \beta_1 \Delta \text{Comp}^{jk}_{t:t+1} + \beta_2 \Delta \text{Comp}^{jk}_{t:t+1} \ln \text{Immig}_{i,t-1} + \gamma_{it} + \gamma_{jt} + \varepsilon \tag{1}$$

The dependent variable (y_i) in Equation (1) denotes either the survival probability or the export sales growth rate of a firm i. The survival probability is denoted as $\text{D}\left(S^{jk}_{i,t+1} > 0 | S^{jk}_{i,t} > 0\right)$ and is a binary variable equal to one if firm i sells a positive value on an industry-destination market jk at time t *and* $t+1$, and zero otherwise. The growth rate of export sales is denoted as $\Delta \ln S^{jk}_{i,t:t+1}$ and is computed as the midpoint growth rate of the value sold by firm i on an industry-destination market jk between time t *and* $t+1$. Using the midpoint enables us to capture the fact that the value sold on a market may drop from a positive value to zero precisely because of an increase in import competition from China.

The variables of interest are the following. $\Delta \text{Comp}^{jk}_{t:t+1}$ denotes the growth rate in import competition from China faced on an industry-destination market jk between time t and $t+1$. This measure of exposure to Chinese competition is built following the literature on the China shock, in particular Bloom et al. (2016), and reads as follows:

$$\Delta \text{Comp}^{jk}_{t:t+1} = \frac{M^{jk,\text{CH}}_{t+1}}{M^{jk,\text{WLD}}_{t+1}} - \frac{M^{jk,\text{CH}}_{t}}{M^{jk,\text{WLD}}_{t}} \tag{2}$$

where $M^{jk,\text{CH}}_{jt}$ denotes the imports of goods from industry j by country k from China at time t and $M^{jk,\text{WLD}}_{t}$ denotes the imports of goods from industry j by country k from the world at time t. k denotes any country but China.

$\ln \text{Immig}_{i,t-1}$ denotes the (log) number of immigrant workers (plus one)[5] employed by firm i at time $t-1$.[6]. The main specification includes industry-year fixed effects to control for time-varying factors at the industry level, such as technology shocks, that may affect the export resilience of a firm. Additionally, when we introduce firm-year fixed effects, we are controlling for firm-specific time-varying factors that may affect the firm resilience to trade shocks and that may cause the coefficient of interest to be biased due to omitted variables. Finally, errors are clustered at the firm level to account for the fact that the observations relative to the same firm may be correlated. In a robustness test, we show to what extent the level of clustering affects the results.

In Equation (1), β_1 represents the effect of an increase in the growth rate of Chinese imports on firm survival probability and export sales growth rate. In line with the literature, we expect this coefficient to be negative. β_2 is the coefficient of interest. Following existing literature and the theoretical insights presented herein before, we expect this coefficient to be positive. In other words, immigrants should mitigate the negative effect of an increase in import competition on firm survival probability and export sales growth rate.

4.2 Endogeneity Concerns

4.2.1 Immigrant Workers

The empirical specification presented in Equation (1) may suffer from endogeneity issues due to reverse causality.[7] First, firms may anticipate the negative effect of import competition and therefore decide to hire immigrant workers accordingly, especially if they are aware of the potential beneficial effects of these workers on their export resilience. Second, larger and more international firms are those more likely to employ immigrant workers. Therefore, these firms might be more resilient to an increase in import competition because they are larger and more productive, and not necessarily because they employ immigrant workers.

So far, studies intending to tackle similar endogeneity issues using two stage least square (2SLS) strategies have instrumented the immigrant employment either by the lagged employment of immigrants, the immigration stock in the region and/or sector of the firm (excluding the number of immigrants employed by the firm) or the immigration stock in a neighbouring country. Some other studies instrument the regional share/stock of immigrants with an imputed share (or shift-share instrument) *à la* Card (2001).

[5] Incrementing the variable by one before taking its natural logarithm may bias the results. Nonetheless, such a transformation plays to our disadvantage since it reduces the skewness of the distribution *i.e.* the asymmetry of the distribution with respect to its mean. In a robustness test, we use a dummy variable to investigate the potential bias induced by imposing a linear relationship across the distribution of immigrant workers.

[6] The literature presents instances analysing immigration in the county of the firm (Mitaritonna et al., 2017; Ottaviano et al., 2018) However, the firm's immigrant employment better captures the direct contribution of these workers to their firm. We thus follow Hiller (2013) and Marchal and Nedoncelle (2019) and consider the *firm-level* employment of immigrant workers.

[7] Endogeneity concerns due to omitted variables at the firm-level are tackled by means of firm-year fixed effects

Since the data at hand allow to observe the employment of immigrant workers at the firm level, we follow the work by Hiller (2013) and implement an IV-2SLS estimation in which we instrument the number of immigrant workers employed by firm i at time $t-1$ by the stock of immigrant workers in the county of the firm (denoted by d) at time $t-1$ excluding the immigrant employees of the firm (denoted $\mathrm{IV}_{i(d),t}$). The stock of immigrant workers in the county of the firm captures the potential supply of immigrant workers to which firms are exposed to at time $t-1$. This instrument is presumably exogenous to firm i's performance since it only affects it through the employment strategy of all the other firms in the county of the firm.

Therefore, to obtain causal results, we instrument the interaction term of interest by the interaction of the import competition measure with the instrumental variable described hereinbefore ($\Delta\mathrm{Comp}^{jk}_{t:t+1} \ln \mathrm{IV}_{i(d),t-1}$, where $\ln \mathrm{IV}_{i(d),t-1}$ denotes the (log) stock of immigrant workers in the county of the firm at time $t-1$ excluding the immigrant employees of the firm).

4.2.2 Chinese Import Competition

Regarding the exogeneity of the Chinese import competition measure, we cannot exclude that some unobserved industry-destination specific demand shocks may affect simultaneously both the measure of import competition as well as the measure of firm performance. Such a simultaneity issue would imply a downward bias. Therefore, the outlined empirical strategy would represent a lower-bound estimate. For instance, it is possible that a negative (positive) demand shock in a given industry-destination market generates a simultaneous decrease (increase) in the demand addressed to both French and Chinese firms. Such a shock would simultaneously decrease (increase) the sales of French firms as well as those of Chinese firms hence decreasing the Chinese import competition faced by French firms on that industry-destination market.

Nonetheless, if we assume that French, Chinese and other firms are affected in a similar way by such a demand shock, then the simultaneity bias induced by the shock should be already controlled for by the competition variable ($\Delta\mathrm{Comp}^{jk}_{t:t+1}$) since it measures the variation in the *share* of Chinese import competition with respect to the world. We can, however, not exclude that firms from different origin countries are affected in a different way by such a demand shock as Armington-type preferences may exist – for instance, consumers may prefer goods imported from a specific country.

5 Results

5.1 Baseline Results

Baseline results are presented in Table 1. Columns (1) and (2) report OLS results obtained without the interaction term of interest. These specifications allow to study the average effect of an increase in import competition on firm resilience across firms. We find that an increase in the growth rate of Chinese imports lowers both the firm survival probability and the growth

rate of export sales in an industry-destination market. A 1 percentage point increase in Chinese imports lowers firm survival probability by 0.19 percentage points (column 1) and their growth rate of sales by 0.24 percent (column 2). These results are consistent with and complementing those of Bernard et al. (2006) who find that an increase in import competition decreases the plant probability of survival in the domestic market.

We then turn to the analysis of the *conditional* impact of an import competition shock from China by introducing the interaction term of interest into the regression (columns 3 and 4). In these regressions, we implement the IV-2SLS strategy described hereinbefore. In column (3), we find that immigrant workers mitigate the detrimental effect of an increase in the growth rate of import penetration from China on both measures of performance. A 1 percentage point increase in the growth rate of Chinese imports lowers the survival probability of firms employing no immigrant worker by 0.44 percentage points. The coefficient associated with the interaction term is positive and highly significant. This result indicates that the negative effect of the China shock is mitigated by the employment of immigrant workers. For instance, the survival probability of a firm employing one immigrant worker drops by 0.37 percentage points, which is lower than the drop endured by a firm employing none.

Then, we find that an increase by 1 percentage point in the growth rate of Chinese imports lowers the growth rate of sales of firms employing no immigrant worker by 0.58 percent (column 4). The interaction term is also positive and highly significant which indicates that the negative effect of Chinese import penetration tends to be mitigated in firms that employ immigrant workers. The growth rate of sales of a firm employing one immigrant worker drops by 0.49 percent, which is lower than the effect for a firm employing none.

In columns (3) and (4), the Kleibergen-Paap F statistic is well above the Stock-Yogo critical value which allows us to infer that the instruments are not weak. First stage results are reported in Table 2. Once interacted with the import competition variable, the instrumental variable correctly predicts the interaction term of interest. Finally, we compare the baseline results obtained with the IV-2SLS strategy and reported in columns (3) and (4) of Table 1 to the OLS results presented in columns (5) and (6) of the same table. Doing so, we can assess the direction of the bias for the immigration variable. Overall, the results point towards a downward bias of the OLS coefficients capturing the mitigation effect of immigrant workers.

Table 1: Baseline Results

	(1) $D\left(S^{jk}_{i,t+1} > 0 \vert S^{jk}_{i,t} > 0\right)$	(2) $\Delta \ln S^{jk}_{i,t:t+1}$	(3) $D\left(S^{jk}_{i,t+1} > 0 \vert S^{jk}_{i,t} > 0\right)$	(4) $\Delta \ln S^{jk}_{i,t:t+1}$	(5) $D\left(S^{jk}_{i,t+1} > 0 \vert S^{jk}_{i,t} > 0\right)$	(6) $\Delta \ln S^{jk}_{i,t:t+1}$
$\Delta \text{Comp}^{jk}_{t:t+1}$	-0.192***	-0.239***	-0.439***	-0.583***	-0.238***	-0.290***
	(0.007)	(0.022)	(0.048)	(0.139)	(0.013)	(0.036)
$\widehat{\Delta \text{Comp}^{jk}_{t:t+1} \ln \text{Immig}_{i,t-1}}$			0.099***	0.138**	0.018***	0.020*
			(0.020)	(0.056)	(0.005)	(0.012)
Observations	6,872,600	5,952,244	6,872,600	5,952,244	6,872,600	5,952,244
R-squared	0.127	0.105	-	-	0.127	0.105
Firm-year FE	yes	yes	yes	yes	yes	yes
Industry-Time FE	yes	yes	yes	yes	yes	yes
Method	OLS	OLS	IV-2SLS	IV-2SLS	OLS	OLS
Kleibergen-Paap F Stat.	-	-	45.813	43.766	-	-
Stock-Yogo critical value (10%)	-	-	16.38	16.38	-	-

Note: This table reports IV-2SLS second stage estimations and OLS estimations. ***, ** and * respectively denote significance at the 1%, 5% and 10% level. Robust standard errors clustered at the firm level are reported in parentheses. First stage results are reported in Table 2.

Table 2: Baseline Results - First stage estimations

	(a) $\Delta \text{Comp}^{jk}_{t:t+1} \ln \text{Immig}_{i,t-1}$	(b) $\Delta \text{Comp}^{jk}_{t:t+1} \ln \text{Immig}_{i,t-1}$
$\Delta \text{Comp}^{jk}_{t:t+1}$	-1.075**	-1.006**
	(0.490)	(0.489)
$\Delta \text{Comp}^{jk}_{t:t+1} \ln \text{IV}_{i,(d)t-1}$	0.337***	0.331***
	(0.050)	(0.050)
Observations	6,872,600	5,952,244
Firm-year FE	yes	yes
Industry-Time FE	yes	yes
Method	IV-2SLS	IV-2SLS

Note: This table reports IV-2SLS first stage estimations. ***, ** and * respectively denote significance at the 1%, 5% and 10% level. Robust standard errors clustered at the firm level are reported in parentheses. Column (a) reports the first stage results for specification (3) and column (b) reports the first stage results for specification (4) in Table 1.

5.2 Robustness Tests

In this section, we investigate the robustness of the baseline results to the use of different immigration variables, different levels of clustering and a different sample. Additionally, we check the robustness of the results *vis-à-vis* the use of an alternative instrumentation strategy. All tables of results are presented in Appendix A.5.

5.2.1 Alternative Immigration Variables

Dummy Variable. First, we test whether the baseline specification is robust to the use of a binary variable to measure the employment of immigrant workers. Doing so, we take into account the fact the effect of immigrant workers may not be linear e.g. that the marginal benefit of hiring immigrant workers may be decreasing. It also enables us to avoid increasing the variable by one when we use its natural logarithm. We thus modify the specification by using a binary variable which equals one if the firm employs a positive number of immigrant workers at time $t-1$ and zero otherwise. The instrumental variable remains unchanged with respect to the baseline specification. Second stage results are reported in Appendix, Table A.2, columns (1) and (2). The results confirm the baseline estimates. We find that an increase in the growth rate of the import penetration from China lowers both firm survival probability and sales growth rate in an industry-destination market. We also find evidence of a mitigation effect of immigrants for both measures of export firm performance.

Foreign-born. Second, we define immigrant workers as foreign-born individuals, while in the baseline specification, the definition of immigrant workers is based on the French citizenship. This

alternative definition enlarges the sample of immigrant workers as it includes individuals who have been naturalised or were born abroad from French parents. We also change the instrumental variable accordingly and consider the stock of foreign-born workers in the county of the firm excluding the foreign-born employees of the firm. Second stage results are reported in Table A.2, columns (3) and (4). At the extensive margin, the results corroborate the baseline estimates. Although the magnitude of the coefficient is smaller, its sign and level of significance are in line with our expectations and show the presence of a mitigation effect of foreign-born workers on firm responses to an increase in the growth rate of Chinese imports. However, we are not able to reproduce the baseline results for the growth rate of sales. This result shows that the definition of an *immigrant* worker matters and that foreign-born individuals may not be as international as workers enjoying a foreign citizenship, having lost, for example, their network in their origin country.

Share of Immigrants. Third, we study whether our results are robust to the use of the share of immigrant workers instead of the log-number, as proposed by Andrews et al. (2016), Mitaritonna et al. (2017), Marchal and Nedoncelle (2019). In doing so, we take into account that employing one additional immigrant worker may have a larger effect for small firms than for large ones. In addition, using a share allows us to normalise immigrant employment by the size of the firm. We follow the paper by Andrews et al. (2016) and instrument the share of immigrant workers by the proportion of immigrant workers in the county of the firm at time $t-1$, excluding the immigrant employees of the firm. Second stage results are reported in Table A.2, columns (5) and (6). The significance level and signs of the coefficients associated to the interaction terms are in line with our baseline estimates for both trade margins.

5.2.2 Alternative Level of Clustering

In the baseline specification, errors are clustered at the firm-level in order to account for the fact that observations belonging to the same firm are likely to be correlated. Additionally, the immigration variable is defined at the firm-year level but does not vary much within one firm. However, our variable of interest (the interaction variable) is also defined at the industry-destination level. Therefore, in an alternative specification, we cluster errors at the industry-destination level. In doing so, we account for the fact that there can be common unobserved random shocks at the industry-destination level that lead to correlation among observations within the same cell of observation. We also cluster errors at the county level to account for the fact that there can be common unobserved random shocks at the country level, which one of the dimensions entering of our instrumental variable. Results are reported in Appendix, Table A.3, and confirm that the baseline findings are robust to the use of an alternative level of error clustering. In columns (1) and (2), errors are clustered at the industry-destination level and the Kleibergen-Paap F statistic remains above the Stock-Yogo critical value. When errors are

clustered at the county level (in columns 3 and 4), the instrumentation strategy appears to be weaker.

5.2.3 Alternative Sample

We pursue our analysis by including the domestic market in the set of destinations served by the firms. We therefore consider both export and domestic sales in the analysis, thus taking into account the Chinese import competition faced by the firm on its export markets *and* in France. In doing so, we enlarge our sample by 4%. The structure of the data does not allow to study the division of domestic sales by industry, as it does for export sales. The balance-sheet data report both the value of the domestic sales and the industry of main activity of the firm. Therefore, by adding the domestic sales to the sample, we are making the assumption that the value of the domestic sales is exclusively coming from the industry of main activity of the firm. The results are reported in Appendix, Table A.4 and corroborate the baseline findings in terms of sign and significance of the coefficients.

5.2.4 Alternative Instrumentation Strategy

Finally, we modify the instrumental variable for the firm-level employment of immigrant workers. We instrument the number of immigrant workers employed by firm i located in county d at time t by a shift-share instrument à la Card (2001) in line with the studies by Mitaritonna et al. (2017), Ottaviano et al. (2018) and Marchal and Nedoncelle (2019). This instrument is computed as the imputed stock of immigrant workers in county d at time t and is built as follows:

$$\text{IV}_{d,t} = \sum_{o} \frac{\text{Immigrants}_{o,d,1990}}{\text{Immigrants}_{o,\text{FR},1990}} \text{Immigrants}_{o,\text{FR},t} \tag{3}$$

The strategy consists in weighting the total number of immigrants in France at time t in a specific 1-digit occupation o (available in the DADS data) by the share of immigrants in that occupation group in each French county in 1990 (available in the census data).

The identification strategy of the shift-share approach relies on the fact that the distribution of immigrant workers across counties is persistent over time due to network effects. Therefore, the imputed stock of immigrant workers in the county of the firm is highly correlated to the supply of immigrant workers to which firms are exposed to. The past distribution of immigrant workers should, however, not have any effect on the present outcomes of the firms.

This instrument presents the following caveat with respect to the baseline instrument: it has no variation across firms located in the same county d. Nonetheless, the shift-share instrument allows us to control for the fact that some non-observable local factors that vary over time may affect both the growth rate of export sales of firms as well as the supply of immigrant workers.

Second and first stage results are presented in Appendix, Tables A.5 and A.6. Second stage results are in line with the baseline estimates both in terms of magnitude and level of significance for both measures of firm export performance. In addition, the identification test confirms that

this instrument cannot be considered as weak. First stage results show that this alternative instrument well predicts the interaction term of interest and is very similar to the baseline instrument.

We now test the validity of the shift-share instrument. If past county-specific shocks were correlated with both the stock of immigrants in 1990 and the measures of the firm performance after 2002, then the exclusion restriction would be violated and the shift-share instrument would not be valid. Following Mitaritonna et al. (2017), we first compute the correlation across counties between the change in the instrument over the period 2003-2014 and the pre-period average economic outcomes in the counties.[8] In Panel A of Table A.7, $\Delta \ln \text{IV}_{d,2003:2014}$ denotes the log-difference of the shift-share instrument between 2003 and 2014. As it is possible to notice, the correlation between the long-run trend in the instrument and the average economic outcomes at the beginning of the period is zero. However, as Mitaritonna et al. (2017) point out, one cannot yet conclude that there is indeed no correlation between the instrument and the pre-sample trends in the economic outcome of interest. The authors suggest the following strategy: in Panel B of Table A.7, we test the validity of the instrument by studying whether its trend for the second half of the sample period is correlated with the trends of the variables of interest for the first half of the sample period. The OLS coefficients obtained are either zero or not significant. This lends support to the fact that the instrument is indeed valid as there is no strong correlation between past economic shocks and subsequent changes in the predicted number of immigrants.

5.3 Complementary Results

In this section, we further investigate the relationship of interest. First, we present results confirming that immigrant workers increase firm-level productivity. The productivity-enhancing effect of immigrant workers has been studied for the case of French firms by Mitaritonna et al. (2017). We present these results to (i) further corroborate our hypothesis that the mitigation effect of immigrant workers can be attributed to the productivity gains they generate and to (ii) complement the results by Mitaritonna et al. (2017), by exploiting the firm-level employment of immigrant workers, rather than the regional stock. Second, we present evidence meant at excluding alternative explanations and therefore at showing that the employment of immigrant workers is not a proxy for firm productivity and does not approximate a more general size effect. Third, we show that the mitigation effect of immigrant workers is present even after controlling for the fact that more productive firms face better an increase in import competition. This suggests that the mitigation effect of immigrant workers is only partly due to their productivity-enhancing effect. This is in line with the existing literature, which highlights how immigrant workers lower informational barriers. In the specific application of this paper, this means that

[8] The first year for which we study the relationship of interest is 2003, the first year of the sample being used to build and lag the instrumental variable. The last year of the sample is lost to compute the midpoint growth rate of export sales.

the superior knowledge that immigrant workers have of the foreign markets allow the firms to face better an increase in import competition in those markets.

5.3.1 The Productivity-Enhancing Effect of Immigrant Workers

To investigate whether immigrants have a positive impact on the productivity of French firms, we rely on the estimation strategy presented in equation (4). To estimate total factor productivity (TFP, henceforth) at the firm level, we follow the widely used methodologies by Levinsohn and Petrin (2003) and Wooldridge (2009).[9] The estimation strategy reads as follows:

$$\ln \text{TFP}_{i,t} = \beta_0 + \beta_1 \ln \text{Immig}_{i,t-1} + \Gamma' X_{i,t} + \gamma_i + \gamma_{jt} + \varepsilon_{i,t} \tag{4}$$

where the left-hand side variable is the TFP of firm i operating in its main industry j at time t and $\text{Immig}_{i,t-1}$ denotes the (log) number of immigrant workers (plus one) employed by firm i at time $t-1$. The specification includes time-varying firm-level controls ($X_{i,t}$) such as the (log) size based on full-time employment, as well as firm and industry-year fixed effects (γ_i and γ_{jt}). In an alternative specification, we replace firm fixed effects with the initial productivity level of the firm. In all specifications, errors are clustered at the firm-level.

Equation (4) may suffer from endogeneity issues which are not fully controlled for by the fact that we use firm immigrant employment in the previous year, and firm fixed effects. The employment of foreign workers at the firm level is presumably endogenous to the firm performance due to reverse causality issues that are persistent over time. For instance, firms may decide to hire immigrant workers if they are aware of the potential productivity gains that these workers may entail. To obtain causal results, we need an instrument that affects the immigrant employment of the firm but does not influence its productivity, if not through the employment of immigrant workers. For this, we employ the instrument proposed in Section 4.2.

Second stage results are reported in Table 3. In column (1), we find a positive and significant effect of immigrant workers on the firm TFP obtained using the method of Levinsohn and Petrin (2003). In column (2), we show that this result is robust to the inclusion of firm fixed effects: the coefficient remains positive and significant at the 10% level. The drop in significance is due to the fact that this set of fixed effects captures a large part of the variation as immigrant employment is persistent over time within firms. Since column (2) exploits the within dimension of the data, the coefficient of interest captures the effect of a change in the employment of immigrant workers on productivity growth. Alternatively, in column (3), we show that the result is robust to the inclusion of the initial level of firm TFP as an additional control variable, and that TFP is persistent over time. This set of results is robust to the use of the TFP measure estimated as suggested by Wooldridge (2009) (columns 4 to 6). Finally, in columns (1) to (6), the Kleibergen-Paap F statistic is well above the Stock-Yogo critical value which allows us to infer that the instruments are not weak. First stage results are reported in Appendix A.2, Table 3.

[9] We detail the approach in Appendix A.4

In all columns, the instrument positively and significantly predicts the firm-level employment of immigrant workers.

Table 3: The Effect of Immigrant Workers on Firm TFP - Second stage estimations

	(1)	(2)	(3)	(4)	(5)	(6)
	$\ln \text{TFP}_{i,t}$					
TFP estimates	Levinsohn and Petrin (2003)			Wooldridge (2009)		
$\widehat{\ln \text{Immig}_{i,t-1}}$	0.350***	0.105*	0.221***	0.304***	0.129**	0.180***
	(0.010)	(0.056)	(0.008)	(0.010)	(0.056)	(0.008)
$\ln \text{TFP}_{i,t0}$			0.358***			0.381***
			(0.005)			(0.006)
Observations	453,618	449,750	431,889	453,618	449,750	431,889
Firm-year control	yes	yes	yes	yes	yes	yes
Firm FE	no	yes	no	no	yes	no
Industry-year FE	yes	yes	yes	yes	yes	yes
Method	IV-2SLS	IV-2SLS	IV-2SLS	IV-2SLS	IV-2SLS	IV-2SLS
Kleibergen-Paap F Stat.	4,798.227	110.491	4,607.131	4,798.227	110.491	4,466.935
Stock-Yogo critical value (10%)	16.38	16.38	16.38	16.38	16.38	16.38

Note: This table reports IV-2SLS second stage estimations. ***, ** and * respectively denote significance at the 1%, 5% and 10% level. Robust standard errors clustered at the firm level are reported in parentheses. The firm-year control consists in the logarithm of the full-time employment of the firm. First stage results are reported in Table 4.

Table 4: The Effect of Immigrant Workers on Firm TFP - First stage estimations

	(a)	(b)	(c)	(d)
	$\ln \text{Immig}_{i,t}$			
$\ln \text{IV}_{i(d),t}$	0.199***	0.067***	0.204***	0.201***
	(0.003)	(0.006)	(0.003)	(0.003)
$\ln \text{TFP}_{i,t0}$			-0.026***	0.016***
			(0.005)	(0.006)
Observations	453,618	449,750	431,889	431,889
Firm-year control	yes	yes	yes	yes
Firm FE	no	yes	no	no
Industry-year FE	yes	yes	yes	yes
Method	IV-2SLS	IV-2SLS	IV-2SLS	IV-2SLS

Note: This table reports IV-2SLS first stage estimations. ***, ** and * respectively denote significance at the 1%, 5% and 10% level. Robust standard errors clustered at the firm level are reported in parentheses. The firm-year control consists in the logarithm of the full-time employment of the firm.

5.3.2 Heterogeneity Across Firms

In this section, we address the concern that the employment of immigrant workers may only represent a proxy for firm productivity and a more general size effect. For instance, since hiring immigrants is more costly than hiring natives due to bureaucratic and cultural costs, employing immigrants could just be a signal of being a large and productive firm which can afford those costs. Failing to adequately control for the size of the firm would thus distort our interpretation of the results and lead us to falsely attribute a mitigation effect to the employment of immigrant workers that should instead be attributed to firm productivity or firm size in general.

To exclude alternative explanations behind the interpretation of the main coefficient of interest – the interaction term between the import competition shock and the immigration variable – we split the sample of firms in two subsamples based on their TFP level at the beginning of the period.[10] We distinguish between firms that exhibit a TFP above the median in 2002 and firms that exhibit a TFP below the median in 2002.

Results for the sample of firms which exhibit a level of TFP above median are presented in columns (1) and (2) and results for the firms which exhibit a level of TFP below the median are reported in columns (3) and (4) of Table 5. In line with the baseline findings, we find that an increase in the growth rate of the import penetration from China lowers the survival probability

[10] We choose the initial year of the sample to avoid endogenity concerns related to the TFP determination and distribution afterwards.

for both samples of firms, with the results being stronger and more precisely estimated for the sample of firms whose initial level of productivity is below the median (column 1 and 3). As for the growth rate of sales, we find that immigrant workers have a non-significant impact on the performance of firms when these firms have a TFP above the median, while their impact remains positive and highly significant for the sample of firms with an initial TFP level below the median.

If it is true that immigrants help firms react to an increase in import competition by increasing firm-level productivity and lowering export costs, then it is reasonable that this effect is stronger for firms which are initially smaller and less productive. In particular, these results are in line with the study by Mitaritonna et al. (2017) which shows a stronger productivity effect of immigrants for firms which exhibit a lower productivity level at the beginning of the period.

Table 5: Heterogeneity Across Firm Productivity

	(1) $\mathrm{D}\left(S^{jk}_{i,t+1}>0\|S^{jk}_{i,t}>0\right)$	(2) $\Delta \ln S^{jk}_{i,t:t+1}$	(3) $\mathrm{D}\left(S^{jk}_{i,t+1}>0\|S^{jk}_{i,t}>0\right)$	(4) $\Delta \ln S^{jk}_{i,t:t+1}$
$\Delta \mathrm{Comp}^{jk}_{t:t+1}$	-0.367***	-0.272	-0.617***	-0.896***
	(0.084)	(0.291)	(0.087)	(0.211)
$\widehat{\Delta \mathrm{Comp}^{jk}_{t:t+1} \ln \mathrm{Immig}_{i,t-1}}$	0.057*	0.016	0.160***	0.246***
	(0.034)	(0.119)	(0.035)	(0.081)
Observations	3,072,257	2,642,132	2,737,349	2,361,130
Sample	TFP in 2002 above median		TFP in 2002 below median	
Firm-year FE	yes	yes	yes	yes
Industry-Year FE	yes	yes	yes	yes
Method	IV-2SLS	IV-2SLS	IV-2SLS	IV-2SLS
Kleibergen-Paap F Stat.	15.010	14.249	24.128	22.823
Stock-Yogo critical value (10%)	16.38	16.38	16.38	16.38

Note: This table reports IV-2SLS second stage estimations. ***, ** and * respectively denote significance at the 1%, 5% and 10% level. Robust standard errors clustered at the firm level are reported in parentheses. First stage results are available upon request.

5.3.3 Evidence on the Mechanisms

We have shown that immigrants help firms mitigate trade shocks, all the more for less productive firms, which is also in line with existing empirical evidence (see Section 5.3.2). We now further investigate how immigrant workers mitigate trade shocks. In particular, we investigate whether immigrant workers mitigate trade shocks thanks to their impact on their firm productivity only. To do so, we augment our baseline estimation with the interaction between the variation in Chinese import competition and the TFP of the firm at time t, as well as the triple interaction between the variation in Chinese import competition, the employment of immigrant workers and the TFP of the firm. As in our baseline model, we include firm-year and industry-year fixed effects.

Results are presented in Table 6. We find that the baseline interaction between the variation in Chinese import competition and the employment of immigrant workers remains significantly positive for both measures of firm resilience. This result indicates that the effect of immigrants is not entirely channelled through productivity, as the inclusion of the interaction between the variation in Chinese import competition and the TFP of the firm does not affect its significance. This latter term is also positive and significant, thus indicating that more productive firms better react to an increase in the growth rate of Chinese imports. Finally, the triple interaction term is negative and significant for both measures of export resilience. The latter result indicates that immigrant workers have a lower mitigation effect on trade shocks when the firm exhibits a higher level of TFP.

Table 6: Evidence on the Mechanisms

	(1) $\mathrm{D}\left(S^{jk}_{i,t+1} > 0 \mid S^{jk}_{i,t} > 0\right)$	(2) $\Delta \ln S^{jk}_{i,t:t+1}$
$\Delta \mathrm{Comp}^{jk}_{t:t+1}$	-2.629***	-4.398***
	(0.466)	(1.435)
$\widehat{\Delta \mathrm{Comp}^{jk}_{t:t+1} \ln \mathrm{Immig}_{i,t-1}}$	1.120***	1.933***
	(0.176)	(0.536)
$\Delta \mathrm{Comp}^{jk}_{t:t+1} \ln \mathrm{TFP}_{i,t}$	0.243***	0.425***
	(0.051)	(0.160)
$\widehat{\Delta \mathrm{Comp}^{jk}_{t:t+1} \ln \mathrm{Immig}_{i,t-1}} \ln \mathrm{TFP}_{i,t}$	-0.112***	-0.198***
	(0.019)	(0.059)
Observations	6,724,135	5,822,771
Firm-year FE	yes	yes
Industry-Year FE	yes	yes
Method	IV-2SLS	IV-2SLS
Bootstrap replications	100	100

Note: This table reports IV-2SLS second stage estimations. ***, ** and * respectively denote significance at the 1%, 5% and 10% level. Bootstrapped standard errors clustered at the firm level are reported in parentheses. First stage results are available upon request.

The result that immigrant workers affect firm resilience on the export market through additional channels, other than productivity, is consistent with the idea that these workers lower trade costs. It is in fact well established that immigrant workers possess a superior knowledge of

foreign markets which lowers variable and fixed trade costs for the firm.[11] Although the data at hands do not allow us to test for the direct presence of this mechanism, we provide evidence of the cost-reducing effect of immigrant workers for French manufacturing firms in the context of our study in Appendix A.6. We analyse the impact of immigrant workers on the survival probability and the growth rate of sales of firms, distinguish between European and non-European destinations. The aim of this last set of results is to provide some suggestive evidence that the effect of immigrant workers on the measures of interest is higher for destination markets where information frictions are arguably higher for French firms, *i.e.* extra European markets. The underlying assumption is that immigrant workers may be more valuable for reacting to export shocks occurring on foreign markets that are more distant and culturally different from France. Results and estimation strategy are presented in Appendix A.6.

6 Conclusion

This paper investigates whether the employment of immigrant workers affects the resilience of firms in their export markets when they are facing an increase in import competition. To this end, we exploit the increase in Chinese import competition that French exporting manufacturers face in all the industry-destination combinations that they serve.

We start by describing the positive correlation between the employment of immigrant workers and the resilience of firms to the variation in import competition. Using an instrumental variable strategy, we then find that an increase in the growth rate of Chinese imports has a negative impact on both firm survival probability and export sales growth rate. However, immigrant workers mitigate this detrimental effect. Although the mitigation effect of immigrant workers is quantitatively small, these findings may matter at the aggregate level. The results show that firms with an initially low productivity level are those benefiting the most from the employment of immigrant workers. As small firms are numerous in France, assessing their resilience to trade shock is important to evaluate the aggregate consequences of such a shock.

Lastly, we show that the mitigation effect of immigrant workers is present, even after controlling for the fact that more productive firms face better an increase in import competition. This

[11] The existing literature has explored the micro-foundations of the positive relationship observed between exports and migration at the aggregate level (among others, see Gould, 1994; Girma and Yu, 2002; Head and Ries, 1998). A large number of papers focus on the role of migrant networks in reducing trade costs for their employing firms, through the reduction of transaction costs that are often intended as cultural and institutional differences as well as better network integration. In particular, using data on service firms in the U.K., Ottaviano et al. (2018) find that an increase in the supply of immigrant workers fosters bilateral exports for language-intensive and culture-specific services. Along the same line, Andrews et al. (2016) for Germany and Hiller (2013) for Denmark show that immigrants help firms reduce their trade costs and foster export sales thanks to their destination-specific knowledge. A related strand of literature shows that immigrant workers foster trade by improving firm integration in the global value chain through their networks and through their knowledge about better inputs for production (Bastos and Silva, 2012; Hatzigeorgiou and Lodefalk, 2016; Egger et al., 2019; Ariu, 2020).

hints towards the fact that the mitigation effect of immigrant workers is not fully channelled through their productivity-enhancing effect. We acknowledge that we are unable to further test whether the mitigation effect is conveyed through a trade-cost effect of immigrants, as the main drawback of the data at hand is related to the lack of information on the origin country of immigrants. Nonetheless, this last result is in line with existing literature and evidence we provide on the fact that immigrant workers generate significant productivity gains within their employing firms and lower informational barriers to exporting.

Our findings are important from a policy perspective for the following reasons. First, our results are instructive because strong and negative effects of import competition from low-wage countries such as China on firm survival probability and growth rate of sales may translate into lower growth and lower employment at the aggregate level. Second, we show that immigrant workers allow firms to smooth negative trade shocks, which is crucial to assess their impact on their host country and to evaluate their contribution to the economic growth. The results of this paper point towards the beneficial effects of immigrants in terms of survival probability and growth of French exporting manufacturers.

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A Online Appendix

A.1 Description of the Data

A.1.1 Data Sources

Administrative data on employees. First, we use administrative data consisting of annual employee declarations by wage-paying establishments located on the French territory (*Déclarations Annuelles des Données Sociales*, DADS postes). The dataset contains about 50 million individual-firm observations per year. We aggregate the data at the firm-year level to obtain firm-level measures of the workforce such as the total number of employees and the number of French and foreign employees. Once aggregate at the firm-year level and keep only the firms belonging to the manufacturing sector, the dataset contains 1,794,441 firm-year observations.

Tax records. We then use balance-sheet data consisting of tax reports filled in by firms located in France (*Fichier de comptabilité unifié dans SUSE*, FICUS and *Fichier approché des résultats d'Esane*, FARE). This dataset contains firms in the manufacturing and service sectors (and excludes the agricultural and financial sectors). Importantly, it contains both small and large firms since no threshold applies on the number of employees for reporting to the tax administration. This dataset provides us with variables related to their accounting. Each firm is assigned only one NACE industry code (NACE rev. 1 until 2007, NACE rev. 2 from 2008). Note that all domestic sales are reported as missing in 2008. The dataset contains 44,037,418 firm-year observations. After keeping firms whose main activity belongs to the manufacturing sector *i.e.* to the divisions 10-33 of the NACE Rév. 2 classification, we obtain a sample of 2,830,364 out of which 1,770,880 also have administrative data on employees available in the DADS data.

Customs data. Finally, we use a dataset from the French customs that contains shipments in value (Euros) and in volume (tons) by CPA6 product and origin/destination country. Firms located on the French mainland territory are required to report their exports of goods only if they reach the following thresholds: Before 2011, shipments to EU countries are reported only if firm's total exports are larger than 150,000 Euros and shipments to other countries are reported only if larger than 1,000 Euros or one ton. From 2011, shipments are reported only if the total exports to EU are larger than 460,000 Euros. This, however, accounts for only a small share of total exports (Berman et al., 2015). The dataset contains export flows at the firm-year-destination-product level. We use a time-invariant CPA6 code whose first four digits provide the main industry of the good exported by the firm (NACE rev. 2). We obtain 17,348,036 observations at the firm-year-destination-industry level. Firms possibly serve several industries as well as several destinations. Note that the firm may serve each of its industry-destination market in a discontinuous way. We therefore fill in the dataset with zeros when the firm does not serve an industry-destination in a year, but serves it at least one year before and one year after. We are then able to merge 8,517,147 observations into the DADS-tax sample.

Census data. We use the 1990 French population census (*Données harmonisées des recensements de la population à partir de 1968*) which contains information on the stocks of native and immigrant populations (defined as foreign citizens) by 1-digit occupation codes and by administrative counties.[12] We use these data to build spatial weights of the supply of foreign citizens across occupations that we then use to build one of the instrumental variables presented in a robustness test. We are then able to match the census data with the sample of interest for all counties of the French territory.

Trade data. We also use the Comtrade dataset that contains bilateral trade flows at the HS6 product level by origin and destination countries in U.S. dollars[13]. We use the classification of HS codes labelled *as reported* in order to match these data with the French customs data. Once the data are matched, we are able to build a time-varying proxy for the Chinese import competition faced by firms on each of their industry-destination market.

A.1.2 Data Structure

The observational unit in our specification is at the firm-destination-industry-year level. The set of destinations includes the domestic and the foreign markets served by the firm. Regarding the domestic market, the French tax records only contain the time-varying industry of the firm's main activity in a year[14]. As for the export sales, the French custom data contains information on the sales of goods of French firms in each industry-destination markets served. We are then able to identify the quantity sold in each industry for each foreign destination served by the firm.

Given that we use first differences in our empirical set-up, the structure of the data has to account for this feature:

- As far as the intensive margin is concerned, we compute the sales growth rate between two consecutive years t and $t+1$ as the midpoint growth rate of sales in an industry-destination (jk) market.

  First, when the firm is discontinuously serving an industry-destination, we fill in the export sales with a zero in the custom data between the first and the last year in which the firm appears to be serving that industry-destination. Otherwise, we would only be able to construct the growth rate for the industry-destination combination that we observe both at time t and $t+1$. This would be problematic because it would prevent us from capturing the fact that a firm may discontinuously serve an industry-destination market precisely

[12] For more details, see: https://www.insee.fr/fr/statistiques/2414232

[13] For more details, see: https://comtrade.un.org

[14] In one robustness test, we include the domestic market in the set of destinations served by the firm. Doing so, we assume that the domestic sales belong to the main industry of the firm only.

because of the competition it faces on that market[15]. Therefore, the growth rate for a jk-market when a firm does not serve jk at time t but does serve a value x at time $t+1$ is equal to 0.5 (that is $(x-0)/(x+0)/2$) and not zero.

Second, regarding the last year available for a jk market (including the domestic market) which we denote T, we distinguish two cases. i) If T is also the last year in which we observe the firm in the dataset, then the sales are considered to be missing at time $T+1$ and it is not possible to compute the growth rate at time t. ii) On the contrary, if the firm is serving some other market jk' at time $T+1$, then the sales of the jk market at time $T+1$ are considered to be zero. We are therefore able to compute the growth rate at time t.

- A similar procedure applies to build the survival probability which takes the value 1 when the firm serves in an industry-destination at time t *and* time $t+1$.

  First, regarding the export markets, when the firm is discontinuously serving an industry-destination market, its participation in the market is equal to zero because its sales are zero, according to the fill-in procedure described above. Therefore, it is possible to compute the survival probability for all the years between the first and the last one in which the firm is serving a particular industry-destination.

  Second, regarding the firm participation in an industry-destination at time t when t is the last year available for a jk combination, we distinguish two cases. i) If T is also the last year in which we observe the firm in the dataset, then the participation at time $T+1$ is considered as missing and it is not possible to compute the survival probability at time t. ii) On the contrary, if the firm is serving some other market jk' at time $T+1$, then the participation of the firm in the jk market at time t is considered to be zero. We are thus able to compute the survival probability at time t.

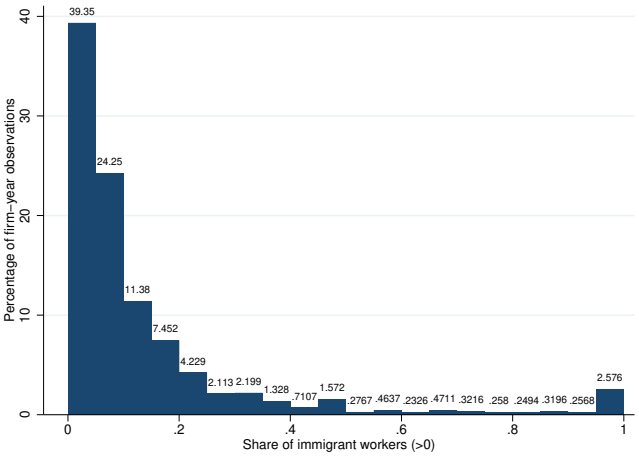
[15] As for the domestic sales that we use in one robustness test, they come from the tax records, so we do not fill in the variable with zero between the first and last year that a firm serves an industry in France. The reason is that a firm changing its main activity between time t and $t+1$ does not necessarily stop serving the (main) industry it served at time t, but rather that this industry is no longer the main industry of the firm.

A.2 Summary Statistics Descriptive Facts

Table A.1: Summary statistics

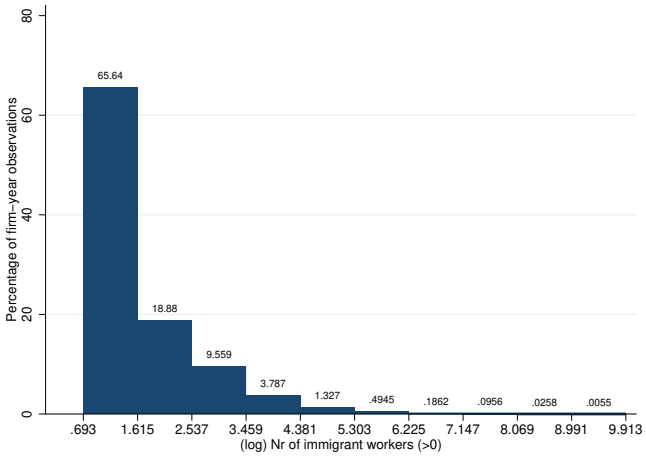
	Null employment of immigrants			Positive employment of immigrants			
	Obs.	**Mean**	**Std. Dev.**	**Obs.**	**Mean**	**Std. Dev.**	Signif.
Firm characteristics							
Gross operating surplus (in thousands euros)	292,620	201	2,377	256,220	1,984	2.10e+04	***
Total revenue (in thousands euros)	292,619	3,316	3.22e+04	256,219	3.45e+04	3.35e+05	***
Assets (in thousands euros)	292,605	1,792	3.32e+04	256,177	2.33e+04	2.46e+05	***
Nr. of employees	292,624	23.750	48.897	256,221	156.166	573.989	***
1-19 employees	292,624	0.669	0.471	256,221	0.256	0.436	***
20-250 employees	292,624	0.327	0.469	256,221	0.621	0.485	***
250+ employees	292,624	0.005	0.069	256,221	0.123	0.328	***
Share of employees in high-skilled occupations	292,252	0.291	0.262	256,186	0.304	0.208	***
Firm-industry-destination characteristics							
Survival probability	1,504,550	0.471	0.000	6,403,005	0.531	0.000	***
Export sales growth rate	1,319,390	-0.504	0.001	5,603,030	-0.368	0.000	***

Figure A.1: Distribution of Immigrant Workers



Data source: French firm-level data

Figure A.2: Distribution of immigrant workers



Data source: French firm-level data

A.3 Theoretical Underpinnings

A.3.1 Model Structure

We consider a world with n markets; a domestic market d and $n-1$ foreign markets. Mono-product firms maximise their profits independently on each market. Because we consider mono-product firms, a *market* equivalently identifies an industry-destination market or a destination market. To keep the model simple and illustrative, we assume that beachhead and fixed costs equal zero for all markets and we focus on firm performance on the export market.

The demand function faced by a firm i on a foreign market k at time t is given by:

$$q_{i,t}^{k}\left(p_{i,t}^{k}\right) = \chi_{i}^{k} - \zeta_{t}^{k} - p_{i,t}^{k} \tag{A.1}$$

Equation (A.1) is a non-negative demand function. In this function, χ_{i}^{k} denotes a time-invariant and market specific parameter that captures firm heterogeneity with respect to market k's conditions and ζ_{t}^{k} denotes a time-varying idiosyncratic shock related to foreign import competition such as the competition faced from China. ζ_{t}^{k} is drawn at each period of time and is defined over a positive support. This shock can be considered as a demand shifter such that when import competition increases on one market, demand decreases for this same market. In other words, ζ_{t}^{k} decreases the demand for the firm for each price level. Following previous literature, we assume that there is no auto-correlation in ζ_{t}^{k} and no correlation between shocks across markets.

The profitability of firm i serving market k at time t is the following:

$$\mu_{i,t}^{k} \equiv \chi_{i}^{k} - \zeta_{t}^{k} - \frac{1}{\phi_{i,t}} \tag{A.2}$$

where $\phi_{i,t}$ denotes the productivity of the firm at time t. $\mu_{i,t}^k$ is a random variable which summarises the uncertainty that firm i faces on market k at time t. Upon the resolution of uncertainty (when χ_i^k and ζ_t^k are realised), $\mu_{i,t}^k$ determines whether the firm is able to serve the market or not.

We consider that the productivity of the firm is a positive function of its total workforce, such that $\phi_{i,t} = \Phi\left(l_{i,t}^d, l_{i,t}^m\right)$, where $l_{i,t}^d$ and $l_{i,t}^m$ denote the firm employment of native and immigrant workers respectively and Φ is a CES aggregator. Both $l_{i,t}^d$ and $l_{i,t}^m$ are drawn from independent distribution functions at the beginning of period t[16]. It follows that $\frac{\partial \phi_{i,t}}{\partial l_{i,t}^d} \geq 0$ and $\frac{\partial \phi_{i,t}}{\partial l_{i,t}^m} \geq 0$[17]. The CES production function allows to incorporate the fact that immigrant workers increase firm-level productivity because they are imperfect substitutes of native workers and through knowledge externalities.

Therefore, firm i is, *ceteris paribus*, more productive if it employs immigrant workers than otherwise, such that:

$$\mathbb{1}_{\left\{l_{i,t}^m > 0\right\}} \phi_{i,t} > \mathbb{1}_{\left\{l_{i,t}^m = 0\right\}} \phi_{i,t} \tag{A.3}$$

where $\mathbb{1}_{\left\{l_i^m > 0\right\}}$ is an indicator function that equals unity if the firm hires at least one immigrant worker and zero otherwise.

The per unit cost function faced by the firm on market k is the following:

$$v_{i,t}^k = \frac{1}{\phi_{i,t}} + \tau_{i,t}^k \tag{A.4}$$

where $\tau_{i,t}^k$ is an iceberg export cost specific to market k (with $\tau_{i,t}^k \geq 0 \forall k \neq d$ and $\tau_{i,t}^d = 0$). The variable export costs of the firm could be a decreasing function of the employment of (skilled) immigrant workers as these workers are known to lower informational barriers to trade. Adding this assumption would, however, not change the predictions of the model.

Firm i determines the quantity it will sell on market k by maximising the following program:

$$\max_{q_{i,t}^k} \left\{ \left(\mu_{i,t}^k - \tau_{i,t}^k - q_{i,t}^k\right) q_{i,t}^k \right\} \tag{A.5}$$

which yields:

$$q_{i,t}^k\left(\tau_{i,t}^k\right) = \mathbb{1}_{\left\{\mu_{i,t}^k > \tau_{i,t}^k\right\}} \left(\frac{\mu_{i,t}^k - \tau_{i,t}^k}{2} \right) \tag{A.6}$$

where $\mathbb{1}_{\left\{\mu_{i,t}^k > \tau_{i,t}^k\right\}}$ is an indicator function that equals unity if the profitability of the firm on market k is larger than its export cost to that same market and zero otherwise.

[16] We remain agnostic regarding the distributions of $l_{i,t}^d$ and $l_{i,t}^m$ by assuming that they are exogenous, and implement an instrumentation strategy in the empirical part of the paper.

[17] Assuming that immigrant workers may have a negative impact on firm productivity would not allow one to obtain a concave production function. In other words, it would not be optimal for firms to hire immigrant workers. There is, however, only limited evidence of this relationship (Parrotta et al., 2014).

A.3.2 Equilibrium, Survival Probability and Export Sales Growth Rate

We consider that firm i is too small to have an impact on the aggregate state of the economy. Therefore, we can infer that an equilibrium exists, and analyse firm i's survival probability and export sales growth rate when it faces a marginal increase in import competition on a foreign market k.

Chinese import competition and firm export performance. We start by studying how an increase in import competition impacts firm i's survival probability and export sales growth rate. Following equation (A.6), a marginal increase in the import competition faced by firm i on market k at time t leads to a decrease in the sales of the firm on that market such that $\frac{\partial q_{i,t}^k}{\partial \zeta_t^k} = -\frac{1}{2}$. Therefore, the probability of firm i to keep serving market k when import competition increases at the margin is negative and reads as follows:

$$\frac{\mathrm{dP}\left(q_{i,t}^k > 0\right)}{\mathrm{d}\zeta_t^k} < 0 \tag{A.7}$$

The sales growth rate of firm i on market k is akin to the following semi-elasticity which is also negative:

$$\frac{1}{q_{i,t}^k}\frac{\partial q_{i,t}^k}{\partial \zeta_t^k} = -\frac{1}{2q_{i,t}^k} < 0 \tag{A.8}$$

The mitigation effect of immigrant workers. We then study to what extent differences in the employment of immigrant workers may induce different firm-level responses in terms of both survival probability and export sales growth rate. We find that the drop in the survival probability of firm i is smaller if it employs immigrant workers:

$$\mathbb{1}_{\{l_{i,t}^m > 0\}}\frac{\mathrm{dP}\left(q_{i,t}^k > 0\right)}{\mathrm{d}\zeta_t^k} \geq \mathbb{1}_{\{l_{i,t}^m = 0\}}\frac{\mathrm{dP}\left(q_{i,t}^k > 0\right)}{\mathrm{d}\zeta_t^k} \tag{A.9}$$

Similarly, we find that the export sales growth rate of firm i drops by less if it employs immigrant workers:

$$\mathbb{1}_{\{l_{i,t}^m > 0\}}\frac{1}{q_{i,t}^k}\frac{\partial q_{i,t}^k}{\partial \zeta_t^k} \geq \mathbb{1}_{\{l_{i,t}^m = 0\}}\frac{1}{q_{i,t}^k}\frac{\partial q_{i,t}^k}{\partial \zeta_t^k} \tag{A.10}$$

Here, one should note that both terms of Equations (A.9) and (A.10) are negative, but the left terms are closer to zero than the right terms.

To conclude, the model predicts that, within an equilibrium defined at time t, immigrant workers mitigate the negative effect of an import competition shock on firm export performance.

A.4 Construction of the Variables of Interest

A.4.1 Estimation of Total Factor Productivity

In order to estimate total factor productivity at the firm level for each industry, we follow one of the most widely used approaches in the literature and we estimate it according to the methodology outlined by Levinsohn and Petrin (2003). As a comparison, we provide estimates of TFP using a FE-OLS method and the GMM approach suggested by Wooldridge (2009).

The control function approach developed by Levinsohn and Petrin (2003) is a two-step procedure that allows one to estimate production functions taking into account the correlation between unobservable productivity shocks and input levels. The production technology is assumed to be a Cobb-Douglas function, and the unobserved productivity term is expressed as a function of two observed inputs, intermediate inputs and capital. All the details regarding the theoretical foundations of this estimation method can be found in the study by Levinsohn and Petrin (2003).

Specifically for this paper, we estimate sector-specific productivity *i.e.* we estimate a coefficient for the labour and the capital inputs specific to each NACE Rév. 2 2-digit industry. We use value added as left-hand side variable, and we deflate it using value-added industry-specific deflators from EU-KLEMS (base year, 2010). For the labour input, we use the number of employees from the tax records. For the capital input, we use the book value of tangible assets as recorded in the tax records. We do not include intangible assets because they are recorded with less precision in this dataset. We deflate the capital input using the industry-specific capital deflators from EU-KLEMS (base year, 2010). Finally, for the control function, we use intermediate inputs, computed as the sum of purchases of raw materials and merchandise. We deflate this using the industry-specific intermediate input deflators from EU-KLEMS (base year, 2010). To clean the data, we drop observations for which the value added or the labour input is zero or missing, and we drop observations for which the capital input and the material input are missing, zero or negative. The estimates by industry, available upon request, are consistent among estimation methods, and present coefficients associated to the labour input and the capital input consistent with the literature *i.e.* $\beta_L = 0.6$ and $\beta_K = 0.4$.

A.4.2 Import Competition Measure

To construct the measure of import competition that a French firm faces at time t in an industry-destination pair jk, we follow the following four-step procedure.

1. We use the Comtrade data to obtain imports from China and from the World for each product-destination-year triplet nkt.

2. We then construct a conversion table that uniquely assigns a time-invariant NACE Rév. 2 code to each HS6 code. The conversion table is built using the French custom data. In these data, a harmonised unique NACE Rév. 2 code is assigned to each product that firms export. Note that there are only 145 product lines (out of 6,000) that are assigned to more

than one industry and only 8 products that are assigned to a different industry code over time. In order to overcome this problem, we construct time-invariant export-based weights to assign a time-invariant industry to these products. On average, the industry assigned to this product represents 84% of the export volume of that product. We are therefore able to assign a NACE Rév. 2 industry to most 6,000 products, which is roughly the same number of HS6 product lines contained in the Comtrade data every year[18].

3. We then merge the Comtrade data with the conversion table, we collapse the data by destination-industry-year triplet (jkt).

4. Finally, we merge this dataset with the custom data by industry-destination-year triplet, jkt, as well as with the tax record data, which provides information about the sales on the domestic market[19].

[18] The NACE Rév. 2 categories that do not appear in the conversion table are those belonging to service sectors, whose trade is not recorded in the custom data.

[19] There are two main concerns regarding the activity of the firms in the domestic destination. The first one is the change in industry classification in 2008, from NACE Rév.1 to NACE Rév. 2. In order to overcome the problem of NACE Rév. 1 codes mapping into several NACE Rév. 2 codes, we rely on the conversion table provided by the French Statistical Agency (INSEE). The second one is the discontinuity in the data in 2008, where all the domestic sales are missing. We remain agnostic about how to treat these observations and therefore we consider the participation variable for the French market in $t+1$ when $t = 2007$ as missing.

A.5 Additional Tables of Robustness Tests

Table A.2: Robustness Test: Alternative Variables of Interest - Second stage estimations

	(1) $\text{D}\left(S^{jk}_{i,t+1} > 0 \mid S^{jk}_{i,t} > 0\right)$	(2) $\Delta \ln S^{jk}_{i,t:t+1}$	(3) $\text{D}\left(S^{jk}_{i,t+1} > 0 \mid S^{jk}_{i,t} > 0\right)$	(4) $\Delta \ln S^{jk}_{i,t:t+1}$	(5) $\text{D}\left(S^{jk}_{i,t+1} > 0 \mid S^{jk}_{i,t} > 0\right)$	(6) $\Delta \ln S^{jk}_{i,t:t+1}$
$\Delta\text{Comp}^{jk}_{t:t+1}$	-1.250***	-1.741***	-0.473***	-0.506***	-0.274***	-0.371***
	(0.225)	(0.632)	(0.065)	(0.180)	(0.016)	(0.048)
$\widehat{\Delta\text{Comp}^{jk}_{t:t+1}\text{D}\left(\text{Immig}\right)_{i,t-1}}$	1.241***	1.761**				
	(0.263)	(0.742)				
$\widehat{\Delta\text{Comp}^{jk}_{t:t+1}\text{For}_{i,t-1}}$			0.092***	0.093		
			(0.021)	(0.058)		
$\widehat{\Delta\text{Comp}^{jk}_{t:t+1}\text{ShImmig}_{i,t-1}}$					0.892***	1.474***
					(0.158)	(0.490)
Observations	6,841,977	5,921,621	6,296,505	5,444,890	6,841,977	5,921,621
Firm-year FE	yes	yes	yes	yes	yes	yes
Industry-Year FE	yes	yes	yes	yes	yes	yes
Method	IV-2SLS	IV-2SLS	IV-2SLS	IV-2SLS	IV-2SLS	IV-2SLS
Kleibergen-Paap F Stat.	53.354	49.404	40.265	39.341	185.993	191.950
Stock-Yogo critical value (10%)	16.38	16.38	16.38	16.38	16.38	16.38

Note: This table reports IV-2SLS second stage estimations. ***, ** and * respectively denote significance at the 1%, 5% and 10% level. Robust standard errors clustered at the firm level are reported in parentheses. $\text{D}\left(\text{Immig}\right)_{i,t-1}$ denotes a dummy variable equal to one if firm i hires a positive number of immigrant workers at time $t-1$ and zero otherwise. $\text{For}_{i,t-1}$ denotes the number of foreign-born workers employed by firm i at time $t-1$. $\text{ShImmig}_{i,t-1}$ denotes the share of immigrant workers employed by firm i at time $t-1$. First stage results are available upon request.

Table A.3: Robustness Test: Alternative Level of Error Clustering - Second stage estimations

	(1) $\mathrm{D}\left(S^{jk}_{i,t+1}>0\vert S^{jk}_{i,t}>0\right)$	(2) $\Delta \ln S^{jk}_{i,t:t+1}$	(3) $\mathrm{D}\left(S^{jk}_{i,t+1}>0\vert S^{jk}_{i,t}>0\right)$	(4) $\Delta \ln S^{jk}_{i,t:t+1}$
$\Delta\mathrm{Comp}^{jk}_{t:t+1}$	-0.439***	-0.583***	-0.439***	-0.581***
	(0.053)	(0.143)	(0.100)	(0.210)
$\widehat{\Delta\mathrm{Comp}^{jk}_{t:t+1}\ln\mathrm{Immig}_{i,t-1}}$	0.099***	0.138**	0.099**	0.137
	(0.021)	(0.057)	(0.043)	(0.090)
Observations	6,872,600	5,952,244	6,872,202	5,951,896
Firm-year FE	yes	yes	yes	yes
Industry-Year FE	yes	yes	yes	yes
Cluster	Industry-destination	Industry-destination	County	County
Method	IV-2SLS	IV-2SLS	IV-2SLS	IV-2SLS
Kleibergen-Paap F Stat.	711.145	662.774	11.629	11.046
Stock-Yogo critical value (10%)	16.38	16.38	16.38	16.38

Note: This table reports IV-2SLS second stage estimations. ***, ** and * respectively denote significance at the 1%, 5% and 10% level. Robust standard errors clustered at the industry-destination or at the county level are reported in parentheses. First stage results are available upon request.

Table A.4: Domestic Market Included - Second stage estimations

	(1) $\mathrm{D}\left(S^{jk}_{i,t+1}>0\vert S^{jk}_{i,t}>0\right)$	(2) $\Delta \ln S^{jk}_{i,t:t+1}$
$\Delta\mathrm{Comp}^{jk}_{t:t+1}$	-0.502***	-0.651***
	(0.051)	(0.139)
$\widehat{\Delta\mathrm{Comp}^{jk}_{t:t+1}\ln\mathrm{Immig}_{i,t-1}}$	0.120***	0.161***
	(0.021)	(0.056)
Observations	7,118,280	6,189,422
Firm-year FE	yes	yes
Industry-Year FE	yes	yes
Method	IV-2SLS	IV-2SLS
Kleibergen-Paap F Stat.	46.216	44.207
Stock-Yogo critical value (10%)	16.38	16.38

Note: This table reports IV-2SLS second stage estimations. ***, ** and * respectively denote significance at the 1%, 5% and 10% level. Robust standard errors clustered at the firm level are reported in parentheses. First stage results are available upon request.

Table A.5: Alternative Instrumentation Strategy - Second stage estimations

	(1) $\mathrm{D}\left(S^{jk}_{i,t+1}>0 \mid S^{jk}_{i,t}>0\right)$	(2) $\Delta \ln S^{jk}_{i,t:t+1}$
$\Delta\mathrm{Comp}^{jk}_{t:t+1}$	-0.512***	-0.734***
	(0.059)	(0.161)
$\widehat{\Delta\mathrm{Comp}^{jk}_{t:t+1}\ln\mathrm{Immig}_{i,t-1}}$	0.128***	0.199***
	(0.025)	(0.065)
Observations	6,872,202	5,951,894
Firm-year FE	yes	yes
Industry-Year FE	yes	yes
Method	IV-2SLS	IV-2SLS
Kleibergen-Paap F Stat.	34.713	32.639
Stock-Yogo critical value (10%)	16.38	16.38

Note: This table reports IV-2SLS second stage estimations. ***, ** and * respectively denote significance at the 1%, 5% and 10% level. Robust standard errors clustered at the firm level are reported in parentheses.

Table A.6: Alternative Instrumentation Strategy - First stage estimations

	(a) $\Delta\mathrm{Comp}^{jk}_{t:t+1}$	(b) $\ln\mathrm{Immig}_{i,t-1}$
$\Delta\mathrm{Comp}^{jk}_{t:t+1}$	-2.771***	-2.641***
	(0.852)	(0.854)
$\Delta\mathrm{Comp}^{jk}_{t:t+1}\ln\mathrm{IV}_{d,t-1}$	0.492***	0.480***
	(0.084)	(0.084)
Observations	6,872,202	5,951,894
Firm-year FE	yes	yes
Industry-year FE	yes	yes
Method	IV-2SLS	IV-2SLS

Note: This table reports IV-2SLS first stage estimations. ***, ** and * respectively denote significance at the 1%, 5% and 10% level. Robust standard errors clustered at the firm level are reported in parentheses. Column (a) reports the first stage results for specification (1) and column (b) for specification (2) in Table A.5.

Table A.7: Testing the Exclusion Restriction Assumption

	$\Delta \ln \text{IV}_{d,2003:2014}$
$\Delta \ln S^{jk}_{i,2003:2004}$	-0.000***
	(0.000)
	[95]
(log) Average wage in 2003	0.000***
	(0.000)
	[95]
(log) Total export value in 2003	0.000***
	(0.000)
	[95]
(log) Total employment in 2003	0.000***
	(0.000)
	[95]
(log) Total Factor Productivity in 2003	0.000***
	(0.000)
	[95]
	$\Delta \ln \text{IV}_{d,2009:2014}$
$\Delta \ln S^{jk}_{i,2003:2008}$	0.000*
	(0.000)
	[94]
(log) Average wage (diff. over 2003-2008)	0.000***
	(0.000)
	[94]
(log) Total export value (diff. over 2003-2008)	-0.000
	(0.000)
	[94]
(log) Total employment (diff. over 2003-2008)	-0.000
	(0.000)
	[94]
(log) Total Factor Productivity (diff. over 2003-2008)	-0.000**
	(0.000)
	[94]

Note: This table reports OLS correlations. Standard errors are reported in parentheses. The number of observations is reported in brackets. The number of observations corresponds to the number of counties (French *départements*) available over the studied sample period. One overseas county is dropped from the second panel of coefficients.

A.6 The Cost-Reducing Effect of Immigrant Workers

We provide evidence of the cost-reducing effect of immigrant workers for French manufacturing firms in the context of our study. We analyse the impact of immigrant workers on the survival probability and the growth rate of sales of firms, distinguish between European and non-European destinations. The estimation strategy is presented in equation (A.11) and reads as follows:

$$y_i = \beta_0 + \beta_1 \ln \text{Immig}_{i,t-1} + \beta_2 \ln \text{Immig}_{i,t-1} * \text{E}_{k,t-1} + \gamma_i + \gamma_{jt} + \gamma_{kt} + \varepsilon_{i,t} \tag{A.11}$$

where, as before, the dependent variable (y_i) denotes either the survival probability or the export sales growth rate of a firm i. The variable $\text{E}_{ik,t-1}$ is a dummy variable equal to unity if destination k served by firm i at time $t-1$ is not a part of the European Union (EU), and zero if it is an EU country. To approximate the ease of doing business as well as the cultural and geographic distance between the firm and the market served, we distinguish between EU countries and non-EU destinations served by the firm. We can then interact $\text{E}_{ik,t-1}$ with the immigration variable to study the differential effect of immigrants across EU and non-EU destinations. The specification includes firm, industry-year and destination-year fixed effects (γ_i, γ_{jt} and γ_{kt}). We cluster errors at the firm-level.

We implement an IV-2SLS estimation in which we instrument the number of immigrant workers employed by firm i at time $t-1$ by the instrumental variable described above ($\text{IV}_{i(d),t}$). Second stage results are reported in Table A.8. In column (1), we find a positive and weakly significant effect of immigrants on the firm survival probability. Yet, this effect is lower for non-European destinations that are more costly to serve for a French firm. In column (2), we show that this result is slightly different when the specification includes destination-year fixed effects. The interaction term is positive and significant, indicating that immigrant workers have a positive impact on the firm survival probability for non-EU destinations only. We replicate these specifications in columns (3) and (4) for the growth rate of sales. In both columns, we find a positive and significant interaction term indicating that immigrant workers have a positive impact on the growth rate of sales for non-EU destinations. In columns (1) to (4), the Kleibergen-Paap F statistic is below the Stock-Yogo critical value which could indicate the presence of weak instruments. First stage results are reported in Appendix A.2, Table A.9 and show that the instrumental variable well predicts the firm-level employment of immigrant workers.

Table A.8: The Effect of Immigrant Workers on Informational Barriers - Second stage estimations

	(1)	(2)	(3)	(4)
	$\mathrm{D}\left(S^{jk}_{i,t+1}>0 \mid S^{jk}_{i,t}>0\right)$		$\Delta \ln S^{jk}_{i,t:t+1}$	
$\widehat{\ln \mathrm{Immig}_{i,t-1}}$	0.078*	0.062	-0.071	-0.044
	(0.044)	(0.044)	(0.076)	(0.075)
$\mathrm{E}_{ik,t-1}$	-0.172***		-0.230***	
	(0.012)		(0.015)	
$\widehat{\ln \mathrm{Immig}_{i,t-1} * \mathrm{E}_{ik,t-1}}$	-0.012**	0.013**	0.031***	0.033***
	(0.006)	(0.006)	(0.007)	(0.007)
Observations	7,227,435	7,227,381	6,257,903	6,257,847
Firm FE	yes	yes	yes	yes
Firm-year control	yes	yes	yes	yes
Industry-year FE	yes	yes	yes	yes
Destination-year FE	no	yes	no	yes
Method	IV-2SLS	IV-2SLS	IV-2SLS	IV-2SLS
Kleibergen-Paap F Stat.	2.804	2.845	3.440	3.478
Stock-Yogo critical value (10%)	7.03	7.03	7.03	7.03

Note: This table reports IV-2SLS second stage estimations. ***, ** and * respectively denote significance at the 1%, 5% and 10% level. Robust standard errors clustered at the firm level are reported in parentheses. The firm-year control consists in the logarithm of the full-time employment of the firm. First stage results are reported in Table A.9.

Table A.9: The Effect of Immigrant Workers on Informational Barriers - First stage estimations

	(a1)	(a2)	(b1)	(b2)	(c1)	(c2)	(d1)	(d2)
	$\ln \text{Immig}_{i,t}$	$\ln \text{Immig}_{i,t} * \text{E}_{ik,t-1}$	$\ln \text{Immig}_{i,t}$	$\ln \text{Immig}_{i,t} * \text{E}_{ik,t-1}$	$\ln \text{Immig}_{i,t}$	$\ln \text{Immig}_{i,t} * \text{E}_{ik,t-1}$	$\ln \text{Immig}_{i,t}$	$\ln \text{Immig}_{i,t} * \text{E}_{ik,t-1}$
$\ln \text{IV}_{i(d),t}$	0.068**	-0.118***	0.065**	-0.084***	0.072***	-0.108***	0.069***	-0.074***
	(0.028)	(0.024)	(0.027)	(0.018)	(0.027)	(0.023)	(0.026)	(0.017)
$\text{E}_{ik,t-1}$	0.053**	-0.619**			0.054*	-0.618**		
	(0.027)	(0.268)			(0.028)	(0.267)		
$\ln \text{IV}_{i(d),t} * \text{E}_{ik,t-1}$	-0.005*	0.269***	0.000***	0.211***	-0.005*	0.269***	0.000**	0.210***
	(0.003)	(0.027)	(0.000)	(0.004)	(0.003)	(0.027)	(0.000)	(0.004)
Observations	7,227,435	7,227,435	7,227,381	7,227,381	6,257,903	6,257,903	6,257,847	6,257,847
Firm FE	yes	yes	yes	yes	yes	yes	yes	yes
Firm-year control	yes	yes	yes	yes	yes	yes	yes	yes
Industry-year FE	yes	yes	yes	yes	yes	yes	yes	yes
Destination-year	no	no	yes	yes	no	no	yes	yes
Method	IV-2SLS	IV-2SLS	IV-2SLS	IV-2SLS	IV-2SLS	IV-2SLS	IV-2SLS	IV-2SLS

Note: This table reports IV-2SLS first stage estimations. ***, ** and * respectively denote significance at the 1%, 5% and 10% level. Robust standard errors clustered at the firm level are reported in parentheses. The firm-year control consists in the logarithm of the full-time employment of the firm.