Immigration and firm performance: evidence from Turkey

Nazlı Karamollaoğlu[1] and Federico Trionfetti[2]

[1] MEF Universtiy, Turkey.

[2] Aix-Marseille University, CNRS, EHESS, Centrale Marseille, AMSE, France.

September 29, 2020

Abstract

Following the intensification of the conflict in Syria in 2012, the number of Syrian refugees in Turkey has reached almost 3.6 million as of 2019, according to the Turkish Directorate General for Migration Management. Syrian refugees have become an important source of informal employment, as almost 2.2 million Syrians are of working age. Therefore, this large flow of immigrants has had major impacts on the dynamics of the labor market through the abundance of largely unskilled labor. This paper provides evidence on the impact of this massive refugee inflow, resulting from the changes in labor markets, on firm-level metrics including total sales, domestic sales, and exports as well as export probabilities using a comprehensive firm-level data and city-level immigration density measures. Preliminary results suggest that firms in cities with greater immigrant penetration saw declining sales, mostly in capital-intensive firms.

J.E.L. codes: F14, F22

Keywords: Syrian Refugees, Capital Intensity, Firm Heterogeneity.

For the second author this work was supported by French National Research Agency Grants ANR-17-EURE-0020.

1 Introduction

From 2013 to 2018 about 3.5 million Syrians found refuge in Turkey representing approximately 4.5% of the Turkish population. This fact, by its magnitude, speed, and unexpected occurrence is probably the most relevant labour market shock in modern history. A comparison with other sudden and unexpected events give the idea of the proportions. In the same five years of massive inflow of Syrian into Turkey about seven hundred thousands people landed on the Italian shores coming from North Africa.[1] This five-year inflow was the largest in history and yet it represented only 1.17% of the Italian population and 0.18% of the European Union population. In the five years that followed the fall of Berlin Wall, about four hundred thousands people moved from East to West Germany, representing about 0.6% of West Germany population.

Migration phenomena have been studied extensively. The vast majority of the literature has focused on the link between migration and labour market outcomes. We join a more recent trend that studies the effect of migration on firm performance but we go one step further with respect to this literature by focusing on the *relative* performance of firms. There are at least two reasons to focus on relative performance. The first reason is that impact of refugees on the labour market is likely to affect different firms differently. Specifically, it is likely to make labour-intensive firms better off relative to capital-intensive firms. The reason is simply that the former use more intensively the factor that becomes more abundant. For example, consider a fall in wages induced by immigration. Such wage reduction reduces costs for all firms but more so for labour-intensive firms because these firms use intensively the factor that has became cheaper. Sales increase for all firms but more so for labour-intensive firms because they benefit from a larger fall in costs. In our empirical implementation we measure the *relative capital-intensity* of a firm as its capital intensity relative to the average capital intensity of firms in the same industry. Our dependent variable is *relative sales* defined as the sales of a firm relative to the average firm sales in the same industry. According to the intuition described above we expect that immigration brings about a fall in relative sales of capital intensive firms and an increase in relative sales of labour-intensive firms. The second reason for focusing on relative sales as endogenous variable is that it considerably attenuates the endogeneity problem typical of this category of studies. Endogeneity between migration and absolute sales (or labour market outcomes) may arise because migrants might choose locations with better job opportunities thus giving rise to a spurious relationship between firm sales and presence of migrants. But our dependent variable is not absolute sales, it is relative sales, and relative sales does not plausibly relate to any variable (such as job opportunity) that could influence the location decision of migrants.[2]. We find that relative sales of firms in a province are negatively related to the the number of refugee in a province and, more importantly, that this negative effect is driven by capital-intensive firms only. For labour-intensive firms we find less clear-cut results with most of the estimates not being statistically significant. Theoretically we would expect a positive relationship between relative sales of labour-intensive firms and the number of refugees in a province. However, the lack of a significant

[1]Sources: ISMU foundation https://www.ismu.org/dati-sugli-sbarchi-gennaio-2020/

[2]A similar strategy is used in Ottaviano and Peri (2012) where they use relative dependent and independent variables (wages and labour supply)

relationships is consistent with the fact that migrants are mostly employed informally by very small firms. Even labour-intensive firms in our sample are, in fact, quite capital intensive relative to the small (unobserved) informal firms where immigration employment concentrates. Then, it is not surprising that we do not find a clear positive effect on the labour-intensive firms in our sample.

2 Literature review.

From the vast literature on migration we have selected the works most relevant for our study. In particular, we review those that deal with the effect of migration on the labor market, those that use data related to the inflow of Syrian refugees in Turkey, and those that focus on firm performance, which is the subject of our paper.

A large literature has focused on the the effects of immigration on wages and employment of native workers. The results are mixed. For instance, one of the earliest papers, Card (1990), studies the effect of the Mariel Boatlift of 1980 on the Miami labor market. He finds no significant effect on wages or on employment of less-skilled workers. In a later reassessment, using a different data set and an improved methodology, Card (2001) finds that occupation-specific wages and employment rates are systematically lower in cities with higher relative supplies of workers in a given occupation. Borjas (2003) innovates on previous studies by using information on both schooling and work experience in defining a skill group. His work uses US Census data for the period 1960-1990 and Current Population Surveys for the period 1998-2001. He finds substantial negative effects of immigration on native wages: a ten percent increase in labor supply reduces wages by three to four percent. In an innovative approach Manacorda et al. (2012) and Ottaviano and Peri (2012) take into account the fact that immigrants and natives are not perfect substitutes. This fact, documented also by Card (2009), when embedded in an appropriate theoretical setting gives rise to very different results. Thus, Manacorda et al. (2012) using a pooled time series of British cross-sectional micro data from the mid-1970s to the mid-2000s find that immigration has primarily reduced the wages of immigrants with only little effect on the wages of the native-born. Ottaviano and Peri (2012), using US data for the period 1990-2006, find an effect on the wage of the least educated native workers that ranges between - 2.1% and +1.7% depending on the specifications (with positive effects being 'preferred' by the data), an effect of +0.6% on average wages of native workers, and a - 6.7% effect on wages of previous immigrants. This brief review is representative of how different the results are across papers. Dustmann et al. (2013) argue that a possible reason for this difference is that immigrants and natives are placed into education-experience cells on the basis of their reported education and age. This allocation into labor market cells is, they argue, misleading because the pervasive phenomenon of downgrading makes that immigrants compete with native workers mostly at the bottom of the education-experience distribution, regardless of their reported education-experience characteristics. To circumvent this problem they derive an estimable model where immigrants are allocated to skill groups according to their observed position in the native wage distribution rather than being pre-allocated according to their observed characteristics. Using data for the United Kingdom in the period 1997-2005 they find that immigration depresses wages below the twentieth percentile but it contributes to wage growth above the fortieth percentile. This, in spite of the fact that, on average, immigrants were more educated than natives in the data set they considered. They also find that the average effects of immigration on wages are slightly positive. Dustmann et al. (2016), in reviewing a large number of studies, provide further evidence that the pre-allocation might lead to misleading results. Brücker et al. (2014) observes that the impact of immigration on wages depends on the flexibility of the labor market. Comparing Denmark, Germany and the UK, he finds that in Germany immigration involves only moderate wage effects but large unemployment effects. The reverse is true for the UK and Denmark.

A number of recent studies have focused on the inflow of Syrian refugees in Turkey. Tumen (2016) documents the importance of the phenomenon of informal labor, which is in part responsible for unobserved employment of refugees. He uses difference in difference methodology and distinguishes between treatment and control regions and pre- and post-immigration period. He finds evidence of a negative effects on employment of informal native workers and a positive but small effect on the employment of formal native workers. He finds no effect on wages of native workers. Del Carpio and Wagner (2018) use a different methodology and, importantly, relay on distance from the Syrian border as an instrument. Results are similar, however: they find that immigration has a positive effect on the propensity of becoming unemployed for informal (uneducated) native workers and a positive effect on the propensity to be formally employed. Ceritoglu et al. (2017) find that the effect on native workers wage is negligible while labor force participation, informal employment, and job finding rates have declined among natives. Aksu et al. (2018), observe that most studies that focused on refugee immigration on the Turkish labor market neglected that formal employment was already growing at the time when immigrant arrived and that the growth was very heterogeneous across Turkish regions. This neglect, may explain why those studies find an overall negative effect on employment. Abandoning the assumption of common trend, embedded in the difference-in-difference methodology, they find no overall effect of immigration on employment: the fall in informal employment is compensated by an equally large increase in formal employment.

Three facts seem to emerging from this literature: (1) The effect of immigration on wages of native workers is found to be negative or null, (2) the vast informal employment in Turkey makes it difficult to measure wages and employment of immigrants, (3) it cannot be excluded that the unobserved employment conditions and wages of migrants are such to reduce the labor cost (because of lower wages or lower employment costs such as omitted social security contributions, safety requirements, etc). These facts, although often emerge from a data set different from ours, are consistent with our findings on firm performance, which hinges on the relative reduction of labor costs.

We now discuss the few papers that focused on migration and firms. Altındağ et al. (2020) is particularly relevant since, like us, it studies the effect of Syrian refugees on Turkish firms. Their focus is on the extensive and intensive margin of production. They find a positive effect on both margins with particular concentration in the informal economy. The effect on the intensive margin is not significant when the dependent variable is firm sales but it is significant and conspicuous when measured by proxies for sales, such as electricity and oil consumption. They also observe a decline in male native wage of approximately

1.9 percent. Akgündüz et al. (2018) investigate the impact of Syrian refugees on firm entry and performance. They document three facts: a large increase in the number of foreign firms in refugee hosting regions, firm-level business indicators such as gross profits and sales are positively affected by the presence of refugees, some weak evidence of an increase in the number of firms in sectors which require low-skill employment. Across sectors, the declining number of firms are mostly in service sectors that need some skilled labor. Brown et al. (2013) use administrative data from the state of Georgia and find that, on average across all firms, employing undocumented workers reduces a firm's hazard of exit by 19 percent. Furthermore, the advantage to firms from employing undocumented workers decreases with the skill level of the firm's workers and increases with the labor intensity of the firm's production process. Using the terminology of heterogeneous firms model the results of these two papers mean that the entry cut-off moves to the left and this is indeed one of our theoretical results. Olney (2013) examines whether firms respond to immigration by expanding their production activities within a city in order to utilize the abundant supply of low-skilled workers. Using data on immigration and the universe of establishments in U.S. cities, his results indicate that firms respond to immigration at the extensive margin by increasing the number of establishments. Not surprisingly, immigration has a more positive impact on the number of establishments that are small in size and in relatively mobile, low-skill intensive industries. This evidence, like the previous one, may be interpreted as a shift to the left of the entry cut off especially strong for the labor intensive firms, which is once again consistent with our mechanism.

While many empirical results are consistent with the mechanism we propose, none of the papers we have found deals explicitly with the effect of migration on relative performance of firms.

3 Theoretical background

In this section we focus on the essential theoretical elements while in the appendix we provide a complete description of the model and the derivation of results. The world economy is composed by two countries, H and F; it produces two differentiated goods, Y and Z, by using two primary factors K and L. Each country is endowed with a fixed quantity of K. To fix notation let labor migrate from F to H. Country H is composed of two locations, m and n. Location m is where migrants settle. We use the index $c = m, n, F$ to denote, respectively, the two locations in H and the rest of the world, F. Labor markets are local. Accordingly, wages w_j^c in addition to be different between countries are also different between the two locations of H.

The representative consumer utility function is $u = (Y)^{\gamma_Y} (Z)^{\gamma_Z}$ where $\gamma_i \in (0, 1)$, $\gamma_Y + \gamma_Z = 1$ and where Y and Z are CES aggregates whose elasticity of substitution between varieties is $\varsigma > 1$. National income in H is $I^H = w_L^m L^m + w_L^n L^n + w_K^H K^H$. National income in F is: $I^F = w_L^F L_F + w_K^F K^F$.

The variable input technology takes the CES form here represented by the marginal cost which, for a firm in industry i of location c, is

$$mc_i^c(t) = \left[(\lambda_i)^\sigma (w_L^c)^{1-\sigma} \alpha(t)^{\sigma-1} + (1-\lambda_i)^\sigma (w_K^c)^{1-\sigma} \beta(t)^{\sigma-1} \right]^{\frac{1}{1-\sigma}}. \quad (1)$$

where $\lambda_i \in (0,1)$ is a constant technology parameter of industry $i = Y, Z$ and $\sigma > 0$ measures gross substitutability between factors. The variable t is a random variable whose cumulative distribution $G(t)$ has support in (t_0, ∞), with $t_0 \geq 0$. The continuous and non-decreasing functions $\alpha(t)$ and $\beta(t)$ - where at least one of them is strictly increasing - contribute to determine the relative marginal productivity of factors. The optimal *K-intensity* in production, $\theta_i^c(t)$, is

$$\theta_i^c(t) = \left(\frac{\Lambda_i}{\omega^c}\right)^{\sigma} (\varphi(t))^{\sigma-1}, \tag{2}$$

where $\omega^c = w_K^c / w_L^c$, where $\Lambda_i = (1-\lambda_i)/\lambda_i$ and where $\varphi(t) = \beta(t)/\alpha(t)$. To fix ideas and without loss of generality we assume that $\Lambda_Y > \Lambda_Z$. This implies that Y is *K-intensive* (see appendix 6). The rest of the model contains fixed entry costs, fixed production costs, fixed exporting costs, and iceberg trade costs. This gives rise to endogenous entry and export cut off values of t, denoted respectively t_i^{*c} and t_{xi}^{*c}. An 'over-line' ($\bar{\cdot}$) or a 'tilde' ($\tilde{\cdot}$) above a variable indicates, respectively, the simple and power mean of of that variable. The detailed expressions are provided in the appendix. Here, we focus on the results of interest for the empirical investigation.

We begin by defining firm-level *K-intensity.* Let $\kappa = \theta_i^c / \overline{\theta}_i^c$. A firm is *K-intensive* relative the average in the same industry and location if $\kappa > 1$. A firm is *L-intensive* if $\kappa < 1$. We shall use this definition extensively.

Let s_{id}^c, and s_{ix}^c denote, respectively, the demand emanating from domestic residents and from foreign residents for the output of a firm in industry i and location c. Then we can define relative sales, RS_{ij}^c, as follows.

$$RS_{ij}^c = \frac{s_{ij}^c}{\overline{s}_{ij}^c}, \qquad j = d, x. \tag{3}$$

In this class of models, relative sales are proportional to relative marginal costs. Thus, for any firm whose realization of t is such that $\theta_i^c = \kappa \overline{\theta}_i^c$, we can use (1), (2) and the fact that $\theta_i^c / \overline{\theta}_i^c = \varphi_i^c / \widetilde{\varphi}_i^c$ to write (3) as follows:

$$RS_{id}^c = \left[\frac{1 + \Lambda_i^{\sigma}\left(\frac{\widetilde{\varphi}(t_i^c)}{\omega^c}\right)^{\sigma-1}\kappa}{1 + \Lambda_i^{\sigma}\left(\frac{\widetilde{\varphi}(t_i^c)}{\omega^c}\right)^{\sigma-1}}\right]^{\frac{1-\varsigma}{1-\sigma}}. \tag{4}$$

An analogous formula applies to RS_{ix}^c where $\widetilde{\varphi}(t_{xi}^c)$ replaces $\widetilde{\varphi}(t_i^c)$. Inspection of expression (4) tells us the effect of factor prices on relative sales. Consider an increase in ω^c due to immigration. We see that the effect on RS_{ij}^c is positive or negative depending on whether κ is smaller or larger than one. That is:

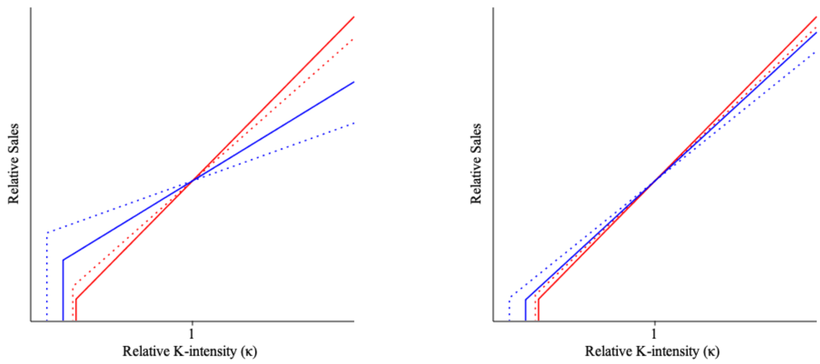
$$\frac{\partial RS_{ij}^c}{\partial \omega^c} \gtreqless 0 \quad \Leftrightarrow \quad \kappa \lesseqgtr 1. \tag{5}$$

To understand this result consider a decline in w_L^c and two firms, one of which is *K-intensive* ($\kappa > 1$) while the other is *L-intensive* ($\kappa < 1$). The decline in w_L^c reduces the marginal cost of both firms but the marginal cost of the *L-intensive* firm falls more strongly because this firm uses intensively the factor whose relative price has declined. As a consequence, sales increase for both firms but sales of the *L-intensive* firm increase more strongly and therefore they increase more than the average. The same result applies of we consider an increase in w_K. Then the marginal cost increases for both but less strongly for the *L-intensive* firms; its relative sale therefore increase. Eq. (4) also shows interaction between factor price changes an industry factor intensity. Recall Z is *L-intensive*. RS_{ij}^c is log-supermodular in (ω^c, Λ_i) for $\kappa > 1$ and log-submodular for $\kappa < 1$:

$$\frac{\partial RS_{Zj}^c}{\partial \omega^c} > \frac{\partial RS_{Yj}^c}{\partial \omega^c} > 0 \quad \Leftrightarrow \quad \kappa < 1 \tag{6}$$

$$\frac{\partial RS_{Zj}^c}{\partial \omega^c} < \frac{\partial RS_{Yj}^c}{\partial \omega^c} < 0 \quad \Leftrightarrow \quad \kappa > 1 \tag{7}$$

This is what we see in Fig. 1a which plots the distribution of relative sales for the two industries and for location m.



(a) RS_{id}^m (b) RS_{ix}^m

Figure 1: Relative Sales

Industry Y is *K-intensive* while Z is *L-intensive* industry. Firms to the left of $\kappa = 1$ are labor intensive relative to the industry average, firms to the right of $\kappa = 1$ are capital intensive relative to the industry average. The solid lines represent the distributions before immigration while the dotted lines represent it after immigration. Relative sales decrease for the *K-intensive* firms and increase for the *L-intensive* firms, which corresponds to expression (5). We also see that the change is stronger for the *L-intensive* industry. This corresponds to the log super- and log sub-modular properties expressed in (6) and (7). Analogous result applying to foreign sales is represented in Fig. 1b.

4 Data

4.1 Sample

In our empirical analysis we exploit different micro datasets obtained from Turkish Statistical Institute. These are Business Register, Annual Survey of Industry and Service Statistics (AISS), and local unit files of AISS. The firm level employment, sales, turnover (revenue), income, investment, amortization value, and wage information come from AISS. Location information comes from two sources Business Register and local unit files of AISS. The number of establishment information of an enterprise comes from local unit files of AISS.

All these micro data files except local unit files of AISS, are at enterprise level which can be formed of several establishments, multi-unit, or just one establishment, single unit. Local unit files of AISS are at establishment level. After aggregating the local unit files at enterprise level, we merge these data files using firm level identification numbers We use local unit files to identify single unit firms. In our panel spanning from 2006-2015 out of 270,960 observations 191,404 are single unit. The rest of the firms have more than one local unit.

Industry classification is based on NACE Rev.2 codes. Although infrequent, some firms are observed to change sector during the time span of our study. This is problematic as we rely on relative sales information to tackle endogeneity. For a given firm, sector switches can result in deflated or inflated numbers of relative values of performance indicators (relative domestic sales and relative exports) for the years in which sectoral categorization shift such that firm is categorized as something different than manufacturing. Therefore, we assign a uniqu e nace code to each firm. Based on this definition 6.6% of the unique NACE code do not match with the original code reported in the data, mostly reported in sectors 25 and 28. Our raw data have 270,960 observations spanning over the period 2006-2015 across 24 NACE Rev.2 2-digit manufacturing sectors. We only drop observations belonging to the upper and lower 2.5 percent of the distribution of the capital intensity variables that we use in our analysis. We have also dropped inconsistent values for relative values for domestic sales and total sales. Table 1 presents the average, mean, minimum, maximum values of the main variables that we use in our empirical investigation across NACE 2-digit sectors.

When testing our predictions, the location information is a key variable as we control city-level immigrant stock in our empirical analysis. The main source of location information is business register which collects this information at the enterprise level for the entire period of our study. However, if the enterprise is multi-unit, the city of the enterprise reported in the data may not be necessarily the location of the production facility which is potentially affected by the immigrants. For example, if the head office is in Istanbul and the textile factory is in Bursa, Business Register may record the location of the factory as Istanbul. In order to this we conduct two additional robustness checks to clarify the location information in the data. As it has been stressed, location information comes from two sources. These are business register and local unit files of AISS. Business Register provides information on the province (NUTS3) of a given enterprise. Local unit files (LUF) also provide location information at province level (NUTS3) but just for the years 2014 and 2015. In our first robustness check, we first aggregate LUF to enterprise level. While doing the aggregation we have assumed that the NUTS3 code of the enterprise is the NUTS3 code of the establishment with highest employment in a given year. When we compare the province level location information coming from BR and local unit files for the years 2014 and 2015 out of 65,475 observations, the city codes do not match for only 5.2% of the observations. This implies that for about 95% of the observations business register correctly reports the location information of the establishment with highest employment level. Our second robustness check is to conduct our empirical investigation based on the sample of single-unit firm observations. This will be discussed in the robustness check section.

Table 1: Descriptive Statistics

	10 - Food products (n=26136)				11 - Beverages (n=1368)			
	min	max	p50	mean	min	max	p50	mean
Ratio (k-intensive)	0.16	0.23	0.19	0.19	0.64	0.80	0.71	0.71
Ratio (single)	0.51	0.60	0.54	0.54	0.46	0.67	0.52	0.56
Ratio (Exporter)	0.29	0.35	0.31	0.31	0.29	0.50	0.40	0.40
CII	0.00	0.00	0.00	0.00	1.00	1.00	1.00	1.00
Relative DS	0.00	5.06	0.01	0.03	0.00	30.95	0.08	0.66
Relative Income	0.00	4.66	0.01	0.03	0.00	30.35	0.08	0.65
	12 - Tobacco products (n=269)				13 - Textiles (n=26949)			
	min	max	p50	mean	min	max	p50	mean
Ratio (k-intensive)	0.36	0.57	0.48	0.48	0.31	0.45	0.35	0.36
Ratio (single)	0.50	0.83	0.73	0.71	0.70	0.74	0.71	0.71
Ratio (Exporter)	0.55	0.96	0.68	0.71	0.43	0.49	0.44	0.45
CII	1.00	1.00	1.00	1.00	0.00	0.00	0.00	0.00
Relative DS	0.00	53.81	0.30	3.83	0.00	3.22	0.01	0.03
Relative Income	0.00	41.58	0.41	3.72	0.00	2.81	0.01	0.03
	14 - Wearing apparel (n=42039)				15 - Leather (n=6013)			
	min	max	p50	mean	min	max	p50	mean
Ratio (k-intensive)	0.00	0.03	0.02	0.02	0.03	0.09	0.04	0.05
Ratio (single)	0.68	0.74	0.73	0.72	0.59	0.72	0.67	0.67
Ratio (Exporter)	0.28	0.42	0.34	0.34	0.41	0.54	0.44	0.45
CII	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Relative DS	0.00	2.55	0.01	0.02	0.00	7.11	0.07	0.15
Relative Income	0.00	2.00	0.01	0.02	0.00	7.86	0.07	0.15
	16 - Wood (n=4285)				17 - Paper paper products (n=5021			
	min	max	p50	mean	min	max	p50	mean
Ratio (k-intensive)	0.40	0.56	0.50	0.48	0.53	0.57	0.54	0.55
Ratio (single)	0.66	0.73	0.70	0.70	0.77	0.83	0.78	0.78
Ratio (Exporter)	0.28	0.41	0.32	0.33	0.56	0.64	0.60	0.60
CII	0.00	0.00	0.00	0.00	1.00	1.00	1.00	1.00
Relative DS	0.00	5.72	0.04	0.10	0.00	8.72	0.05	0.17
Relative Income	0.00	5.95	0.04	0.10	0.00	9.31	0.05	0.17
	18 - Printing (n=3800)				19 - Coke and petroleum (n=593)			
	min	max	p50	mean	min	max	p50	mean
Ratio (k-intensive)	0.39	0.65	0.48	0.51	0.56	0.82	0.69	0.69
Ratio (single)	0.74	0.86	0.81	0.81	0.71	0.83	0.75	0.76
Ratio (Exporter)	0.26	0.36	0.32	0.32	0.36	0.52	0.44	0.43
CII	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Relative DS	0.00	21.84	0.10	0.23	0.00	1.02	0.03	0.08
Relative Income	0.00	20.98	0.10	0.23	0.00	0.84	0.03	0.07
	20 - Chemicals (n=6186)				21 - Pharmaceutical products (n=1212)			
	min	max	p50	mean	min	max	p50	mean
Ratio (k-intensive)	0.50	0.60	0.54	0.55	0.42	0.56	0.50	0.50
Ratio (single)	0.61	0.71	0.63	0.64	0.57	0.66	0.60	0.61
Ratio (Exporter)	0.60	0.70	0.68	0.67	0.61	0.70	0.63	0.65
CII	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Relative DS	0.00	11.30	0.03	0.14	0.00	11.80	0.19	0.77
Relative Income	0.00	13.25	0.03	0.14	0.00	11.02	0.20	0.77

Notes: Ratio represents percentage of observations (as a percentage of total observation in the specified sector) in which firms are categorized as single or k-intensive. CII (=1) represents capital intensive industry. DS represents domestic sales. Relative values are firms' domestic sales and revenues divided by total industry export and sales in year t, respectively. Capital stock has been calculated based on method 1, and capital intensity measure is definition 1.

Table 2: Descriptive statistics

	22 - Rubber and plastic (n=15217)				23 - Other non-met. pr. (n=19764)			
	min	max	p50	mean	min	max	p50	mean
Ratio (k-intensive)	0.32	0.38	0.36	0.36	0.38	0.62	0.50	0.48
Ratio (single)	0.66	0.73	0.70	0.70	0.62	0.72	0.65	0.65
Ratio (Exporter)	0.53	0.61	0.55	0.56	0.27	0.35	0.28	0.30
CII	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Relative DS	0.00	4.88	0.02	0.05	0.00	3.64	0.01	0.04
Relative Income	0.00	4.53	0.02	0.06	0.00	3.43	0.01	0.04
	24 - Basic metals (n=8250)				25 - Fabricated metal pr. (n=24753)			
	min	max	p50	mean	min	max	p50	mean
Ratio (k-intensive)	0.49	0.65	0.57	0.58	0.13	0.19	0.17	0.17
Ratio (single)	0.69	0.81	0.72	0.73	0.72	0.83	0.77	0.77
Ratio (Exporter)	0.39	0.61	0.54	0.52	0.38	0.47	0.44	0.43
CII	1.00	1.00	1.00	1.00	0.00	0.00	0.00	0.00
Relative DS	0.00	10.89	0.01	0.09	0.00	3.91	0.01	0.04
Relative Income	0.00	9.64	0.01	0.09	0.00	3.42	0.01	0.04
	26 - Computer/electronic (n=2519)				27 - Electrical equipment (n=8842)			
	min	max	p50	mean	min	max	p50	mean
Ratio (k-intensive)	0.34	0.55	0.46	0.45	0.37	0.46	0.42	0.42
Ratio (single)	0.71	0.83	0.77	0.78	0.73	0.77	0.73	0.74
Ratio (Exporter)	0.42	0.58	0.47	0.50	0.55	0.63	0.59	0.59
CII	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Relative DS	0.00	43.20	0.03	0.39	0.00	24.85	0.02	0.10
Relative Income	0.00	40.20	0.03	0.39	0.00	25.56	0.01	0.10
	28 - Machinery and equipment (n=18796)				29 - Motor vehicles (n=8289			
	min	max	p50	mean	min	max	p50	mean
Ratio (k-intensive)	0.35	0.44	0.37	0.39	0.41	0.51	0.46	0.46
Ratio (single)	0.75	0.81	0.78	0.77	0.78	0.86	0.81	0.81
Ratio (Exporter)	0.60	0.66	0.62	0.62	0.58	0.65	0.59	0.61
CII	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Relative DS	0.00	8.10	0.02	0.05	0.00	14.42	0.01	0.10
Relative Income	0.00	9.61	0.02	0.05	0.00	17.35	0.01	0.09
	30 - Other transport eq. (n=3040)				31 -Furniture (n=11970)			
	min	max	p50	mean	min	max	p50	mean
Ratio (k-intensive)	0.16	0.39	0.27	0.25	0.02	0.04	0.03	0.03
Ratio (single)	0.82	0.88	0.85	0.85	0.64	0.69	0.67	0.67
Ratio (Exporter)	0.29	0.40	0.33	0.34	0.38	0.50	0.40	0.42
CII	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Relative DS	0.00	25.44	0.04	0.31	0.00	10.97	0.03	0.08
Relative Income	0.00	24.03	0.03	0.31	0.00	10.15	0.03	0.08
	32 - Other manufacturing (n=5863)				33 - Repair and installation (n=6249)			
	min	max	p50	mean	min	max	p50	mean
Ratio (k-intensive)	0.07	0.16	0.12	0.12	0.45	0.51	0.48	0.48
Ratio (single)	0.58	0.72	0.61	0.63	0.80	0.92	0.89	0.88
Ratio (Exporter)	0.40	0.69	0.55	0.55	0.08	0.18	0.13	0.13
CII	0.00	0.00	0.00	0.00	1.00	1.00	1.00	1.00
Relative DS	0.00	43.47	0.04	0.17	0.00	28.98	0.04	0.13
Relative Income	0.00	35.56	0.04	0.16	0.00	31.44	0.03	0.13

Notes: Ratio represents percentage of observations (as a percentage of total observation in the specified sector) in which firms are categorized as single or k-intensive. CII (=1) represents capital intensive industry. DS represents domestic sales. Relative values are firms' domestic sales and revenues divided by total industry export and sales in year t, respectively. Capital stock has been calculated based on method 1, and capital intensity measure is definition 1.

4.2 Variable Definitions

4.2.1 Construction of Capital Stock

To carry out our analysis we construct two different measures of capital stock variable by using the depreciation value and investment data. In the first method we simply calculate capital stock, K, as the ratio between the amortization value, D, and the depreciation rate, d (K=D/d). However, there are missing amortization vales ranging from 12.8 to 44 percent of the observations across NACE sectors. For the missing amortization values we have estimated an imputed amortization value for the firms with missing observations using the size (employment), electricity and energy consumption, and year fixed effects across 2-digit NACE classifications. The firm level correlation between imputed amortization and real amortization values are on average 76.7% in manufacturing sector. In the second method, we construct capital stock using perpetual inventory method described below:

$$K_{i,t+1} = (1-\gamma)K_{i,t} + I_{i,t} \tag{8}$$

where K is capital stock, γ is depreciation and I is investment. In order to construct initial level of capital stock we first assume the depreciation rate as 10%. We generated initial capital stock is equal to the first year the firm reports non-zero amortization ($K_0 = D_0/d$). Then we apply perpetual inventory method described in Eq. 8. For the firms with 0 amortization value for all observations, it's not possible to construct initial level of capital stock. For these firms, as an additional robustness check, we have also created an alternative capital stock measure using imputation. We have imputed capital stock by using capital stock/employment (K/L) ratio of the firms in the same 2-digit industry and size category. We have only imputed capital stock series of the firms which have zero values for all their observations. The results based on the capital stock with imputed capital stock calculated based on method 2 will be discussed in the robustness checks. The rest remain as missing.

4.2.2 Capital Intensitive Firms and Industries

We use two different measures of capital intensity at firm level. These definitions measure capital intensity as capital stock divided by employment and total wage bill, respectively. The employment is the summation of paid and unpaid employment.

Firm is defined as capital intensive if its capital intensity is above the mean value of all sectors' capital intensity in a given year. In this definition a given firm can be both capital and labour intensive during different years. For non-missing values of firm level capital intensity measures almost 75% of the firms don't switch from capital intensive category to labour intensive category and viceversa.[3] Since we use two different measures of capital intensity and two different methods of calculating capital stock firms' capital intensity status might change across these four definitions, too. When we compare the capital

[3] For the first definition of capital intensity (capital stock divided by employment), out of 66,247 firms with capital intensity measure available 49,695 firms do not switch any category based on method 1. For method 2, out of 48,302 firms with capital intensity measure, 39,316 do not switch any category. For the second definition where we define capital intensity as capital stock divided by wages, we have a similar picture.

intensity status of a given firm across these four definitions, in 67% of the observation firm level capital intensity status is same across four definitions. Based on the same capital stock measure (either method 1 or 2) 85% and 87% of the observations are same across 2 definitions of capital intensity, respectively

We depict kernel densities of capital intensities across the 2 digit Nace Rev.2. sectors. Figures x-y present kernel density plots of capital intensity measures based on the two definitions described above. For the capital intensity measures, to control for outliers we drop top 2.5 percent of the observations. [4]. As seen in Figure 2 kernel density plots the capital intensity varies considerably across firms in a given industry. Furthermore, kernels are lognormal.

We apply the same approach to identify capital intensive industries. Our reference value to define industry level capital intensity is set based on yearly averages of capital intensities of the firms belonging to all sectors (manufacturing and non-manufacturing). For a given capital intensity measure, some sectors can switch their capital intensity status across years but this is rare. Across 24 sectors, depending on the definitions of capital intensity and the capital stock measure, between 75 and 100 of of the sectors do not switch status during the period of the study. If a given sector switches status we categorize it as capital or labour intensive based on the average value of its capital intensity dummies. The given sector is capital intensive if the averages of capital intensity dummies are greater than 0.5, and labour intensive if the averages are lower than 0.5. So the sector is defined as capital or labour intensive during the period of our study. Across definitions also, sectoral capital intensities are consistent. When we compare the capital intensity status based on two definitions, 21 sectors out of 24 have the same status based on capital stock measure calculated using method1, while 23 sectors out of 24 have the same status based on the second measure of capital stock.

5 Methodology and Estimation Results

We investigate the impact of migration on firm-level performance indicators using the following specification.

$$Y_{ijt} = \alpha_1 + \alpha_2 R_{it} + \alpha_3 c_i + \alpha_4 T_t + \tau\mu_j + \epsilon_{it} \tag{9}$$

where Y_{ijt} is the relative performance measure calculated at the firm level. Relative performance measure is the relative domestic sales and relative revenues of a given firm with respect to the industry that the firm belongs to. R_{it} stands for the immigration stock in province i which has positive values for the years after 2012. For the years before 2013, immigration stock is equal to zero. In order to deal with time invariant individual unobserved effects we apply fixed effect estimation model. We include dummy variables for time, T_t and for the province c_i , as well as firm fixed effect, μ_j, to control province, time specific, and firm-specific effects that might cause the change in the relative performance measures. In this set up, immigration stock is measured at city level, while relative performance measures, relative domestic sales and revenues are measured at firm-level. Year fixed effects controls time variation, while

[4]The underlying capital stock measure has been calculated using the second method which applies perpetual inventory method with imputations of capital stock by using capital stock/employment (K/L) ratio of the firms in the same 2-digit industry and size category

province fixed effects account for time- invariant differences across cities. The time span for our estimation is 2006-2015 period. Equation 2 has been estimated at firm-level.

In the baseline specification, we are trying to measure within firm variation across time in the relative domestic sales and relative revenues. Our main coefficient of interest is the coefficient of immigration stock (R_{it}). Positive (negative) and significant values of the coefficient α_2 imply that immigration has a positive (negative) impact on the firm level performance measures.

In addition, to account for time variant factors, we estimate three additional different specifications including (i) time trends for 5 regions, (ii) the interactions of 5-region and year-fixed effects, (iii) the interactions of NACE Rev.2 and year-fixed effects. The first specification make it possible to control trends across regions, while the latter two specifications allow calendar year effects to change across regions and two digit NACE Rev.2 sectors.

5.1 Identification strategy for the impact of migration

Factors that potentially cause endogenous location choice for immigrants such as city level living conditions may introduce an endogeneity with respect to the error term. Particularly in the literature on migration and wages there is an issue of endogeneity through omitted variables and simultaneity. The primary reason for endogeneity commonly stressed in the literature is simultaneity between immigration variable and dependent variable as migrants might prefer to live in areas with better living conditions (regional migrant selectivity problem). Another problem stated is that the omitted variables which may be correlated with immigrant location choice. Omitted variables bias occurs becasue for instance, technical progress would influence positively wages and would be correlated with migration via the increased job opportunities. Our dependent variable is relative sales or revenue which is not not correlated with any variable (such as job opportunity) that could influence the location decision of migrants. This strategy make our specification immune to the endogeneity problem. Also, simultaneity problem disappears when we use relative values.

In order to deal with this endogeneity, previous studies adopted a common approach in which as an identification strategy a distance-based instrument has been utilized. For example, Del Carpio and Wagner (2018) constructs an instrument using stock of immigrants, the distances between Turkish regions and Syrian provinces, as well as pre-war population shares of Syrian provinces, while Aksu et al. (2018) construct an identical instrument but uses actual origin-province distribution of the Syrians in Turkey instead of pre-war population distribution of Syrian provinces. On the other hand, Orrenius et al. (2020) use a lagged immigration variable to tackle endogeneity. Time elapsed after the immigration is also important when dealing with endogeneity . During the initial years of migration, Syrian migration has been examined in a quasi-experimental framework with the application of difference in difference type of analysis **?**. In this approach, the forced nature of the migration during the preliminary years of the migration process makes it is possible to treat the location choice of the migrants as exogenous.

In addition, different from previous studies- e.g. Akgündüz et al. (2018), Orrenius et al. (2020), the level of estimationin our analysis is at firm level, therefore simultaneity bias prevalent in province level estimation is less of a concern. In the province level estimations, immigrants may choose their location based on the living conditions of the province. This leads to simultaneity between the number of immigrants and the dependent variable. However, in firm level estimation, refugees are more readily absorbed by firms with more elastic labor demand therefore it's not a matter of preference as in the preference of location.

5.2 Results

The results of our regression analysis are presented in Tables 3a - 4a.. Our dependent variables are relative domestic sales and relative revenue. We have used five different samples in our analysis. The first sample covers all manufacturing firms in the AISS (NACE Rev.2 Sectors between 10-33), second and third sample includes capital and labour intensive firms while fourth and fifth sample include capital intensive firms in capital intensive industries and labor intensive firms in labor intensive industries, respectively. The results presented in the tables are based on capital intensity measure defined as capital stock divided by employment. For the capital stock measure, we use method 1 and method 2 explained in the data section. For method 2, we present results based on capital stock values which do not include imputed values of capital stock.

The baseline regression results are presented in column (1) of corresponding tables. The subsequent columns (2-4) represent additional specifications in which we control for both regional time trends (column 2) as well as year effects across regions (column 3) and sectors (column 4). Results of relative domestic sales based on the all manufacturing sectors sample (3a), finds a statistically significant and negative coefficient of immigration stock with the exception of specification 2 indicating that as the number of Syrian migrant stock increase relative domestic sales declines. The results are robust with respect to the capital stock measures. We further test our theoretical predictions using capital- and labour-intensive firm samples. When we restrict our sample only to capital intensive manufacturing firms (Table 3a), the impact of immigrant stock on domestic sales is negative and significant in all specifications. On the other hand, for the labour-intensive firms, the impact of immigration stock on relative domestic sales is not significant. Another point worth making is that the coefficient of immigrant stock is smaller in the sample including both capital and labour intensive firms than the sample that covers only K- intensive firms (Table 3a). These finding are in line with the predictions of the model. When we look at the results based on the sample restricted to capital intensive firms in capital intensive industries, we report negative and significant coefficients for immigrant stock in parallel to our previous findings. For the sample consisting of labour intensive firms in labour intensive industries regression results on the coefficient of immigration stock do not appear as significant in any of the specifications.

When we look at the results of relative revenue (Table 4a)), the findings are in parallel to the findings of relative domestic sales reported in Table 3a). The immigrant stock has a negative impact on the relative revenues of firms based on the sample covering all manufacturing sectors. When we spilt the sample between capital- and labor-intensive firms, we report negative coefficients for the immigrant stock in all specifications and insignificant but positive coefficients in the sample of labour-intensive firms.

For the relative sales, for the capital intensive firms belonging to capital intensive manufacturing sectors sample, we report significant and negative coefficients for migration stock in all specifications and across the two methods (Table 4a). For the labour intensive firms belonging to labor intensive industries, again we report all insignificant coefficients for the immigrant stock(Table 4a).

Note that becasue of informal employment, the measures of capital intensity, defined as total capital stock divded by employment or wage bill, can assign labour intensive firms as capital intensive as we do not know the real employment or wages (they are reported lower). This is also a factor that implies that our predictions are on the downside.

5.3 Robustness

We further conduct robustness checks using i)only single unit firms in the sample, and ii)using alternative definitions of capital intensity. The results of domestic sales and relative sales based on single unit firms are presented in Tables 3b and **??**. The observation numbers drop approximately 30 percent across the four different samples that we run our regressions. Overall, for the sample consisting only single unit firms the findings are in parallel to the results obtained using all firms although there are lower number of negative and significant coefficients. In addition, for both domestic sales and relative sales, the coefficients appear as insignificant mostly in the other four samples (Table 3b).

As an alternative definition, we define capital intensity as capital stock divided by wages. Based on the second definition the results are weaker. We attribute this finding to the under-reported wages which might potentially categorize labour intensive firms as capital intensive. In the first definition of capital intensity, capital intensity has been measured as capital stock divided by employment which is the summation of both employed and unemployed labour. So, the effect of under-reporting may be less viable in the first definition.

For the capital stock measures calculated based on method 2, we also run an additional robustness check using imputed values of missing observation for capital stock variable. In order to do this, for the firms with 0 amortization value we have imputed an alternative capital stock measure by using capital stock/employment (K/L) ratio of the firms in the same 2-digit industry and size category. We have only imputed capital stock series of the firms which have zero values for all their observations. The results for domestic sales are perfectly in line with our previous findings. We have also observed several positive coefficient for the immigrant stock in the sample covering labour intensive firms based on the second definition of capital intensity (capital stock divided by wages), and labour intensive firms in labour intensive industries based on the first definition of capital intensity (capital stock divided by employment). For the relative sales, the findings are in line with the results across the two definitions of capital intensity.

5.4 Conclusion

In this paper we present firm-level evidence on Turkish manufacturing firms performances to Syrian immigrant flows. Using different sources of microdata on manufacturing firms , our paper contributes to two large aspects of literature, respectively on immigrant impact of firm-level outcomes and endogeneity problem.

Using different specifications and different samples, we document statistically significant and negative coefficient for immigration stock for capital intensive firms implying that as the number of Syrian migrant stock increase both relative domestic sales and revenues decline for the firms in this sample. This is in line with the prediction of our theoretical model. On the other hand, we do not observe any significant coefficients, except few positive and significant in different samples and across different definitions of capital intensity, of migration in the sample of labour intensive firms.

From a policy perspective, significant and negative impact of immigration on capital intensive firms has several implications. Currently, informal employment in Turkey is approximately 31%, corresponding to 9.7 million of workers being almost equally divided in agriculture and non-agricultural sectors. Rising immigration is a factor that intensifies the labour demand in favour of unskilled and non registered labour, a potential drag on the fight against informal economy. Another potential effect could be on productivity dynamics. Turkish productivity has been on a declining trend since the global recession as many other developing countries. The abundance of cheap labour is an incentive for switching across factor inputs as well as industries. Empirically, we partly see this trend as 25% of the firm in our sample switch between capital and labour intensive status. As a result of the availability of unskilled (and cheap labour) there might be tendency to shift lower productivity activities which may deter the productivity statistics further.

Table 3a: Fixed Effect Model: Dependent Variable: Relative Domestic Sales - Manufacturing Firms

Dependent Variable : Relative Domestic Sales

Capital Stock Measure	1	2	3	4
Sample: All Firms				
Method 1	-0.000172**	-7.43e-05	-0.000139*	-0.000204**
	(7.37e-05)	(7.31e-05)	(7.79e-05)	(8.35e-05)
Observations	256,525	256,525	256,525	256,525
R-squared	0.001	0.001	0.001	0.005
Number of id	65,933	65,933	65,933	65,933
Method 2	-0.000186**	-0.000121	-0.000189**	-0.000212**
	(7.65e-05)	(7.61e-05)	(8.16e-05)	(8.64e-05)
Observations	259,279	259,279	259,279	259,279
R-squared	0.001	0.001	0.001	0.005
Number of id	66,020	66,020	66,020	66,020
Sample: Capital Intensive Firms				
Method 1	-0.000790***	-0.000510*	-0.000685**	-0.000828***
	(0.000278)	(0.000284)	(0.000295)	(0.000311)
Observations	72,596	72,596	72,596	72,596
R-squared	0.001	0.002	0.003	0.022
Number of id	26,673	26,673	26,673	26,673
Method 2	-0.00112***	-0.000891**	-0.00111***	-0.00120***
	(0.000384)	(0.000397)	(0.000412)	(0.000447)
Observations	51,407	51,407	51,407	51,407
R-squared	0.002	0.003	0.003	0.020
Number of id	15,035	15,035	15,035	15,035
Sample: Labour Intensive Firms				
Method 1	-1.60e-05	1.02e-05	-1.35e-05	-2.74e-05
	(4.79e-05)	(4.28e-05)	(4.65e-05)	(5.46e-05)
Observations	183,929	183,929	183,929	183,929
R-squared	0.001	0.001	0.001	0.023
Number of id	55,778	55,778	55,778	55,778
Method 2	9.00e-05	8.13e-05	8.24e-05	7.26e-05
	(6.02e-05)	(5.36e-05)	(5.76e-05)	(6.37e-05)
Observations	153,143	153,143	153,143	153,143
R-squared	0.001	0.001	0.002	0.015
Number of id	41,928	41,928	41,928	41,928
Sample: Capital Intensive Firms in Capital Intensive Industries				
Method 1	-0.000992***	-0.000800**	-0.000932**	-0.00100**
	(0.000374)	(0.000384)	(0.000415)	(0.000417)
Observations	48,920	48,920	48,920	48,920
R-squared	0.002	0.002	0.003	0.027
Number of id	17,562	17,562	17,562	17,562
Method 2	-0.00224***	-0.00170**	-0.00213**	-0.00240***
	(0.000763)	(0.000809)	(0.000848)	(0.000891)
Observations	20,828	20,828	20,828	20,828
R-squared	0.002	0.004	0.005	0.015
Number of id	5,466	5,466	5,466	5,466
Sample: Labour Intensive Firms in Labour Intensive Industries				
Method 1	-1.85e-05	-1.40e-05	-7.30e-06	-5.75e-05
	(5.49e-05)	(4.46e-05)	(4.89e-05)	(5.71e-05)
Observations	126,698	126,698	126,698	126,698
R-squared	0.001	0.001	0.001	0.004
Number of id	37,179	37,179	37,179	37,179
Method 2	7.67e-05	5.71e-05	6.44e-05	4.98e-05
	(6.35e-05)	(5.45e-05)	(5.81e-05)	(6.88e-05)
Observations	122,292	122,292	122,292	122,292
R-squared	0.001	0.002	0.002	0.010
Number of id	33,111	33,111	33,111	33,111
Year FE	Yes	Yes	Yes	Yes
City FE	Yes	Yes	Yes	Yes
Local Units	multi	multi	multi	multi
5 Region Linear Time Trends	No	Yes	No	No
5 Region-Year Fixed Effects	No	No	Yes	No
Nace-Year Fixed Effects	No	No	No	Yes

Table 3b: Fixed Effect Model: Dependent Variable: Relative Domestic Sales - Manufacturing Firms

Dependent Variable : Relative Domestic Sales

Capital Stock Measure	1	2	3	4
Sample: All Firms				
Method 1	-0.000149**	-4.17e-05	-0.000143*	-0.000123**
	(6.72e-05)	(7.74e-05)	(8.24e-05)	(5.90e-05)
Observations	181,261	181,261	181,261	181,261
R-squared	0.000	0.001	0.001	0.015
Number of id	58,069	58,069	58,069	58,069
Method 2	-0.000138*	-4.90e-05	-0.000149*	-0.000103
	(7.11e-05)	(7.89e-05)	(8.44e-05)	(6.43e-05)
Observations	182,872	182,872	182,872	182,872
R-squared	0.000	0.001	0.001	0.015
Number of id	58,099	58,099	58,099	58,099
Sample: Capital Intensive Firms				
Method 1	-0.000398*	-0.000124	-0.000339	-0.000218
	(0.000239)	(0.000290)	(0.000290)	(0.000203)
Observations	51,350	51,350	51,350	51,350
R-squared	0.001	0.002	0.003	0.077
Number of id	22,149	22,149	22,149	22,149
Method 2	-0.000584	-0.000269	-0.000559	-0.000322
	(0.000409)	(0.000456)	(0.000459)	(0.000350)
Observations	31,968	31,968	31,968	31,968
R-squared	0.001	0.003	0.004	0.068
Number of id	11,679	11,679	11,679	11,679
Sample: Labour Intensive Firms				
Method 1	-6.36e-05	-2.18e-05	-8.65e-05	-7.21e-05
	(5.15e-05)	(4.41e-05)	(5.71e-05)	(5.27e-05)
Observations	129,911	129,911	129,911	129,911
R-squared	0.001	0.001	0.001	0.010
Number of id	48,038	48,038	48,038	48,038
Method 2	1.76e-05	4.28e-05	5.14e-06	7.25e-06
	(4.36e-05)	(4.50e-05)	(4.78e-05)	(4.19e-05)
Observations	107,085	107,085	107,085	107,085
R-squared	0.002	0.002	0.002	0.019
Number of id	35,482	35,482	35,482	35,482
Sample: Capital Intensive Firms in Capital Intensive Industries				
Method 1	-0.000374	-0.000379	-0.000490	-2.81e-05
	(0.000273)	(0.000372)	(0.000408)	(0.000147)
Observations	35,635	35,635	35,635	35,635
R-squared	0.001	0.001	0.001	0.139
Number of id	15,051	15,051	15,051	15,051
Method 2	-0.00139	-0.000657	-0.00139	-0.000707
	(0.000913)	(0.00111)	(0.00114)	(0.000726)
Observations	12,444	12,444	12,444	12,444
R-squared	0.001	0.006	0.010	0.072
Number of id	4,254	4,254	4,254	4,254
Sample: Labour Intensive Firms in Labour Intensive Industries				
Method 1	-2.51e-05	8.29e-06	-3.68e-05	-3.66e-05
	(6.67e-05)	(5.12e-05)	(7.14e-05)	(6.47e-05)
Observations	87,805	87,805	87,805	87,805
R-squared	0.001	0.001	0.001	0.007
Number of id	32,018	32,018	32,018	32,018
Method 2	-1.41e-05	2.04e-05	-1.46e-05	-2.09e-05
	(2.87e-05)	(3.35e-05)	(3.11e-05)	(2.93e-05)
Observations	85,207	85,207	85,207	85,207
R-squared	0.002	0.002	0.002	0.013
Number of id	28,106	28,106	28,106	28,106
Year FE	Yes	Yes	Yes	Yes
City FE	Yes	Yes	Yes	Yes
Local Units	single	single	single	single
5 Region Linear Time Trends	No	Yes	No	No
5 Region-Year Fixed Effects	No	No	Yes	Yes
Nace-Year Fixed Effects	No	No	No	No

Table 4a: Fixed Effect Model: Dependent Variable: Relative Sales - Manufacturing Firms

Dependent Variable : Relative Sales

Capital Stock Measure	1	2	3	4
Sample: All Firms				
Method 1	-0.000174***	-7.29e-05	-0.000132**	-0.000200***
	(5.81e-05)	(5.24e-05)	(5.59e-05)	(6.67e-05)
Observations	257,179	257,179	257,179	257,179
R-squared	0.001	0.001	0.001	0.007
Number of id	66,016	66,016	66,016	66,016
Method 2	-0.000165***	-0.000105*	-0.000165***	-0.000185***
	(6.07e-05)	(5.74e-05)	(6.15e-05)	(6.84e-05)
Observations	259,922	259,922	259,922	259,922
R-squared	0.001	0.001	0.002	0.007
Number of id	66,102	66,102	66,102	66,102
Sample: Capital Intensive Firms				
Method 1	-0.000757***	-0.000430**	-0.000597***	-0.000764***
	(0.000213)	(0.000195)	(0.000201)	(0.000248)
Observations	72,704	72,704	72,704	72,704
R-squared	0.002	0.004	0.005	0.021
Number of id	26,704	26,704	26,704	26,704
Method 2	-0.00101***	-0.000790***	-0.000987***	-0.00106***
	(0.000300)	(0.000293)	(0.000303)	(0.000339)
Observations	51,501	51,501	51,501	51,501
R-squared	0.003	0.004	0.005	0.023
Number of id	15,058	15,058	15,058	15,058
Sample: Labour Intensive Firms				
Method 1	-8.88e-06	6.29e-06	-1.14e-05	-2.20e-05
	(4.03e-05)	(3.77e-05)	(4.09e-05)	(4.36e-05)
Observations	184,475	184,475	184,475	184,475
R-squared	0.001	0.001	0.001	0.022
Number of id	55,863	55,863	55,863	55,863
Method 2	7.44e-05	6.27e-05	6.44e-05	5.87e-05
	(4.73e-05)	(4.25e-05)	(4.50e-05)	(4.88e-05)
Observations	153,588	153,588	153,588	153,588
R-squared	0.001	0.002	0.002	0.019
Number of id	41,995	41,995	41,995	41,995
Sample: Capital Intensive Firms in Capital Intensive Industries				
Method 1	-0.000806***	-0.000519**	-0.000654**	-0.000768**
	(0.000275)	(0.000252)	(0.000271)	(0.000318)
Observations	48,968	48,968	48,968	48,968
R-squared	0.003	0.004	0.004	0.029
Number of id	17,573	17,573	17,573	17,573
Method 2	-0.00198***	-0.00143**	-0.00178***	-0.00214***
	(0.000578)	(0.000563)	(0.000586)	(0.000668)
Observations	20,854	20,854	20,854	20,854
R-squared	0.003	0.006	0.007	0.020
Number of id	5,467	5,467	5,467	5,467
Sample: Labour Intensive Firms in Labour Intensive Industries				
Method 1	-2.85e-06	-8.77e-06	-3.58e-06	-3.48e-05
	(4.70e-05)	(4.04e-05)	(4.37e-05)	(4.78e-05)
Observations	127,170	127,170	127,170	127,170
R-squared	0.001	0.002	0.002	0.004
Number of id	37,241	37,241	37,241	37,241
Method 2	6.33e-05	3.83e-05	4.53e-05	3.69e-05
	(4.83e-05)	(4.09e-05)	(4.26e-05)	(5.11e-05)
Observations	122,696	122,696	122,696	122,696
R-squared	0.002	0.002	0.002	0.010
Number of id	33,164	33,164	33,164	33,164
Year FE	Yes	Yes	Yes	Yes
City FE	Yes	Yes	Yes	Yes
Local Units	multi	multi	multi	multi
5 Region Linear Time Trends	No	Yes	No	No
5 Region-Year Fixed Effects	No	No	Yes	No
Nace-Year Fixed Effects	No	No	No	Yes

Table 4b: Fixed Effect Model: Dependent Variable: Relative Sales - Manufacturing Firms

Dependent Variable : Relative Sales

Capital Stock Measure	1	2	3	4
Sample: All Firms				
Method 1	-0.000148***	-4.30e-05	-0.000127**	-0.000141***
	(5.30e-05)	(5.29e-05)	(5.65e-05)	(5.41e-05)
Observations	181,739	181,739	181,739	181,739
R-squared	0.001	0.001	0.001	0.008
Number of id	58,156	58,156	58,156	58,156
Method 2	-0.000106*	-2.48e-05	-0.000103*	-8.96e-05
	(5.71e-05)	(5.53e-05)	(5.92e-05)	(5.84e-05)
Observations	183,340	183,340	183,340	183,340
R-squared	0.001	0.001	0.002	0.009
Number of id	58,184	58,184	58,184	58,184
Sample: Capital Intensive Firms				
Method 1	-0.000411**	-0.000115	-0.000305	-0.000333
	(0.000185)	(0.000190)	(0.000187)	(0.000210)
Observations	51,431	51,431	51,431	51,431
R-squared	0.001	0.004	0.005	0.043
Number of id	22,177	22,177	22,177	22,177
Method 2	-0.000427	-0.000134	-0.000351	-0.000361
	(0.000325)	(0.000318)	(0.000318)	(0.000349)
Observations	32,035	32,035	32,035	32,035
R-squared	0.002	0.005	0.007	0.045
Number of id	11,700	11,700	11,700	11,700
Sample: Labour Intensive Firms				
Method 1	-5.47e-05	-2.64e-05	-7.77e-05	-6.62e-05
	(4.37e-05)	(4.03e-05)	(5.03e-05)	(4.45e-05)
Observations	130,308	130,308	130,308	130,308
R-squared	0.001	0.001	0.001	0.009
Number of id	48,123	48,123	48,123	48,123
Method 2	6.92e-06	2.71e-05	-4.76e-06	-2.14e-06
	(3.42e-05)	(3.73e-05)	(3.91e-05)	(3.35e-05)
Observations	107,395	107,395	107,395	107,395
R-squared	0.002	0.002	0.002	0.017
Number of id	35,549	35,549	35,549	35,549
Sample: Capital Intensive Firms in Capital Intensive Industries				
Method 1	-0.000240	-0.000128	-0.000234	-2.57e-05
	(0.000180)	(0.000213)	(0.000234)	(0.000155)
Observations	35,674	35,674	35,674	35,674
R-squared	0.001	0.002	0.002	0.081
Number of id	15,063	15,063	15,063	15,063
Method 2	-0.00110*	-0.000300	-0.000767	-0.000941
	(0.000654)	(0.000656)	(0.000641)	(0.000730)
Observations	12,459	12,459	12,459	12,459
R-squared	0.004	0.012	0.016	0.044
Number of id	4,256	4,256	4,256	4,256
Sample: Labour Intensive Firms in Labour Intensive Industries				
Method 1	-2.90e-05	-1.05e-05	-4.60e-05	-3.79e-05
	(5.36e-05)	(4.16e-05)	(5.74e-05)	(5.14e-05)
Observations	88,137	88,137	88,137	88,137
R-squared	0.001	0.001	0.001	0.006
Number of id	32,080	32,080	32,080	32,080
Method 2	-1.68e-05	7.30e-06	-2.05e-05	-2.43e-05
	(2.56e-05)	(2.92e-05)	(2.76e-05)	(2.60e-05)
Observations	85,485	85,485	85,485	85,485
R-squared	0.002	0.002	0.002	0.011
Number of id	28,160	28,160	28,160	28,160
Year FE	Yes	Yes	Yes	Yes
City FE	Yes	Yes	Yes	Yes
Local Units	single	single	single	single
5 Region Linear Time Trends	No	Yes	No	No
5 Region-Year Fixed Effects	No	No	Yes	No
Nace-Year Fixed Effects	No	No	No	Yes

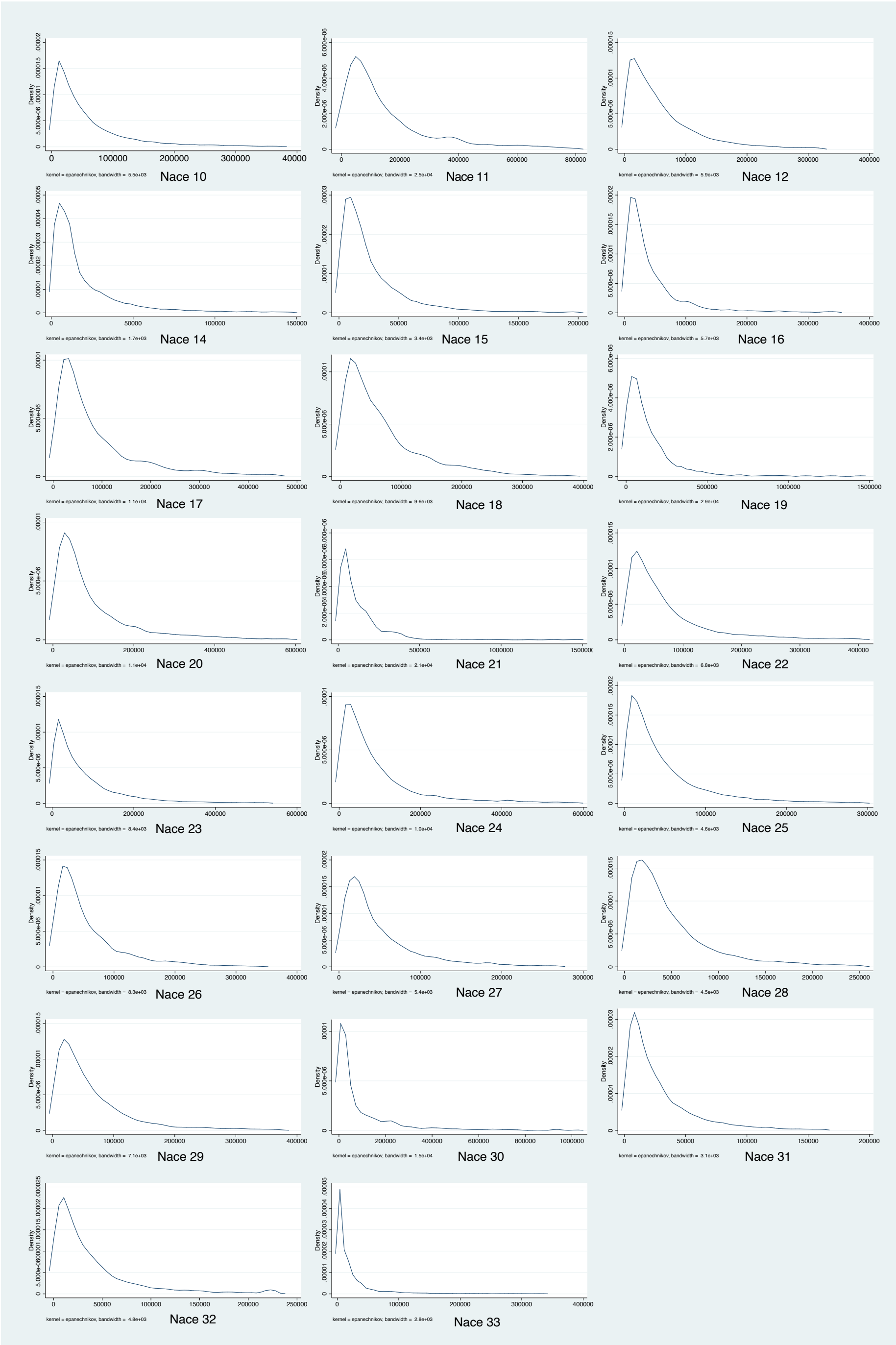


Figure 2: Kernel Density Plots (Capital Intensity=K/employment)

6 Appendix

In the text we have presented the setting of the model, the variable input technology, and consumer preferences. This appendix completes the description of the model and derives the results.

Averages. The average values of $\alpha(t)$, $\beta(t)$, and $\varphi(t)$ are:

$\widetilde{\alpha}_i^c = \left(\frac{1}{1-G\left(t_i^{*c}\right)} \int_{t_i^{*c}}^{\infty} \alpha(t)^{\sigma-1} dG \right)^{\frac{1}{\sigma-1}}$,

$\widetilde{\beta}_i^c = \left(\frac{1}{1-G\left(t_i^{*c}\right)} \int_{t_i^{*c}}^{\infty} \beta(t)^{\sigma-1} dG \right)^{\frac{1}{\sigma-1}}$,

$\widetilde{\varphi}_i^c = \left(\frac{1}{1-G\left(t_i^{*c}\right)} \int_{t_i^{*c}}^{\infty} \varphi^{1-\sigma} dG \right)^{\frac{1}{1-\sigma}}$.

The average marginal cost and the average *K-intensity* in industry i of location c are defined respectively as $\widetilde{mc}_i^c = \left\{ \frac{1}{1-G\left(t_i^{*c}\right)} \int_{t_i^{*c}}^{\infty} \left(mc_i^c\right)^{1-\sigma} dG \right\}^{\frac{1}{1-\sigma}}$ and $\overline{\theta}_i^c = \frac{1}{1-G\left(t_i^{*c}\right)} \int_{t_i^{*c}}^{\infty} \theta_i^c\left(t\right) dG$. Then, we have

$$\widetilde{mc}_i^c = \left[(\lambda_i)^\sigma \left(w_L^c\right)^{1-\sigma} \left(\widetilde{\alpha}_i^c\right)^{\sigma-1} + (1-\lambda_i)^\sigma \left(w_K^c\right)^{1-\sigma} \left(\widetilde{\beta}_i^c\right)^{\sigma-1} \right]^{\frac{1}{1-\sigma}} \quad (10)$$

$$\overline{\theta}_i^c = \left(\frac{\Lambda_i}{\omega^c}\right)^\sigma \left(\widetilde{\varphi}_i^c\right)^{\sigma-1} \quad (11)$$

For further reference note that $\widetilde{mc}_i^c = mc_i^c\left(\widetilde{\alpha}_i^c, \widetilde{\beta}_i^c\right)$ and that $\overline{\theta}_i^c = \theta\left(\widetilde{\varphi}_i^c\right)$. Analogous formulas where $\widetilde{\varphi}(t_{xi}^{*c})$ replaces $\widetilde{\varphi}(t_i^{*6c})$ apply to $\widetilde{\alpha}_{ix}^c$, $\widetilde{\beta}_{ix}^c$, $\widetilde{\varphi}_{ix}^c$, $\widetilde{mc}_{ix}^c$, and $\overline{\theta}_{ix}^c$.

Fixed costs. Assuming that the fixed input technology is homogeneous or that it is heterogeneous gives qualitatively the same results. We assume homogeneous fixed costs since this assumption allows focusing on heterogeneity in the production process (which is the heart of the matter). This is the assumption most commonly retained in the literature (Melitz, 2003; Bernard, Redding and Schott, 2007; and many others). Specifically we assume that the fixed input technology is represented by the cost function $\widetilde{mc}_i^c$ described in equation (10). Thus, the fixed production cost is $F_i\widetilde{mc}_i^c$ where F_i is a positive constant. This assumption represents the fixed input as a homogenous, non-traded, composite good produced in a perfectly competitive market by assembling in a CES all varieties of the domestic industry output (similarly to Ethier, 1980). But it may also be interpreted as in Yeaple (2005) who assumes that the fixed cost is represented by output that must be produced by the firm and that ultimately cannot be sold; with the difference that in our model this output requires a unit cost function $\widetilde{mc}_i^c$. Analogously to fixed production cost, the fixed entry cost is $F_{ie}\widetilde{mc}_i^c$ and the fixed exporting cost is $F_i\widetilde{mc}_{ix}^c$, where F_{ie} and F_{ix} are positive constants. These assumptions have the convenient property that the average factor intensity in production of output is the same as in the production of the fixed input. Then the average factor intensity in the industry is independent of the scale of the industry. This assures no (average) factor intensity reversal and makes the ranking of industry factor intensity entirely determined by the ranking of Λ_i.

Demand. Given consumer preferences described in the text the demand emanating from domestic residents, s_{id}^m, and from foreign residents, s_{ix}^m for the output of a firm in industry i of location m is:

$$s_{id}^m(t) = \left(\frac{p_{id}^m(t)}{P_i^H}\right)^{1-\varsigma} \gamma_i I^H, \qquad s_{ix}^m(t) = \left(\frac{p_{ix}^m(t)}{P_i^F}\right)^{1-\varsigma} \gamma_i I^F, \tag{12}$$

where $p_{id}^m(t)$ and $p_{ix}^m(t)$ are prices and P_i^H is the price index. The absence of internal trade costs makes that consumers in the same country face the same prices and the same price index regardless of the location. Analogous functions obtain for the other locations. Total firm sales are represented by $s_i^c(t) = s_{id}^c(t) + s_{ix}^c(t)$.

Profit maximization and zero profit. With monopolistic competition and under the large-group assumption, the profit-maximising prices for the domestic and the foreign market are:

$$p_{id}^c(t) = \frac{\varsigma}{\varsigma - 1} mc_i^c(t), \quad p_{ix}^c(t) = \frac{p_{id}^c}{\tau} \tag{13}$$

The notation $mc_i^c(t)$ reminds us that firms with different t have different marginal costs; they therefore apply different prices and will obtain different sales. Indeed, for any two firms with draws t' and t'' the relative sales are

$$\frac{s_{ij}^c(t')}{s_{ij}^c(t'')} = \left[\frac{mc_i^c(t')}{mc_i^c(t'')}\right]^{1-\varsigma}, \qquad j = d, x. \tag{14}$$

By paying the fixed entry cost, a firm draws randomly the value of t. At any point in time has a probability of death that, without loss of generality, we set equal to 1. This is equivalent to say that firms live for one instant. After drawing t the firm stays in the market if the expected realization of profits is non negative and exits otherwise.[5] Firm's profit in each market may be written as $\pi_{id}^c(t) = s_{id}^c(t)/\varsigma - F_i\widetilde{mc}_i^c$ and $\pi_{ix}^c(t) = s_{ix}^c(t)/\varsigma - F_{ix}\widetilde{mc}_i^c$, from which we obtain the zero profit conditions

$$s_{id}^c(t_i^{*c}) = \varsigma F \widetilde{mc}(t_i^{*c}), \tag{15}$$

$$s_{ix}^c(t_{ix}^{*c}) = \varsigma F \widetilde{mc}(t_{ix}^{*c}). \tag{16}$$

Aggregation. Applying equations (14) and (15) to $s_{id}^c(t)/s_{id}^c(t_i^{*c})$ gives domestic sales of any firm as function of the cut off value t_i^{*c}; that is: $s_{id}^c(t) = \left[\frac{mc_i^c(t)}{mc(t_i^{*c})}\right]^{1-\varsigma} \varsigma F \widetilde{mc}_i^c$. From this expression we obtain the average domestic sales defined as $\overline{s}_{id}^c = \frac{1}{1-G(t_i^{*c})}\int_{t_i^{*c}}^{\infty} s_i^c(t)dG$. Applying the same procedure to foreign sales we finally

[5]Given that $G(t)$ and that the probability of death are constant over time, it is irrelevant for the equilibrium value of the endogenous variables whether the firm decides to stay on the basis of expected profit or the basis of actual (instant) profit.

obtain

$$\bar{s}_{id}^{c} = \left[\frac{\widetilde{mc}_i^c(t_i^{*c})}{mc(t_i^{*c})}\right]^{1-\varsigma} \varsigma F \widetilde{mc}_i^c(t_i^{*c}), \tag{17}$$

$$\bar{s}_{ix}^{c} = \left[\frac{\widetilde{mc}_i^c(t_{ix}^{*c})}{mc(t_{ix}^{*c})}\right]^{1-\varsigma} \varsigma F_x \widetilde{mc}_i^c(t_i^{*c}). \tag{18}$$

Computing the average domestic and foreign profit in industry i of country c we obtain

$$\bar{\pi}_{id}^{c} = \left[\frac{\bar{s}_{id}^{c}}{\varsigma} - F \widetilde{mc}_i^c(t_i^{*c})\right], \tag{19}$$

$$\bar{\pi}_{ix}^{c} = \left[\frac{\bar{s}_{ix}^{c}}{\varsigma} - F_x \widetilde{mc}_i^c(t_i^{*c})\right]. \tag{20}$$

Average total profit is $\bar{\pi}_i^c = \bar{\pi}_{id}^c + \chi_i^c \bar{\pi}_{ix}^c$. Using profit-maximizing prices we compute the average domestic price, the average export price and the price indices:

$$\widetilde{p}_{id}^{c} = \frac{\varsigma}{\varsigma - 1} \widetilde{mc}_i^c, \qquad \widetilde{p}_{ix}^{c} = \frac{\varsigma}{\varsigma - 1} \widetilde{mc}_{ix}^c, \tag{21}$$

$$P_i^H = \left[M_i^m \left(\widetilde{p}_{id}^m\right)^{1-\varsigma} + M_i^n \left(\widetilde{p}_{id}^n\right)^{1-\varsigma} + \chi_i^c M_i^F \left(\widetilde{p}_{ix}^H\right)^{1-\varsigma}\right]^{\frac{1}{1-\varsigma}}, \tag{22}$$

$$P_i^F = \left[\chi_i^m M_i^m \left(\widetilde{p}_{ix}^m\right)^{1-\varsigma} + \chi_i^n M_i^n \left(\widetilde{p}_{ix}^n\right)^{1-\varsigma} + M_i^F \left(\widetilde{p}_{id}^F\right)^{1-\varsigma}\right]^{\frac{1}{1-\varsigma}}, \tag{23}$$

where M_i^c is the mass of firms in industry i of location c.

General Equilibrium. In addition to profit-maximising prices and to the zero profit conditions discussed above, there are five additional sets of equilibrium conditions. First, stationarity of the equilibrium requires the mass of potential entrants, M_{ei}^c, to be such that at any instant the mass of successful entrants, $[1 - G(t_i^{*c})] M_i^c$ equals the mass of incumbent firms who die, M_i^c:

$$[1 - G(t_i^{*c})] M_{ei}^c = M_i^c. \tag{24}$$

Second, free entry ensures that the expected benefit from entry equals the entry cost:

$$[1 - G(t_i^{*c})] \bar{\pi}_i^c = F_e \widetilde{mc}_i^c\ . \tag{25}$$

The left-hand-side is the present value - prior to entry - of the expected profit and the right-hand-side is the entry cost.

Third, we need to ensure goods market equilibrium. Computing the average demand from (12) we see that average demand is equivalent to replacing the average price into the demand function. This allows writing the goods market equilibrium equations as follows:

$$\bar{s}_{ij}^c = s_{ij}^c\left(\widetilde{p}_{ij}^c\right) \qquad c = m, n, F; \qquad j = d, x. \tag{26}$$

Fourth, equilibrium in factor market requires that total factor demand, denoted L_i^c and K_i^c, be equal to factor supply

$$L_Y^c + L_Z^c = L^c, \qquad c = m, n, F \tag{27}$$

$$K_Y^c + K_Z^c = K^c \qquad c = H, F. \tag{28}$$

After replacing equations (17)-(23) into (25)-(28) we can count equations and unknowns as a preliminary check. We count 17 independent equilibrium conditions and 18 endogenous variables. The equations are the six free-entry conditions (25), any five out of the six goods market equilibrium conditions (26), and the six factor market equilibrium (27)-(28). The endogenous are three $\{t_i^{*c}\}$, three $\{t_{ix}^{*c}\}$, six $\{w_L^c, w_H^c\}$ and six $\{M_i^c\}$. The equilibrium value of all other endogenous variables can be computed from these. The choice of a numéraire makes the model determined.

Factor abundance and factor price. In our model, the standard negative relationship between relative factor abundance and relative factor price holds. Thus, immigration of L for any given K reduces the relative price of L:

$$\frac{d\omega^c}{dL^c} < 0 \tag{29}$$

Numerical simulations show this unequivocally. After all, this result is intuitive since our model structure has the property of no (average) factor intensity reversal.

References

Akgündüz, Y. E., M. van den Berg, and W. Hassink (2018). The impact of the syrian refugee crisis on firm entry and performance in turkey. *The World Bank Economic Review 32*(1), 19–40.

Aksu, E., R. Erzan, and M. G. Kirdar (2018). The impact of mass migration of syrian on the turkish labor market.

Altındağ, O., O. Bakış, and S. V. Rozo (2020). Blessing or burden? impacts of refugees on businesses and the informal economy. *Journal of Development Economics 146*, 102490.

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

Brown, J. D., J. L. Hotchkiss, and M. Quispe-Agnoli (2013). Does employing undocumented workers give firms a competitive advantage?*. *Journal of Regional Science 53*(1), 158–170.

Brücker, H., A. Hauptmann, E. J. Jahn, and R. Upward (2014). Migration and imperfect labor markets: Theory and cross-country evidence from denmark,germany and the uk. *Journal of International Economics 66*, 205–225.

Card, D. (1990). The effect of immigration along the distribution of wages. *Industrial and Labor Relations Review 43*(2), 245–257.

Card, D. (2001). Immigrant inflows, native outflows, and the local labor market impacts of higher immigration. *Journal of Labor Economics 19*(1), 22–64.

Card, D. (2009). Immigration and inequality. *The American Economic Review 99*(2), 1–21.

Ceritoglu, E., H. B. G. Yunculer, H. Torun, and S. Tumen (2017). The impact of syrian refugees on natives'labor market outcomes in turkey: evidence from a quasi-experimental design. *IZA Journal of Labor Policy 6*(1), 5.

Del Carpio, X. V. and M. Wagner (2018). The impact of syrian refugees on the turkish labor market.

Dustmann, C., T. Frattini, and I. P. Preston (2013). The effect of immigration along the distribution of wages. *The Review of Economic Studies 80*(1), 145–173.

Dustmann, C., U. Schönberg, and J. Stuhler (2016). The impact of immigration: Why do studies reach such different results? *The Journal of Economic Perspectives 30*(4), 31–56.

Manacorda, M., A. Manning, and J. Wadsworth (2012). The impact of immigration on the structure of wages: Theory and evidence from britain. *Journal of the European Economic Association 10*(1), 120–151.

Olney, W. W. (2013). Immigration and firm expansion*. *Journal of Regional Science 53*(1), 142–157.

Orrenius, P. M., M. Zavodny, A. Abraham, et al. (2020). The effect of immigration on business dynamics and employment. Technical report.

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

Tumen, S. (2016). The economic impact of syrian refugees on host countries: Quasi-experimental evidence from turkey. *The American Economic Review 106*(5), 456–460.