Immigration and investment: some theory and evidence on Italian firm level data

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Abstract

The aim of this paper is to assess the impact of immigration in Italian cities on the investment decisions by firms. First, we present a theoretical model which shows, in a partial equilibrium monopolistic competition framework, how firms endogenously respond to the skill level of their workforce by changing their investment decisions. Second, we test the predictions of the model in a sample of Italian manufacturing firms. We find that on average a larger immigrant inflow, computed at provincial level, increases firms' investment rate in machineries. Our finding is robust to endogeneity concerns. Immigration increases the probability to make large investments while small firms and more competitive sectors react to the availability of foreign workers by accumulating relatively more capital.

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1 Introduction

In the last 15 years immigration to Italy has significantly intensified. The share of foreign born population, smaller than 1 per cent in 1991, reached 5.1 percent sixteen years later. This figure, comparable to that of the most industrialized countries, makes Italy rank third after the US and the UK among the main destination countries of immigration (OECD, 2007). As Borjas (1994) points out, large inflows of immigrants, especially from less developed economies, usually draw the attention of scholars and policy makers on the absorbing capacity of an economy. Immigration inflows are indeed seen as a true supply shift of (allegedly) unskilled workers, which in turn should affect the relative scarcity of each educational group and, thus, the economic conditions of both skilled and unskilled native workers in the destination country.

Along these lines a number of empirical studies for the US and Europe tried to quantify the effects of immigration on native workers' employment opportunities (Okkerse, 2008, for a recent and comprehensive review). The majority of these studies have failed to find any significant effect of immigration on both wages and employment rates.[1] This finding is quite surprising in a neoclassical world with downward sloped labor demand curves, even in presence of nominal factor price rigidities. D'Amuri and Pinotti (2008) preliminarily confirm these results for Italy. [2]

The literature has advanced two lines of explanations for this somewhat surprising evidence. A first one (Peri and Sparber (2008)) relies on some form of labor segmentation. Using occupational task-intensity data, they show that foreign-born workers specialize in occupations that require manual and physical labor skills, while natives pursue jobs more intensive in communication and language tasks.

Other scholars have searched for immigration-compensating changes at the sector or firm-level productive structure. The basic idea is that an exogenous immigration-induced increase in the availability of low skilled workers could cause a shift toward more low skill intensive productions: this can occur with a reallocation of resources toward sectors that make a more

[1] While some complementarity between low-skilled immigrant and high-skilled native workers seems to be at work (Ottaviano and Peri, 2006; Ottaviano and Peri, 2008), economists generally find that unskilled wages and employment opportunities seem insensitive to large inflows of immigrants workers.

[2] Interestingly, it holds for countries with very different degrees of labor market rigidity like Germany, US and UK; For US cities, Card (2007) shows that the impact of immigrant arrivals has not been offset by outflows of natives and earlier generations of immigrant.

intense use of low skilled labor force (between sectors effect) or toward firms whose technology is more intensive of low skilled workers (within sector-between firms effect) or at the firm-level, with a shift toward productions or technologies that are more intensive in low skilled workers (within firm effect). Dustmann and Glitz (2007) provide a precise disaggregation of such adjustment mechanisms.

Empirical evidence quite neatly rejects the between sector hypothesis.[3] Lewis (2004) for the US, Dustmann and Glitz (2007) for Germany, and Gandal, Hanson and Slaughter (2004) for Israel find that there is no significant change in the output mix in response to a greater availability of immigrants. Interestingly, this result holds for both skilled (in Israel) and unskilled immigration (US, Germany).

The within sector hypothesis is similar in nature to the Skill Biased Technological Change argument (SBTC, Acemoglu, 2002; Beaudry and Green, 2003; Beaudry and Green, 2005). As innovatively conjectured by these papers, the technical change may have been in part an endogenous response to the growing availability of more (or less, in the immigration case) educated workers. International evidence of SBTC for immigration has received some empirical support. Looking at low-skilled Mexican immigration in the US, Lewis (2004) and Card and Lewis (2005) show that most of the increases in the relative supply of low education labor has been absorbed by changes in skill intensity within narrowly defined industries, that is to say through a more intense use of low skill intensive technologies. According to Gandal et al. (2004), the high-skilled Russian immigration had an analogous effect, but of opposite sign, in Israel with a shift toward more skill intensive productions.

Evidence at firm level of this phenomenon is provided by Lewis (2005) and Dustmann and Glitz (2007). Lewis (2005) relates low-skilled immigration in US metropolitan areas, used as instrument for high school dropouts, with the use of automation technologies and find a negative causal impact of the former on the latter. This is to say that firms "downgrade" their technologies when the relative supply of low skilled workers (exogenously) increases. Using a German matched employer-employee dataset Dustmann and Glitz (2007) suggests that the technological adjustment is due to the within firm component: factor intensities (defined for labor force only), indeed, shift toward a relative more intense use of low skilled workers. Such

[3]The between sectors explanation is theoretically well-grounded into the Hecksher-Olin model of trade that suggests that shifts in the relative supply of unskilled labor can be absorbed by a change in industry composition with an expansion of low-skill-intensive industries and no change in relative wages of unskilled workers.

an effect is mostly due to firms in tradable industries.

Our paper complement the analysis by Dustmann and Glitz (2007) on changes in skill intensities by looking at adjustment in capital intensity. First, we present a partial equilibrium monopolistic competition model, in which firms endogenously respond to the downgrading of the skill level of their workforce by changing their investment in machineries decisions. The model shows that investment rates rise in response to immigration flows whenever capital accumulation is able to significantly compensate the increase of workers' inefficiency and, thus, rise the firm's profits. Second, we empirically investigate the impact of low skilled immigration on machinery investment in a sample of Italian manufacturing firms over the period 1996-2006. As compared to Lewis (2005), who looks at categorical variables on the use of automation technologies, our focus on investment in machinery aims at addressing the impact of immigration from a more general and pervasive perspective. The richness of our dataset (the Survey of Italian Industrial Firms collected by the Bank of Italy, SIM) allows to control for other many firm-level variables that are relevant for the investment activity and might be correlated with demand for immigrant workers. In line with the papers cited above, we measure the growth rate in the share of immigrants at provincial level and, to minimize endogeneity concerns, we instrument it by using a variable based on ethnic enclaves in 1990; to capture immigration for emerging markets, we consider the first 20 developing countries with the higher number of immigrants in 1990.[4]

Controlling for provincial location, industry and year, our econometric evidence indicates that an increase in the share of low-skilled immigrants has a positive impact on investment in machinery; the probability to make a large investment is higher when firms locate in a province with a more intensive inflow of unskilled immigrants. This result is larger for small firms and less technologically intensive industries. The remainder of the paper is organized as follows. The next three sections illustrate the theoretical model, the empirical specification and the data, respectively. Section 5 presents the results. Section 6 deals with heterogeneity across sectors and firm size. The last section concludes.

[4]These countries were Egypt, Iran, Romania, Argentina, Poland, Ethiopia, Nigeria, Serbia, Albania, Philippines, Brazil, Pakistan, India, Tunisia, Sri Lanka, Morocco, Ghana, China, Senegal, Somaliland.

2 The theoretical model

In this section we provide some theoretical guidance to the empirical analysis, by sketching a simple partial equilibrium model to fix the way we think about the relation between immigration and investment, which works through the skill content of immigration.

Demand structure – Consumers preferences are represented by the following utility function:

$$U = Z + \alpha \ln Q \tag{1}$$

where Z is an homogenous good (which will be taken as *numeraire*) and $Q = \left(\int_0^N q_i^{(\sigma-1)/\sigma} di \right)^{\sigma/(\sigma-1)}$ is the usual Dixit-Stiglitz aggregate, with $\sigma > 1$.

Standard utility maximization yields

$$Z = E - \alpha \tag{2}$$

$$Q = \frac{\alpha}{P}, P = \left[\int_0^N P_i^{1-\sigma} \right]^{\frac{1}{1-\sigma}} \tag{3}$$

$$q_j = \alpha p_j^{-\sigma} P^{\sigma-1} \tag{4}$$

where E is expenditure.

Supply structure – There is a mass N of heterogenous profit maximizing firms in the differentiated sector. We will assume that there is no free entry, so firms can make positive profits. Each firm maximizes the following profit function:

$$\pi_j = (p_j - c_j) q_j \tag{5}$$

where c_j is the marginal cost. Standard profit maximization leads to:

$$p_j = \frac{\sigma}{\sigma - 1} c_j \tag{6}$$

$$q_j = \frac{\alpha}{P^{1-\sigma}} \left(\frac{\sigma - 1}{\sigma} \right)^{\sigma} c_j^{-\sigma} \tag{7}$$

$$\pi_j = \frac{\alpha}{P^{1-\sigma}} \frac{(\sigma-1)^{\sigma-1}}{\sigma^{\sigma}} c_j^{-\sigma} = \frac{\alpha}{\sigma \int_0^N c_i^{1-\sigma} di} c_j^{-\sigma} = A c_j^{-\sigma} \tag{8}$$

Technology – Each firm has the following production function:

$$Q = a_j(K) \left\{ (\beta L)^{\frac{\theta-1}{\theta}} \left[(1-\beta) b_F L \right]^{\frac{\theta-1}{\theta}} \right\}^{\frac{\theta}{\theta-1}} \tag{9}$$

where L is labor employed, β is the share of native worker in the province labor force, $b_F < 1 = b_N$ is a discount factor to account that the skill level of a foreign worker is smaller than the one of a native, $a(K_j)$ is the technological set available for the workers, which depends on the firm specific level of K_j. $a_j(\cdot)$ is such that $a(K_j) > 1$, $a' > 0$, $a'' < 0$ and whenever K increase to K', $a(K'_j) = a(\gamma)a(K_j)$.

Marginal cost to produce is

$$c_j = \frac{w}{a(K_j)b} \tag{10}$$

where w is the wage paid to workers and b is the average skill level in the province, which can be expressed as

$$b = \left\{ \beta^{\frac{\theta-1}{\theta}} + \left[(1-\beta)b_F\right]^{\frac{\theta-1}{\theta}} \right\}^{\frac{\theta}{\theta-1}}. \tag{11}$$

For the sake of simpler algebra w is equal for all workers in the economy. Since our workers have the same job qualification and they can only differ by their type, this amounts to suppose that firms cannot observe the type of the worker (whether he or she is skilled or not), the status of immigrant is a noisy signal for the worker's type and there is central bargaining for all workers. For the model to to go through, anyway, we only need the wage to be firm specific, that is two firms can pay different wages (since we are in partial equilibrium) but a firm needs to pay all of its workers the same wage. This latter assumption is supported by empirical evidence: in the Italian labor market the natives-immigrants wage gap is mostly accounted by *i)* sectoral composition and *ii)* between firm wage differences due to productivity differences (Brandolini, Cipollone and Rosolia, 2005).

The imperfect information about immigrants workers' skills also implies that the skill distribution of the labor force within the firms mirrors the skill distribution of the local labor market. That is, it is as if the firm, being unable to discriminate workers by their (apriori unobservable) skill, just picks up each worker from the entire distribution.[5] This implies that: i) the average quality of each firm's labor force is equal for all firms in the same local labor market; ii) it equals b; and iii) it depends on the same local labor market specific β. Note that b is non linear in β, but $\partial b/\partial\beta$ approaches 1 for β converging to 1, which implies that for a large share of natives the average skill of a firm is increasing in the share of natives.

[5] Alternatively it can be supposed that sizeable search costs prevent firms from engaging in a thorough search process.

Technological change – Suppose that a firm decides to increase its production capacity, that is to increase its capital stock. This can be done at a cost of a linear adjustment cost ϕ.[6]

When choosing their capita stock firms maximize marginal profit they reap from accumulating more capital stock, that is the following gain

$$\pi(K'_j) - \pi(K_j) = G(\gamma) = a(K)^\sigma A \left(\frac{b}{w}\right)^\sigma [a(\gamma)^\sigma - 1] - \phi(\gamma - 1) \tag{12}$$

$$\text{where} \quad K' = \gamma K, \quad K' > K \tag{13}$$

$$\text{and} \quad a(K') = a(K)a(\gamma). \tag{14}$$

The first order condition is

$$a(K)^\sigma \sigma A \left(\frac{b}{w}\right)^\sigma a(\gamma)^{\sigma-1} a'(\gamma) = \phi. \tag{15}$$

Supposing from now on that $a(K) = K^\rho$, $\rho \in (0,1)$ implies

$$\sigma A \left(\frac{b}{w}\right)^\sigma \gamma^{\rho(\sigma-1)} \rho \gamma^{\rho-1} K^{\rho\sigma} = \phi. \tag{16}$$

$$\gamma^* = \left[\frac{\phi}{\rho\sigma A}\left(\frac{w}{b}\right)^\sigma \frac{1}{K^{\rho\sigma}}\right]^{\frac{1}{\rho\sigma-1}} \tag{17}$$

Recall that $\gamma^* - 1$ is the theoretical counterpart of the investment rate we focus on in the empirical part and γ^* is the optimal size of technological change. Since for a large share of natives $\partial b/\partial\beta > 0$, an immigrant inflow that reduces the share of natives in the labor force lowers b. The impact on the size of the technological change of a change in the average quality of the labor force is given by the differential effect of a change of b on γ^*, where that is:

$$\frac{\partial\gamma^*}{\partial b} = -\frac{\sigma}{\rho\sigma - 1}\left[\frac{\phi}{\rho A\sigma}\left(\frac{w}{b}\right)^\sigma \frac{1}{K^{\rho\sigma}}\right]^{\frac{1}{\sigma\rho-1}} b^{\sigma-1} \frac{\phi w^\sigma}{\rho A\sigma K^{\rho\sigma}} < 0 \quad \text{for} \quad \sigma > \frac{1}{\rho}. \tag{18}$$

Thus firms' reaction to the inflow of migrants is higher *i)* the higher σ, that is the higher the substitutability across goods, that is the higher the possibility to steal other products' market shares; *ii)* the higher ρ, thats is the higher the productivity of the capital stock.

[6] ϕ is a pure technological cost; we abstract from credit market determinants of the investment decision since we condition them out in the empirical exercise.

The result of the model $\partial\gamma^*/\partial b < 0$ works whenever $\partial b/\partial\beta > 0$, which is always true when $\beta \to 1$, whatever the elasticity of substitution between natives and migrants in the firms' production function. Nevertheless, it would be interesting to be able to assess the following:

Proposition 1 *Whenever* $\dfrac{\partial b}{\partial \theta} > 0 \Rightarrow \dfrac{\partial \gamma^*}{\partial \theta} < 0.$

Proof of proposition 1
In a CES it is true that $\partial b/\partial\theta > 0$ (intuition for a CES production function: as θ increases one gets closer to perferct competition and output increases). It is easy to show that $\dfrac{\partial \gamma^*}{\partial \theta} = \dfrac{\partial \gamma^*}{\partial b}\dfrac{\partial b}{\partial \theta} < 0$, since the first term of the product is negative by (18) (the core result of the model), and the second term term is larger than zero as just inferred.

3 The empirical model

For the empirical specification we start from the standard investment theory and add immigration and other relevant controls. In the baseline model, we estimate the following specification:

$$\begin{aligned}\frac{I_{ijt}}{K_{ijt-1}} =& \alpha + \alpha_t + \alpha_s + \alpha_j + \beta_1 \Delta \ln \frac{L_{jt}^{imm}}{Pop_{jt}} + \beta_2 \frac{L_{ijt-1}^{blue}}{L_{ijt-1}} + \beta_3 \ln \frac{y_{ijt-1}}{L_{ijt-1}} \\ &+ \beta_4 \ln L_{ijt} + \beta_5 \Delta \ln L_{ijt} + \beta_5 X_{ijt-1} + \varepsilon_{ijt}, \end{aligned} \tag{19}$$

where firms are indexed by i, sectors by s, provinces where i is located are indexed by j, and time is indexed by t. The coefficient of interest is β_1, which captures the correlation between the change in the log of the share of immigrants coming from developing and emerging economies over total population at the provincial level ($\Delta \ln \dfrac{L_{jt}^{imm}}{Pop_{jt}}$) and firms' investment rate (i.e. the investment to capital ratio I_{ijt}/K_{ijt-1}). This correlation is conditional on the sectoral composition of the economy (α_s), the business cycle (α_t), provincial fixed effects (α_j), firms' labor productivity (y_{ijt-1}/L_{ijt-1}), firms' employment level (L_{ijt-1}) and growth ($\Delta \ln L_{ijt}$), firms' share of blue collar over total employment ($L_{ijt-1}^{blue}/L_{ijt-1}$), and a bunch of other firm characteristics (X_{ijt-1}) like age, cash flow, a dummy variable for the firm being credit rationed and a dummy variable for the investment being reversible[7].

[7] All variables on firm's characteristic come from Bianco, Golinelli and Parigi (2008).

To contain simultaneity problems, all explanatory variables are lagged one year.

As to the dependent variable, the use of investment rates instead of qualitative automation variables as in Lewis (2005) has some advantages. Given our high quality data on investment, our analysis is less plagued by measurement error problems. Moreover, it allows to approach a firm's technical change in a more general and pervasive way. Notice that since we control for employment growth at the firm-level a change in the investment rate implies a change in capital intensity.[8]

As it is, model (19) potentially suffers for the endogeneity of the share of immigrants in the province. A larger share of immigrants could be due to specific choices (including investments) by a relevant group of firms that raise demand for specific skills. To address this concern we resort to an IV estimation where, as in previous papers, we use an immigrant inflow which is plausibly exogenous to the evolution of investment decisions. We can use the fact that immigrants tend to move in areas where other immigrants of the same nationality settled before (Altonji and Card (1991), Saiz (2007)). To generate the instrument, total immigration levels in Italy are traslated into expected immigration by province. The instrument we use is as follows:

$$Instr_{jt} = \Delta \ln \frac{\widehat{L_{jt}^{imm}}}{Pop_{jt}}, \tag{20}$$

where $\widehat{L_{jt}^{imm}} = \sum_c \delta_{jc1990} L_{ct}^{imm}$ is the predicted numbers of immigrants in province j at time t, L_{ct}^{imm} is the total number of immigrants in Italy coming from country c at time t, $\delta_{jc1990} = L_{jc1990}^{imm}/L_{c1990}^{imm}$ is the share of country c nationals residing in region j in 1990. The assumption that this prediction is indipendent of time region-specific shocks driving current investment decision is based upon two reasonable considerations. First, the immigrant inflow in 1990 is not driven by omitted variables which are likely to affect investments in the future. This assumption is easily fulfilled since firms' investment decisions are forward looking and they do not suffer of any pile-up problem. Second, national inflows are not determined by the economic conditions of few provinces (i.e. each province is small compared to the national labor market). This is also likely to be satisfied: Italian provinces are 95 and the largest one in terms of share of immigrant population (Milan) did not exceed the 15 per cent of the total immigrant population in 1990.

[8] We use the time series of the stock of capital and the deflator constructed by Bontempi, Golinelli and Parigi (2007).

The fact that investments are lumpy and volatile (Zevi, 2008) might create some problems in the estimation due to the presence of outliers in the distribution of the dependent variable. In order to cope with this problem, we actually exclude from regression all the firms with an investment-capital ratio larger than one (i.e. all the firms that more than doubled their production capacity).

In a robustness check, we also explore different definitions of a technological expansion. The distribution of the investment rate variable is characterized by a large number of very low values. An "almost zero" investment rate may suggest that the firm is not changing at all its the production capacity and therefore this figure cannot be correctly interpreted as an (although small) technological expansion. In order to cope with this problem, we consider the probability to make a large investment with the aim to capture a true production capacity shift. We use two definitions of large investment with two thresholds on the investment rate variable: the first is when a firm invests more than the 30 per cent of the existing capital; the second is whether firm's investment in machineries exceeds half of the installed production capaticity. The model is probit estimated and we use IV to cope with the possible endogeneity problems.

We further conduct a number of experiments aimed at assessing the possible existence of heterogenous effects across sectors and firm size.

First we focus on sectors and use the OECD classification (OECD, 2003) to split firms into two groups according to the technological level of the sector they belong to: low and medium-low tech (LMLT) on one side and medium-high and high tech (MHHT) on the other. The idea is that LMLT firms produce less differentiated goods and are more exposed to the international competition by emerging markets. On the other hand, MHHT sectors are generally more sheltered by low-income countries competition due to higher fixed costs (typically R&D) to start the production and therefore their intra-industry elasticity of substitution is comparatively low.

Then we concentrate on heterogeneity due to firm size. We interact the immigration variable with the log of the size of firm, with the aim to be able to assess whether the effect of immigration somehow changes as long as firm size increases.

4 Data

We base our analysis on the Survey on Investment in Manufacturing (SIM) dataset, an annual survey collected by the local branches of the Bank of

stats	N	mean	sd	p50	time range	type
investment ratio - machinery	10116	0.181	0.158	0.137	1996-2006	continuous
change in the share of immigrants	1045	0.130	0.214	0.108	1996-2006	continuous
firm size	10116	430.619	966.217	168	1996-2006	continuous
productivity	10116	258.13	458.33	185.15	1996-2006	continuous
cash flow[1]	10116	0.270	0.380	0.220	1996-2006	continuous
age	10116	38.377	27.727	33	1996-2006	discrete
credit rationing	10116	0.034	0.181	0	1996-2006	binary
reversibility	10116	0.331	0.470	0	1996-2006	binary
share of blue collars	10116	0.673	0.197	0.718	1996-2006	continuous
employment growth	10116	0.009	0.151	0	1997-2006	continuous

Notes: Cash flow is scaled by one-year lagged capital stock.

Table 1: Statistics: average 1996-2006

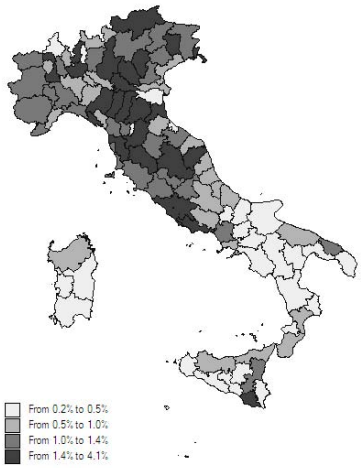
Italy. We use only the subsample of firms with at least 50 employees, which is continuosly available since 1984; firms with 20-49 employees have entered the survey only in 2002.

SIM is particularly rich and includes information on employment, sales, investments, export, ownership structure. Data on investment flows are of particularly high quality and very detailed: they are separately available for machineries and equipment, ICT, land and buildings. Information on firms' employment structure is also detailed: there is a breakdown in terms of both number of workers and the share of blue and white collars.

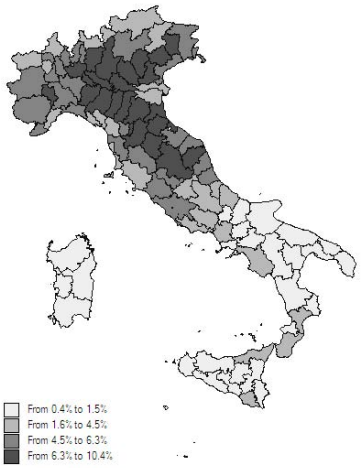
SIM does not provide figures on installed capital stock. For this we rely on the measure built by Bontempi et al. (2007) who matched SIM with the balance sheet figures available in the Company Account Data Service (CADS) dataset. We send to Bontempi et al. (2007) for a detailed description of the methodology for the computation of capital stock and investment deflator; for our purposes here, it is worth recalling that the total capital stock used to normalize machinery investment refers properly to machinery. The measure of investment reversibility and that of change in governance are taken from Bianco et al. (2008).

For our baseline exercise, this sample is an unbalanced panel with more than 8,000 observations over the period 1996-2006 on 2,000 surveyed firms. Descriptive statistics for the pooled sample of firms are in Table 1.

As expected, average size of our firms is much larger than in reality: given our median size equal to 168, our sample is representative of medium-large Italian firms. Not surprisingly the dynamics of employment is very low (0.9 percent increase on average). The investment rate for machinery is on average equal to 18 percent, the share of blue collars skim over the 70



panel a: 1996



panel b: 2006

per cent, while the average increase in the share of immigrant population at provincial level is quite high (18 per cent), thus reflecting the large inflows of immigrants in the period cosidered.

The stock of migrants by country of origin and province of destination is taken by the annual permits released by the Italian Ministry of Interior. From population registers, instead, we get total population for each province. The distribution of the ratio between immigrants and total population across provinces for 1996 (initial year) is depicted in figure 1 (panel a). Clearly, the spatial distribution of foreign citizens is not uniform across provinces and it actually mirrors the unbalanced territorial distribution of economic development in Italy: foreigners are concentrated in the wealthy and attractive regions of the Centre and the North of the country. Despite more intense immigration flows, this pattern is confirmed in 2006 (figure 1, panel b).

5 Results

We first estimate model (1) by OLS.

The first column in Table 2 shows a specification with variables that are typical in standard empirical analysis of investment (Bond and Van Reenen, 2007). On average the investment rate is positively correlated with firm

productivity, cash flow and the employment growth of the previous period, while being rationed on the credit market, reduces the amount of investments carried by a firm. The other coefficients have the expected sign, but are insignificantly different from zero. The coefficient of the immigration inflow at provincial level is positive but not significant at standard levels. This result may be due to the fact that immigration and investments might be driven by a common shock, which is likely to attenuate the effect of the arrival of foreign workers on firms' technological decisions. In the scond column we correct this possible endogeneity problem by using equation (20) as an instrument. Results now change and they become in line with the theoretical predictions. The effect of immigration inflow is now positive and significant thus showing that a rise in the share of foreign population at provincial level actually induces firm to increases their investment decisions. The F-test of the first stage is 43.9, a figure which is safely above the standard levels of the weak instruments literature (Bound, Jaeger and Baker, 1995).

We further check whether the inflow of immigrants impact on the probability to make a large investment. We estimate two probit and two IV-probit models (Table 3) with a dependent variable indicating one whether the investment and can be cosidered as a true shift in the production capactity. We set two thresholds in the investment rate: 0.3 (columns (1) and (3)) and 0.5 (columns (2) and (4)). Results are diplayed in Table 3, where the first two columns are probit estimates and the other two are IV-probit. Coefficients for immigration seem to reiforce the previous results: they are positive and significant for both thresholds. This implies that the probability to make a large investment increases when the immigrant inflow is larger.

6 Heterogeneous effects

So far we have obtained quite an interesting result: on average firms react to the inflow of immigrant workers by investing more in machineries. This result is confirmed by the probability to make a large investment and it is actually robust to possible endogeneity problems.

In this section we assess the existence of heterogenous effects of immigration across sectors and size firms as predicted by the theoretical model.

As explained in section 3, we split our sample according to the the technological level of the sector they belong to: low and medium-low tech (LMLT) and medium-high and high tech (MHHT). Results are displayed in table 4, which reports IV estimates only; column (1) shows the coefficients for the

	(OLS)	(IV)
share of immigrants	0.003	0.251*
	(0.009)	(0.133)
size	-0.002	-0.001
	(0.002)	(0.002)
labor productivity	0.006*	0.006*
	(0.003)	(0.003)
age	-0.000	-0.000
	(0.000)	(0.000)
employment growth	0.119***	0.118***
	(0.014)	(0.013)
credit rationing	-0.011	-0.012
	(0.009)	(0.009)
reversibility	0.001	0.000
	(0.004)	(0.004)
share of blue collars	0.005	0.004
	(0.011)	(0.011)
cash flow	0.048***	0.047***
	(0.006)	(0.006)
constant	0.193***	0.088***
	(0.029)	(0.031)
Observations	8189	8189
F first step		43.89

*** p<0.01, ** p<0.05, * p<0.1. All regressions includes sector, year and provincial fixed effects. Residuals are clustered at firm level. Sector dummies are at 2 digits of Nace classification.

Table 2: Machinery investment rate: baseline specification

	Probit		IV Probit	
	(1)	(2)	(3)	(4)
share of immigrants_dl	-0.052	0.114	2.594**	3.014**
	(0.122)	(0.202)	(1.236)	(1.378)
size	-0.097***	-0.082***	-0.085***	-0.069**
	(0.022)	(0.031)	(0.022)	(0.030)
productivity	0.018	-0.065	0.015	-0.058
	(0.037)	(0.050)	(0.034)	(0.044)
age	-0.001	-0.000	-0.001	-0.000
	(0.001)	(0.001)	(0.001)	(0.001)
employment growth	0.940***	0.545**	0.840***	0.464**
	(0.159)	(0.215)	(0.167)	(0.201)
credit rationing	-0.134	0.130	-0.142	0.091
	(0.117)	(0.140)	(0.112)	(0.128)
reversibility	0.001	-0.006	-0.004	-0.010
	(0.047)	(0.067)	(0.044)	(0.060)
share of blue collar	0.023	0.258	0.009	0.218
	(0.131)	(0.181)	(0.120)	(0.168)
cash flow	0.402***	0.346***	0.355***	0.298***
	(0.053)	(0.075)	(0.063)	(0.081)
Observations	8172	7893	8172	7893

*** p<0.01, ** p<0.05, * p<0.1. Probit estimates. Dependent variable equal to one if the investment is lumpy (investment rate >0.5). All regressions includes sector and year fixed effects. Residuals are clustered at firm level. Sector dummies are at 2 digits of Nace classification. In specifications (1) and (3) an investment is considered lumpy when the investment rate is larger than 0.3. In specifications (2) and (4) an investment is considered lumpy when the investment rate is larger than 0.5.

Table 3: Machinery investment rate: Lumpy investments

LMLT industries, while column (2) for MHHT group. The impact of an increase of the availability of immigrant workers is in line with thoeretical predictions: coefficient for the LMLT group is positive and significant and almost twice the MHHT one (which is instead not insignificant).

Regression estimates also confirm the idea that small firms react to immigrant inflows by investing relatively more than large firms. By interacting the immigration variable with the log of the size of firm (column (3)), we find that "share of immigrants" is positive and significant, while its interaction with size is negative and statistically different from zero. This implies that the effect is stronger for on small firms compared to larger ones.

7 Concluding remarks

The large inflow of immigrant workers has recently raised a number of concerns on how firms might react to the arrival of a high number of unskilled immigrants in their workforce. In this paper, we first present a theoretical model which shows in a partial equilibrium monopolistic competition framework that, under some parameter restrictions, firms might couteract to the arrival of less productive workers by investing more in machineries. This effect is stronger in more competitive industries and for small firms.

We subsequently checked these predictions on a sample of Italian manufacturing firms on the period 1996-2006. In line with the theoretical predicitions, Italian firms invested more in machineries if they happen to be located in areas which attracted more foreign citizens. This result is robust to endogeneity concerns or the possible bias due to the lumpy nature of investment decisions. Moreover, this result is particulalrly strong for low and medium-low tech, which are likely to produce less differentiated goods and it partially vanishes as long as firm employment increases.

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	Heterogenous effects		
	(1)	(2)	(3)
share of immigrants	0.323*	0.191	0.369***
	(0.184)	(0.186)	(0.141)
interaction with size			-0.024**
			(0.009)
size	-0.001	-0.001	0.002
	(0.002)	(0.003)	(0.002)
labor productivity	0.008**	-0.002	0.006*
	(0.004)	(0.006)	(0.003)
age	-0.000	-0.000	-0.000
	(0.000)	(0.000)	(0.000)
employment growth	0.097***	0.143***	0.118***
	(0.016)	(0.026)	(0.013)
credit rationing	-0.002	-0.027*	-0.012
	(0.012)	(0.015)	(0.009)
reversibility	0.005	-0.009	0.001
	(0.005)	(0.008)	(0.004)
share of blue collars	0.004	0.000	0.004
	(0.016)	(0.017)	(0.011)
cash flow	0.050***	0.040***	0.047***
	(0.008)	(0.008)	(0.006)
constant	0.057	0.385***	0.073**
	(0.042)	(0.048)	(0.032)
Observations	5380	2809	8189
F first step	23.65	20.20	21.95

*** p<0.01, ** p<0.05, * p<0.1. All regressions includes sector, year and provincial fixed effects. Residuals are clustered at firm level. Sector dummies are at 2 digits of Nace classification. Regressions includes controls of the baseline specification

Table 4: Machinery investment rate: technological level and interaction with size