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A Firm Level Perspective on Migration

Giulia Bettin *(Polytechnic University of Marche)*, ***Alessia Lo Turco*** *(Polytechnic University of Marche)*, and ***Daniela Maggioni*** *(Polytechnic University of Marche)*

UNIVERSITÀ DELLA CALABRIA

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A firm level perspective on migration

Giulia Bettin, Alessia Lo Turco and Daniela Maggioni*
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Abstract

Making use of the 9^{th} wave of the Capitalia survey for the period 2001-2003, we address the role of migrant workers from extra-EU in manufacturing production providing firm-level evidence on their substitutability/complementarity with respect to the other production factors. We also try to uncover whether their role in production changes according to the firm' size, location, activity and international involvement. The insight gathered from the analysis of partial price and demand elasticities confirms the complementarity (both *p*- and *q-complementarity*) between migrants and natives in manufacturing production and show their *p-complementarity* with respect to capital and *p-substitutability* with respect to material and services. However some differences emerge across the heterogeneity dimensions that we explore (i.e. size, location, sector and international involvement). Also, we calculate the Morishima elasticities of substitution which show that in general domestic and foreign labour seem to be MES-substitutes.

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1 Introduction and related literature

Immigration, and specifically workers' mobility, is a wide and complex phenomenon that has long since drawn the attention of social sciences. Moreover, it represents a controversial issue in the ongoing political debate everywhere in the world, across the members of the European Union, but also in the United States, Canada and Australia. Large inflows of immigrants, mainly from developing countries, have drawn attention on the absorbing capacity of developed economies. Public opinion is often concerned that immigrants take jobs away from native workers, and burden on developed countries' welfare systems already fighting with population aging and birth rates decline.

The current economic downturn could easily strengthen these fears and an anti-immigrant attitude with dangerous consequences in terms of social integration, notably in the most recent immigration countries.

Even if a consensus has not been reached yet in the economic literature as far as immigration impact on host countries' wages and employment is concerned, there is quite a volume of empirical studies that finds only modest evidence of detrimental effects, or even no evidence at all. The crucial point in this context is whether immigrant workforce could substitute or complement the native one in terms of skill levels.

A mechanism of labour market segmentation might be at work, since immigrant workers acquire some degree of specialisation in jobs that are typically manual and low-skill intensive, while native workers prefer high-skill intensive jobs, or simply requiring different levels of ability in terms of language and communication tasks.

Moreover, it could be the case that changes in the production structure somehow compensate for effects directly deriving from immigration. Thanks to the increased availability of low-skilled workers, production might shift towards low-skill intensive sectors and technologies, the consequent reallocation of resources cushioning the original impact on wages and employment rates.

The theoretical aspects concerning the immigration impact on the labour market of destination countries are usually described with a neo-classical competitive model in which it is generally postulated that inflows of immigrant workers lower the price of the factor they substitute for (Chiswick, 1982).

Restrictive assumptions at the basis of these models (among others, international immobility of capital, complete openness to international trade) together with the presence of other factors affecting the immigration's impact (for example, the skill mix of native and foreign-born population) prevent from finding a definitive solution and this theoretical uncertainty has long encouraged empirical research to look for effective evidence concerning the labour market impact of immigration flows into developed economies as destination countries.

1.1 Empirical evidence on immigration's effects on the labour market

Friedberg and Hunt (1995) highlight in their survey that labour market outcomes of native workers are only slightly affected by immigration: there is no evidence of significant reduction of employment rates and most studies find that a 10 percent increase in the fraction of immigrants in the population reduces the wages of native workers by 1 percent at most.

Along the same line, Card (2001) uses U.S. Census data to show that a rise in the relative fraction of population in a specific skill group due to immigrant inflows produces only a small reduction in employment rates for natives and earlier immigrants with the same level of skills. Relative wages are only slightly affected, too. The effects on relative labour market performance seem therefore to be quite small even when large inflows of immigrants are taken into account.

On the other hand, Borjas (2003) using a general equilibrium approach finds that immigration has a negative effect on the wage of competing workers: over the period 1960-2000, a 10 percent increase in immigrant inflows reduces U.S. workers' average wage by 3-4 percent. The loss is much higher (almost 9 percent) for native workers without a high school degree.

Ottaviano and Peri (2006) share the same general equilibrium framework but the outcomes are completely different. They claim that imperfect substitutability exists between U.S. native workers and immigrants and this results in an increase of the U.S.-born average wages, at the expenses of earlier immigrants. The wage loss they calculate for the native unskilled workers is much lower than what Borjas found while the natives with at least a high school degree saw their real wage increase by 0.7-3.4 percent. The group who bears the most adverse effects is the group of earlier immigrants, with whom the new ones are going to compete.

More recently, Borjas, Grogger, and Hanson (2008) state once again perfect substitutability between comparably skilled immigrants and natives while Peri (2009) shows that no crowding-out effects seem to derive from immigration in terms of employment and hours worked by natives. The impact of immigration seems to be positive on total factor productivity while capital intensity and the skill-bias of production technologies diminish as the number of immigrant increases.

The debate is therefore open and results deriving from empirical analysis seem to be still ambiguous. All the main studies mentioned so far analyse the U.S. case, but there is also some empirical evidence concerning the consequences of immigration into European countries. Lower labour market flexibility and different policies (notably, minimum wage and employment protection legislation) could translate in a larger impact on employment rates than on wages. Besides, lower mobility of native workers' than in the U.S. might fail to partly neutralise the impact of immigration on the labour market.

While there is some evidence, albeit weak, of a small decrease in natives' wages in France (Hunt, 1992), no significant impact emerges for Germany (Pischke and Velling, 1997; D'Amuri, Ottaviano, and Peri, 2008).

Similar studies about the Italian case have been limited by the scarcity of data. Gavosto, Venturini, and Villosio (1999) find a positive impact of immigration on the wages of natives. Immigrant workers seem to fill a gap on the labour market since there are specific, tipically low-skilled jobs that native workers do not will to accept anymore. Nevertheless, when the immigrant share on total employment has reached a certain threshold (7.7 percent) foreign-born workers start to compete with natives and their effect on wages become negative.

Concerning the effect of immigrants on employment rates for native workers, in Northern Italy, where most immigrants are settled, the probability of finding a job, when looking for a new job, is either positively affected or not affected at all by the share of immigrants in the region (Venturini and Villosio, 2006). A complementary effect is at work also when considering transition of native workers from employment to unemployment.

Results are quite discouraging in terms of immigrants assimilation (Venturini and Villosio, 2008): the general pattern for foreign workers seems to be an extremely fragmented career, with high chances of being confined to seasonal or temporary jobs, or moving between legal and illegal sector. The level of wage upon entrance into employment is almost the same for natives and immigrants employed in the private sector, but the two wage profiles diverge as experience increases. Assimilation does not occur from an employment perspective, either: the differential in employment between foreign and native workers existing upon entrance increases over time.

1.2 Firm level evidence: our contribute

As already suggested in the introduction, one possible explanation for the fact that many studies fail to find a significant impact of immigration inflows on either employment or wages is related to the structure of the production sector. An increased availability of low-skilled workers could generate a reallocation of resources in different directions: toward sectors where production is low-skilled labour intensive, inside sectors towards firms that use low-skill intensive technology, or even inside firms, towards goods of such a kind.

Lewis (2005) and Card and Lewis (2005) show that, while a change in the national industry composition is not supported by empirical evidence, inside different U.S. production sectors low qualified Mexican immigration has been absorbed mainly by the firms that were already using low-skill intensive technologies. An opposite effect (*i.e.* a shift towards more skill intensive firms) was sorted out in Israel because of the high-skilled immigrants coming from Russia (Gandal, Hanson, and Slaughter, 2004).

At the firm level, again Lewis (2005) analyses the relationship between the use of automation technologies and immigration in U.S. metropolitan areas and finds that the latter has a negative causal impact on the former. This means that an increase in the supply of low-skilled workers induce firms to downgrade the technology they are using in the production process. The impact of immigration to Italy on firm-level strategies is analysed in Accetturro, Bugamelli, and Lamorgese (2009), who consider investment decisions and hence adjustments in capital intensity as an endogenous response to the increase in the relative abundance of low-skilled workers due to immigration inflows. They find that in a sample of Italian manifacturing firms over the period 1996-2006, a larger inflow of low-skilled immigrants, computed at provincial level, has on average a positive impact on firms' investment rate in machinery. In particular, results are stronger for small firms and less technologically intensive industries.

Using firm level data, Barba Navaretti, Bertola, and Sembenelli (2008) look at the relationship between the use of foreign labour and offshoring strategies, albeit from the opposite perspective, showing that firms that offshore are usually less likely to employ immigrant workforce.

Against this background, the aim of our study is to provide new evidence on the role of immigrant labour inside the production process. As we have just seen, the vast majority of the studies investigates the effects of immigration for native workers by means of Census or Labour Force Survey data, while to the best of our knowledge firm-level evidence on these aspects is still scarce.

Making use of the 9^{th} wave of the Survey on Manufacturing Firms (Indagine sulle imprese manifatturiere) carried out by Capitalia in 2004 (with information on the period 2001-2003), our contribution is meant to add to the existing evidence in two respects. On one hand, we investigate how immigrant workers directly contribute to the productivity of Italian firms. On the other hand, we try to shed light on the type of relationship (complementarity/substitution) existing between immigrant labour and the other inputs in the production process, especially native labour. From the estimation of the production function, we first retrieve the Technical Elasticity of Substitution (TES), to quantify the changes in the use of native labor in response to an exogenous shock in the supply of labor due to migration, while all other inputs are fixed in the short term. Then we proceed calculating the partial price elasticies, that may tell us how the increase in the availability of immigrants actually affects the wage of native workers. Making use of a dual approach, we also calculate the partial demand elasticities from the estimates of a cost function to understand the response of the demand for foreign (domestic) labour to an increase of the wage of domestic (foreign) workers. Finally, we employ a further measure of substitutability, the Morishima elasticity of substitution (MES) which measures the percentage change in the ratio of domestic to foreign (foreign to domestic) labor when only the price of foreign (domestic) labor varies and all other prices are constant.

2 Data and descriptive analysis

Data used in the following analysis are retrieved from the 9^{th} wave of the Capitalia Survey, containing plenty of information on manufacturing firms' characteristics and their activities. The sample includes all firms with more than 500 employees, while for firms with less than 500 employees a rotating sample is created stratifying by industry, size class and geographical area. Provided data concern firms' output, input, investments, innovation activity, financial situation and, more importantly for our aims, firms' internationalisation strategies and labour composition with a special focus on foreign employees[1].

After a cleaning procedure[3], we end up with a sample of 3,264 firms for a total of 9,314 firm-year observations for the period 2001-2003; 3,822 firm-year observations concerns firms that have used migrant workers in one year of the

[1]It is not possible to extend the analysis using also data from the 10^{th} wave concerning 2004-2006, as an unbalanced panel, because, unfortunately, the question about the firms' use of foreign workers has changed over time. In the 9^{th} wave firms are asked about Extra European Community (EC) employees[2] and this information concerns a three-year panel (2001-2003). In opposite in the 10^{th} wave there is only a cross-sectional information for 2006 about the number of all foreigners the firms have employed, both from the EC and outside the EC. In addition, in this wave the foreign employees are split according to their skills: managers, white-collars and blue-collars but there are serious inconsistencies concerning the total number of workers in the firm and the number of white and blue collar migrant and domestic workers, so we decided to stick to the $9th$ wave.

[3]We drop observations with missing data for variables of interest (output, value added, labour, capital, material, and labour costs), or with implausible negative values. We also delete firms which are considered as outliers for at least one year in the sample period. We consider as outliers observations from the bottom and top 1 percent of distribution of some main ratios: va/labour, capital/va.

sample period[4]. Looking at the evolution over time, despite the short period, we can notice an increase in the number of Italian manufacturing firms hiring immigrant workers, from 39.23% in 2001 to 42.89% in 2003.

Table 1 shows that firms employing foreigners are larger than firms using only native workers, but they seem to be less productive, less capital intensive and present a lower skill intensity. This is an interesting evidence, even if it could rest on the sectors or geographical areas where these firms operate, or on their international involvement.

Table 1: Firms employing foreign workers

IMMIGRANTS	Y	LP	SIZE	KL	SKILL
Yes	9.375	3.796	4.150	3.297	0.295
No	9.205	3.829	3.915	3.335	0.346
t-test	6.30	3.67	10.08	1.72	13.85

Y: output; LP: labour productivity, SIZE: number of employees;
KL: capital intensity; SKILL: skill ratio.
All variables are in logarithm with the exception of the skill ratio.
All differences are significant at least at 10%.

Table 2 shows the distribution of firms employing foreign workers across types of sector (according to Pavitt classification), size classes, geographical areas and internationalisation strategies. The share of firms that employ foreign labour ($MIGR$), the average share of foreign employees on the total employment for all firms (shL^M) and for firms making use of immigrants in their production process ($shL^M_{MIGR=1}$) are reported.

Focusing on the technological level, we cannot detect any strong pattern even if science-based (high-tech) sectors seem to be less likely to employ foreign workers. Nevertheless, scale intensive and traditional sectors display the highest shares of immigrants' labour. As we can notice, the use of foreign labour is more widespread in Northern and Central Italy. There is no monotonic relationship between firm's size and the use of immigrants' labour although, the smaller the firm, the higher the share of migrant workers in total employment. When we cross both the dimensions, sector and firm size, we can notice that the evidence of the lower share of migrant workers in larger firms is a common feature to all sectors, regardless of their technological level. Anyway, it is for example interesting to notice that the share of migrant labour for larger firms in traditional sectors is comparable in magnitude to the ones of smaller firms in high-tech sectors, and that in general, in traditional sectors the variability across size classes is not as important as in other type of sectors (Table 3).

Turning our attention to the firms' internationalisation strategies, we try to highlight the linkages between the use of migrant labour and the firms' involvement in foreign market. Both the export activity and the competition with foreign firms[5] are taken into account. This analysis points out a positive correlation between the hiring of foreigners and firms' international involvement: exporters and firms facing with foreign competitors are more likely to employ

[4] In the sample there are 1,403 firms that have employed migrant workers at least in one year of the period 2001-2003.

[5] In the questionnaire, firms are asked if foreign firms are potential competitors.

Table 2: Firms using immigrants by sector, size, area and international strategies

SECTOR (Pavitt)	$MIGR$	shL_M	$shL_{M\ MIGR=1}$
High Tech	30.89	1.95	6.33
Scale Intensive	42.28	4.92	11.63
Specialized	41.45	2.61	6.29
Traditional	41.16	3.97	9.66

FIRM SIZE	$MIGR$	shL_M	$shL_{M\ MIGR=1}$
< 21	28.06	4.11	14.64
$\geq 21 \& < 50$	37.73	4.18	11.08
$\geq 50 \& < 250$	51.98	3.99	7.68
$\geq 250 \& < 500$	47.45	1.96	4.13
≥ 500	29.96	1.06	3.54

AREA	$MIGR$	shL_M	$shL_{M\ MIGR=1}$
North-West	46.00	3.87	8.42
North-East	51.14	5.50	10.75
Centre	35.47	3.27	9.23
South	13.12	0.66	5.00

EXPORTER STATUS	$MIGR$	shL_M	$shL_{M\ MIGR=1}$
Yes	42.02	3.65	8.69
No	38.50	4.44	11.53

FOREIGN COMPETITORS	$MIGR$	shL_M	$shL_{M\ MIGR=1}$
Yes	45.74	3.69	8.06
No	38.32	3.91	10.22

All values are in percentage (%).

Table 3: % of Migrant Labour by Sector and Firm Size

Firm Size Class	High Tech	Scale Intensive	Specialized	Traditional	Total
< 21	2.04	4.49	3.35	4.28	4.10
$\geq 21 \& < 50$	1.95	5.39	2.98	4.17	4.18
$\geq 50 \& < 250$	2.93	5.73	2.49	3.93	3.99
$\geq 250 \& < 500$	0.32	2.58	1.66	2.24	1.96
≥ 500	0.49	0.60	0.66	2.24	1.06
Total	1.95	4.92	2.61	3.97	

immigrants. Nevertheless, the share of foreign labour on the firm's total labour is higher for non-internationalised firms, possibly highlighting the larger size of internationalised firms. Thus, it could be important to control for the firm's size, sector and region in order to test if this positive correlation holds even whether these corrections are implemented. Building on this evidence, we follow Bernard and Bradford Jensen (1999) and, through a probit regression, we try to estimate the relationship between the firm's probability to employ foreign workers and its international status controlling for firm size, sector, region and year dummies. This is mainly a descriptive analysis and no causal relationship can be gathered from these estimates (Table 4).

Table 4: Immigrants' Labour Use and Internationalisation Strategies

VARIABLES	(1)	(2)
Exporter	-0.113**	
	[0.058]	
Foreign Competitors		0.122**
		[0.049]
Size	0.141***	0.119***
	[0.022]	[0.021]
Observations	9238	9323

All regressions include sector, region and time dummies.
Robust standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1

The export status surprisingly turns out to be negatively associated to the use of foreign workers. On the opposite, international competition is still positively and significantly related to the probability of hiring immigrants; this finding could hide the firm's need to lower its labour costs, through the use of low-wage immigrants' labour, in order to compete with the production in developing countries[6]. In the rest of the paper, after having studied the complementarity/substitutability pattern between inputs and foreign labour use for the overall sample, we will also try to test if some peculiarities and heterogeneity exist according to the firms' international status.

In our analysis, in addition to investigate the firm's production function, we also try to estimate its dual cost function. The estimation of the cost function requires the use of input prices. Since we have not at our disposal firm level prices for production factors we make use of sectoral level prices. Material, capital and services prices have been retrieved from EU-KLEMS Database and are defined at NACE rev. 1.1 sub-sections level. Concerning wages, from our Capitalia sample we are only able to compute an average wage regardless of the worker nationality[7]. Thus, we make use of an additional data source in order to retrieve the average wages for both native and immigrant workers. These data are computed by region and NACE division from WHIP database. In order to check the reliability of these external data we have tried to recalculate the labor

[6]This is only a hypothesis because unfortunately we do not know the exact nationality of the foreign workers (whether they come from developed or developing countries) and their skill composition (blue vs. white collars) to ascertain the cost-saving motive for hiring foreign workers.

[7]The average wage is obtained as the ratio between the firm total labour cost from balance sheet and the number of employees.

share in total cost for the two categories of workers. The correlation between the total wage bill calculated using WHIP average weekly wages for domestic and migrant workers and the wage bill from balance sheet information, available in Capitalia dataset, is 96% and turns to 93% for firms employing migrants. Also Figure 1 in the Appendix compares the distributions of the logs of the two wage bills and shows that the two measures are fairly similar across the three years of the sample and also when only migrant employers are considered.

3 The empirical model

The substitutability/complementarity among factors of production can be assessed by the estimates of the technology parameters retrieved by a production function or its dual cost function. Our interest on the substitutability among factors and the availability of firm-level information on production inputs and output led us to choose a translog production function which imposes no a priori restrictions on the relationships among factor inputs. The function is specified as follows

$$lnY_f = \alpha_0 + \sum_i \alpha_i lnX_{fi} + \frac{1}{2} * \sum_i \alpha_{ii} lnX_{fi} lnX_{fi} + \sum_{i=} \sum_{j \neq i} \alpha_{ij} lnX_{fi} lnX_{fj} \quad (1)$$

For each firm f in our sample, Y measures real output and lnX_i represents the log of the quantity of input i used in production, that respectively refers to input of materials, *IM*, services, *IS*, capital, *K*, domestic, L_D, and foreign, L_M, labour. In applied work, to improve efficiency, the production function is usually augmented with the input share equations obtained as its first derivatives:

$$S_{fi} = \alpha_i + \alpha_{ii} lnX_{fi} + \sum_{j \neq i} \alpha_{ij} lnX_{fj} \quad (2)$$

Under the hypothesis of constant return to scale and profit maximization S_i represents the share of input i in total output/cost, as a matter of fact

$$\frac{\partial lnY}{\partial lnX_i} = \frac{\partial Y}{\partial X_i} * \frac{X_i}{Y} = S_i \quad (3)$$

To overcome the lack of information on the share of labour costs attributable to foreign workers, we follow Yasar and Morrison Paul (2008) and we express the share of the two inputs as a sum, then we include the share of overall labour which we observe:

$$\begin{aligned} &S_{fL} = S_{fL_D} + S_{fL_M} = \\ &(\alpha_{L_D} + \alpha_{L_M}) + (\alpha_{L_D L_D} + \alpha_{L_{L_M} L_D}) * L_D + (\alpha_{L_M L_M} + \alpha_{L_M L_D}) * L_M + \\ &+ (\alpha_{L_D K} + \alpha_{L_M K}) K_f + (\alpha_{L_D IM} + \alpha_{L_M IM}) IM_f + (\alpha_{L_D IS} + \alpha_{L_M IS}) S_f \end{aligned} \quad (4)$$

From the parameter estimates of the above system it is then possible to infer the substitutability/complementarity relationship among factors of production.

A first measure of substitutability is the Technical Elasticity of Substitution, TES, which is aimed at appraising the changes in the use of a production factor in response to an exogenous shock in the supply of another input (for instance, in the supply of labor due to migration), while all other inputs are fixed in the short term. From the translog production function the measure can be obtained as

$$TES_{ij} = \frac{\alpha_j + \alpha_{jj} lnX_{fj} + \sum_{k \neq j} \alpha_k lnX_{fk}}{\alpha_i + \alpha_{ii} lnX_{fi} + \sum_{k \neq i} \alpha_k lnX_{fk}} \tag{5}$$

and measures the % rise in factor quantity X_i forced by the reduction in the quantity X_j of input j in order to hold output constant.

Secondly, making use of the predicted shares for domestic and foreign labour obtained from the estimate of the production function, it is straightforward to calculate the elasticity of complementarity among input i and j, c_{ij} which, *ceteris paribus*, measures a percentage change in the price ratio p_i/p_j with respect to a change in the input ratio X_i/X_j (Hamermesh, 1993). From this, the partial price elasticity can be obtained as

$$\epsilon_{p_i x_j} = c_{ij} * S_j = \frac{\alpha_{ij} + S_i * S_j}{S_i} \tag{6}$$

and describes the response of the price of input i to an increase of 1% in the availability of input j. If an increase in the availability of input j raises/reduces the return to input i the two factors are defined as *q-complements/substitutes*.

Partial elasticities are particularly interesting in our case since they could tell us whether the increase in the availability of immigrants actually lowers the wage of native workers. Furthermore they also show the complementarity/substitutability relationship between foreign and native labour and the remaining inputs in production.

On the other hand, another part of the story could be hidden in the response of the demand for foreign labour to an increase of the wage of domestic workers. In this respect, one could observe a null or positive response of the domestic wage to the increased availability of foreign workers while an increase in the wage of domestic workers could actually foster their substitution with immigrant workers. If an increase in the price of input j raises/lowers the demand of input i the two factors can be classified as *p-substitutes/complements*.

This piece of information is contained in the estimates of the partial demand elasticities which are based on the estimates of the Allen elasticities of substitution (AES), σ. The dual approach represents the most natural way to retrieve the estimates of the AES and consequently the partial demand elasticities from the estimates of a cost function of the same form as the production function above, only with prices substituting for inputs and the log of the cost substituting for the log of output. So, we also proceed estimating a translog short-run cost function of the following form:

$$lnC_f = \beta_0 + \sum_i \beta_i lnP_{fi} + \frac{1}{2} * \sum_i \beta_{ii} lnP_{fi} lnP_{fi} + \sum_{i=} \sum_{j \neq i} \beta_{ij} lnP_{fi} lnP_{fj} + \\ + \gamma_k lnK + \sum_i \gamma_{ki} lnK lnP_{fi} + \gamma_y lnY + \sum_i \gamma_{yi} lnY lnP_{fi} \tag{7}$$

We use two digit sector level prices of material and inputs, average wages for domestic and foreign labour at the region-sector level, keeping capital fixed and adopting the strategy already mentioned to overcome the lack of information on the exact firm-level measure of the shares of domestic and foreign labour.

The partial demand elasticities are calculated as follows:

$$\eta_{x_i p_j} = \sigma_{ij} * S_j = \frac{\beta_{ij} + S_i * S_j}{S_i} \tag{8}$$

From the coefficient estimates of the cost function we can, then, recover the demand elasticities and through these we can also calculate a further measure of substitutability, the Morishima elasticity of substitution, (MES) calculated as follows:

$$MES_{ij} = \eta_{x_i p_j} - \eta_{x_j p_j} = \frac{\partial ln(X_i/X_j)}{\partial ln p_j} \tag{9}$$

whereas cross-price elasticities are absolute measures of substitution, the MES represents a relative substitution elasticity and measures the percentage change in the ratio of input i to j when only p_j varies and all other prices are constant. Finally, two factors i and j are termed MES-substitutes if $MES_{ij} > 0$ and MES-complements if $MES_{ij} < 0$. In the following, we employ the Maximum Likelihood Zellner-efficient estimator to estimate the system of the production function (cost function) and share equations.

4 Results

4.1 Production function, TES and ϵ_s

Migrants have lower reservation wages and are keen to accept lower wages than domestic workers, on the other hand skilled migrants are likely to accept low skilled jobs thus also providing a higher productivity at a lower cost. Then one could expect that an increase in the availability of migrant workers could reduce the wage of the natives and that firms respond to the increase in the wage of natives increasing the demand for migrants. This could be more so for firms particularly exposed to competition, such as smaller firms, firms performing more traditional activities and firms competing in international markets. On the other hand, as most of the evidence suggests, migrants could actually perform those activities that native workers are not willing to perform, in this case a complementarity relationship should hold and however one could expect that the degree of complementarity changes according to the firm typology. If migrants especially perform blue collar activities the degree of complementarity with natives again could differ across sectors, size and international exposure since they might prove more important in smaller firms performing more traditional activities and facing competition in international markets.

So we mean to explore the role of migrants in production and their substitutability/complementarity with respect to the remaining inputs of production across sectors, international involvement, size and location estimating a different production function for each sub-group of firms. Table 7 shows the production function coefficient estimates and the estimated output elasticities for the five factors of production for the overall sample and when firms are first split according to the typology of activity performed in the two groups of $HighTech\&Scale$ sectors, $Traditional$, and $Specialized\ Suppliers$[8]. Then, we

[8]In the $HightTech$ sector unfortunately the number of firms was too low to run estimations.

have estimated a separate production function for $Exporters$, firms declaring to have $ForeignCompetitors$, smaller and medium size firms, $SMEs$ and finally for firms located in the $North - West$ and the $North - East$ of Italy. The results are from the estimates of a constant returns to scale technology[9] and all the specifications include time, sector, area and firm size dummies. Also we include the regional unemployment rate and the regional share of the shadow economy, both indicators are from Istat. As taking the log of migrant workers turns to missing those observations where this variable is equal to zero, we restrict the sample to the firms using foreign labour. As a consequence, we controlled for sample selection including the inverse Mill's ratio from a probit model of the probability to hire migrant workers[10]. The bottom part of the Table shows the output elasticities for each input: in the whole sample (column 1) the doubling of migrants in production would correspond to an increase of only 1.5% in output of Italian manufacturing, contribution of natives would be ten times larger and for capital only double; the larger elasticities are displayed for materials and services.

We now turn to the regularity conditions implied by the theory of production which require monotonicity and quasi-concavity of the production function.

Monotonicity implies that the estimated share equations are non-negative and the left part of Table 5 in the Appendix shows the shares obtained form balance sheet data, S_i, and their predicted values, $\hat{S}_i$, so as obtained from the estimation of the production function. From the Table, the two shares are pretty similar.

Then, making use of the average wages from WHIP, we calculate the shares of migrant and domestic workers in total output and compare them to the average of their prediction from the estimates of the empirical model. Also we show for each prediction the total % of violation of monotonicity, i.e. the number of negative predictions which is fairly low in general. However comparing the predicted and "actual" shares of foreign and domestic workers in total output we find that, although not exactly equal, the prediction reflects our calculations, also very similar are the sample averages and the average predictions for material, services and capital. The number of violations is very modest and we drop these observations from our sample in order to proceed in our calculations of TES and price elasticities.

Turning to the second order conditions for the production function, sufficient condition for quasi-concavity is that the bordered hessian is negative semi-definite and this condition is validated both at the mean and the median of the sample. This implies that the elements on the main diagonal, f_{ii} need to be non positive, as a matter of fact quasi-concavity implies that the own partial price elasticities be non positive and the upper panel of Table 6 shows that this is the case for our sample. The five columns respectively report the mean and median elasticities calculated according to formula 6 across the observations[11],

[9] Homogeneity and symmetry are imposed through the following restrictions: $\sum_i \alpha_{L_M} = \lambda$, $\sum_j \alpha_{ii} = 0$ and $\alpha_{ij} = \alpha_{ji}$. For the linear homogeneity $\lambda = 1$. We estimated the production function both for the linear homogeneity case and the results are almost the same, so, for the sake of brevity we decided to present the results for the constant returns to scale production technology, the remaining set of results is readily available form the Authors upon request.

[10] The probit includes real output and inputs together with the firm's age and size and their squared value, an dummies for investors, innovators, offshoring, import and export status and intensity, a dummy for the destination of offshoring and for the type of activity offshored.

[11] In this case we calculated the elasticity for each observation in the sample and then

and the elasticities evaluated at the mean of the prediction of the shares, at the mean of the shares calculated using WHIP wages. The four sets of elasticities are negative and bear consistent insights, in particular the own price elasticities are often very similar. Only, the average of the predicted own price elasticity is positive for services, but since we are going to work with elasticities calculated at the mean of the shares this is not going to represent an obstacle. Finally, the last column displays the share of observations with positive estimated elasticities, then some violations occur at some data points however the results shown below are not affected by this[12].

Moving to the appraisal of the substitutability/complementarity relationship across factors we follow the idea to explore the contribution of migrants in production across different dimensions of the Italian manufacturing sector.

The output elasticities are pretty similar even if some differences emerge confirming the heterogeneity across economic activities, firm size and location: the contribution of migrants is higher in traditional sectors and their output elasticity is larger also for SMEs and for firms located in the North-East of Italy. The estimated output elasticity of capital, as expected, is higher for firms involved in high-tech and scale intensive sectors, while the contribution of domestic labour is particularly high for specialized suppliers and for firms located in the North-West. Now, Table 8 shows the TES estimated from the technology parameters above. A 1% reduction in the availability of foreign workers calls for an increase of .25% of natives to keep output constant. This elasticity is the highest in *Traditional* sectors and is the lowest for firms in the North-West of the country and for *Specialised Suppliers.* As a consequence, these two groups of firms require the largest increase in migrant work to face a 1% reduction in natives'work to keep output constant. Due to the small contribution of migrants in manufacturing production compared to the remaining factors of production the estimated TES involving migrant labour change in response to a drop in the availability of the remaining inputs are always larger than the ones involving native labour. By the same token, less of the remaining inputs is required to face a reduction of migrants to keep output constant with respect to the percentages changes required to face a drop in the availability of domestic labour.

Finally, the upper panel of Table 10 shows the partial price elasticity for our factors of production.

For the sake of brevity, we show the estimated elasticities only for the two types of labour with respect to the remaining inputs, however by symmetry their sign also tells us the kind of relationship of the remaining inputs with respect to domestic and foreign labour. A general message from the first panel of the Table is that domestic and foreign labour are $q - complements$, an increase in the availability of one of the two type of workers does not threaten the earnings of the other. This result confirms the evidence provided by Gavosto et al. (1999). The highest elasticity of domestic wage with respect to foreign workers is displayed for *High tech & Scale* sectors while the lowest is recorded for firms located in the North-West of Italy. The highest partial elasticity of migrant wage with respect to domestic labour is recorded in the sub-group of *Specialized*

respectively took the average and the median together with the average and the median significance level.

[12] Wales (1977) discusses how the rejection of either monotonicity or concavity does not necessarily imply that the elasticity estimates are incorrect.

Suppliers while the lowest is in *Traditional* sector firms. While domestic labour is a complement for the remaining factors of production, foreign labour is less so: across sectors, the complementarity with respect to capital is not significant for *High tech & Scale* sectors and for firms located in the North-West of the country and a similar pattern emerges for the complementarity of migrant and material inputs for *Specialized Suppliers*, *Exporters*, and firms with *Foreign Competitors*. For firms located in the North-West, migrants are q-substitutes for material and services and this is valid for migrant and services in *Specialized Suppliers* too. Unfortunately this result cannot be qualified in more detail since the definition of services is quite aggregate. Finally the own price elasticities are higher for the *weaker* labour group and this supports the evidence on segmented labour markets provided by Hamermesh(1993). Also the estimated own elasticity of natives is around .25 in absolute value which is pretty close to estimated price elasticities in previous studies.

4.2 Cost function, η_s and MES

Now, from the estimated coefficients of the cost function in Table 9 we can retrieve the partial demand elasticities according to formula 8 and the results are displayed in the bottom panel of Table 6. Before moving to the presentation of the demand elasticities, the right part of Table 5 in the appendix shows the sample and predicted variable cost shares from the estimation of the cost function. There are a few violations for the prediction of the share of migrant labour, nevertheless, when excluding these observations, the second order conditions are satisfied and the own demand elasticities in the lower panel of Table 10 are all negatives and display 0 violations. Now, the evidence of complementarity between domestic and foreign labour is confirmed also form this further set of results in Table 10. As a matter of fact, the negative sign on the elasticity of the demand of domestic (foreign) labour with respect to the wage of migrant (domestic) workers implies that the two factors are $p-complements$ and the firm demand for the two types of labour behaves similarly. The elasticity of the demand of migrant workers with respect to the wage of domestic labour is higher than the elasticity of domestic labour with respect to the wage of foreign workers and in general foreign labour displays a higher sensitivity with respect to the prices of the other factors of production. The estimated own elasticity of natives ranges between -.67 and -.88 whith -.77 being the elasticity for the whole sample. Again, this figures are in line with the estimated elasticities reported in the wide evidence gathered by Hamermesh (1993), together with the cross elasticity of labour with respect to materials. A new feature is that, according to our calculations, both types of labour are p-substitutes with respect to materials and it is less so with respect to service inputs. A 1% increase in the price of material increases the demand for natives' labour of .73% and for migrant labour of 2.07%, then firms especially tend to substitute migrant labour for material inputs and this is valid for firms in *Traditional* sectors especially, while *Specialized Suppliers* seem to substitute materials with natives' labour only. Firms in the *North-East*, *Specialised Suppliers* and firms belonging to *High-Tech& Scale* sectors also tend to substitute domestic labour for services too. Finally, migrant labour appears as a *q-complement* with respect to service inputs, with one exception being the *Specialised Suppliers*. In particular, the demand for migrants is much more responsive than the demand for domestic labour with respect to price changes of services and material. While the demand elasticities for the response to services' prices are higher in general for migrant workers, when the price of materials changes the demand for natives is much less responsive than the one for foreign workers, especially from firms in High-Tech and Scale sectors and involved in international activities. This could reflect the different skill composition of domestic and foreign labour force in these sectors. When considering how the demand for materials and services responds to changes in the price of labour, changes in the demanded quantities for material and services mainly reflect increases in the wage of the domestic workers.

Finally, Table 11 shows the estimates of the Morishima elasticities of substitution obtained according to formula 9. As already mentioned, part of the literature (Blackorby and Russell, 1989; Nguyen and Streitwieser, 1997; Frondel, 2004) points at MES as providing complementary information with respect to cross-price elasticities. MES of domestic labour with respect to foreign labour would shows the change in the domestic/migrant labour ratio in response to changes in the wage of foreign workers. From the Table, domestic and foreign labour are MES- substitutes since an increase in the wage of migrants increases the natives/migrants ratio and an increase of the wage of natives increases the migrants/natives ratio. It is worth noticing that this second feature is not always valid across the firm categories considered in the analysis. In particular, the elasticity of the migrants/natives ratio with respect to changes in the natives' wage is only significant for *High-Tech& Scale* and *Traditional* sectors and for firms declaring to have a *Foreign Competitor*. The elasticity is particularly high in *Traditional* sectors: a 1% increase of domestic wages increases the ratio between migrants and natives in production of 1.07%. This set of estimates then hints at substitutability of the two types of labour in the production techniques even if, with some exceptions, migrants prove to be relatively *more* substitutable than *natives*. Turning to the remaining *MES*, from the whole sample estimates in the first column, it is interesting to notice that a 1% increase in the price of materials increases the migrants/materials ratio of 2.67% while in the reverse case a 1% increase in the wage of migrants increases the materials/migrants ratio of 1.24%. Then, as far as materials are more expensive, the migrant labour intensity of production increases more than the material intensity of production when migrant wages tend to grow. In general the *MES* between the two types of labour and services and materials are higher for migrants than for domestic labour thus reflecting their higher substitutability in production and this is true in all of the cases but one exception: for *Specialised Suppliers* an increase of migrants' wage does not increase the materials/migrants (services/migrants) ratio while an increase of natives' wage does increase the materials/natives (services/natives) ratio.

5 Conclusions

We add to the existing evidence on the complementarity/substitutability nexus between native and foreign born workers providing firm-level evidence on their interaction in Italian manufacturing production. Using a flexible functional form for the production and cost functions, we estimate technical elasticities of substitution, TES, partial price and demand elasticities and the Morishima elasticity of substitutions among five inputs: native labour, foreign labour, capital, materials and services.

Firstly, regarding the contribution of migrants in production, output elasticities confirm the presence of heterogeneity across economic activities, firm size and location: the contribution of migrants is higher in traditional and scale sector, SMEs and for firms located in the North-East of Italy, while the contribution of domestic labour is particularly high for specialized suppliers and for firms located in the North-West. Estimated TES show that, *ceteris paribus*, a 1% reduction in the availability of foreign workers calls for an increase of .25% of natives to keep output constant, on the contrary a drop of 1% in the availability of natives requires an increase of about 10.61% of migrant workers to the same purpose. The contribution of migrants in manufacturing production is small compared to the remaining factors of production therefore the estimated TES involving a migrant labour change in response to a drop in the availability of the remaining inputs are always larger than the ones involving native labour.

Secondly, Our findings on the cross price and demand elasticities confirm the complementarity (both *p-* and *q-complementarity*) between migrants and natives.

As a matter of fact, an increase in the availability of either domestic or foreign labour does not threaten the earnings of the other group. However, while domestic labour is a *q-complement* for the remaining factors of production, foreign labour is a *q-complement* especially with respect to capital while it is a *q-substitute* with respect to materials and services for *Specialised Suppliers* and for firms located in the *North-West* of the country. Also, the elasticity of the demand of domestic (foreign) labour with respect to the wage of migrant (domestic) workers is negative hence implying that the two kinds of labor are p-complements. The demand of migrant workers is more responsive to a change in the wage of domestic labour compared to what happens with the demand of domestic labour when the wage of foreign workers increases and in general foreign labour displays a higher sensitivity with respect to the prices of the other factors of production. Both foreign and domestic labour are p-substitutes with respect to material and it is less so with respect to service inputs.

Finally, domestic and foreign labour are shown to be MES-substitutes since an increase in the wage of migrants increases the natives/migrants ratio and an increase of the wage of natives increases the migrants/natives ratio but the results are significant only in $High - Tech\&Scale$ and $Traditional$ sectors and for firms declaring to have a *Foreign Competitor*, so the substitutability of the two types of labour in the production techniques does not hold across all firm categories considered.

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Table 5: Regularity Conditions - Monotonicity

Share	Production Function Mean		Cost Function Mean	
S_L	0.183		0.156	
$\hat{S}_L$	0.184	0.00%	0.157	0.75%
S_{L_D}	0.150		0.160	
$\hat{S}_{L_D}$	0.157	1.00%	0.143	0.46%
S_{L_M}	0.012		0.013	
$\hat{S}_{L_M}$	0.015	1.19%	0.014	14.34%
S_{IM}	0.473		0.549	
$\hat{S}_{IM}$	0.521	0.30%	0.547	0.00%
S_{IS}	0.245		0.296	
$\hat{S}_{IS}$	0.275	0.70%	0.296	0.00%
S_K	0.033			
$\hat{S}_K$	0.038	1.83%		
Observations:	3274		3199	

Figure 1: Wage Bill - Comparison WHIP Balance sheet

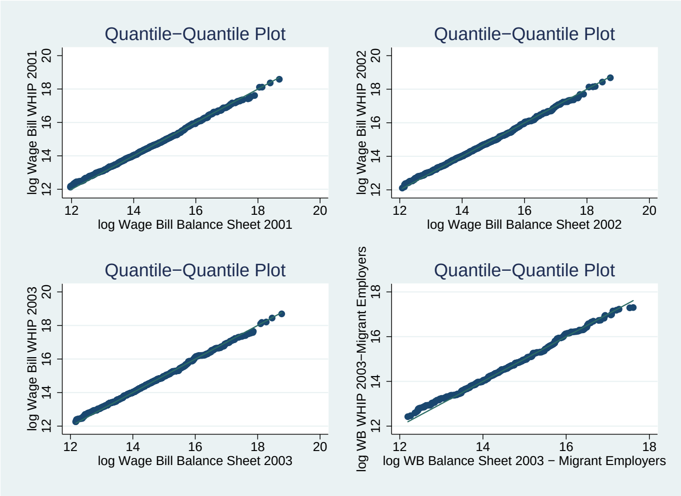

Table 6: Regularity Conditions - Own Partial Price and Demand elasticities

	Constant Returns to Scale Production Function				
	$\epsilon_{p_i x_j}$ based on:				
	mean ϵ_{ij} **across** i	**median** ϵ_{ij} **across** i	**estimated shares**	**calculated shares**	**Violations**
$\epsilon_{p_{L_D} x_{L_D}}$	-0.11	-0.33	-0.27	-0.32	10.78%
$\epsilon_{p_{L_M} x_{L_M}}$	-0.73	-0.81	-0.88	-0.87	0.18%
$\epsilon_{p_K x_K}$	-0.23	-0.64	-0.61	-0.59	2.87%
$\epsilon_{p_{IM} x_{IM}}$	-0.03	-0.09	-0.09	-0.09	11.20%
$\epsilon_{p_{IS} x_{IS}}$	0.04	-0.15	-0.12	-0.11	18.02%
	Constant Returns to Scale Cost Function				
	$\eta_{x_i p_j}$ based on:				
	mean ϵ_{ij} **across** i	**median** ϵ_{ij} **across** i	**estimated shares**	**calculated shares**	**Violations**
$\epsilon_{p_{L_D} x_{L_D}}$	-0.72	-0.76	-0.77	-0.76	0.00%
$\epsilon_{p_{L_M} x_{L_M}}$	-1.73	-1.20	-1.19	-1.22	0.00%
$\epsilon_{p_{IM} x_{IM}}$	-0.60	-0.60	-0.59	-0.59	0.00%
$\epsilon_{p_{IS} x_{IS}}$	-0.66	-0.66	-0.66	-0.66	0.00%

Table 7: Production Function Estimates

	All	High Tech&. Scale	Traditional	Specialized Suppliers	Exporters	Foreign Competitor	SMEs	North-West	Noth-East
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]
α_{L_D}	0.532***	0.559***	0.491***	0.616***	0.510***	0.526***	0.536***	0.569***	0.524***
	[0.006]	[0.011]	[0.009]	[0.015]	[0.007]	[0.010]	[0.006]	[0.010]	[0.009]
α_{L_M}	0.052***	0.057***	0.055***	0.033***	0.033***	0.033***	0.060***	0.031***	0.068***
	[0.004]	[0.007]	[0.007]	[0.009]	[0.005]	[0.007]	[0.005]	[0.007]	[0.006]
α_{IM}	0.091***	0.074***	0.106***	0.045***	0.123***	0.115***	0.086***	0.103***	0.081***
	[0.004]	[0.008]	[0.006]	[0.010]	[0.005]	[0.007]	[0.004]	[0.006]	[0.006]
α_K	0.089***	0.088***	0.094***	0.084***	0.083***	0.078***	0.087***	0.097***	0.082***
	[0.004]	[0.008]	[0.005]	[0.009]	[0.005]	[0.006]	[0.004]	[0.006]	[0.006]
α_{IS}	0.236***	0.222***	0.254***	0.222***	0.252***	0.248***	0.230***	0.200***	0.245***
	[0.005]	[0.009]	[0.007]	[0.009]	[0.005]	[0.007]	[0.005]	[0.007]	[0.007]
α_{IMIM}	0.198***	0.201***	0.197***	0.202***	0.197***	0.193***	0.198***	0.195***	0.201***
	[0.001]	[0.001]	[0.001]	[0.002]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]
α_{IML_D}	-0.062***	-0.066***	-0.057***	-0.072***	-0.059***	-0.061***	-0.062***	-0.066***	-0.061***
	[0.001]	[0.001]	[0.001]	[0.002]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]
α_{IML_M}	-0.006***	-0.006***	-0.008***	-0.004***	-0.004***	-0.005***	-0.007***	-0.002***	-0.008***
	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]
α_{IMK}	-0.013***	-0.016***	-0.012***	-0.012***	-0.011***	-0.008***	-0.012***	-0.014***	-0.012***
	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]
α_{IMIS}	-0.117***	-0.113***	-0.120***	-0.113***	-0.122***	-0.119***	-0.116***	-0.113***	-0.121***
	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]
α_{KK}	0.012***	0.016***	0.010***	0.012***	0.010***	0.005***	0.012***	0.013***	0.012***
	[0.001]	[0.002]	[0.001]	[0.002]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]
α_{KL_D}	0.006***	0.008***	0.005***	0.005**	0.007***	0.008***	0.006***	0.012***	0.004***
	[0.001]	[0.002]	[0.001]	[0.002]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]
α_{KL_M}	0.003***	0	0.003***	0.004***	0.002***	0.003***	0.002***	0	0.003***
	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]
α_{KIS}	-0.008***	-0.009***	-0.007***	-0.009***	-0.007***	-0.007***	-0.008***	-0.011***	-0.007***
	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]
α_{ISIS}	0.158***	0.156***	0.158***	0.161***	0.161***	0.161***	0.158***	0.165***	0.159***
	[0.001]	[0.002]	[0.001]	[0.002]	[0.001]	[0.002]	[0.001]	[0.001]	[0.002]
α_{ISL_D}	-0.030***	-0.030***	-0.027***	-0.037***	-0.029***	-0.032***	-0.030***	-0.039***	-0.027***
	[0.001]	[0.002]	[0.001]	[0.002]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]
α_{ISL_M}	-0.003***	-0.003***	-0.003***	-0.002**	-0.003***	-0.003***	-0.004***	-0.002**	-0.004***
	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]
$\alpha_{L_DL_D}$	0.081***	0.081***	0.072***	0.106***	0.077***	0.080***	0.082***	0.092***	0.078***
	[0.002]	[0.003]	[0.002]	[0.004]	[0.002]	[0.002]	[0.002]	[0.003]	[0.002]
$\alpha_{L_DL_M}$	0.005***	0.008***	0.006***	-0.001	0.004***	0.006***	0.005***	0.001	0.005***
	[0.001]	[0.002]	[0.001]	[0.002]	[0.001]	[0.001]	[0.001]	[0.002]	[0.001]
$\alpha_{L_ML_M}$	0.002***	0.002	0.001	0.004**	0.001	0	0.004***	0.003***	0.004***
	[0.001]	[0.001]	[0.001]	[0.002]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]
Observations	3274	1060	1428	786	2527	1327	3006	1327	1334
R-squared	0.993	0.994	0.993	0.994	0.993	0.994	0.99	0.995	0.994

Output Elasticities

K	0.038***	0.044***	0.039***	0.032***	0.034***	0.025***	0.037***	0.040***	0.033***
	[0.002]	[0.003]	[0.002]	[0.003]	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]
L_D	0.151***	0.162***	0.132***	0.193***	0.148***	0.152***	0.155***	0.179***	0.148***
	[0.002]	[0.004]	[0.003]	[0.005]	[0.002]	[0.003]	[0.002]	[0.003]	[0.003]
L_M	0.014***	0.015***	0.017***	0.008***	0.008***	0.008***	0.015***	0.007***	0.017***
	[0.001]	[0.002]	[0.002]	[0.002]	[0.001]	[0.002]	[0.001]	[0.002]	[0.002]
IM	0.520***	0.502***	0.540***	0.485***	0.530***	0.522***	0.517***	0.503***	0.527***
	[0.001]	[0.003]	[0.002]	[0.003]	[0.002]	[0.002]	[0.001]	[0.002]	[0.002]
IS	0.276***	0.278***	0.272***	0.282***	0.280***	0.292***	0.276***	0.272***	0.274***
	[0.002]	[0.003]	[0.002]	[0.003]	[0.002]	[0.003]	[0.002]	[0.003]	[0.003]

*** $p<0.01$, ** $p<0.05$, * $p<0.1$. Robust S.E. in brackets. All the specifications include area, time and sector dummies together with controls for regional unemployment rate and shadow economy.

Table 8: Technical Elasticities of Substitution

	All	High Tech&. Scale	Traditional	Specialized Suppliers	Exporters	Foreign Competitor	SMEs	North-West	Noth-East
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]
$TES_{L_D L_M}$	0.250***	0.269***	0.297***	0.166***	0.229***	0.165***	0.240***	0.222***	0.226***
	[0.011]	[0.022]	[0.018]	[0.017]	[0.013]	[0.017]	[0.011]	[0.015]	[0.017]
$TES_{L_D K}$	3.442***	3.091***	4.096***	2.507***	3.595***	3.439***	3.346***	2.816***	3.565***
	[0.049]	[0.077]	[0.089]	[0.068]	[0.057]	[0.077]	[0.049]	[0.054]	[0.074]
$TES_{L_D IM}$	1.828***	1.710***	2.064***	1.459***	1.900***	1.923***	1.783***	1.524***	1.853***
	[0.032]	[0.053]	[0.056]	[0.045]	[0.036]	[0.051]	[0.032]	[0.038]	[0.046]
$TES_{L_D IS}$	0.094***	0.090***	0.131***	0.039***	0.056***	0.055***	0.100***	0.037***	0.115***
	[0.008]	[0.015]	[0.014]	[0.013]	[0.009]	[0.012]	[0.009]	[0.011]	[0.013]
$TES_{K L_D}$	3.996***	3.717***	3.372***	6.014***	4.376***	6.076***	4.166***	4.503***	4.432***
	[0.182]	[0.301]	[0.205]	[0.632]	[0.244]	[0.621]	[0.198]	[0.298]	[0.327]
$TES_{IM L_D}$	0.290***	0.324***	0.244***	0.399***	0.278***	0.291***	0.299***	0.355***	0.281***
	[0.004]	[0.008]	[0.005]	[0.011]	[0.004]	[0.006]	[0.004]	[0.007]	[0.006]
$TES_{IS L_D}$	0.547***	0.585***	0.484***	0.685***	0.526***	0.520***	0.561***	0.656***	0.540***
	[0.010]	[0.018]	[0.013]	[0.021]	[0.010]	[0.014]	[0.010]	[0.016]	[0.013]
$TES_{L_M L_D}$	10.612***	11.091***	7.640***	25.502***	17.896***	18.154***	10.007***	26.945***	8.678***
	[0.946]	[1.812]	[0.838]	[8.484]	[2.924]	[4.068]	[0.900]	[7.717]	[0.996]
$TES_{L_M K}$	2.655***	2.984***	2.266***	4.240***	4.090***	2.988***	2.402***	5.984***	1.958***
	[0.249]	[0.490]	[0.266]	[1.461]	[0.673]	[0.695]	[0.229]	[1.715]	[0.254]
$TES_{L_M IM}$	36.532***	34.278***	31.296***	63.944***	64.340***	62.429***	33.483***	75.887***	30.932***
	[3.016]	[5.238]	[3.090]	[20.618]	[10.122]	[13.436]	[2.779]	[21.112]	[3.233]
$TES_{L_M IS}$	19.401***	18.968***	15.769***	37.216***	34.002***	34.915***	17.837***	41.054***	16.077***
	[1.614]	[2.920]	[1.565]	[12.085]	[5.357]	[7.553]	[1.493]	[11.453]	[1.710]
$TES_{K L_M}$	0.377***	0.335***	0.441***	0.236***	0.245***	0.335***	0.416***	0.167***	0.511***
	[0.035]	[0.055]	[0.052]	[0.081]	[0.040]	[0.078]	[0.040]	[0.048]	[0.066]
$TES_{IM L_M}$	0.027***	0.029***	0.032***	0.016***	0.016***	0.016***	0.030***	0.013***	0.032***
	[0.002]	[0.004]	[0.003]	[0.005]	[0.002]	[0.003]	[0.002]	[0.004]	[0.003]
$TES_{IS L_M}$	0.052***	0.053***	0.063***	0.027***	0.029***	0.029***	0.056***	0.024***	0.062***
	[0.004]	[0.008]	[0.006]	[0.009]	[0.005]	[0.006]	[0.005]	[0.007]	[0.007]

*** p<0.01, ** p<0.05, * p<0.1. S.E. in brackets.

Table 9: Cost Function Estimates

	All Scale [1]	High Tech&. [2]	Traditional Suppliers [3]	Specialized [4]	Exporters [5]	Foreign Competitor [6]	SMEs [7]	North-West [8]	Noth-East [9]
β_{L_D}	0.539***	0.808***	0.413***	0.501***	0.452***	0.456***	0.547***	0.493***	0.700***
	[0.063]	[0.109]	[0.085]	[0.176]	[0.072]	[0.098]	[0.066]	[0.117]	[0.098]
$\beta_{L_D L_D}$	0.013**	-0.003	0.021**	0.027	0.016**	0.013	0.016**	0.022**	0.002
	[0.006]	[0.010]	[0.008]	[0.018]	[0.007]	[0.009]	[0.006]	[0.011]	[0.009]
β_{L_M}	0.209***	0.314***	0.107***	0.184***	0.204***	0.224***	0.200***	0.244***	0.187***
	[0.018]	[0.030]	[0.026]	[0.041]	[0.020]	[0.027]	[0.020]	[0.028]	[0.029]
$\beta_{L_M L_M}$	-0.003	0	-0.007***	0.008	-0.003	-0.004	-0.001	-0.003	0.002
	[0.002]	[0.003]	[0.003]	[0.006]	[0.002]	[0.003]	[0.002]	[0.003]	[0.003]
β_{IM}	-0.582***	-0.863***	-0.630***	-0.204	-0.757***	-0.594***	-0.653***	-1.098***	-0.391**
	[0.129]	[0.193]	[0.219]	[0.312]	[0.146]	[0.209]	[0.135]	[0.245]	[0.180]
β_{IMIM}	-0.077**	-0.134***	0.204**	-0.118	-0.157***	-0.131*	-0.085**	-0.124	-0.074*
	[0.035]	[0.046]	[0.096]	[0.094]	[0.041]	[0.079]	[0.035]	[0.087]	[0.043]
β_{IS}	0.835***	0.742***	1.111***	0.518*	1.101***	0.914***	0.906***	1.361***	0.505***
	[0.109]	[0.161]	[0.182]	[0.286]	[0.124]	[0.179]	[0.114]	[0.205]	[0.149]
β_{ISIS}	0.014	-0.033	0.339***	-0.098	-0.005	-0.05	0.012	0.056	-0.037
	[0.029]	[0.036]	[0.086]	[0.090]	[0.036]	[0.076]	[0.029]	[0.079]	[0.033]
γ_{K}	-0.221***	-0.223***	-0.213***	-0.241***	-0.216***	-0.238***	-0.224***	-0.219***	-0.210***
	[0.013]	[0.026]	[0.017]	[0.028]	[0.014]	[0.020]	[0.013]	[0.023]	[0.018]
β_{IML_D}	0.026**	0.037**	0.034*	0.007	0.050***	0.026	0.029**	0.059***	0.022
	[0.011]	[0.017]	[0.019]	[0.028]	[0.013]	[0.019]	[0.012]	[0.021]	[0.015]
β_{IMIS}	0.029	0.066*	-0.263***	0.106	0.079**	0.087	0.035	0.033	0.046
	[0.030]	[0.037]	[0.088]	[0.088]	[0.036]	[0.075]	[0.030]	[0.080]	[0.035]
γ_{KIS}	0.008***	0.005	0.010***	0.009**	0.005*	0.006*	0.009***	0.009**	0.003
	[0.002]	[0.004]	[0.003]	[0.004]	[0.002]	[0.003]	[0.002]	[0.004]	[0.003]
β_{ISL_D}	-0.031***	-0.017	-0.056***	-0.015	-0.058***	-0.031*	-0.036***	-0.071***	-0.012
	[0.010]	[0.014]	[0.016]	[0.027]	[0.011]	[0.016]	[0.010]	[0.018]	[0.012]
β_{ISL_M}	-0.011***	-0.015***	-0.019***	0.006	-0.016***	-0.006*	-0.011***	-0.019***	0.003
	[0.002]	[0.004]	[0.004]	[0.005]	[0.003]	[0.003]	[0.003]	[0.004]	[0.004]
β_{IML_M}	0.022***	0.031***	0.025***	0.005	0.028***	0.019***	0.021***	0.031***	0.006
	[0.003]	[0.005]	[0.005]	[0.005]	[0.003]	[0.004]	[0.003]	[0.004]	[0.004]
γ_{KIM}	-0.028***	-0.025***	-0.028***	-0.032***	-0.025***	-0.028***	-0.028***	-0.029***	-0.022***
	[0.003]	[0.005]	[0.004]	[0.005]	[0.003]	[0.004]	[0.003]	[0.004]	[0.004]
γ_{KL_D}	0.016***	0.016***	0.018***	0.017***	0.015***	0.017***	0.018***	0.014***	0.016***
	[0.002]	[0.003]	[0.002]	[0.004]	[0.002]	[0.003]	[0.002]	[0.003]	[0.003]
γ_{KL_M}	0.003**	0.005*	0	0.005	0.005***	0.006***	0.001	0.006**	0.002
	[0.001]	[0.003]	[0.002]	[0.004]	[0.002]	[0.002]	[0.001]	[0.002]	[0.002]
$\beta_{L_D L_M}$	-0.008***	-0.016***	0.001	-0.019***	-0.009***	-0.008***	-0.009***	-0.010***	-0.011***
	[0.002]	[0.004]	[0.003]	[0.006]	[0.002]	[0.003]	[0.002]	[0.004]	[0.003]
γ_{Y}	1.896***	1.910***	1.898***	1.913***	1.818***	1.826***	1.931***	1.918***	1.904***
	[0.019]	[0.037]	[0.026]	[0.043]	[0.022]	[0.030]	[0.019]	[0.032]	[0.028]
γ_{YL_D}	-0.074***	-0.072***	-0.079***	-0.079***	-0.067***	-0.066***	-0.079***	-0.073***	-0.077***
	[0.003]	[0.005]	[0.004]	[0.006]	[0.003]	[0.004]	[0.003]	[0.004]	[0.004]
γ_{YL_M}	-0.013***	-0.017***	-0.007**	-0.009*	-0.013***	-0.015***	-0.011***	-0.017***	-0.011***
	[0.002]	[0.004]	[0.003]	[0.005]	[0.002]	[0.003]	[0.002]	[0.003]	[0.003]
γ_{YIM}	0.141***	0.141***	0.140***	0.134***	0.121***	0.138***	0.146***	0.148***	0.133***
	[0.004]	[0.008]	[0.006]	[0.008]	[0.004]	[0.006]	[0.004]	[0.006]	[0.006]
γ_{YIS}	-0.054***	-0.051***	-0.054***	-0.046***	-0.042***	-0.057***	-0.056***	-0.058***	-0.045***
	[0.003]	[0.007]	[0.005]	[0.007]	[0.004]	[0.005]	[0.004]	[0.005]	[0.005]
Observations	3199	1025	1396	778	2493	1306	2937	1300	1316
R-squared	0.994	0.995	0.994	0.994	0.994	0.995	0.992	0.995	0.994

*** p<0.01, ** p<0.05, * p<0.1. Robust S.E. in brackets. All the specifications include area, time and sector dummies together with controls for regional unemployment rate and shadow economy.

Table 10: Price and Demand Elasticities

	All	High Tech&. Scale	Traditional	Specialized Suppliers	Exporters	Foreign Competitor	SMEs	North-West	Noth-East
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]
Partial Price Elasticities: Direct Estimates From the Production Function									
$\epsilon_{p_{L_D} x_{L_D}}$	-0.252***	-0.288***	-0.241***	-0.276***	-0.252***	-0.246***	-0.254***	-0.238***	-0.259***
	[0.011]	[0.018]	[0.018]	[0.025]	[0.012]	[0.018]	[0.012]	[0.016]	[0.016]
$\epsilon_{p_{L_D} x_{L_M}}$	0.048***	0.074***	0.058***	0.037**	0.039***	0.037***	0.053***	0.026***	0.056***
	[0.006]	[0.009]	[0.010]	[0.015]	[0.006]	[0.009]	[0.007]	[0.010]	[0.009]
$\epsilon_{p_{L_D} x_K}$	0.083***	0.086***	0.095***	0.049***	0.099***	0.112***	0.077***	0.092***	0.073***
	[0.006]	[0.011]	[0.010]	[0.014]	[0.007]	[0.010]	[0.006]	[0.009]	[0.009]
$\epsilon_{p_{L_D} x_{IM}}$	0.080***	0.072***	0.067***	0.102***	0.078***	0.053***	0.084***	0.097***	0.078***
	[0.005]	[0.009]	[0.009]	[0.011]	[0.006]	[0.009]	[0.006]	[0.007]	[0.009]
$\epsilon_{p_{L_D} x_{IS}}$	0.041***	0.056***	0.020*	0.088***	0.036***	0.043***	0.040***	0.023***	0.051***
	[0.006]	[0.010]	[0.010]	[0.010]	[0.007]	[0.009]	[0.006]	[0.008]	[0.010]
$\epsilon_{p_{L_M} x_{L_M}}$	-0.894***	-0.977***	-0.904***	-1.110***	-1.041***	-1.173***	-0.816***	-0.355	-0.842***
	[0.052]	[0.085]	[0.065]	[0.335]	[0.091]	[0.120]	[0.062]	[0.244]	[0.071]
$\epsilon_{p_{L_M} x_{L_D}}$	0.512***	0.824***	0.444***	0.936**	0.706***	0.681***	0.534***	0.702***	0.488***
	[0.062]	[0.103]	[0.073]	[0.386]	[0.107]	[0.155]	[0.068]	[0.267]	[0.076]
$\epsilon_{p_{L_M} x_K}$	0.239***	0.051	0.263***	0.710***	0.272***	0.176	0.232***	0.182	0.176***
	[0.045]	[0.077]	[0.053]	[0.235]	[0.081]	[0.111]	[0.045]	[0.172]	[0.060]
$\epsilon_{p_{L_M} x_{IM}}$	0.106***	0.079	0.126***	-0.228	0.057	0.172*	0.070*	-0.293**	0.121**
	[0.035]	[0.062]	[0.043]	[0.171]	[0.069]	[0.092]	[0.036]	[0.136]	[0.049]
$\epsilon_{p_{L_M} x_{IS}}$	0.036	0.023	0.071	-0.309**	0.007	0.143*	-0.02	-0.236**	0.058
	[0.034]	[0.060]	[0.043]	[0.146]	[0.062]	[0.080]	[0.035]	[0.119]	[0.047]
Partial Demand Elasticities: Direct Estimates From the Cost Function									
$\eta_{x_{L_D} p_{L_D}}$	-0.766***	-0.888***	-0.712***	-0.672***	-0.744***	-0.763***	-0.747***	-0.705***	-0.846***
	[0.0419]	[0.0759]	[0.0604]	[0.103]	[0.0476]	[0.0631]	[0.0428]	[0.0720]	[0.0639]
$\eta_{x_{L_D} p_{L_M}}$	-0.0402***	-0.0892***	0.0197	-0.102***	-0.0478***	-0.0400*	-0.0466***	-0.0479*	-0.0679***
	[0.0154]	[0.0280]	[0.0224]	[0.0381]	[0.0171]	[0.0216]	[0.0166]	[0.0251]	[0.0242]
$\eta_{x_{L_D} p_{IM}}$	0.729***	0.800***	0.819***	0.551***	0.900***	0.722***	0.742***	0.914***	0.701***
	[0.0791]	[0.123]	[0.145]	[0.167]	[0.0899]	[0.128]	[0.0800]	[0.141]	[0.106]
$\eta_{x_{L_D} p_{IS}}$	0.0778	0.177*	-0.126	0.222	-0.108	0.0808	0.0512	-0.162	0.213**
	[0.0676]	[0.103]	[0.123]	[0.156]	[0.0778]	[0.112]	[0.0686]	[0.120]	[0.0869]
$\eta_{x_{L_M} p_{L_M}}$	-1.189***	-0.971***	-1.685***	-0.252	-1.244***	-1.240***	-1.086***	-1.155***	-0.811***
	[0.136]	[0.116]	[0.263]	[0.524]	[0.173]	[0.173]	[0.164]	[0.200]	[0.258]
$\eta_{x_{L_M} p_{L_D}}$	-0.396***	-0.417***	0.26	-1.499***	-0.537***	-0.364*	-0.510***	-0.428*	-0.803***
	[0.151]	[0.131]	[0.296]	[0.561]	[0.192]	[0.197]	[0.181]	[0.225]	[0.287]
$\eta_{x_{L_M} p_{IM}}$	2.074***	1.613***	3.047***	0.913**	2.734***	1.698***	2.155***	2.371***	1.077***
	[0.188]	[0.156]	[0.453]	[0.464]	[0.230]	[0.253]	[0.224]	[0.250]	[0.354]
$\eta_{x_{L_M} p_{IS}}$	-0.489***	-0.225*	-1.622***	0.838**	-0.953***	-0.0939	-0.560***	-0.788***	0.537*
	[0.160]	[0.131]	[0.383]	[0.410]	[0.197]	[0.213]	[0.191]	[0.212]	[0.299]

*** $p<0.01$, ** $p<0.05$, * $p<0.1$. S.E. in brackets.

Table 11: Morishima Elasticities of Substitution, $\frac{\partial ln(X_i/X_j)}{\partial lnp_j}$

	All	High Tech&. Scale	Traditional	Specialized Suppliers	Exporters	Foreign Competitor	SMEs	North-West	Noth-East
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]
Morishima Elasticities of Substitution: Direct Estimates From the Cost Function									
$mes_{L_D L_M}$	1.149***	0.882***	1.704***	0.15	1.196***	1.200***	1.039***	1.107***	0.743***
	[0.149]	[0.139]	[0.281]	[0.559]	[0.187]	[0.190]	[0.178]	[0.222]	[0.278]
$mes_{L_D IM}$	1.321***	1.522***	0.894***	1.271***	1.637***	1.419***	1.354***	1.619***	1.287***
	[0.125]	[0.188]	[0.267]	[0.287]	[0.142]	[0.221]	[0.127]	[0.256]	[0.165]
$mes_{L_D IS}$	0.736***	0.981***	-0.574*	1.231***	0.614***	0.957***	0.714***	0.352	1.038***
	[0.126]	[0.165]	[0.312]	[0.369]	[0.152]	[0.300]	[0.128]	[0.295]	[0.145]
$mes_{L_M L_D}$	0.370**	0.471***	0.972***	-0.827	0.207	0.399*	0.237	0.276	0.0428
	[0.160]	[0.155]	[0.306]	[0.593]	[0.202]	[0.208]	[0.190]	[0.243]	[0.296]
$mes_{L_M IM}$	2.667***	2.335***	3.123***	1.633***	3.471***	2.395***	2.767***	3.076***	1.663***
	[0.217]	[0.201]	[0.528]	[0.548]	[0.261]	[0.327]	[0.253]	[0.333]	[0.389]
$mes_{L_M IS}$	0.169	0.578***	-2.071***	1.846***	-0.231	0.782**	0.103	-0.274	1.362***
	[0.190]	[0.180]	[0.470]	[0.499]	[0.235]	[0.332]	[0.218]	[0.333]	[0.321]
$mes_{IM L_D}$	0.956***	1.092***	0.907***	0.856***	0.978***	0.957***	0.945***	0.968***	1.028***
	[0.0550]	[0.0962]	[0.0833]	[0.135]	[0.0622]	[0.0844]	[0.0563]	[0.0985]	[0.0820]
$mes_{IM L_M}$	1.244***	1.060***	1.740***	0.272	1.308***	1.290***	1.138***	1.231***	0.834***
	[0.136]	[0.117]	[0.264]	[0.525]	[0.174]	[0.174]	[0.164]	[0.201]	[0.259]
$mes_{IM IS}$	1.006***	1.233***	-0.623	1.524***	1.161***	1.328***	1.025***	0.878**	1.206***
	[0.150]	[0.183]	[0.447]	[0.460]	[0.184]	[0.394]	[0.152]	[0.410]	[0.171]
$mes_{IS L_D}$	0.804***	0.967***	0.655***	0.795***	0.691***	0.803***	0.772***	0.623***	0.947***
	[0.0539]	[0.0924]	[0.0774]	[0.147]	[0.0620]	[0.0861]	[0.0554]	[0.0944]	[0.0784]
$mes_{IS L_M}$	1.165***	0.950***	1.629***	0.283	1.203***	1.235***	1.061***	1.110***	0.833***
	[0.136]	[0.116]	[0.263]	[0.524]	[0.173]	[0.173]	[0.164]	[0.200]	[0.258]
$mes_{IS IM}$	1.237***	1.468***	-0.259	1.574***	1.553***	1.537***	1.275***	1.344***	1.288***
	[0.161]	[0.203]	[0.469]	[0.462]	[0.194]	[0.399]	[0.164]	[0.426]	[0.192]

*** p<0.01, ** p<0.05, * p<0.1. S.E. in brackets.