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DECOMPOSING PRODUCTIVITY DIFFERENTIAL: EVIDENCE FROM FOREIGN OWNED AND DOMESTIC FIRMS IN ITALY

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Abstract
Using the idea of the multidimensional generalization of the Duncans' index (Silber 1992), the productivity per worker differential across groups of firms can be decomposed into different components attributed to differences in: sectoral productivity, investment in human and physical capital, employment and other determinants. More specifically, for decomposing group productivity differential we propose an Oaxaca's decomposition – based approach which assumes a Reimer's weighting scheme. An application of the decomposing method aimed at evaluating productivity differences across foreign owned and domestic firms in Italy is also provided.

KEYWORDS: Productivity, Foreign acquisitions, Oaxaca decomposition.

1. Introduction

The increase of labor productivity is the driving force of improving living standards. The role of input reallocation in productivity growth has been studied by using various kinds of decomposition methods. Some studies have examined inter-industry restructuring (Bernard and Jones, 1996) and some other intra-industry restructuring using firm or establishment data (Baily *et al*., 1992; Baily *et al*., 2001; Foster *et al*., 2001). New theories go beyond the representative firm framework by emphasizing the role of firms (and establishment) heterogeneity in the economic development even at a deeper level (Grossman and Helpman, 1991; Hopenhayn, 1992; Melitz, 2003; Helpman *et al*., 2004; Klette and Kortum, 2004). The employment structures of the firms/establishments and intra-firm/intra-establishment restructuring through hiring and separation of workers is potentially an important source of heterogeneity for productivity levels and growth rates between firms/establishments. Changes in the employment structures affect the skill composition, which in turn, according to the human capital literature (Becker 1962), should be reflected in productivity and wage growth at different levels of aggregation (Krueger and Lindahl, 2001).

The recent empirical literature on productivity measurement and economic growth has shown evidence of the role of firms heterogeneity, sectoral composition as well as foreign acquisitions on productivity differentials at both macro and micro economic level (Van Ark, 2004; Karpaty, 2007).

Evidence of the contribution of the ownership structure in explaining relevant and persistent differences in productivity among firms/establishments has been found in literature showing the importance of being a foreign or domestic firm or a multinational firm (Bellak 2004). Besides ownership factors, sources of productivity differentials are: size, wage and skill gaps also connected to the high capital (physical and human) intensity of foreign firms, and differences related to competition and international trade, even within the same industry. Other studies have shown that the substantive productivity gaps ascribed to foreign ownership declines after controlling for labor productivity.

In this vein, this paper proposes a framework for studying the sources of labour productivity differentials between groups of foreign-owned and domestic firms. Using the idea of the multidimensional generalization of the Duncans' index (Silber 1992), the productivity per worker differential across groups of firms can be decomposed into different components attributed to differences in: sectoral productivity, investment in human and physical capital, employment and other characteristics. More specifically, we propose an Oaxaca's decomposition - based approach which assumes a Reimer's weighting scheme. The idea is to measure and decompose the difference among the average per worker value added of the groups of firms into three components: one related to differences in the human and physical capital, a second due to value added differentials and a third which is linked to the existence of occupational composition by sector differences. The decomposition is based on a parametric model aimed at identifying the potential determinants of value added per worker differentials and analyzing the relative importance (weight) of each source of productivity differential within the groups of firms we are interested on. Our approach provides a way to quantify the contribution of each well-identified source of productivity differential either in a micro or macro framework.

An empirical micro-economic analysis is presented with the aim of analyzing the differences between foreign-owned and domestic Italian firms with respect to productivity, focusing the attention on determinants as human and physical capital.

The remainder of the paper is organized as follows. Section 2 describes the proposed productivity decomposition method. In section 3 we describe the used data set and discuss the estimated models and the results of the productivity decomposition. In the last section we present some concluding remarks.

2. Methodology

Following the approach of Silber (1992), a multidimensional generalization of the Duncans'index, which amounts to comparing actual with expected shares, may be derived as follows.

Let N_{ij} be the number of workers in sector *i* belonging to the firm group *j* and let ln y_{ij} be the corresponding average logarithm of their per worker value added (VA).

The average ln y_{0j} for all sectors belonging to the group *j* may be written as:

$$\ln y_{0j} = \sum_i \left(\frac{N_{ij}}{N_{0j}} \right) \ln y_{ij} \qquad (1)$$

where $N_{0j} = \sum_i N_{ij}$ is the total number of workers of group *j*.

The average ln y_{0h} for all sectors belonging to the group *h*, is defined analogously.

When there is independence, the expected number of workers in sector i belonging to group j, $\mathrm{E}(N_{ij})$, is equal to:

$$\mathrm{E}(N_{ij}) = \frac{N_{0j} N_{i0}}{N} \tag{2}$$

where N_{i0} and N are respectively the total number of workers in sector i and the total employment (in all sectors).
The expected log of the per worker value added relative to group j and h, $\mathrm{E}(\ln y_{0j})$ and $\mathrm{E}(\ln y_{0h})$, is respectively written as:

$$\begin{aligned} E(\ln y_{0j}) &= \sum_i \left(\frac{N_{i0}}{N} \right) \ln y_{ij}, \\ E(\ln y_{0h}) &= \sum_i \left(\frac{N_{i0}}{N} \right) \ln y_{ih}. \end{aligned} \tag{3}$$

The expected gap between logs of the per worker VA relative to firms belonging to the groups j and h, $(\mathrm{E}\Delta_{jh})$ is equal to:

$$E\Delta_{jh} = \sum_i \left(\frac{N_{i0}}{N} \right) (\ln y_{ij} - \ln y_{ih}) \tag{4}$$

Using EQ (1) the actual gap between the logs of per worker Vas, (Δ_{jh}) can be written as:

$$\Delta_{jh} = \sum_i \left[\left(\frac{N_{ij}}{N_{0j}} \right) \ln y_{ij} - \left(\frac{N_{ih}}{N_{0h}} \right) \ln y_{ih} \right] \tag{5}$$

Combining Equations (4) and (5) gives:

$$\Delta_{jh} = \sum_i \left\{ \left[\left(\frac{N_{ij}}{N_{0j}} \right) - \left(\frac{N_{i0}}{N} \right) \right] \ln y_{ij} - \left[\left(\frac{N_{ih}}{N_{0h}} \right) - \left(\frac{N_{i0}}{N} \right) \right] \ln y_{ih} \right\} + \left[\sum_i \left(\frac{N_{i0}}{N} \right) \left(\ln y_{ij} - \ln y_{ih} \right) \right] \tag{6}$$

The expression within curly brackets in (6) represents the part of the actual per worker VA gap which is due to occupational composition by sector differences. The second part of (6) is used to compute the contribution to the gap due to some specific components such as human and physical capital, which are relevant in explaining the actual per worker VA gap Δ_{jh}.

In this respect, for each group *j* and *h*, we introduce the following statistical models:

$$\begin{aligned} \ln y_{ijl} &= \sum_k \beta_{ijk} x_{ijkl} + \varepsilon_{ijl} \\ \ln y_{ihl} &= \sum_k \beta_{ihk} x_{ihkl} + \varepsilon_{ihl} \end{aligned} \tag{7}$$

where the dependent variables are the log of per worker VA of firm *l* operating in sector *i* belonging to group *j*(*h*), β_{ijk} and β_{ihk} are the parameters of the *k*-th ($k = 1,.., p$) explanatory variables relative to sector *i* and groups *j* and *h* respectively. ε_{ijl} and ε_{ihl} are the corresponding error terms.

Using coefficients estimates $\hat{\beta}_{ijk}$ and $\hat{\beta}_{ihk}$ we have[1]:

$$\begin{aligned} \ln y_{ij} &= \sum_k \hat{\beta}_{ijk} \bar{x}_{ijk} \\ \ln y_{ih} &= \sum_k \hat{\beta}_{ihk} \bar{x}_{ihk} \end{aligned} \tag{8}$$

[1] Assuming exogeneity of regressors, the conditional expectations of the error terms are zero.

Finally, applying Oaxaca's (1973) approach to (2) and using Reimer's (1983) weighting scheme it can be shown that the differential of the logs of the per worker VA of groups *j* and *h* of firms operating in sector *i* is given by:

$$\ln y_{ij} - \ln y_{ih} = H_i + D_i \quad (9)$$

where:

$$H_i = \sum_k \left(\left(\hat{\beta}_{ijk} + \hat{\beta}_{ihk} \right) / 2 \right) \left(\bar{x}_{ijk} - \bar{x}_{ihk} \right) \quad (10)$$

$$D_i = \sum_k \left(\left(\bar{x}_{ijk} + \bar{x}_{ihk} \right) / 2 \right) \left(\hat{\beta}_{ijk} - \hat{\beta}_{ihk} \right) \quad (11)$$

H_i in Eq (9) represents that part of the differential between the means of the logs of the per worker VA of group *j* and *h* in sector *i*, which is explained by group differences in factor endowments relative to the determinants introduced into the model specification whereas D_i in Eq(9) represents the contribution of group differences in the impacts of factor inputs .
Combining Eq (6), (9), (10) and (11) gives:

$$\Delta_{jh} = S + H + D \quad (12)$$

where:

$$S = \sum_i \left\{ \left[\left(\frac{N_{ij}}{N_{0j}} \right) - \left(\frac{N_{i0}}{N} \right) \right] \ln y_{ij} - \left[\left(\frac{N_{ih}}{N_{0h}} \right) - \left(\frac{N_{i0}}{N} \right) \right] \ln y_{ih} \right\} \quad (13)$$

$$H = \sum_i \left(\frac{N_{i0}}{N} \right) H_i \quad (14)$$

$$D = \sum_i \left(\frac{N_{i0}}{N} \right) D_i \tag{15}$$

S in Eq (12) and (13) represents that part of the overall differential between groups *j* and *h* which stems from the existence of group differences in occupational composition by sector. *H* in Eq (12) and (14) and *D* in Eq (12) and (15) give respectively the contributions of group differences in factor endowments and in the impacts of factor inputs.
This decomposition separates total productivity differential between two groups of firms into three broad components: the overall *endowment component* given by *H*, the overall *impact component* given by *D*, and the *S* component which measures the contribution of the occupational composition by sector.
Although the generalization of the Duncan index is used, the dependence between the occupational composition and the groups examined may be checked on the basis of other indices, such as entropy indices or generalizations of the Gini index. However, the present study is limited to the use of the generalization of the Duncan index which also refers to the case when more than two groups are distinguished, but this does not imply that this index should be preferred.

3. Application to the Italian manufacturing sector

The empirical analysis presented in this section is aimed at analyzing the differences between foreign owned and domestic firms with respect to productivity. This study is based on a dataset resulting from a survey on Italian firms in the manufacturing sector linked with balance sheets data for the same firms.
Our analysis was done by specifying separate regression functions for each group, and then examining coefficients for differentials in productivity. Interpretation of the parameter values is not the primary concern.

3.1 Data and measures

The data comes from the 9th wave (covering the years 2001-2003) of the sample survey carried out every three years by Capitalia on Italian manufacturing firms[2].

The target population refers to manufacturing firms with more than 10 employees: firms with more than 500 employees are totally sampled whereas firms with less than 500 employees are selected on the basis of a stratified sample by size, activity sector (*Pavitt* classification) and geographical area (North, Centre-South). The original sample consists of 4289 firms.

The survey collects detailed quantitative and qualitative information on property and businesses relationships, labour force, investments, innovation and R&D, internationalization, market and finance. Information is linked with balance sheet data for the three years 2001-2003 covered by the survey, and available only for 3450 firms. Since we need balance sheets data to calculate productivity measures and other variables used in the analysis, we only rely on firms with complete data. Our analysis focus on year 2003.

The variable used to discriminate between "domestic" and "foreign" firms is obtained recoding the survey responses on the firm proprietary assets. Firm is asked to list for each of the main shareholders, in decreasing order of importance, the nationality, the share of the firm's capital she/he holds, and whether she/he controls the firm.

We classify a firm as "foreign" owned if there is one or more foreign subjects that own a share greater than 10% of the capital of the firm, using the definition provided by the OECD and the IMF. "Domestic" firms are then all the firms whose capital is totally hold by residents and firms with a share of foreign ownership below 10%.

We consequently excluded from the sample all firms whose ownership could not be properly identified (81 firms). Ownership information refers at the time of the interview, therefore we implicitly assume that ownership did not change in the considered period.

Productivity differentials are measured between these two groups of firms.

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[2] Capitalia was one of the largest banks in Italy. Recently, Capitalia has been incorporated in the Unicredit group.

Firms are also grouped by sectors using the taxonomy *à la Pavitt*[3]. We use a *Pavitt* taxonomy instead of a Nace based classification mainly because the latter results in groups with a small numbers of firms, especially for the foreign ones. For the same reason, we finally use a three sectors classification comprising: (i) *Supplier dominated* - *Pavitt* sector 1; (ii) *Scale intensive* and *Science based* - *Pavitt* sectors 2 and 4; (iii) *Specialized suppliers* - *Pavitt* sector 3. However, the *Pavitt* taxonomy is also used as sample stratification variables.

The productivity indicator is labour productivity at 2003 measured as value added per worker.

Value added at 2003 is obtained as turnover minus costs of materials and services. Value added is deflated with the corresponding two-digit implicit deflator index to ensure comparability across industries[4].

As a proxy measure for the physical capital we employ the value of fixed assets, deflated with the producer price index[5]. Missing data on value added and stock of fixed capital are imputed with the corresponding values calculated for the year 2002 (or 2001 if the latter is not available).

As indicator of human capital we use skill composition of labour force calculated as shares of managers, white collar, and blue collar on firm's total employment. Even in this case, missing data were imputed with values at 2002 or 2001[6]. Stock of fixed capital and labour force composition are the covariates used in the baseline regression for productivity.

We then proceed by specifying some extended models where other relevant covariates are considered. More specifically we consider: size, measured as turnover at 2003 instead of number of employees, product and process innovation, membership of economic group, subcontracting and the type of market for the output (final or intermediate). For the variables' definition see table 4 in the appendix.

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[3] The Pavitt taxonomy is a classification of economic sectors based on technological opportunities, innovations, R&R intensity and knowledge. It comprises 4 categories: *Supplier dominated, Scale intensive, Specialized suppliers, Science based.*

[4] Implicit deflators for two-digit industries are calculated as the ratio of value added at current prices in 2003 and value added in 2003 at constant prices of 2000 (Istat).

[5] We use the 2003 producer price index for intermediate goods based at 2000 (Istat).

[6] Unfortunately we cannot use the information on labour force composition by education because of too much missing data and in absence of information for the previous years.

Given that there are missing data on various covariates used in different specification and, in order to guarantee comparability across models, we consider only observation with complete data (3225 firms). The number of foreign firms is 229 (7.1% of the sample) that account for the 16.4% of total employment.

Table 1 shows the distribution of firms and employees by sector in domestic and foreign firms. For the whole sample, there is a prevalence of firms in *Suppliers dominated* sectors (sector 1) but the distribution is quite different between domestic and foreign firms. In the latter group the majority of firms (42%) belongs to *Specialized supplier* (sector 3) while the corresponding percentage of employees reduces to 29%. In this respect, the average size (in terms of employment) of firms in this sector is smaller than the average size of firms in sector 1. The reverse happens in the group of domestic firms as well as in the whole sample.

TABLE 1. Distribution of firms and employees by sector (domestic and foreign firms)

Sector		*Domestic*		*Foreign*		*Total*	
		n	*%*	*n*	*%*	*n*	*%*
1	Firms	1616	53.9	76	33.2	1692	52.5
	employees	125701	43.9	20448	36.5	146149	42.7
2	Firms	615	20.5	56	24.4	671	20.8
	employees	77344	27.0	19301	34.4	96645	28.2
3	Firms	765	25.5	97	42.4	862	26.7
	employees	83222	29.1	16307	29.1	99529	29.1
Total	Firms	2996	100	229	100	3225	100
	employees	286267	100	56056	100	342323	100

Table 4 in appendix reports basic statistics of some characteristics for domestic and foreign firms. In particular notice that value added per worker is on average greater for foreign than domestic firms, as well as turnover and stock of capital. Moreover, foreign firms have on average a larger share of white collar on total employment.

3.2 Model specification

The relative labor productivity equation is formulated as follows:

$$\ln y_{ijl} = \beta_{ij0} + \beta_{ij1} x_{ij1l} + \ldots + \beta_{ijpl} x_{ijpl} + \varepsilon_{ijl} \qquad (16)$$

where y_{ijl} is the value added per worker and x_{ijkl} is the k-th regressor (k=1,…p), the index l refers to firms, i refers to sectors, j refers to groups of foreign or domestic firms, β_{ijk} are the parameters to be estimated and vary across sectors in each group, ε_{ijl} are uncorrelated random errors with zero mean and equal variances.

As a result of a preliminary analysis we select four alternative model specifications (results are showed in tables 5 and 6 in appendix).

The baseline model (model 1) considers only the stock of capital and the labour composition (all the covariates are in logarithmic terms). In the second model (model 2) we add two variables capturing the effect of size, the log of turnover at 2003 and its squared term. Model 3 also considers a binary variable for product innovation. The inclusion of binary variables for both product and process innovation results not significant in every group. Model 4 includes the share of turnover deriving from sales of final goods, the share of turnover deriving from subcontracting and the share of subcontracting turnover coming from abroad[7].

Good results of measures of fit (*adjusted* R^2 greater than 98%) are obtained for all models, either for foreign or domestic firms. Direct comparison *via* LR tests between couples of nested models (and separately for foreign and domestic firms) confirm that each added covariate (or set of covariates) significantly contributes to model

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[7] A specification including group membership (as defined in appendix) has been tested against model 3 with an LR test and rejected ($\chi(9)$=12.58, *p value*=0.183 for domestic firms and $\chi(9)$=12.92, *p-value*=0.166)

improvement. As expected, parameters estimates and contribution of covariates differ across sectors as well as across groups.
For domestic firms, we found that human and physical capital are important determinants of the labour productivity. The human capital variables in the labour productivity equations for domestic firms behave as expected in almost all sectors and are significant at the 1% significance level. Nevertheless, the size variable seems to capture an important quote of variability not explained by the previous factors, in fact the constants' values reduce significantly as well as the coefficients of the fixed capital.
The signs of coefficients on size and its square term are positive and negative respectively across all sectors. Thus, size has a significant positive effect on per worker productivity but at a decreasing rate.
Other characteristics are significant only for the *Supplier dominated* sector (sector 1).
For foreign firms only human and physical capital are associated with labor productivity, even if not so strongly as in the case of domestic firms. No other variables are significant for labor productivity.

3.3 Results of productivity decomposition

According to the methodology introduced in section 2, productivity differences relative to each sector between the two groups of firms are decomposed into the components attributed to human and physical capital differences (*H*) and VA differences (*D*).
The first two components are calculated, for each sector, from the estimated models using equations (10) and (11). Results are presented in table 2.
According to these results, the differential for each sector is almost always due to the different characteristics of the groups of foreign and domestic firms (the H_i components) while the unexplained components (D_i) are much smaller, with the only exception of sector 2 in model 1. However, when we introduce further covariates the *D* component becomes smaller than the *H* component also for the latter sector.

TABLE 2. Difference between the average logarithms of per worker Vas of foreign versus domestic firms by sector

Model	*Sector*	H_i	D_i	*Total difference Δlny*
M1	1	0.140	0.022	0.162
	2	0.061	0.228	0.288
	3	0.096	0.066	0.162
M2	1	0.198	-0.036	0.162
	2	0.234	0.054	0.288
	3	0.147	0.015	0.162
M3	1	0.186	-0.024	0.162
	2	0.233	0.056	0.288
	3	0.147	0.015	0.162
M4	1	0.170	-0.008	0.162
	2	0.221	0.067	0.288
	3	0.141	0.021	0.162

Table 3 presents results of the decomposing procedure for productivity differential between domestic and foreign firms into the components *H*, *D* and *S*. *H* and *D* are calculated using (14) and (15). The component *S* is calculated using equation (13) and accounts for the different occupational composition by sector between foreign and domestic firms.

There is a differential of 0.22 between foreign and domestic firms. Focusing on the explained (by characteristics) and unexplained components we can see that their contribution differ significantly.

Apart for model 1, where only capital's dimensions are controlled for, the *H* component accounts for more than 80% of the total differential while the *D* component accounts for only the 10% of the total or even less. This suggests that the measured characteristics, like human and physical capital but also size, innovation, and type of output contribute for the most part to the total differential.

TABLE 3. Difference between the average logarithms of per worker Vas of foreign versus domestic firms

Model	*Δlny*	*S* Differences in occupational composition		*H* Differences in firms' characteristics		*D* Differences in Value Added	
		value	*%*	*value*	*%*	*value*	*%*
M1	0.217897	0.0201	9.24	0.1047	48.05	0.0931	42.71
M2	0.217900	0.0201	9.24	0.1934	88.77	0.0043	1.99
M3	0.217896	0.0201	9.24	0.1877	86.12	0.0101	4.64
M4	0.217899	0.0201	9.24	0.1760	80.76	0.0218	9.99

With reference to the *S* component, our results indicate that the employment distribution by sector is less important than the differences in firms' characteristics in explaining productivity differentials between the foreign and domestic firms and weigh almost equally as the *D* component.

4. Concluding remarks

In this paper we propose an approach to decompose productivity differentials among groups of firms. The idea is to decompose the productivity gap among groups of firms into three different components that can be interpreted as the part of the gap that is explained by group differences in: (i) average observable characteristics of the firms, (ii) the impact of these characteristics, and (iii) occupational composition by sector.

Distinctive features of our work are, on the one hand, the indicator assumed to measure the labor productivity differential, which is consistent with a nonlinear functional form for the productivity relationship, and, on the other hand, the explicit consideration of the *S* component which is linked to the potential dependence between the occupational composition and the groups examined.

The proposed approach has been used to explain differences in productivity between foreign owned and domestic firms in the Italian manufacturing sector. Our results, based on data from a survey carried out by Capitalia for the years 2001-2003, show that productivity differential between foreign-owned and domestic firms are mainly due to the different characteristics, especially in terms of human and physical capital, of the firms in the two groups. This is true for each sector as well as for the whole manufacturing sector. This explained component accounts for more than 80% of the overall productivity differential. The different sectoral composition in terms of employment accounts only for the 9%. Productivity differential due to firms heterogeneity not explained by the observed characteristics is even smaller.

In this respect, our results attempt to provide the first set of evidence on the role of well-defined determinants in analyzing the productivity differences from foreign and domestic ownership firms in Italy, even at a sectoral level, and offer a new analysis's perspective.

This method should be of interest also in the decomposition of price and poverty indices by population subgroups as well as in the growth model analysis aimed at decomposing the total output into factor contributions and a residual term that is the total factor productivity.

Our framework can be extended in a number of ways. One is to explain changes in productivity gaps over time. Another extension would be to take selectivity into account. Selectivity issues that can be explored concern (i) the potential sample selection problem connected to the probability that the firm appears in the sample and/or (ii) the selection into the domestic and foreign groups, that is a group assignment selection. The sample selection correction term (the inverse Mills ratio) can then be used to adjust the group mean difference in the outcome variable by modeling the probability that the firm appears in the sample. Analogously, the group assignment problem can be dealt with by modeling the probability of being in one group rather than the other, and then by using the selection correction terms to adjust the difference in group means.

These issues represent directions for future research and empirical investigation.

Appendix

TABLE 4. Characteristics of domestic and foreign firms

	Domestic		*Foreign*	
Characteristics	*mean*	*cv*	*mean*	*cv*
VA per worker	48.615	0.638	61.273	0.623
Turnover (thousand eu)	22190.580	4.468	74522.210	3.434
Stock of capital (thousand eu)	4381.787	4.039	12141.350	2.556
Share of managers	0.063	1.042	0.041	1.107
Share of white collar	0.263	0.649	0.360	0.591
Share of blue collar	0.674	0.266	0.600	0.385
Majority in a group	0.067	3.740	0.100	2.999
Subsidiary in a group	0.144	2.443	0.467	1.070
Intermediate in a group	0.055	4.156	0.153	2.359
Product innovation	0.411	1.198	0.541	0.922
Process innovation	0.429	1.155	0.498	1.007
Product and process innovation	0.242	1.769	0.328	1.436
Share of turnover deriving form subcontracting	57.239	0.795	55.310	0.828
Share of subcontracting turnover from abroad	19.411	1.517	30.316	1.163
Share of turnover deriving from final goods sales	25.810	1.548	20.878	1.793

TABLE 4. Definition of the variables used in model specifications

Name	*Description*	*Type*
Lnva	Value added per worker (log)	Continuous
Lnstock	Stock of fixed capital (log)	Continuous
Lndirig	Share of managers on employment (log)	Continuous
Lnwhite	Share of white collars on employment (log)	Continuous
Lnblue	Share of blue collars on employment (log)	Continuous
Lnfat	Turnover (log)	Continuous
Lnfatsq	Log of turnover squared	Continuous
Magg	Group membership - majority position	Binary
Subsid	Group membership - subsidiary position	Binary
Interm	Group membership - intermediate position	Binary
Innopro	Product innovation in 2001-03	Binary
Innoprc	Process innovation in 2001-2003	Binary
Innoboth	Product and process innovation in 2001-2003	Binary
Subcontr	Share of turnover from subcontracting	Continuous
Commest	Share of subcontracting turnover from abroad	Continuous
Finmark	Share of turnover from final goods sales	Continuous

TABLE 5. Model estimates - Domestic firms

Variable	*Sector*	*model1*	*model2*	*model3*	*model4*
Constant	1	3.153***	0.801	0.837	0.45
	2	3.454***	0.035	0.066	0.116
	3	3.396***	-0.129	-0.15	-0.173
Lnstock	1	0.107***	0.052***	0.053***	0.048***
	2	0.100***	0.016	0.017	0.016
	3	0.087***	0.014	0.015	0.015
Lndirig	1	0.034***	0.064***	0.062***	0.064***
	2	0.021	0.066***	0.065***	0.064***
	3	0.012	0.050***	0.049***	0.047***
Lnwhite	1	0.143***	0.107***	0.110***	0.112***
	2	0.184***	0.115***	0.118***	0.121***
	3	0.159***	0.084*	0.089*	0.081*
Lnblue	1	-0.228***	-0.186***	-0.188***	-0.192***
	2	0.02	0.024	0.018	0.022
	3	-0.183**	-0.184**	-0.183**	-0.191***
Lnfat	1		0.466***	0.460***	0.542***
	2		0.666***	0.661***	0.654***
	3		0.700***	0.708***	0.725***
Lnfatsq	1		-0.017**	-0.017**	-0.020***
	2		-0.024***	-0.024***	-0.023***
	3		-0.028***	-0.028***	-0.029***
Innopro	1			-0.060**	-0.042
	2			-0.065	-0.069
	3			-0.048	-0.034
Finmark	1				-0.001***
	2				0.000
	3				-0.001**
Subcontr	1				0.001*
	2				0.000
	3				-0.001
Commest	1				-0.002***
	2				0.001
	3				-0.001

TABLE 5. Continued

	model1	*model2*	*model3*	*model4*
Obs	2996	2996	2996	2996
Adjusted R-squared	0.9864	0.9877	0.9877	0.9880
Log-Likelihood	-1800.663	-1643.178	-1636.58	-1603.766
Df	15	21	24	33
AIC	3631.327	3328.356	3321.159	3273.533
LR test (Model K – Model K-1)				
Chi-Squared		314.97	13.20	65.63
Df		6	3	9
P-value		0.0000	0.0042	0.0000

TABLE 6. Model estimates - Foreign firms

Variable	*sector*	*model1*	*model2*	*model3*	*model4*
Constant	1	2.720***	-2.415	-1.663	-1.798
	2	4.280***	1.972	1.706	2.521
	3	3.811***	2.291	2.664	2.781
Lnstock	1	0.145***	0.132***	0.122**	0.121**
	2	-0.011	-0.134**	-0.132**	-0.110**
	3	0.090**	0.031	0.03	0.032
Lndirig	1	0.05	0.075	0.074	0.072
	2	0.051	0.150**	0.143**	0.166**
	3	0.05	0.082*	0.077	0.079
Lnwhite	1	0.023	-0.006	0.028	0.028
	2	-0.062	-0.018	0	0.003
	3	0.293**	0.198	0.196	0.199
Lnblue	1	-0.315	-0.321	-0.301	-0.352
	2	-0.062	0.037	0.05	0.076
	3	-0.008	-0.022	-0.022	-0.003
Lnfat	1		0.990*	0.868	0.892
	2		0.387	0.448	0.32
	3		0.253	0.192	0.2
Lnfatsq	1		-0.046	-0.039	-0.04
	2		-0.003	-0.006	-0.001
	3		-0.006	-0.003	-0.004
Innopro	1			-0.141	-0.124
	2			-0.075	-0.162
	3			-0.16	-0.138
Finmark	1				-0.001
	2				0.002
	3				-0.002
Subcontr	1				0.001
	2				-0.002
	3				-0.001
Commest	1				-0.002
	2				0.003
	3				0.000

TABLE 6. Continued

	model1	*model2*	*model3*	*model4*
Obs	*229*	*229*	*229*	*229*
Adjusted R-squared	0.9873	0.9892	0.9894	0.9894
Log-Likelihood	-135.815	-113.5883	-110.4004	-104.6273
df	15	21	24	33
AIC	301.63	269.1766	268.8009	275.2545
LR test (Model K – Model K-1)				
Chi-Squared		44.45	6.38	11.55
Df		6	3	9
P-value		0.0000	0.0947	0.2401

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