

ANALYSING REGIONAL DIFFERENCES IN TFP.  
EVIDENCE FROM ITALIAN MICRO-DATA

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**Abstract.** This work presents a territorial analysis of total factor productivity in Italy (TFP) from 1998 to 2006 using data at firm level. The territorial aspect is looked at in depth by dividing the TFP into the two components *within-firms* and *between-firm*. These two effects are calculated for both the entire sample and for subgroups of firms in order to consider the sector to which firms belong and their innovative efforts, as well as their internationalisation. The paper finds three main results. The first confirms the role of TFP as a key factor in explaining the recent slowdown of the Italian economy. The second result shows that a modernising of the industrial system has taken place in Italy which has limited the effects deriving from the slowing down of productivity. Finally, we show how this restructuring process has had differing results in the country's different areas, without, however, modifying the technological dualism of the Italian economy.

*Key words:* Manufacturing sector, total factor productivity, Italian regional divide  
*JEL code:* L60, O14, R11

## 1. Introduction

A number of papers have shown how the sluggish growth in the Italian economy, which has been observed over the last decade, can be attributed to structural characteristics in the productive system which render it incapable of dealing with the competitive pressures brought about by market globalisation (e.g. Brandolini and Bugamelli, 2009; Ciocca, 2004; Faini and Sapir 2005, OECD 2007 amongst others). However, analyses based on microeconomic data show how the entrepreneurial system has diversified and underline the presence of a restructuring process which renders the evaluation of Italy's economic situation both more complex and less negative. The slowdown in growth is not widespread and, faced with a loss in international competitiveness,

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Italian firms have adopted diverse strategies in order to reorganise production and develop activities outside the productive cycle. The lesson to be learnt from this literature is that the industrial system has continued to show signs of dynamism, even in the recent phase of low growth (Brandolini and Bugamelli, 2009; Aiello *et al.* 2009; ISTAT, 2009b; Barba Navaretti *et al.*, 2007; Confindustria, 2006).

The aim of this paper is to contribute to the debate by proposing a territorial approach to the problem. This type of evaluation is crucial for Italy where, as is well noted, a territorial dualism persists. As an example, it is sufficient to consider that, in 2007, the average income for an inhabitant of the richest region (Valle d'Aosta) was 2.6 times that of an inhabitant of the poorest region (Calabria) and that the regional distribution of pro-capita income has not varied significantly in the course of the last 25 years (ISTAT, 2005; 2008a).

The territorial analysis proposed here looks in depth at the role of total factor productivity (TFP) which, as has been widely discussed in the literature, is the principle cause of Italy's economic slowdown (Aiello *et al.* 2009; Brandolini and Bugamelli 2009; Saltari and Travaglino, 2008; ISTAT, 2007b; Van Ark, O'Mahony and Ypma, 2007; OECD, 2007; Fachin and Gavosto, 2007; Daveri and Jonia-Lasinio, 2005; ISAE, 2005; Bassanetti *et al.*, 2004; Venturini, 2004; Milana and Zeli, 2003; Brandolini and Cipollone, 2001). The research contributes to this debate by focusing on three areas of interest, the first of which concerns the relationship between labour productivity and multi-factorial productivity. We study this link both on national and territorial bases. The second distinguishing feature of the study regards the decomposition of productivity into a component which measures the technological changes within firms (*within-firms* effect) and another component which depends upon variations in market shares (*between-firms* effect). Finally, the third aspect analysed is linked to the evaluation of whether there are differences in TFP and its components in relation to the economic sector to which firms belong, to their presence in foreign markets and to whether they innovate.

The empirical analysis uses the method proposed by Levinshon and Petrin (2003) in order to estimate a production function. This approach is widely applied in micro-econometric analyses because it controls for simultaneity issues caused by the potential correlation between inputs and TFP. The Levinshon and Petrin method (2003) has been used to analyse the dynamics of other countries' economies (Rizov *et al.*, 2005; Van Beveren, 2007), while in Italy it has been applied to some works regarding the relationship between TFP and the trade orientation of economic activity (Castellani and Giovannetti, 2010; Casaburi *et al.*, 2008; Crinò and Epifani, 2008; Barba Navaretti *et al.*, 2007; Benfratello and Razzolini, 2007; Del Gatto *et al.*, 2005 and 2008), or to the differences in sectoral productivity (Aiello *et al.* 2009).

The results obtained confirm that regional differences in labour productivity are closely correlated to differences in TFP. Moreover, it is shown that there are territorial variations in *within-firms* and *between-firms* effects and that there is a significant market restructuring process in all of the geographical areas. This process has also involved southern Italian firms, without, though, reducing the technological gap of this part of the country.

The work is organised as follows. Paragraph 2 presents the methodology used (§ 2.1) and a breakdown of the sample (§ 2.2). Paragraph 3 synthesises the empirical results regarding the dynamic of aggregate productivity and investigates the role that the reallocation of market shares between firms has had in determining the aggregate TFP. Paragraph 4 introduces the territorial analyses of the TFP by identifying the role of *within* and *between* effects in each macro-area of the country. A discussion and some final comments follow.

## 2. Methodology, data and sample characteristics

### 2.1 Methodology and data

TFP at firm level can be estimated through different methods, one of which is that proposed by Levinshon and Petrin (2003)<sup>†</sup>. The relevance of this approach depends upon the solution adopted to resolve the problem of simultaneity, common to all studies where production function estimates are made. This problem is a consequence of the fact that the error component incorporates firms' TFP, which is not observable, but is, in some way, known to the firm when it decides on the quantity of inputs to use. The solution proposed by Levinshon and Petrin (2003) is to use demand for intermediate goods as a *proxy* of productivity.

Productivity was estimated using the following log-linear specification of a production function:

$$y_{it} = \beta_0 + \beta_K^{MAT} k_{it}^{MAT} + \beta_l l_{it} + u_{it} \quad (1)$$

with  $i = 1, \dots, N$  firms,  $t = 1998, \dots, 2006$  and where  $y$  represents the value added,  $l$  the number of employees,  $k^{MAT}$  the stock of physical capital,<sup>‡</sup>  $\beta_0$  measures the average efficiency and  $u_{it}$  represents the deviation of firm  $i$  from this average at time  $t$ . The error term can be decomposed into two parts:

$$u_{it} = \omega_{it} + \eta_{it} \quad (3)$$

where the term  $\omega_{it}$  represents the productivity of firm  $i$  at time  $t$  and  $\eta_{it}$  is a stochastic term which includes not only the measurement error, but also the shocks which are unobservable to firms, and, therefore, do not correlate with inputs.

<sup>†</sup> For an exhaustive report on the TFP estimation methods, see Van Biesebroeck (2008).

<sup>‡</sup> The stock of physical capital is measured by the tangible fixed assets.

Productivity  $\omega_{it}$  is known to the firm which, therefore, in the case of positive shocks to productivity, can decide to increase production by raising the level of inputs. This determines a problem of simultaneity which Levinshon and Petrin (2003) resolved by identifying in the demand for intermediate goods a proxy related to the variations in TFP which are known to firms<sup>§</sup>. Demand for intermediate goods was measured by the operating costs.<sup>\*\*</sup>

The data used come from the Xth Capitalia-UniCredit survey (2009) of Italian manufacturing firms, the information for which is collected through a questionnaire and firms' balance sheets. The survey, which covers a sample of firms of between 11 and 500 employees and all firms with over 500 employees, is aimed at gathering information about the principle characteristics of the Italian manufacturing system. The Xth Capitalia-UniCredit survey questionnaire refers to 2004-2006 and contains information on firm structure, ownership structure, work force composition, investment activity in physical capital and innovation, as well as the degree of internationalization. The balance data refer, instead, to 1998-2006. Although the original data refer to 5,100 firms, in the empirical analysis an unbalanced panel of 24,973 observations obtained after carrying out a data cleaning procedure is used.<sup>††</sup>

## 2.2 Sample characteristics

This paragraph presents some descriptive statistics of the sample of firms used in the empirical analysis. Table 1 presents the distribution of firms over the territorial area and on the basis of some of their characteristics, such as the Pavitt sector to which they belong, the relevance of exports and their innovative behaviour. There are 3033 firms, 40% of which are located in the North of Italy, 16% in the centre and 10% in the South. The sectoral composition of the sample shows a substantial concentration in traditional sectors, 62% in the South, and in sectors of high specialisation, particularly in the North (31%). The incidence of firms which operate in high technology sectors is residual, on average 5% of the sample.

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<sup>§</sup> For a detailed presentation of the methodology, besides Levinshon and Petrin's original article (2003), see Petrin *et al.* (2004) and Aiello *et al.* (2009).

<sup>\*\*</sup> The data used to estimate equation (1) have been deflated. In particular, the value added has been deflated by using the ISTAT production price index which is available for each ATECO sector. With regards the tangible fixed assets, data have been deflated by using the average production price indices of the following sectors: machines and mechanical appliances, electrical machines and electrical equipment, electronics and optics and means of transport. This procedure is analogous to that followed by Smarzynska (2004) and Castellani and Giovanetti (2010). For the operating costs, we adopt the intermediate consumption deflator calculated by using data from ISTAT.

<sup>††</sup> The firms which presented negative values of value added have been eliminated from the original archive. Moreover, in order to eliminate *outliers*, firms with a growth rate of value added and of employees below the first or above the ninety-ninth percentile of the distribution have also been eliminated. Finally, firms for which at least 7 years data regarding employee numbers was not available were also excluded.

The sample has a large proportion of exporting firms,<sup>††</sup> although there are differences from one area to another. In the North, exporting firms make up 70% of the total and, on average, exports account for 30% of their sales. In the South of Italy, the percentage of exporting firms is as high as 50% of the total, however, on average, exports only account for 18% of sales. As far as the innovative dimension is concerned, marked differences in numbers of innovating firms do not emerge across the different areas,<sup>§§</sup> while the intensity of expenditure in innovative activity with respect to sales varies from 10.2% in the North East to 5% in the Centre. A further indicator of the territorial differences between firms is provided by the share of sales deriving from innovative products, varying from 8% in the South to 14.7% in the Centre (12% North). In conclusion, firms in the sample are mostly corporations (over 90%), of medium size, innovative and operating in international markets, primarily located in the North and belonging to supplier-dominated or specialised supplier sectors.

To complete the description of the data, the statistics describing the variables used in the econometric section are presented in the appendix.

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<sup>††</sup> The percentage of exporting firms in the sample is 68% as opposed to 17% according to ISTAT data (2008b). This might be a consequence of the fact that in the Capitalia-Unicredit sample, there are few firms with fewer than 50 employees that represent a low degree of internationalisation. According to the ISTAT data (2008b), in fact, exporting firms make up only 10% of those firms with fewer than 9 employees and 46% of those with between 10 and 50 employees, while this figure becomes 78% for firms with more than 50 employees.

<sup>§§</sup> Firms which declared having performed innovative activity during the three years looked at by the Xth Capitalia-UniCredit survey (2003-2006) are identified as innovators.

**Table 1 Main characteristics of the sample**

	North west	North east	Centre	South	Italy
<b>Numbers of firms*</b>	1.345 44%	921 30%	472 16%	295 10%	3.033 100%
Supplier dominated	576 43%	459 50%	253 54%	183 62%	1471 48%
Scale intensive	266 20%	147 16%	108 23%	64 22%	585 19%
Specialised suppliers	421 31%	284 31%	93 20%	41 14%	839 28%
Science based	82 6%	31 3%	18 4%	7 2%	138 5%
Exporters	940 70%	656 71%	313 66%	147 50%	2056 68%
Non exporters	394 29%	257 28%	156 33%	145 49%	952 31%
Innovators	782 58%	530 58%	292 62%	159 54%	1763 58%
Non innovators	496 37%	324 35%	143 30%	122 41%	1085 36%
<b>Average values</b>					
Esports/Sales (%)	30,6	31,0	27,4	18,1	29,0
Expenditure on innovation/Sales (%)	6,8	10,2	5,0	6,3	7,5
Share of sales for innovative products (%)	12,1	12,0	14,7	8,0	12,1

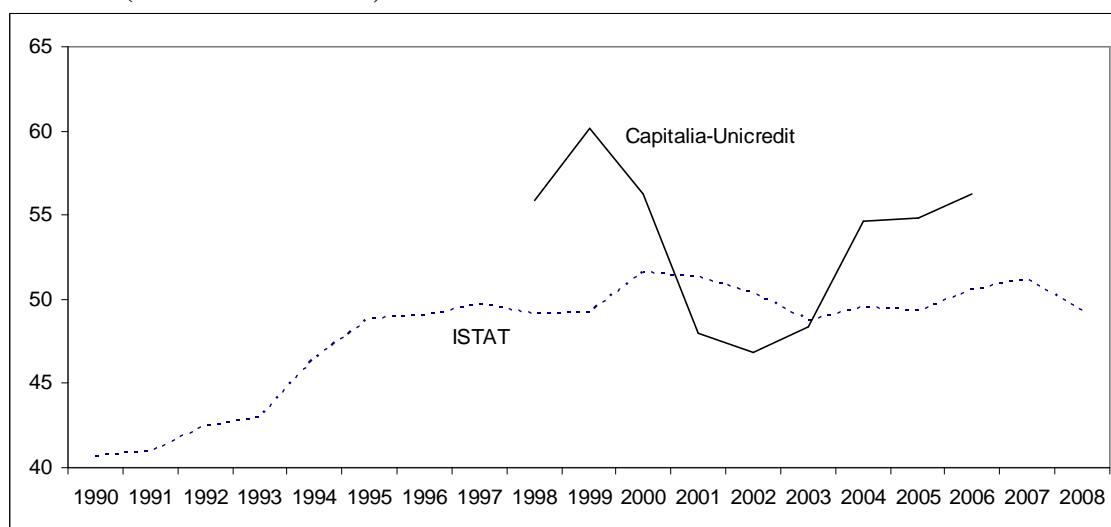
\* The sum of the exporting/non exporting firms and the innovating/non innovating firms may not coincide with the total of firms in the sample since some firms did not answer the questions in the survey.

Source: elaborations on data from Capitalia-UniCredit (2009)

### 3. Productivity Dynamics in Italy

Recent national accounting data published by ISTAT (2009a) show how, in the course of the last thirty years (1990-2008), labour productivity in the Italian manufacturing sector has risen at an annual rate of 1.28% from 41,000 euros in 1990 to 49,000 euros in 2008 (values expressed at constant year 2000 prices). Over this period, labour productivity has exhibited different dynamics: in the first decade, it had quite sustained growth (1.48% per year), followed by a period of relative stagnation from 2000 to 2003. In the final years (2003-2007), there was a weak recovery, although 2008 data show a change in tendency, probably as a result of the first effects of the financial crisis (figure 1).

**Figure 1 Labour productivity in the Italian manufacturing sector (1990-2008)**  
(thousands of euros)



Source: elaborations on data from ISTAT (2009a) and Capitalia-UniCredit (2009)

Figure 1 shows the labour productivity obtained by using ISTAT (2009a) data and the dynamics of this indicator calculated using Capitalia-UniCredit data. In both cases, labour productivity is given by the ratio between the value added and the number of employees.

Limiting the discussion to the period analysed in this article (1998-2006), the ISTAT data indicate that labour productivity in the manufacturing sector recorded an average annual growth rate of 0.3% (from 49,000 euros to 51,000 euros). This result is in line with that obtained using data from Capitalia-UniCredit (0.1%), as we observe that the dynamics of productivity are analogous, even though the changes in productivity are more marked in the Capitalia-UniCredit sample. Indeed, in the period 2000-2002, productivity diminished (5.9% per year according to Capitalia-UniCredit data and 0.8% according to the ISTAT data), while an inversion of tendency took place from 2002 onwards (3.7% per year in the Capitalia-UniCredit sample of firms and 0.1% according to the ISTAT data, figure 1). With the exception of 2001-2003, firms' labour productivity was greater in the Capitalia-UniCredit sample for every year. This difference is probably imputable to the differing composition of the sample. Indeed, the firms analysed are primarily made up of corporation (over 90%), whose economic performance is superior to the average for Italian firms, while the analysis excludes (cfr. § 2.1) those very small firms (fewer than 11 employees) which normally have low labour productivity (ISTAT 2008b; ISTAT 2009b).<sup>\*\*\*</sup> Moreover, there is a significant presence of exporting firms which might explain the marked reduction in labour

<sup>\*\*\*</sup> Labour productivity of corporation is, on average, 56 thousand euros per employee, but increases as company dimensions increase and in relation to economic activity (for example, it is higher for firms with a high density of R&S, a value of 77.3 thousand euros, or which present economies of scale, 66.1 thousand euros; while it is lower in traditional manufacturing) (ISTAT, 2009b, tab. 2.10).

productivity during the recessive phase and the relevant recovery in the following years. Indeed, it was these exporting firms which most suffered from the introduction of the euro and the competitiveness of emerging economies. The consequence of this was that exporting firms adopted a policy of restructuring which, in the course of time, allowed them to achieve better performances with respect to other firms (Bugamelli *et al.*, 2009).

Much has been said about the Italian economic slowdown, which began in the mid 1990s at the latest, although the causes are still not clear.<sup>†††</sup> In the same way, the causes of the recovery in productive activity which began in 2002-2003 are also debated. This recovery might be of a conjunctural nature, related to the favourable world business cycle, and particularly, to that observed in Germany, or of a structural nature, due to the reorganisation process carried out as a consequence of the greater competitiveness brought by China and other emerging economies to international markets and of the impulse given by the adoption of the euro and of the growing integration of European markets (Brandolini and Bugamelli, 2009).

Notwithstanding the difficulty in identifying the underlying reasons for the dynamics of the Italian economy, it is widely accepted that the slowdown in labour productivity can be mainly attributed to the dynamics of TFP (Aiello *et al.*, 2009; Brandolini and Bugamelli, 2009; Saltari and Travaglini, 2008; ISTAT, 2007; Van Ark, O'Mahony and Ypma, 2007; OECD, 2007; Fachin and Gavosto, 2007; Daveri and Jona-Lasinio, 2005; ISAE, 2005; Bassanetti *et al.*, 2004; Venturini, 2004; Milana and Zeli, 2003; Brandolini and Cipollone, 2001). Our results confirm this evidence (figure 2).<sup>†††</sup> Indeed, the correlation between labour productivity and TFP is, on average, 0.86% and has an even higher value (0.96%) when the period 2001-2006 is considered.<sup>§§§</sup>

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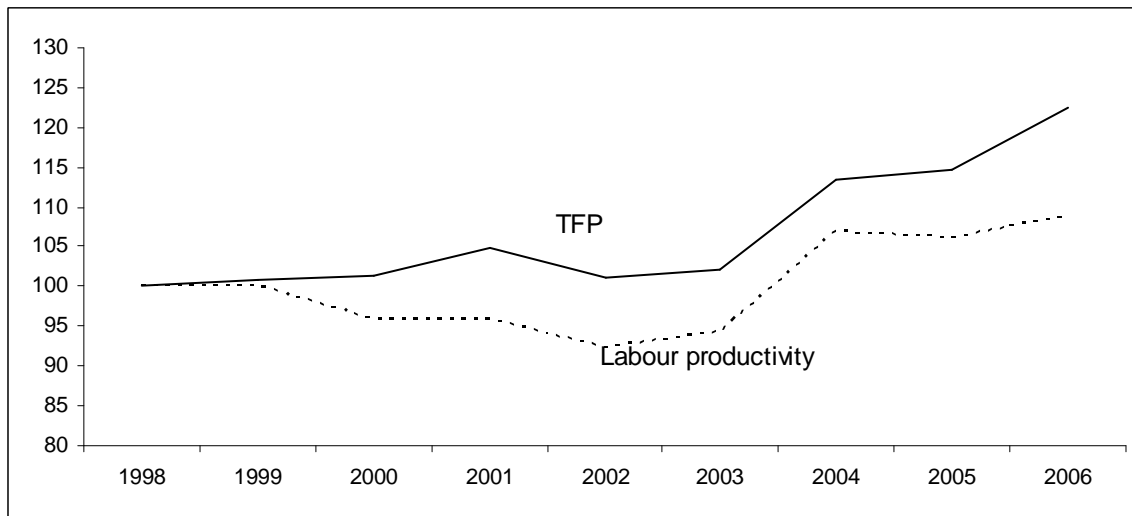
<sup>†††</sup> Among the principle factors indicated in the literature, it is necessary to consider the position of Italy in the international markets, the ownership structure and firm size, the low propensity to innovate, the quantity and quality of material and immaterial infrastructure, the excessive economic regulation, labour market rigidity and the inefficiency of public administration (OECD, 2007; Faini and Sapir, 2005; Allegra *et al.*, 2004; Milana and Zeli, 2003; Nicoletti and Scarpetta, 2003). For a taxonomy of the possible determinants of the slowdown in the Italian economy, see, amongst others, Ciocca (2004).

<sup>†††</sup> Labour productivity, like TFP, is calculated as a weighted average of firms' productivity, using as a weight the firm's value added with respect to the group of reference (in this case the whole sample, or rather the value added of the area in the case of averages relative to the territorial area).

<sup>§§§</sup> It is considered that the correlation between labour productivity and TFP presents high values in each area of the country: the highest value (0.97) and the lowest value (0.82) are recorded in the South and the North-West respectively.



**Figure 2 Labour productivity and TFP from 1998 to 2006 in Italy**



Source: see table 1

From 1998 to 2006, TFP in Italy had an annual growth rate of 2.9%. This was the result of a growth phase of 1.2% per year for 1998-2001, followed by a period of marked contraction of 0.9% per year for 2001-2003, and then a strong recovery over the following years (4.6% per year from 2003 to 2006). This evidence is similar to that found by Bassanetti *et al.* (2008) and by Daveri and Jona-Lasinio (2008), even though our results are not directly comparable with the ones from those studies because they were obtained by using methodologies which are different from the Levinshon and Petrin (2003) estimator.

The analytical method used allows the results to be interpreted in depth, since it is possible to divide TFP into a component which measures the generalised technological changes within firms and another component which depends on variations in market shares. Indeed, average productivity reflects, in the first place, the individual behavior of all the firms belonging to the system, which may improve their productivity by investing in new processes and technology and so bring about a generalised increase in productivity (*within-firms* effect). Secondly, average productivity might increase as a result of the market's capacity to stimulate the absorption of market share by more productive firms to the detriment of the less efficient ones, so increasing aggregate productivity (*between-firms* effect).\*\*\*\*

It is possible to obtain a measure of these two effects by decomposing aggregate productivity as follows:

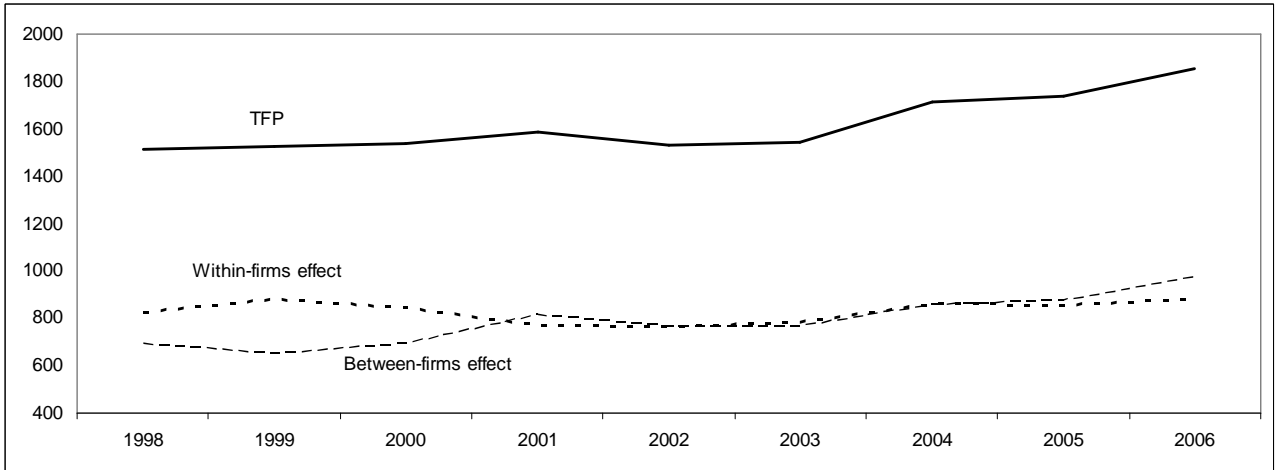
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\*\*\*\* Productivity may also vary because of the entry of new firms into and the exit of less productive firms from the market. However, it is not possible to evaluate the influence of these entry and exit movements in this study since the Capitalia-Unicredit data do not provide the information necessary to measure them.

$$\Omega_t = \sum_{i=1}^N s_{it} \omega_{it} = \bar{\omega}_t + \sum_{i=1}^N \Delta s_{it} \Delta \omega_{it} \quad (2)$$

with  $\Delta s_{it} = s_{it} - \bar{s}_t$  and  $\Delta \omega_{it} = \omega_{it} - \bar{\omega}_t$  and where  $s_{it}$  indicates the market share of firm  $i$ ,  $\bar{s}_t$  is the simple average of market share,  $\bar{\omega}_t$  is the simple average of productivity and  $\sum_{i=1}^N \Delta s_{it} \Delta \omega_{it}$  is the covariance between productivity and the firm's market share. A high value of the simple average indicates firms' capacity to obtain advantages from a more efficient or a more intense use of factors (*within-firms* effect); while a high value of the covariance indicates a greater market share for the more productive firms and, consequently, a greater aggregate productivity (*between-firms* effect). Figure 3 presents these two effects between 1998 and 2006 with the aim of evaluating their contribution to the dynamics of aggregate TFP.

**Figure 3. Total Factor Productivity from 1998 to 2006 in Italy**



Source: see table 1

If the problem is analysed over time, it can be seen that the growth period (2002-2006) exhibited an analogous positive trend for both TFP components. This means that there was an improvement in efficiency both at market level, indicated by the marked reallocation of share towards more efficient firms, and at firm level. On the other hand, in 1998-2002, the positive dynamic of the *between-firms* component was compensated for by the negative trend of the *within-firms* effect and, as a consequence, TFP did not show substantial variations (figure 3). Therefore, the relative TFP stability of the period when labour productivity was diminishing hid, in practice, a generalised loss of efficiency at firm level, partially compensated for by a reallocation process of market share in favour of the more efficient firms.

The analysis carried out of the evolution of productivity and its components provides a dynamic and complex image of the Italian economy and confirms the conclusions of Aiello *et al.* (2009), Brandolini and Bugamelli (2009), ISTAT (2009b), Barba Navaretti *et al.* (2007), de Nardis (2007), Bugamelli and Rosolia (2006), Confindustria (2006) regarding the restructuring process which the Italian industrial system has been involved in over the last decade. The following paragraph widens the analysis by referring specifically to the territorial dimension. The aim is to identify the role of the *within-firms* and *between-firms* effects in each area of the country.

## **4. Total Factor Productivity by macro-regions**

The aim of this paragraph is to study the TFP, by analysing the time trend of the *within-firms* and *between-firms* effects in each geographical area. This analysis is carried out for the whole sample (§ 4.1), for the subsets of exporting/non exporting, innovating/non innovating firms and for the groups of firms which are classified on the basis of their economic activity (§ 4.2).

### **4.1 The role of *within-firms* and *between-firms* effects**

Figure 4a shows the *within-firms* component of TFP in Italy, the South, the Centre, the North East and the North West from 1998 to 2006. It can be seen how TFP in the South was lower than that of other areas for the whole period, underlining the technological gap in Italy which has already been discussed in literature (Byrne *et al.*, 2009; Iuzzolino, 2009; Ladu, 2006; Ascari-Di Cosmo, 2005). The results also show how such gap was not uniform over time, but was wide at the beginning and the end of the period and more limited in 2002-2003. This reduction in the technological gap of the South was, however, due not so much to the performance of Southern firms but to that of firms in the Centre-North. Indeed, the phase of greatest reduction of TFP in the Italian economy (1999-2001) mostly effected the more dynamic areas of the country, while an improvement in southern firm efficiency took place over the following years. It can, though, be seen that this southern recovery was short-lived and much more limited than that which occurred elsewhere (figure 4a).

If all this confirms, on one hand, the dualistic nature of the Italian economy, on the other hand, it does not capture the effects of the restructuring process which has taken place in the Italian manufacturing system over the last decade (Brandolini and Bugamelli, 2009; Bugamelli *et al.*, 2009). Some indications of this process can be found in the analysis of figure 4b where the *between-firms* effect of TFP is shown. One of the first things to emerge is that this effect is always positive, indicating how, in every area of the country, the more efficient firms are those which gain the largest market share. Another thing to underline is that the South follows different dynamics from the rest of Italy. Until 2000, and unlike that which can be seen for the Centre-North, the *between-*

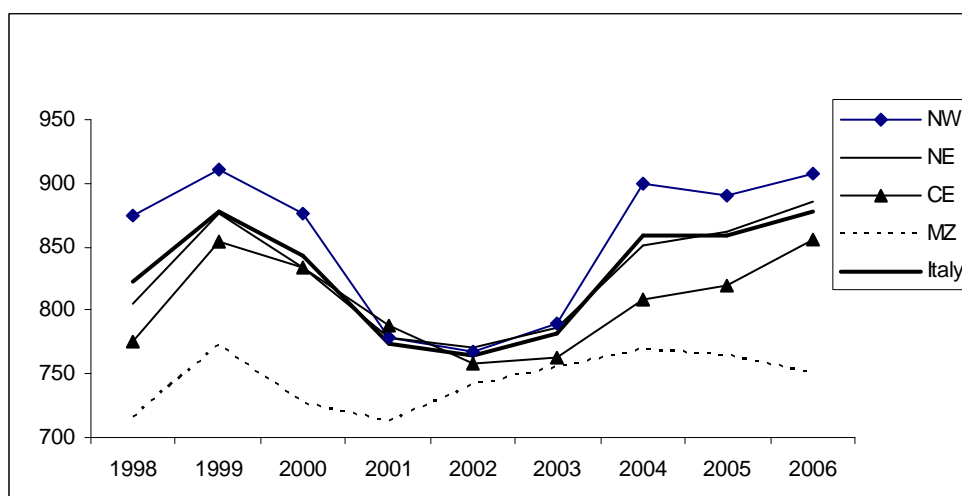
*firms* effect was diminishing. In 2000-2003, an increase in this productivity component occurred, while there was a reversal in the final years of the period analysed, only partially compensated for in 2006. Finally, during the recovery years of 2002-2006, the reallocation effect was, on average, greater in the South than in other areas (figure 4b).

Figure 4c presents the aggregate TFP obtained from the sum of the *within-firms* and *between-firms* effects (*cfr* eq. 2). From 1999 to 2002, a reduction in average productivity (*within-firms* effect, figure 4a) can be seen in all areas (up to 2001 in the South) and it is only thanks to an increase in the market share of the more efficient firms (*between-firms* effect, figure 4b) that aggregate TFP shows a relative stability. If the following period is considered, TFP increased in all areas (with the exception of the South where TFP diminished in 2004), both because of increases in average productivity (*within-firms* effect) and the reallocation effect (*between-firms* effect). Just looking at the South, it can be seen that, in some years (2002-2004), the TFP was higher than that of other areas. This result is due to a reallocation effect which is much more relevant in the South than elsewhere (fig. 4b) and hides the weakness of the southern productive system which is, instead, systematically less efficient than that of the rest of the country (fig. 4a).

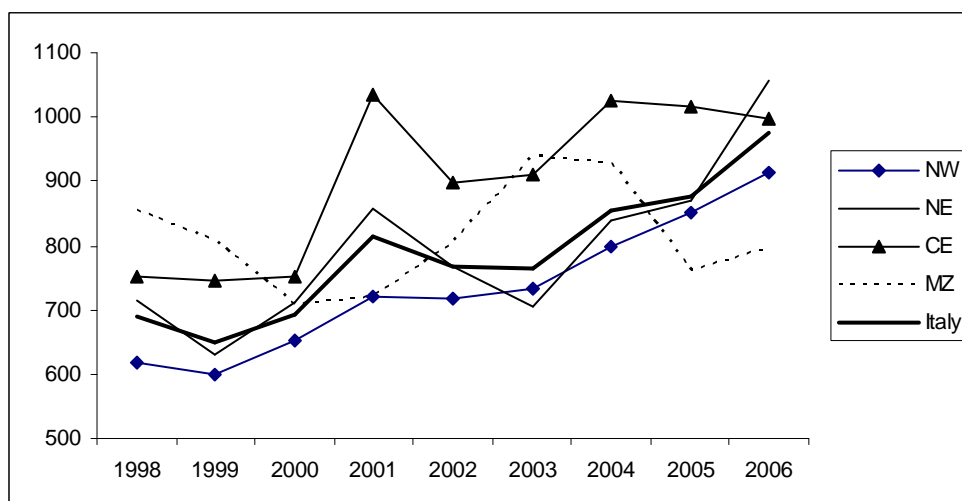
The analysis presented here would seem to suggest that the context in which firms operate is of great importance. Indeed, southern firms always present lower average productivity than do firms from other areas, highlighting the systematic technological inefficiency of the southern economy. On the other hand, though, the restructuring process has been intense and has involved all of the country's areas, although the South has followed different dynamics. The availability of micro data allows a detailed comparison between the South and other areas of Italy since the analysis can be made by considering specific groups of firms and, following this line of research TFP and its components can be studied area-by-area for specific groups of firms. This will be looked at in the next paragraph.

**Figure 4. TFP by area from 1998 to 2006.**

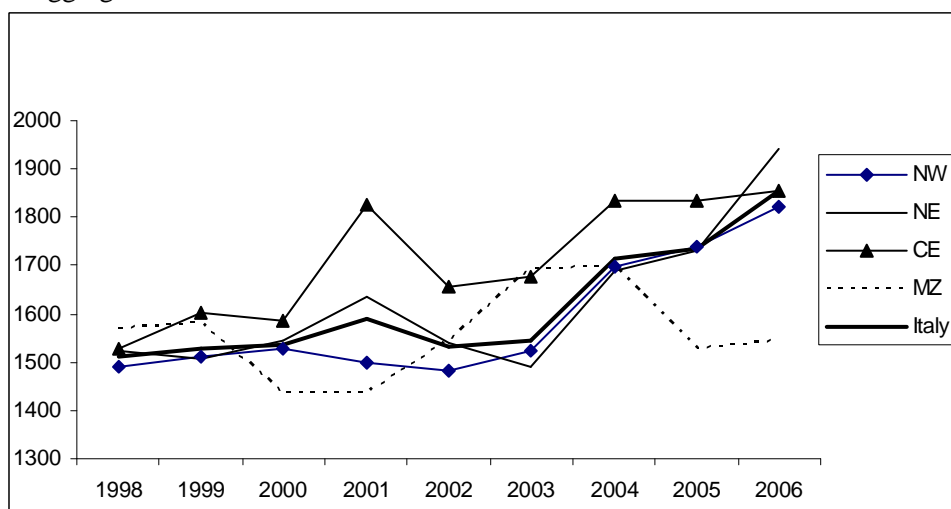
a. *Within-firms effect*



b. *Between-firms effect*



c. *Aggregate TFP*



Source: see table 1

## 4.2 A disaggregated analysis of TFP

An elaboration of the work consists in analysing the TFP and its components by considering subsets of firms on the basis of the sector to which they belong or whether they are exporters or innovators.<sup>††††</sup> The entire period considered (1998-2006) is divided into two sub-periods: the first considers the years from 1998 to 2002 when there was a slowdown of the Italian economy, while the second sub-period is 2002-2006 when there was a recovery (figure 4a). The aim is to evaluate whether TFP variations differ from group to group either in terms of economic efficiency within firms (*within-firms* effect) or in terms of market share reallocation among firms (*between-firms* effect).

### 4.2.1 Sectoral analysis

Subdividing firms on the basis of their sector of activity produces some interesting results. In the years 1999-2002, every sector contributed to the reduction in the *within-firms* effect, although the contribution varied from one area to another. On the other hand, it can be seen that the role of the reallocation of market share was very different between the different sectors. In particular, it should be underlined that, in all areas, the positive variation of the *between-firms* component was principally due to traditional, supplier dominated, sectors, while the variation in the effect of market share reallocation was negative in scale intensive and high-tech sectors. With regards 2002-2006, the increase in average TFP can be explained mainly by the performance of firms operating in specialised suppliers (3% in Italy on average, 4% in the North West and 3.7% in the North East), while the influence of firms in the science-based sector was minimal. The contribution of the *between-firms* effect is primarily attributable to the specialised suppliers and high-tech sectors (excluding central Italy) and this is particularly true in the North-East. For the South, the positive impact of these two sectors is neutralised by the negative variations recorded for the scale-intensive and supplier dominated sectors. For central regions, the process of market share reallocation in favour of more productive firms affects the scale-intensive sectors and, unlike other areas, continues to involve the traditional sectors too.

However, the analysis carried out thus far does not fully grasp some of the evidence found in the South which, as already mentioned, follows different dynamics from the rest of the country. In particular, it should be underlined that the period used to better understand the TFP dynamic in the South is 2003-2006 as 2003 was the year in which the *between-firms* effect reached its highest value (figure 5b). If 2002 and 2006 were compared, the result would indicate relative stability. If 2006 is compared with 2003, instead, a drop in TFP of -8.9% emerges (tab. 2). This reduction can be

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<sup>††††</sup> The status of exporting and innovating firms refers to 2006 and 2004-2006, respectively, and thus is time invariant.

attributed prevalently to the reallocation effect (-8.6%) which involved all of the sectors except for the technological sectors (tab. 2) and the exporting and innovating firms (figures 5b and 6b).

**Table 2. Breakdown of the TFP % change**

	% Change 2002-1999					% Change 2006-2002					
	North west	North east	Centre	South	Italy	North west	North east	Centre	South	South <sup>1</sup>	Italy
<b>PTF</b>	<b>-1.8%</b>	<b>2.1%</b>	<b>3.5%</b>	<b>-2.2%</b>	<b>0.25%</b>	<b>22.9%</b>	<b>26.2%</b>	<b>12.0%</b>	<b>-0.01%</b>	<b>-8.9%</b>	<b>21.0%</b>
<b>Within-firms effect</b>	<b>-9.5%</b>	<b>-7.0%</b>	<b>-6.0%</b>	<b>-2.0%</b>	<b>-7.5%</b>	<b>9.5%</b>	<b>7.5%</b>	<b>6.0%</b>	<b>0.6%</b>	<b>-0.3%</b>	<b>7.5%</b>
Supplier dominated	-2.4%	-1.8%	-2.4%	0.9%	-1.9%	2.1%	1.7%	2.8%	-1.2%	-0.9%	1.8%
Scale intensive	-2.6%	-1.8%	-2.8%	-2.0%	-2.4%	2.1%	1.7%	2.3%	0.6%	-0.3%	1.9%
Specialized suppliers	-3.8%	-2.5%	-0.7%	-0.5%	-2.6%	4.0%	3.7%	0.5%	0.3%	0.4%	3.0%
Science based	-1.1%	-1.3%	-0.1%	-0.9%	-0.6%	1.1%	0.3%	0.3%	0.9%	0.6%	0.7%
<b>Between-firms effect</b>	<b>7.7%</b>	<b>9.1%</b>	<b>9.5%</b>	<b>-0.2%</b>	<b>7.7%</b>	<b>13.4%</b>	<b>18.7%</b>	<b>6.0%</b>	<b>-0.6%</b>	<b>-8.6%</b>	<b>13.6%</b>
Supplier dominated	6.9%	11.2%	9.2%	11.2%	8.9%	-2.8%	-3.2%	3.8%	-0.9%	-5.8%	-1.8%
Scale intensive	3.5%	-2.2%	-2.2%	-9.4%	-0.1%	-0.4%	5.2%	8.9%	-4.1%	-5.6%	2.6%
Specialized suppliers	-0.7%	2.9%	0.7%	0.2%	0.8%	6.3%	15.4%	-5.6%	0.2%	-0.3%	8.0%
Science based	-2.1%	-2.8%	1.8%	-2.2%	-1.8%	10.3%	1.4%	-1.2%	4.1%	3.1%	4.8%

<sup>1</sup>% Change 2006-2003

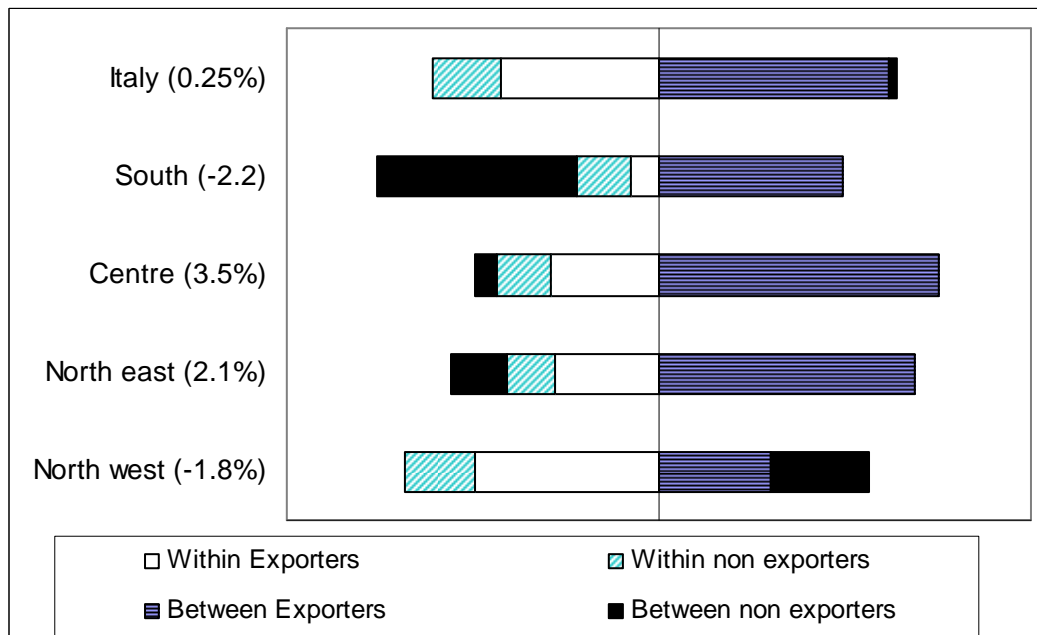
Source: see table 1

#### 4.2.2 Exporting firms

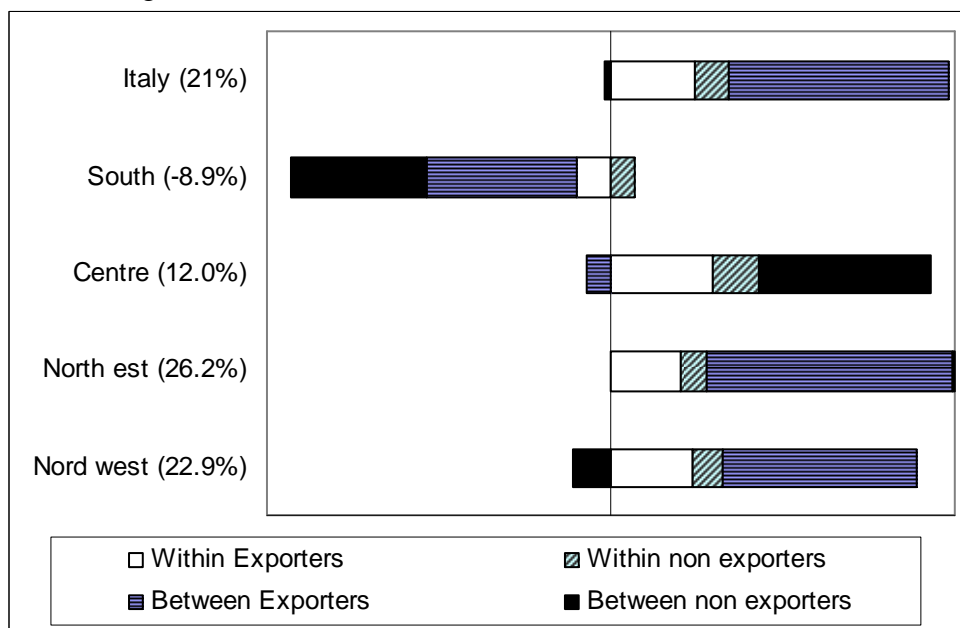
In this part of the paper, attention is focused upon aspects linked to firm's internationalisation. In figure 5 the breakdown of *within-firms* and *between-firms* effects for exporting and non exporting firms for each geographical area is given together with, in brackets, the variations in aggregate TFP. In general, as can be noted, TFP stability from 1999 to 2002 (0.25%) was due to the *within* effect (-7.7%) which was counterbalanced by the reallocation effect (7.7%). The reduction in the *within* component common to all areas, was, apart for in the South, principally led by a loss in efficiency by exporting firms. The relevance of the reallocation effect, which limited and, in some cases (North-west and Centre), counterbalanced the *within* effect can be attributed to this group of firms. From 2002 to 2006 there was a growth in TFP which involved all of the areas except for the South. This growth was the result of the combined effect of efficiency recovery and the reallocation process which mostly involved exporting firms. With regards firms located in the central regions of Italy, the contribution of the reallocation effect to TFP growth can be attributed to non exporting firms.

**Figure 5. Breakdown of variations in TFP: role of exporting and non exporting firms\***

a. % change 2002-1999



b. % change 2006-2002\*\*



\*The % changes in aggregate TFP for each area are presented in brackets.

\*\* For the South the % change is calculated with respect to 2003.

Source: see table 1

#### 4.2.3 Innovating firms

With regards the subdivision of firms on the basis of the innovative character of their activity, figure 6 shows that the decline in efficiency in the years 1999-2002 was driven by innovating firms. Moreover, it is not possible to draw unequivocal indications for all of the areas when the *between-firms* effect is considered. Indeed, for the North-West and Centre, this process seems to

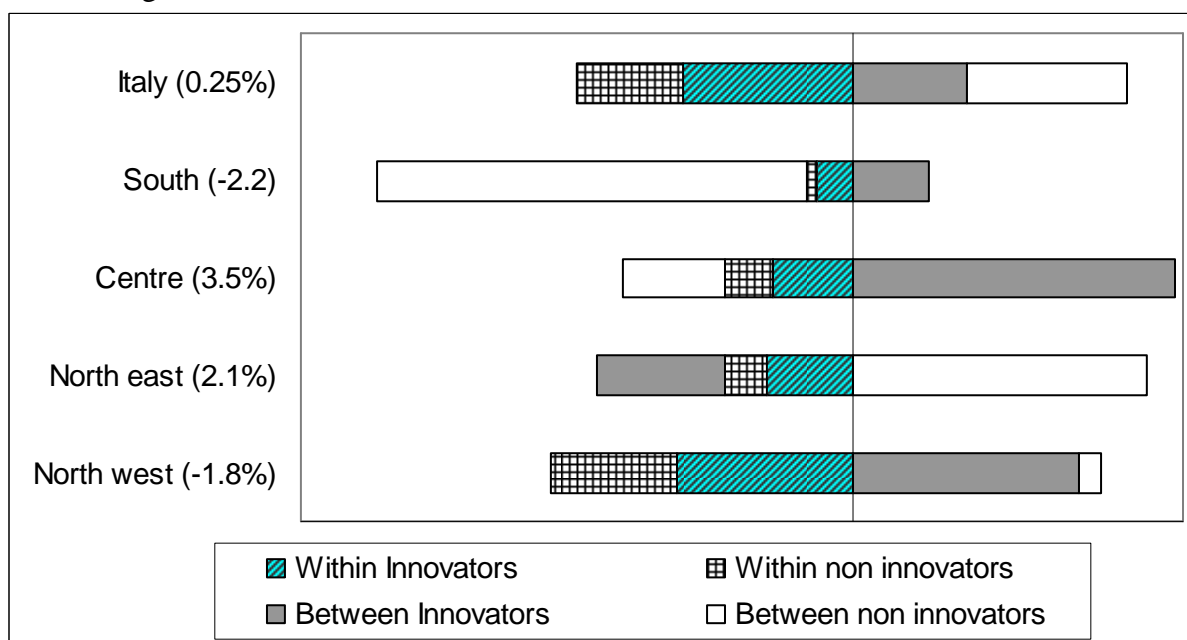


have been principally attributed to the performance of innovating firms. The opposite was in the North-East, where the *between-firms* effect of innovators was negative, and it was only thanks to the process of market share reallocation towards the more productive non-innovating firms that the aggregate *between-firms* effect contributed positively to the variation in TFP. If the recovery years of the Italian economy are considered, a positive effect can be seen for the *within-firms* component with a predominant role of innovating firms in all areas of the country. With regards the *between-firms* component, there is a higher aggregate value for non innovating (8.7%) than for innovating firms (5.4%). This result depends exclusively upon firms in the North-East, while in the other areas of the country the reallocation effect mostly involved innovating firms (figure 6).

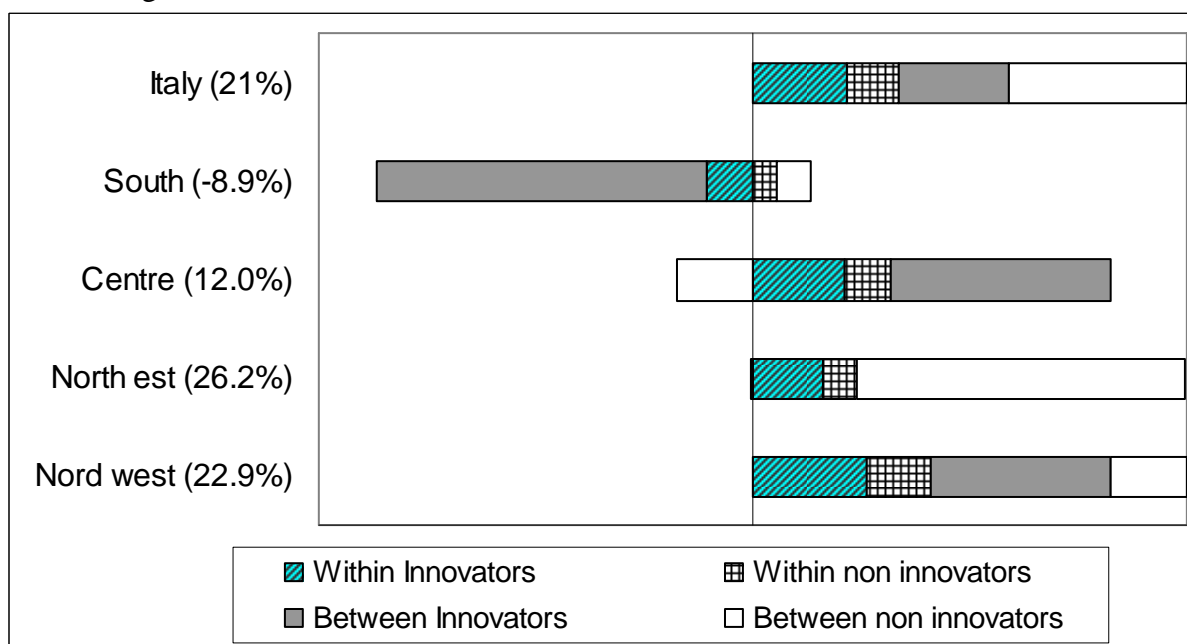
To summarise, this analysis shows how low TFP growth between 1999 and 2002 can be attributed to a generalised reduction in average productivity which was counterbalanced by the reallocation effect. This effect principally involved exporting firms and firms belonging to traditional supplier-dominated sectors, in other words the firms which are most exposed to competition from countries with low labour costs and to effects relating to the introduction of the euro (Bugamelli *et al.*, 2008). During the period of recovery there was an improvement in efficiency throughout the country except for the South. The market share reallocation process continued to involve northern exporting and innovating firms, with the exception of those located in the Centre of Italy. This process did not occur in traditional sectors, except for those in central Italy, while the specialized suppliers and high-tech sectors, above all, were involved in the North. The generalised improvements in TFP between 2002 and 2006 were most probably the result of the modernisation of the productive system deriving from (a) the adoption of new business strategies, (b) the broadening of the range of products and (c) firms' entry into markets others than those they occupied at the beginning of the decade (Bank of Italy, 2007). Finally, it can be seen how the South was only marginally involved in this process of transformation, as has also been discussed in Cannari *et al.* (2009).

**Figure 6. Breakdown of variations in TFPF: role of innovating and non innovating firms\***

a. % change 2002-1999



b. % change 2006-2002\*\*



\*The % changes in aggregate TFP for each area are presented in brackets.

\*\* For the South the % change is calculated with respect to 2003.

Source: see table 1

## 5. Discussion e conclusions

The analysis carried out in this paper confirms the results regarding the role of TFP as a key factor in explaining the progression of labour productivity in Italy over the last ten years. It introduces other evaluation elements since it distinguishes, in territorial terms, between the role played by a strictly technological component of TFP and that of market share reallocation between firms. The aim is to verify whether productivity follows different dynamics and processes in the different areas of the country.

The study presents a varied and articulated image of the Italian economy and shows that, over the last decade, there has been a substantial restructuring process in the industrial system, as has also been shown by Aiello *et al.* (2009), Brandolini and Bugamelli (2009), ISTAT (2009b), Barba Navaretti *et al.* (2007), de Nardis (2007), Bugamelli and Rosolia (2006), Confindustria (2006). The novelty of this work is that it demonstrates how this process has brought about different reactions in the differing areas of the country. For instance, there is a systematic technological delay in the South, indicating the importance of the *context* in which the firm operates. However, this picture is not static because, just as in the rest of the country, southern regions also have experienced a reallocation of market share between firms, although the dynamics of this were different from those in the other macro-regions.

A second element which this work looks at in depth is related to the description of the results obtained when considering the sector to which a firm belongs and its level of internationalisation, as well as the innovative content of production. In order to provide a more accurate description of the phenomena in course, the analysis considered the slowing down period (1999-2002) and the years of the economic recovery (2002-2006) separately.

The low growth of the manufacturing system, owing to the general reduction in TFP, has principally involved exporting firms, those that have innovated their products and those belonging to the scale-intensive and specialised-supplier sectors. The slowdown over these years would have been, on average, much more relevant if the process of restructuring had not been adopted by exporting and non innovating firms together with those operating in traditional sectors, or, in other words, those firms which were most exposed to competition from emerging economies and the effects resulting from the introduction of euro (Bugamelli *et al.*, 2008).

During the recovery period there was a generalised improvement in efficiency in the whole of country, except for the South. The reallocation process, on the other hand, continued to involve exporting firms and those which operate in the *specialized suppliers* and the high-tech sectors, in the North, and the innovating firms in the whole of Italy, except for the Centre. The generalised improvements in TFP observed for 2002-2006 were probably the result of the restructuring process

in the Italian productive system which forced firms to adopt new strategies, renew and diversify production (Bank of Italy, 2007). In the South, this transformation process was less intense (Cannari *et al.*, 2009) and this might help explain the territorial technological differences found in this study. However, the possibility that there will be a reduction in this gap is restricted by the presence in the South of numerous limits to creation, adoption and diffusion of technical progress. In addition, the technical deficits of the South are also, albeit with differing intensities, those of the whole of Italy, a country with a development model and an innovation system which render it a *follower* in the global paradigm of technological creation.

In this context, public action may perform a relevant role in terms of support for technological growth in southern enterprises. If it is true that efficiency recovery is principally determined by innovation, then it is equally true that this activity has a long term impact, while the South needs short term actions. With this in mind, it would be better to adopt policies aimed at increasing firms' capacity to absorb external technology since this would permit immediate technological "fertilisation" of production. Moreover, these short term policies help to form an environment which is suitable to the creation of new knowledge and, therefore, long term growth. It is evident that all of this is possible if firms rely upon human capital which is capable of transforming embedded technologies into new products and new processes. In this respect, the South can make use of an ample supply of educated human capital whose relative price in terms of unskilled workers is lower than that found in other areas of the country.

In short, this study indicates that a process of restructuring began in Italy which permitted the industrial system to reduce the effects relating to the slowdown of productivity. This process involved certain categories of firms and had different results in different areas of the country, without changing the dualistic nature of the economy. It remains to be investigated whether the recent crisis has stopped the modernisation process in course and what the consequences of the crisis are for Italy and, above all, for the South.

## Appendix

Descriptive statistics of the variables used in the econometric analysis (1998-2006)\*

*Data in value expressed in euros.*

	Employees	Added value	Material capital	Intermediate consumption
<i>North-West</i>				
Mean	110	63,458	52,556	130,377
Median	43	20,324	13,012	34,146
CV	2	3	4	4
<i>North-East</i>				
Mean	127	70,951	55,509	149,958
Median	49	22,637	14,347	42,398
CV	3	3	3	4
<i>Centre</i>				
Mean	97	57,791	52,442	163,391
Median	41	18,217	12,848	36,920
CV	2	3	4	8
<i>South</i>				
Mean	90	49,159	72,030	129,792
Median	42	17,175	23,569	36,541
CV	2	2	4	2
<i>Italy</i>				
Mean	111	63,549	55,256	141,445
Median	44	20,203	14,158	37,290
CV	3	3	4	5

\*The mean refers to all years and firms.

Source: elaborations on Capitalia - Unicredit (2009) data.

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