DIPARTIMENTO DI ECONOMIA
UNIVERSITÀ DEGLI STUDI DI PARMA
Via J. F. Kennedy, 6 – 43100 Parma – Italia

A. LASAGNI, A. NIFO, G. VECCHIONE

FIRM PRODUCTIVITY AND INSTITUTIONAL QUALITY. EVIDENCE FROM ITALIAN INDUSTRY

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Firm productivity and institutional quality. Evidence from Italian industry

Andrea Lasagni
(andrea.lasagni@unipr.it)
Università degli Studi di Parma

Annamaria Nifo
(nifo@unisannio.it)
Università degli Studi del Sannio

Gaetano Vecchione
(gaetano.vecchione@unina2.it)
Seconda Università di Napoli

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Abstract.

This paper aims at contributing to the debate on the determinants of differentials in firms' productivity. The case of Italy looks particularly interesting, since it is characterized by a substantial and long-lasting productivity gap of industrial firms located in the Southern regions with respect to the rest of the country. We test the hypothesis that the macro factors, particularly the quality of institutions, play a central role in explaining Italian firms' productivity. Consistent with previous studies, our results show that institutional quality is one of the basic determinants of the observed TFP differentials across firms located in different Italian regions.

JEL code: **C33, D24, L60, O43, R11**

Keywords: *productivity, macroeconomic factors, institutional quality, differentials*.

Introduction.

The last years have witnessed a growing interest on the issue of heterogeneity in firms' productivity. While a bulk of empirical evidence has been gathered about large, persistent and ubiquitous productivity differentials across businesses, the central theoretical question on the main determinants of the observed heterogeneity is still under debate. Therefore, in the search for a satisfactory answer to the question recently asked by Syverson (2011, pag. 3): "*is it a dumb luck, or instead something – or many things – more systematic?*", economists have tried to identify the factors possibly affecting productivity and single out their relative weight in explaining inter-firm differences.

An appealing taxonomy of the determinants of productivity differentials is that distinguishing between *internal* and *external* factors. The former are meant as the ones engendered and controlled by decisions made by firms' managers' or owners', while the latter as those connected to the outside environment rather than insiders' behavior. A list of the first kind of factors usually includes: size (Van Biesebroeck, 2005), industry (Sinkkonen, 2005), the adopted technology (Jorgenson et al., 2008; Bartelsman et al., 2009; Faggio et al., 2009), the endowment of human capital (Shearer, 2004; Bandiera et al., 2009) and especially managerial skills (Bushnell and Wolfram, 2009; Bloom and Van Reenen, 2010), the amount of R&D investments (Doraszelski et al., 2009), the degree of international openness (Wagner, 2002), the propensity to innovate and the ability to promote product upgrading (Kortum et al., 2004; Balasubramanian et al., forthcoming), etc. Conversely, the second source of inter-firm productivity differences typically concern the *macroeconomic* context in which firms operate: for example, more competitive and contestable markets, a context more favorable to innovation, inter-firm cooperation and positive spillovers and so on. Often, a positive and important *external* factor is also recognized in the good institutional quality of the geographical area where the firm is located. This is meant like a fruitful combination of formal institutions, good rules and practices, cooperation among firms, researchers and policy

makers. High levels of institutional quality may significantly help to enhance the ability of a territory to grab development opportunities (North, 1990; OECD, 2001), and this mechanism may come out through increases in local firms' productivity.

Pin-pointing the most relevant determinants of firms' productivity and evaluating their relative importance might be crucial not only for assessing the economic performance of regions and countries and understanding its underpinnings, but also for developing better-targeted policies. From the policy maker viewpoint, this issue seems to be particularly relevant when firms' productivity differentials are evidently connected to different geographical locations. In this occurrence, the *macro* factors, such as the local institutional quality, are expected to be especially significant to explain the observed diversity. The case of Italy, in this respect, looks particularly interesting, since it is characterized by a substantial and long-lasting productivity gap of industrial firms located in the regions of *Mezzogiorno* (a large area accounting for about one third of the whole national territory[1]) vis a vis the ones of the rest of the country.

As we will see later in greater detail, the relevance of institutions and more generally macroeconomic factors in explaining inter-firm productivity differentials is widely recognized by theoretical literature and validated by empirical investigations. While more often these studies deal with international comparisons, in other cases the attention is rather on interregional heterogeneity. This paper focuses on Italian industrial firms, aiming at contributing to the discussion on the main determinants of the observed gap between Center-North and Southern firms' Total Factor Productivity (TFP). Our working hypothesis is that differences in local institutional quality endowments are crucial in shaping inter-firm productivity differentials.

To this purpose, we build up a unique dataset by matching two sources: MET (2008) reports containing information collected through direct interviews to a large representative sample of about

[1] *Mezzogiorno* corresponds to the Southern regions plus the islands, namely Abruzzo, Molise, Campania, Puglia, Basilicata, Calabria, Sicily and Sardinia.

25,000 manufacturing companies with at least 11 employees, and the AIDA Bureau Van Dick data containing information on financial variables for the same firms. As a result, we get a rich dataset for an unbalanced panel of about 4,000 units over the period 1998-2007. The estimation of TFP and its determinants is carried out by employing several different estimation techniques (OLS, FE, GMM and Levinson-Petrin). The robust result is consistent with most of the existing literature: institutions matter, as they come out to be one of the main driver of firms' productivity differentials.

The paper is organized as follows: after this introduction, Section 2 provides an overview of the literature on external factors as determinants of productivity levels, growth and differentials, and particularly on the role of *institutional quality*. Section 3 presents the econometric investigation, illustrates the estimation methods and discusses the main results. The Section 4 summarizes the main conclusions.

2. The macroeconomic determinants of firms' productivity. A literature review.

The idea that social, historical and cultural factors, institutions and the political and administrative context may have a decisive role in conditioning and steering the development process, as well as the economic success or decline of countries, regions and individual firms, has been largely considered by the economic literature, both from the more general perspective of national and regional growth and from the viewpoint of firms' productivity.

From the former perspective, a very broad strand of literature has focused on the ties between the above mentioned macroeconomic factors and the economic growth of countries and regions: in this vein, many eminent contributions (for example, Hall and Jones, 1999; Acemoglu et al., 2001, 2002; Easterly and Levine, 2003; Alcála and Ciccone, 2004) have provided theoretical ground and massive empirical evidence supporting the role of macroeconomic factors (such as institutional quality, openness to international trade, and geographic conditions) as "fundamental determinants of long run productivity" and drivers of growth.

On the other hand, many other authors have been concerned with the influence of the environment, and more specifically of institutional quality, on firms' productivity. Firms' productivity can be affected by the operating environment through a variety of channels. Syverson (2010) and Chanda and Dalgaard (2008) identify the presence of spillovers and the degree of competition as the main channels through which the external macroeconomic factors impinge on the level of business productivity. In this interpretation, spillovers basically operate through *incentive mechanisms*: they encourage companies to invest more in R&D (Griffith et al., 2007), shorten the technology distance (Bloom et al., 2007), accelerate the process of convergence to the productivity levels of the leader in the domestic market (Bartelsman et al., 2008). Other related studies (Foster et al., 2001; Melitz, 2003; Bloom et al., 2009; Eslava et al., 2004, Bernard et al., 2006; Fernandes, 2007; Verhoogen, 2008) focus on the relationship between *intensity of competition* and productivity. Greater competition allows the best companies to gain larger market shares at the expense of less efficient firms: the so-called "Darwinian selection of the market" rewards the most competitive, dynamic, flexible and innovative producers. In addition, competition creates greater opportunities for comparing performance, making it easier for owners to monitor managers (Lazear and Rosen, 1981; Nalebuff and Stiglitz, 1983). Also, improvements in productivity may generate higher revenues and profits in a more competitive environment where price elasticity of demand tends to be higher and, since more competition is likely to raise the likelihood of bankruptcy at any given level of managerial effort, managers have to work harder to avoid this outcome (Shmidt, 1996; Aghion and Howitt, 1998). An additional effect of greater competition on firms' productivity may derive from the increased incentive for workers, provided that product market rents are shared with workers in the form of higher wages or reduced effort (Haskel and Sanchis, 1995).

Other studies focus on the relationship between *intensity/quality of market regulation* and productivity. In this view, a poor or inadequate regulation can create perverse incentives that reduce

productivity (Bridgam et al., 2009). By contrast, largely positive effects can be associated to the implementation of an incentive program combining the gains of economic operators to obtain particular standards of operational efficiency (Knittel, 2002), similar to those of the programs of product market regulations in OECD countries (Nicoletti and Scarpetta, 2005, Arnold et al. 2008), or programs of privatization of the Eastern European countries (Brown et al., 2006).

Concerning more closely the role of institutions, it is at least from the work of Douglass North (1990, p. 3), for whom "institutions are the rules of the game in a society", that institutions have been recognised to crucially contribute to forming the set of incentives underlying behaviour and individual choices. As institutions significantly affect the degree of development of an economy, its capacity for growth, the extent of inequalities, etc., many scholars have focused their attention on the links between institutional quality and economic results. The importance of institutional quality as a basic determinant of economic growth and TFP in the long term has been assessed by many recent contributions (for example, McGuinness, 2007; Acemoglu and Robinson, 2008; Chanda and Dalgaard, 2008). These have shown how better institutions create a favourable business environment and a legal structure which facilitates investments and directs them towards activities able to ensure higher and faster economic growth. Good institutions promote accumulation of physical and human capital (Rodrik et al., 2004), encourage firms to use better technology, invest in knowledge creation and transfer (Loayza et al., 2005), produce on a larger scale and operate with a long time horizon, with a positive impact on competitiveness and economic performance (Aron, 2000), thereby ensuring higher levels of efficiency and often a fairer distribution of income (Bowen and De Clercq, 2008). More generally, other studies, both for cross-country (Barro and Lee, 1993; Nugent, 1993; Mauro, 1995; World Bank, 1997; Brunetti, 1997; Knack and Keefer, 1997; Djankov et al., 2002) and inter-regional comparisons (Heliwell and Putnam, 1995; Barro and Sala-i-Martin, 1995; Arrighetti and Serravalli, 1999a; Dall'Aglio, 1999), have provided evidence for significant

correlations between measures of institutional quality and various indicators of economic performance.

An important related issue concerns the measure of institutional quality. As the concept of institution is a complex one, it has often been somehow represented by a weighted average of measures of socio-politico-administrative indicators (for example, the degree of corruption, the good or bad definition of property rights, trial times, administrative capacity of local and regional governments – concerning for example health and social policies and waste management – markets' competitiveness and barriers to entry, tax evasion and the size of shadow economy, the endowment of social and economic infrastructures and so on). Nifo and Vecchione (2012), with reference to Italian provinces, built up the synthetic indicator Institutional Quality Index (IQI), based on five groups of elementary indexes (in turn connected to measures of corruption, governance, regulation, law enforcement and social partecipation). To some extent the IQI follows the framework proposed by Kaufmann et al. (2011) for the World Governance Indicator (WGI) with three major differences: first, it is meant to represent the local (i.e. provincial) environment rather than a national context and, secondly, it fails to consider political instability connected to violent overthrowing and terrorism, third, it considers a different methodological framework. The other items of IQI are similar to the ones of WGI and concern major dimensions of institutional quality: the degree of freedom of press and association (Voice and Accountability), the quality of public service and the policies formulated and implemented by the (Government Effectiveness), the ability of government to promote and formulate effective regulatory interventions (Regulatory Quality), the perception concerning the law enforcement both in terms of contract fulfilment, property rights, police forces, activities of the magistracy and crime levels (Rule of Law), the degree of corruption of those performing public functions both in terms of illegal gains and private proceeds acquired to the detriment of society (Control and Corruption).

Each of these distinct facets of institutional quality has been earlier separately analyzed by literature.

The relationship between corruption and regional or national productivity has been long discussed from both a theoretical (Krueger 1974; Rose-Ackerman 1978; Baumol 1990; Acemoglu and Verdier, 2000) and empirical perspective (Méon and Sekkat, 2005; Salinas-Jimenez, 2011). While the specific relationship between corruption and firm productivity remains almost unexplored (a relevant exception being De Rosa et al., 2010), both theory and empirical evidence highlight the negative consequences of corruption for resource allocation, entrepreneurship, investment and innovation (Baumol, 1990). Other studies emphasize how the entry of new firms is made more difficult in the presence of greater corruption and larger unofficial economies (Djankov et al., 2002); investment decisions are discouraged by de facto entry barriers into otherwise competitive markets (Alesina et al., 2003); corruption affects directly the sources of productivity enhancements, technological progress and investment (Svensson, 2005; Krusell and Rios-Rull, 1996).

Concerning "Regulatory Quality", other contributions show the positive impact of liberalization and privatization policies in OECD area on productivity in all sectors (Nicoletti and Scarpetta, 2003) and document the negative relationship between entry barriers and services' productivity in France and Italy (Daveri et al., 2011). An investigation on micro data from Bangladesh, China, India and Pakistan (Dollar et al., 2003) shows that the impact of *investment climate* on firms' TFP is systematically positively related to the "Regulatory Quality" indicators.

Concerning the issue of "Government Effectiveness", some studies have highlighted the impact of the history of peoples and the connected institutional structures on the economic performance of countries (Hall and Jones, 1999), focussing for example on the role of political institutions in steering entrepreneurial efforts towards more productive activities and supporting business (Baumol, 1990; Murphy et al., 1991). Arrighetti and Lasagni (2011) argue that private firms are more able to innovate and to push technological change where the intermediate government bodies

(primarily local political and administrative institutions) play a more active and positive role, influencing also firms' productivity. More effective public policies in health, transport and education (Kneller and Misch, 2010), transport (Datta, 2008; Shirley and Winston, 2004), public electricity services (Reinkka and Svensson, 2002) are found to positively affect firms' productivity.

The empirical works regarding the "Rule of Law" find that a higher degree of "Rule of Law" is associated with better long-run economic performances (Haggard and Tiede, 2011).

Related to the literature on institutional quality, there is a large number of contributions on institutional thickness (Amin and Thrift, 1994) and social capital (Putnam, 1993a; Narayan and Pritchett, 1997; Woolcock, 1998). Both these concepts are connected to a wide combination of factors including the presence of virtuous local institutions and inter-institutional links able to create a sharing culture and a set of values which help construct the so-called "social-atmosphere", generate mutual trust, enhance innovative capacity, expand common knowledge and strengthen local economic activity. Empirical evidence has clarified what role social cohesion (Rodrik, 1997; Ritzen Easterly and Woolcock, 2000) and the spread of collaborative and associative practices (Putnam, 1993a and 1993b; Narayan, 1999) may have as a driver of economic development, showing that growth is favoured by greater social peace and political stability, and by a better quality of institutions and public services.

The item "Voice and Accountability" of IQI fits into the debate on social capital *à la Putnam*, while representing a dimension of social capital more consistent with the focus of the present work: a fair picture of the degree of citizens' participation in social and public life, of their willingness to act as volunteers, including no-profit organizations' activities, books published, presence of social cooperatives. The literature focused on the relationship between social participation and firm performance suggests that knowledge flows are geographically bound as they tend to stream through social networks (Powell and Owen-Smith 2004; Sorenson 2003; Tallman et al. 2004).

From the policy maker viewpoint, the issue of the impact of institutional quality on firms' performance seems to be particularly relevant when firms' productivity differentials are evidently connected to different geographical locations. In this occurrence, the *macro* factors, such as the local institutional quality, are expected to be especially significant to explain the observed inter-firm diversity. The case of Italy, in this respect, looks particularly interesting, since it is characterized by a substantial and long-lasting productivity gap of industrial firms located in the Southern regions with respect to the rest of the country. for Italy, the literature largely recognizes a role for institutions in explaining productivity differentials. Nifo (2011), Aiello *et al*. (2010), Basile *et al*. (2009), Cannari et al. (2009), Viesti (2005) attach a crucial role to *context* factors in accounting for the significant and persistent productivity dispersion across Italian firms and regions. More in particular, concerning institutions, Del Monte and Giannola (1997) claim that institutional factors have contributed to creating an unfavorable business environment and preventing decades of aid policies in the South being effective, while Scalera and Zazzaro (2010) argue how public policies have been undermined by a poor institutional context. All these papers point out the negative impact on Southern firms' and regions' economic performance exerted by worse institutional quality, corruption, excessive bureaucratisation, poor or inefficient organisation of public services, a lower endowment of infrastructures, lack of security.

On the empirical ground, the shortage of reliable micro data has seriously curbed empirical investigations. Nevertheless, a few studies on the *macro* determinants of smaller productivity in Southern Italy are worth being mentioned. Aiello *et al*. (2012) explain the gap with the poor endowment of infrastructure, the lower efficiency of local administration and the lower investments in R&D. Fazio and Piacentino (2010) find that, especially for labor intensive firms, the lower productivity in the South is due to worse territorial socio-economic conditions more than to firm specific factors. Erbetta and Petraglia (2008), arguing that firms located in the Italian *Mezzogiorno* suffer from a significant productivity gap, conclude that this is due to a less favorable environment

(in terms for instance of transports and communications, education, public order) rather than to allocative distortions in the choice of input mixes. Finally, according to Di Giacinto and Nuzzo (2006), the labour productivity gap suffered by firms located in the South is explained only for one third by composition effects (prevalence of less productive industries) while most of the differential should be imputed to differences in human capital endowments and total factor productivity.

3. Empirical investigation

3.1 Data

We use two main sources for our firm-level data. The first one is the MET survey. This is based on a very large sample of Italian firms operating both in manufacturing and service sectors. The data we use come from the 1st MET survey which was carried out in September 2008. An important feature of this survey its attitude to provide a detailed picture of the Italian industrial system with its regional, dimensional and sector-based detail. We merge MET survey data with additional information obtained from the AIDA Bureau Van Dijk database. This database collects balance-sheet data and financial information of private companies throughout Italy[2]. The data obtained from AIDA were used to go back in time and re-construct the dynamics of balance sheet data in the period 1998-2007 for MET-surveyed firms.

To get our final dataset, some cleaning procedures are preliminarly performed. First, we drop all firms of the MET survey not reported data in AIDA database for years 2005-2007; this practically amounts to consider firms with at least 10 employees , since private not-limited-liability micro-enterprise (1-9 employees) are not required to provide balance sheet to the National Business Register and so are not present in AIDA. Second, we keep data only for firms classified in the manufacturing sectors (ISTAT Ateco codes 15-37). Third, we checked the data for outliers and

[2] The original source is the National Business Register. All the companies have to be registered in the National Business Register, specifying the data about their structure at the moment of establishment and the subsequent changes.

some gaps in the time series available. Finally, in order to reduce anomalies in the data, we delete all firms reporting abnormal values (i.e. the lower and higher 1 percent of values) in key variables such as revenues, total tangible assets, and employees.

The final database is made of about 4,000 firms for the period 1998-2007 (more than 36,000 observations). Our estimations of TFP are obtained for an unbalanced panel of firms (allowing for free entry or exit of firms founded between 1998 and 2007) [3]. As we will explain later (paragraph 3.3.), an additional data source is Nifo and Vecchione (2012) for the index of institutional quality IQI.

3.2 Measuring productivity

In this paper we are testing if institutional quality can have an effect on the productivity of Italian firms, controlling for other factors which are internal to the firm. Our empirical strategy consists in two stages: in the first stage, proxies for firm-level productivity are obtained, adopting the common approaches of TFP estimation. In literature, TFP is defined as an efficiency measure that can be identified investigating the use the production factors. The values of this proxy are not observable and one way of studying them is by estimating the parameters of a production function[4]. Estimating the level of TFP we concentrated on a productivity measure that is output-based, i.e., it measures how much extra output a firm produces relative to another firm, conditional on its (extra) input use. This is a common approach, and it is based on a simple production model embedded in the following equation:

$$Y_{it} = A_{it} F_i(K_{it}, L_{it}) \qquad (1) \qquad \text{then:} \qquad A_{it} = \frac{Y_{it}}{F_i(K_{it}, L_{it})}$$

[3] Additional details on 2008 MET survey and some tables with summary statistics, can be found in Annex 1 (tables A1.1-A1.3).

[4] Please see van Biesebroeck (2007) for discussion on the differences among various methods for estimating TFP.

2)

Where Y is firms revenue, K is our measure of physical capital, namely the value of tangible fixed assets as reported in the balance sheet; L is our measure of employment level, namely the number of employee. The values (natural logs) of all variables are observed for the i-th firm (i=1,…, about 4,000) in different years t (t=1,…,10)[5].

The Cobb-Douglas version for (1) with constant return to scale $\alpha_k + \alpha_l \equiv 1$ is:

$$Y_{it} = A_{it} K_{it}^{\alpha_k} L_{it}^{\alpha_l} \tag{3}$$

Taking the natural logarithm and adding m_{it} $\alpha_0, w_{it}, \varepsilon_{it}$ as respectively: i) the value of expenditures for purchase of material goods (as suggested in Van Beveren, 2010), the item is labeled "Raw materials expenditures", ii) a constant fixed term, iii) a firm time depending term (our proxy for the TFP), iv) an error measurement term, the final equation will be:

$$y_{it} = \alpha_0 + \alpha_l l_{it} + \alpha_k k_{it} + \alpha_m m_{it} + w_{it} + \varepsilon_{it} \tag{4}$$

where lower case letters indicate natural logarithms. Substituting in (2):

$$\ln(A_{it}) = \ln(Y_t) - \alpha^l \ln(L_{it}) - \alpha^k \ln(K_{it}) - \alpha^m \ln(M_{it}) - \varepsilon_{it}$$

where:

$$\mathrm{E}\left[\ln(A_{it})\right] = w_{it} \tag{5}$$

Thus, we assume that the productivity is in the residual, after controlling for inputs K, L and M, and we will apply a set of techniques to estimate firm-level TFP values. We estimate separate

[5] To control for inflation effects, our original data for the revenue of fims were deflated by using ISTAT index of producer prices in different sectors (ISTAT ATECO codes for the detail at 2 digit level). The data for physical capital and the purchase of material goods were deflated by using ISTAT index of producer prices for capital goods.

production functions for 11 manufacturing classification groupings[6]. By estimating separate production functions for various industry groups, one can examine in a more consistent manner the individual heterogeneity in the data. As recalled by van Biesebroeck (2007), "productivity is intrinsically a relative concept", therefore it is necessary to compare TFP "indexes". We compute our TFP index as a ratio between the value of w_{it} and the average of w_{it} across all firms in the industry (2 digit ISTAT ATECO code).

As mentioned before, there are different estimators to compute a TFP index. In our paper four of them are considered and equation 4 can be estimated using: Ordinary Least Square (OLS), Fixed effects (FE), Blundell-Bond system General Method of Moments (SYS-GMM), or Levinsohn-Petrin (LP) methodology. OLS approach assumes that the inputs in the production function are exogenous or, in other words, determined independently from the firm's efficiency level. The simultaneity problem has been the main focus of the methodological literature dealing with TFP estimation. As it is well known in the literature, traditional methods to deal with the endogeneity of inputs issue include FE and instrumental variables approach (Griliches and Mairesse, 1995). Theoretically, the FE estimator corrects for both the simultaneity and selection bias. As a consequence, the coefficients on the variable inputs (labour and materials) are expected to be lower compared to those produced in the OLS results (Van Biesenbroeck, 2007). However, as explained by Arnold (2005), there are still some drawbacks with the FE estimator. First, a substantial part of the information in the data is left unused. A fixed-effect estimator uses only the across time variation, which tends to be much lower than the cross-section one. This means that the coefficients will be weakly identified. Second, the assumption that technology is fixed over time may not always be reasonable, making the whole procedure invalid. In the literature (see van Beveren 2010), two GMM methods are generally employed to handle these problems: the "difference" GMM and

[6] See Appendix 2 for details on industries included in groupings.

more recently the "system" GMM proposed by Arellano and Bover (1995) and further developed by Blundell and Bond (2000)[7]. The system GMM uses a system of equations where lagged levels of variables are used as instruments for an equation in first differences and lagged first differences are used as instruments for an equation in levels[8]. A fourth, largely-employed methodology is the one proposed by Levinsohn and Petrin (2003). This is a technique that is very close to the semi-parametric Olley and Pakes approach, but it has the advantage of requiring less data at firm level [9].

[7] In very short terms, to tackle 'endogeneity of inputs' or simultaneity bias (i.e., the correlation between the level of inputs chosen and unobserved productivity shocks, see De Loecker, 2007) it is necessary to find good instruments. This is the basic idea at the heart of the Arellano-Bond (AB) estimator that stems in the Anderson & Hsiao (AH) estimator. AH removed the individual heterogeneity differencing the basic panel model and then instrumenting to fix the endogeneity problem. Arellano and Bond (1995) proposed the model in the context of a GMM estimator. As van Beveren (2010) recalled, possible instruments include the lagged levels of the inputs. Specifically, after first-differencing the production function, lagged inputs can be used as instruments for changes in the inputs. However, because inputs tend to be highly persistent over time, lagged levels of inputs tend to be only weakly correlated with input changes. In empirical practice, using lagged inputs to instrument for changes in inputs may cause the capital coefficient to be biased downwards (and often insignificant) and led to unreasonably low estimates of returns to scale. Thus, Blundell and Bond (1999) propose an extended (GMM SYS) estimator using lagged first-differences of the variables as instruments in the level equations and find that this estimator yields more reasonable parameter estimates. "Blundell Bond estimator augments Arellano-Bond by making an additional assumption, that first differences of instrument variables are uncorrelated with the fixed effects. This allows the introduction of more instruments, and can dramatically improve efficiency" (Roodman 2009, p. 1).

[8] Blundell and Bond (2000) suggest that the system GMM is the most appropriate estimator when estimating first differences with weak instruments and the system GMM has been shown to be a more reliable and robust estimator than the difference GMM when estimating production functions (see e.g. Lokshin et al., 2008; Hempell, 2005; O'Mahony and Vecchi, 2009; Ballot et al., 2001).

[9] The method suggested by Olley and Pakes generates consistent and unbiased estimates if and only if there is a strictly monotonous relationship between the proxy and output. Consequently, firms that make only intermittent investments will have their zero-investment observations truncated from the estimation routine because the monotonicity condition

In our data, the estimation of the production function (Table A2.1) produces an elasticity with respect to labour between 0.10 and 0.49 and with respect to capital between 0.06 and 0.14, when significant. The variance for the elasticity with respect to material expenditures is somewhat larger: between 0.18 and 0.91, but for few cases the Levinsohn-Petrin procedure estimates a materials coefficient equal to one[10]. As expected, we found that OLS and FE model often underestimates the coefficient of capital, which turns to be larger in GMM and LP regressions. Table 1 shows the correlation among the different TFP estimators for our data. We found that the different methods yield remarkably high correlation in TFP estimates (as in Van Biesenbroeck, 2007, and van Beveren, 2010).

[Table 1 - here]

To complete our discussion on the estimated values of TFP across firms, we use a graphical comparison of the cumulative distributions of TFP (see Figure 1). In this case, the aim is to confirm the magnitude of the North-South gap productivity in our data. Regardless of the estimation method, the TFP distribution for firms localized in the South lies always above (and to the left of) the TFP distribution for firms localized in the North.

[Figure 1 - here]

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does not hold for these observations. Levinsohn and Petrin (2003) suggested to use of intermediate inputs as a proxy rather than investment. Typically, many datasets will contain significantly less zero-observations in materials than in firm-level investment. Levinson and Petrin also offer several specification tests to check for the appropriateness of the proxy used. For additional information see Olley and Pakes (1996). We do not refer to Olley-Pakes method because we do not have any firm exit in our data, but only entry.

[10] As Arnold (2005) explained, this is due to an imposed upper limit in the estimation algorithm.

All in all, we arrived at reasonably robust firm-level TFP estimates which have been calculated to be used in the second step, namely when we have to examine the effect of institutional quality on firms' productivity performance.

3.3 Explaining productivity: can institutional quality make the difference?

Once obtained firm-level estimated TFP, in the second stage of our research, we use it as a dependent variable, to assess the role of institutional quality as a explanatory factor for firms' productivity. Our measure of institutional quality is the IQI indicator introduced in section 2 and originally, proposed by Nifo and Vecchione (2012).

Mor in detail, the IQI is structured into 24 elementary and 5 aggregate indexes (dimensions)[11] regarding some major quality characteristics of a governance system. Each dimension is the result of the aggregation of simple indexes whose values are gathered from official sources and surveys conducted by public, private and non-governmental institutions[12].

Figure 2 illustrates the geographical pattern of IQI, in Italy, showing the institutional quality gap between the North and South of the Country.

[Figure 2 - here]

The importance of the North-South gap with respect to a broad range of socio-economic conditions, widely documented by the literature (Daniele, Malanima, 2007; Giannola, Lopes, 2011; Giannola, 2009; Graziani, 1998; Scalera, Zazzaro, 2010), is confirmed by Figure 2 for institutional

[11] Voice and accountability, Government effectiveness, Regulatory quality, Rule of law, Control and corruption

[12] For a more detailed discussion of the aggregation method and data sources, see Nifo and Vecchione (2012).

quality as well: all the provinces in the *Mezzogiorno* are characterised by lower levels of institutional quality than in the rest of Italy.

The estimation of the determinants of firms' TFP is carried out through equation (6) whose parameters are estimated by five alternative mothods. In each model, we regress firm TFP on index IQI and a set of other regressors used as controls:

$$TFP_i = \alpha_i + \beta_1 X_i + \beta_2 S + \beta_3 IQI_i + \varepsilon_i \quad (6)$$

where TFP_i is the TFP index calculated as average across years 2005-2007 to reduce short-time shock bias; X is a vector including firms' age in years (NOME), two dummy variables relative to firms' class size (SIZE) , a group membership dummy (GROUP), industry dummies (PAVITT); S is a South dummy equal to 1 for firms localized in Souhern regions, and 0 otherwise; IQI is the institutional quality index. We are not able to extend our basic specification further because the MET survey was completed in 2008. Since some variables (innovation performance, exports, R&D expenditures, etc.) are measured successively (or at best simultaneously) with respect to our TFP estimates, to avoid any reverse causality bias, we limit our estimation to the period 1998-2007.

[Table 2 - here]

Table 2 reports the results of regressions. As a first evidence, we can notice that basically our working hypothesis is confirmed: IQI coefficients are positive and significant in all the four different models. The estimated coefficients indicate that higher institutional quality tends to improve firm performance by about 19-26% depending on the estimation techniques. This outcome is confirmed even with the inclusion of dummy South, capturing various other effects related to the less favourable location.

The estimated impact of control variables is also fairly informative. First, small and medium sized enterprises show lower levels of TFP than large firms employing more than 250 workers. The productivity gap is mostrly evident for the smallest firms with less than 50 employees (about 20% of our sample; see Table A1.2). We believe that this result is consistent with previous literature on Italian industry (for example, see Castellani and Giovannetti, 2010 or Aiello et al., 2012), where productivity premia for non-small-sized firms are associated with other factors as well (e.g. internationalization, economies of scale or human capital endowment). Second, firms belonging to a business group have come out to show significantly higher levels of TFP than other firms. Finally, age seems not be relevant in determining TFP (except for the GMM1 or 2 estimation, when its coefficient shows a significantly positive sign).

An interesting question that can be answered with our data is whether the positive relationship between IQI and firm-level TFP can be attributed to some specific factors that are included in the synthetic index. In other words, it would be important to extend our set of results by looking at *how* institutional quality affects the level of firms' efficiency in Italy. To evaluate the possibly different effects of each sub-index composing the IQI, we run a set of regressions using some IQI sub-indexes (or dimensions). We believe that these additional insights can turn out to be particularly useful to design measures to promote productivity.

In Table 3 and 4, when the sub-indexes "Control and Corruption" and "Regulatory Quality" are included in our model in place of IQI. For these particular indexes, we do not find significant effects on firms' TFP. Both of them has a correct (negative) sign across all models, but coefficients are never statistically significant.

[Table 3 - here]

A possible explanation is that the level of corruption across Italian regions is not very different (De Rosa et al., 2010), and small differences are unlikely to be associated with productivity differentials at firm level.

[Table 4 - here]

A bit surprisingly, and in contrast with previous studies on the relationship between *investment climate* and firm performance (for example Dollar et al., 2003), we also can not found a significant impact of "Regulatory Quality" on firms' TFP. Conversely, when considering the IQI dimension "Government Effectivness" (Table 5), we get estimated coefficients significant and similar in magnitude to those reported in Table 2.

[Table 5 - here]

Concerning the dimension "Rule of Law" (including indexes on judges' productivity, trial times, shadow economy and crimes), we get coefficinet with the expected sign across all models, but unfortunatly not statistically significant.

[Table 6 - here]

Finally, in Table 7, where the results of regressions using the IQI sub-index "Voice and Accountability" are reported. According to our results, the measure of how much citizens participate in social life, is positively associated with firm level TFP and its influence is statistically signifivant. In particular, we can see the estimated impact of "Voice and Accountability" reported in Table 2 and Table 5. This happens probably because where "Voice" is relatively low,

firms incur in higher organizational costs connected to larger distrust levels and low degree of cooperation across social groups.

[Table 7 - here]

Summarizing, the results of our regression analysis seem to confirm that in Italy firm-level productivity premia are associated with the institutional quality of provinces where firms are located. This conclusion supports the view that the comparative performance of firms located in Southern Italy is significantly undetermined by the South wich sets out additional constraint to their effort to increase productivity and competitiveness.

4. Concluding remarks

This paper explores the hypothesis that differences in institutional quality endowments are crucial in shaping inter-firm productivity differentials. To this purpose, we build up a unique dataset for an unbalanced panel of about 4,000 Italian manufacturing companies over the period 1998-2007 and the estimation of TFP and its determinants is carried out by employing several different estimation techniques (OLS, FE, GMM and Levinson-Petrin).

The robust result, in line with our hypothesis, is consistent with most of the existing literature that ascribes to business environment and institutional context a key role in determining firms' productivity: "institutions do matter" as they come out to be one of the main driver of differentials. Firms' productivity, as measured by TFP, does appear to be affected by institutional features, suggesting that future research would carefully consider the possible consequences of alternative institutional settings on a variety of economic variables. The presence of invaluable spillovers connected to good quality institutions and the incentive mechanisms, activated by them, is one of

the main channels through which the macroeconomic factors positively impact on the *investment climate* and competitiveness.

In addressing the multidimensionality of institutional structure, this paper provides a more nuanced analysis of the institutional determinants of firms' productivity as well. In particular, among the different aspects and elementary indexes constituting the synthetic IQI indicator, the dimensions relative to "Government Effectiveness" and "Voice and Accountability", that is the adequacy and strenght of government policies and the social capital endowment at the territorial level, turn out to be the most relevant in affecting firms' productivity. Interestingly and - in such way - surprisingly, corruption is not seen to have a robust impact on the Italian firms' productivity.

From a policy perspective our results imply that institutional and regulatory reform – especially in "Government Effectiveness" and "Voice and Accountability" – may enhance the ability of lagging regions to catch the development opportunities, for example by moving up to specialization in higher-valued products and to reap benefits from international integration.

This analisys stops before the crisis. Further extensions aimed at extending the analysis of the correlation between institutional quality and productivity during and after the crisis, will certainly be very interesting and desirable.

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TABLE 1: Correlation table of TFP measures

Estimation method	Nr. Firms	(1)	(2)	(3)	(4)	(5)
(1) OLS	4,066	1				
(2) FE	4,066	0.911	1			
(3) GMM1	3,922	0.561	0.776	1		
(4) GMM2	3,922	0.590	0.808	0.969	1	
(5) LP	4,066	0.540	0.511	0.361	0.380	1

Source: MET 2008 survey and AIDA Bureau Van Dick database; author's elaborations.
Note: GMM2 refers to estimates of production function which have been performed with a smaller number of instruments with respect to GMM1 (see table in Appendix).

TABLE 2: The effect of IQI (institutional quality index) on firm-level TFP (mean value 2005-2007): OLS regressions

	Y=TFP-OLS	Y=TFP-FE	Y=TFP-GMM1	Y=TFP-GMM2	Y=TFP-LP
Size class 1 (d)	0.035	-0.421***	-1.323***	-1.277***	-0.262*
	(0.05)	(0.07)	(0.15)	(0.16)	(0.15)
Size class 2 (d)	0.001	-0.220***	-0.886***	-0.826***	-0.264*
	(0.05)	(0.07)	(0.15)	(0.16)	(0.15)
Group (d)	0.048**	0.075***	0.145***	0.121***	0.05
	(0.02)	(0.02)	(0.03)	(0.03)	(0.04)
Age of the firm (in log.)	-0.016	0.006	0.030**	0.030**	0.006
	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)
Firm localiz. (South=1) (d)	-0.061*	-0.073**	-0.113**	-0.093**	0.073
	(0.04)	(0.04)	(0.04)	(0.04)	(0.10)
IQI - Institutional qual. index	0.241***	0.192**	0.198*	0.188*	0.264*
	(0.07)	(0.07)	(0.10)	(0.10)	(0.16)
Costant	0.895***	1.179***	1.858***	1.801***	1.056***
	(0.09)	(0.10)	(0.19)	(0.19)	(0.22)
Pavitt dummies	Yes	Yes	Yes	Yes	Yes
Obs.	4066	4066	3922	3922	4066
Firms	0.017	0.074	0.222	0.23	0.003

Note: (d) indicate a dummy variable. Standard errors in parentheses - Clustered by province (NUTS3) groups. * p < 0.10, ** p < 0.05, *** p < 0.01. Size class 1 = 10-49 employees, Size class 2 = 50-249 employees. The dependent variable for "Y=TFP-GMM2" is different from "Y=TFP-GMM1", since the estimates of production function have been performed with a smaller number of instruments (see table in Appendix).

TABLE 3: The effect of IQI sub index control and corruption on firm-level TFP (mean value 2005-2007): OLS regressions.

	Y=TFP-OLS	Y=TFP-FE	Y=TFP-GMM1	Y=TFP-GMM2	Y=TFP-LP
Size class 1 (d)	0.041	-0.416***	-1.319***	-1.274***	-0.256*
	(0.05)	(0.07)	(0.15)	(0.16)	(0.15)
Size class 2 (d)	0.006	-0.217***	-0.884***	-0.824***	-0.260*
	(0.05)	(0.07)	(0.15)	(0.16)	(0.15)
Group (d)	0.053***	0.080***	0.150***	0.125***	0.056
	(0.02)	(0.02)	(0.03)	(0.03)	(0.05)
Age of the firm (in log.)	-0.013	0.008	0.032**	0.032**	0.009
	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)
Firm localiz. (South=1) (d)	-0.147***	-0.152***	-0.198***	-0.176***	-0.042
	(0.05)	(0.04)	(0.04)	(0.04)	(0.11)
IQI - Control & corruption	-0.009	-0.039	-0.049	-0.053	-0.072
	(0.08)	(0.08)	(0.08)	(0.07)	(0.19)
Costant	1.068***	1.345***	2.038***	1.978***	1.302***
	(0.09)	(0.10)	(0.17)	(0.18)	(0.23)
Pavitt dummies	Yes	Yes	Yes	Yes	Yes
Obs.	4066	4066	3922	3922	4066
Firms	0.013	0.072	0.221	0.229	0.002

Note: (d) indicate a dummy variable. Standard errors in parentheses - Clustered by province (NUTS3) groups. * p < 0.10, ** p < 0.05, *** p < 0.01. Size class 1 = 10-49 employees, Size class 2 = 50-249 employees. The dependent variable for "Y=TFP-GMM2" is different from "Y=TFP-GMM1", since the estimates of production function have been performed with a smaller number of instruments (see table in Appendix).

TABLE 4: The effect of IQI sub index regulatory quality on firm-level TFP (mean value 2005-2007): OLS regressions.

	Y=TFP-OLS	Y=TFP-FE	Y=TFP-GMM1	Y=TFP-GMM2	Y=TFP-LP
Size class 1 (d)	0.04	-0.416***	-1.319***	-1.273***	-0.254*
	(0.05)	(0.07)	(0.15)	(0.16)	(0.15)
Size class 2 (d)	0.004	-0.218***	-0.885***	-0.824***	-0.258*
	(0.05)	(0.07)	(0.15)	(0.16)	(0.15)
Group (d)	0.050***	0.077***	0.144***	0.122***	0.055
	(0.02)	(0.02)	(0.03)	(0.03)	(0.04)
Age of the firm (in log.)	-0.013	0.008	0.032**	0.032**	0.009
	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)
Firm localiz. (South=1) (d)	-0.125***	-0.127***	-0.145***	-0.140***	-0.024
	(0.04)	(0.04)	(0.04)	(0.03)	(0.08)
IQI - Regulatory quality	0.056	0.035	0.105	0.052	-0.017
	(0.07)	(0.07)	(0.07)	(0.07)	(0.12)
Costant	1.028***	1.291***	1.932***	1.900***	1.247***
	(0.08)	(0.10)	(0.17)	(0.18)	(0.21)
Pavitt dummies	Yes	Yes	Yes	Yes	Yes
Obs.	4066	4066	3922	3922	4066
Firms	0.014	0.072	0.222	0.229	0.002

Note: (d) indicate a dummy variable. Standard errors in parentheses - Clustered by province (NUTS3) groups. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Size class 1 = 10-49 employees, Size class 2 = 50-249 employees. The dependent variable for "Y=TFP-GMM2" is different from "Y=TFP-GMM1", since the estimates of production function have been performed with a smaller number of instruments (see table in Appendix).

TABLE 5: The effect of IQI sub index rule of law on firm-level TFP (mean value 2005-2007): OLS regressions.

	Y=TFP-OLS	Y=TFP-FE	Y=TFP-GMM1	Y=TFP-GMM2	Y=TFP-LP
Size class 1 (d)	0.035	-0.421***	-1.322***	-1.277***	-0.260*
	(0.05)	(0.07)	(0.15)	(0.16)	(0.15)
Size class 2 (d)	0.002	-0.219***	-0.885***	-0.826***	-0.262*
	(0.05)	(0.07)	(0.15)	(0.16)	(0.15)
Group (d)	0.052***	0.078***	0.148***	0.124***	0.054
	(0.02)	(0.02)	(0.03)	(0.03)	(0.04)
Age of the firm (in log.)	-0.014	0.008	0.032**	0.032**	0.009
	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)
Firm localiz. (South=1) (d)	-0.123***	-0.123***	-0.166***	-0.141***	-0.003
	(0.03)	(0.03)	(0.03)	(0.02)	(0.08)
IQI - Rule of Law	0.127*	0.096	0.092	0.103	0.092
	(0.07)	(0.07)	(0.09)	(0.08)	(0.11)
Costant	0.971***	1.244***	1.930***	1.859***	1.174***
	(0.09)	(0.10)	(0.19)	(0.19)	(0.19)
Pavitt dummies	Yes	Yes	Yes	Yes	Yes
Obs.	4066	4066	3922	3922	4066
Firms	0.014	0.072	0.221	0.229	0.002

Note: (d) indicate a dummy variable. Standard errors in parentheses - Clustered by province (NUTS3) groups. * p < 0.10, ** p < 0.05, *** p < 0.01. Size class 1 = 10-49 employees, Size class 2 = 50-249 employees. The dependent variable for "Y=TFP-GMM2" is different from "Y=TFP-GMM1", since the estimates of production function have been performed with a smaller number of instruments (see table in Appendix).

TABLE 6: The effect of IQI subindex governmente effectiveness on firm-level TFP (mean value 2005-2007): OLS regressions

	Y=TFP-OLS	Y=TFP-FE	Y=TFP-GMM1	Y=TFP-GMM2	Y=TFP-LP
Size class 1 (d)	0.039	-0.418***	-1.321***	-1.275***	-0.258*
	(0.05)	(0.07)	(0.15)	(0.16)	(0.15)
Size class 2 (d)	0.001	-0.220***	-0.887***	-0.827***	-0.265*
	(0.05)	(0.07)	(0.15)	(0.16)	(0.15)
Group (d)	0.051***	0.077***	0.147***	0.122***	0.052
	(0.02)	(0.02)	(0.03)	(0.03)	(0.04)
Age of the firm (in log.)	-0.017	0.005	0.029**	0.029**	0.005
	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)
Firm localiz. (South=1) (d)	-0.096***	-0.099***	-0.144***	-0.122***	0.037
	(0.03)	(0.03)	(0.03)	(0.03)	(0.09)
IQI - Government Effectiveness	0.261***	0.218**	0.201*	0.193**	0.296*
	(0.10)	(0.10)	(0.10)	(0.09)	(0.18)
Costant	0.971***	1.236***	1.926***	1.865***	1.136***
	(0.08)	(0.09)	(0.17)	(0.17)	(0.18)
Pavitt dummies	Yes	Yes	Yes	Yes	Yes
Obs.	4066	4066	3922	3922	4066
Firms	0.016	0.073	0.222	0.23	0.003

Note: (d) indicate a dummy variable. Standard errors in parentheses - Clustered by province (NUTS3) groups. * p < 0.10, ** p < 0.05, *** p < 0.01. Size class 1 = 10-49 employees, Size class 2 = 50-249 employees. The dependent variable for "Y=TFP-GMM2" is different from "Y=TFP-GMM1", since the estimates of production function have been performed with a smaller number of instruments (see table in Appendix).

TABLE 7: The effect of IQI subindex voice and accountability on firm-level TFP (mean value 2005-2007): OLS regressions

	Y=TFP-OLS	Y=TFP-FE	Y=TFP-GMM1	Y=TFP-GMM2	Y=TFP-LP
Size class 1 (d)	0.045	-0.413***	-1.315***	-1.269***	-0.249*
	(0.05)	(0.07)	(0.15)	(0.16)	(0.15)
Size class 2 (d)	0.012	-0.211***	-0.878***	-0.818***	-0.248*
	(0.05)	(0.07)	(0.15)	(0.16)	(0.14)
Group (d)	0.052***	0.078***	0.148***	0.124***	0.053
	(0.02)	(0.02)	(0.03)	(0.03)	(0.04)
Age of the firm (in log.)	-0.015	0.007	0.031**	0.031**	0.006
	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)
Firm localiz. (South=1) (d)	-0.113***	-0.111***	-0.156***	-0.131***	0.04
	(0.03)	(0.03)	(0.03)	(0.02)	(0.08)
IQI -Voice and accountability	0.130***	0.115**	0.105*	0.111**	0.243**
	(0.05)	(0.05)	(0.06)	(0.06)	(0.10)
Costant	0.986***	1.245***	1.934***	1.868***	1.100***
	(0.07)	(0.09)	(0.17)	(0.18)	(0.19)
Pavitt dummies	Yes	Yes	Yes	Yes	Yes
Obs.	4066	4066	3922	3922	4066
Firms	0.015	0.073	0.222	0.23	0.004

Note: (d) indicate a dummy variable. Standard errors in parentheses - Clustered by province (NUTS3) groups. * p < 0.10, ** p < 0.05, *** p < 0.01. Size class 1 = 10-49 employees, Size class 2 = 50-249 employees. The dependent variable for "Y=TFP-GMM2" is different from "Y=TFP-GMM1", since the estimates of production function have been performed with a smaller number of instruments (see table in Appendix).

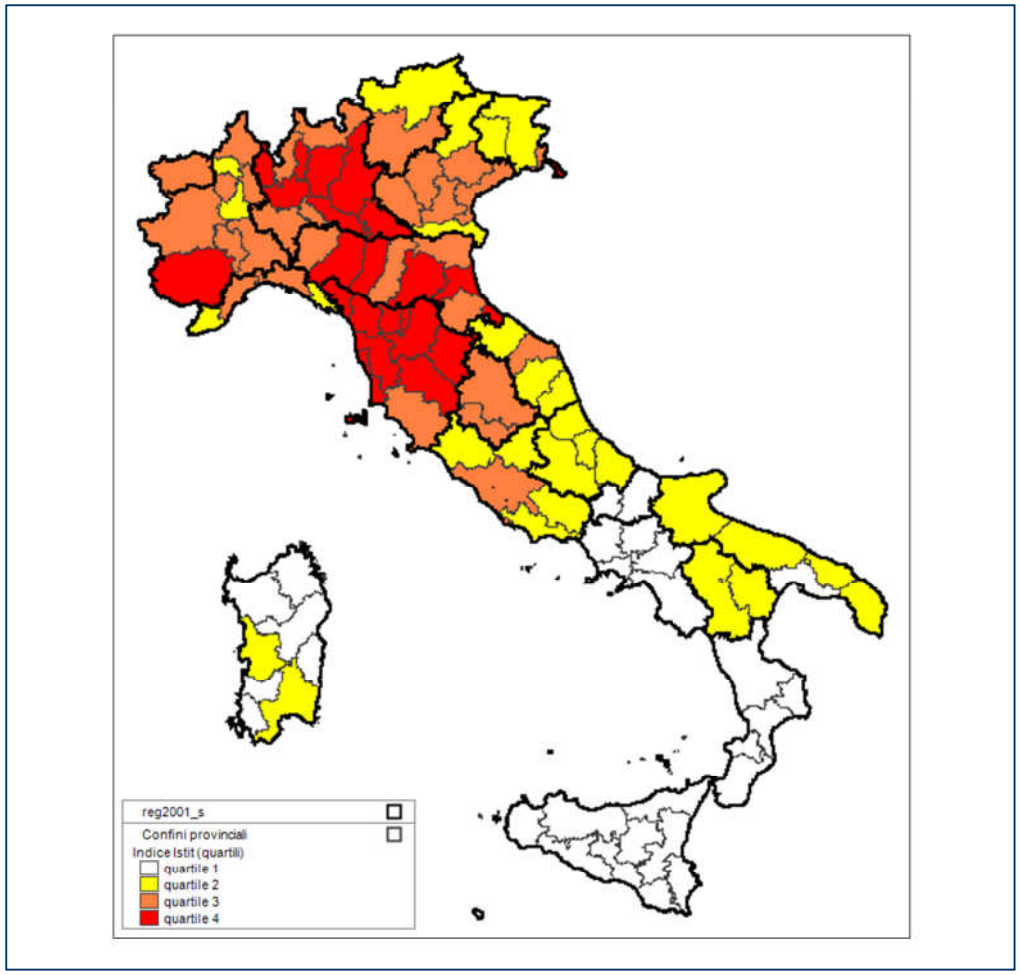

FIGURE 1: Geographical distribution of IQI.
Source: Nifo and Vecchione (2012)

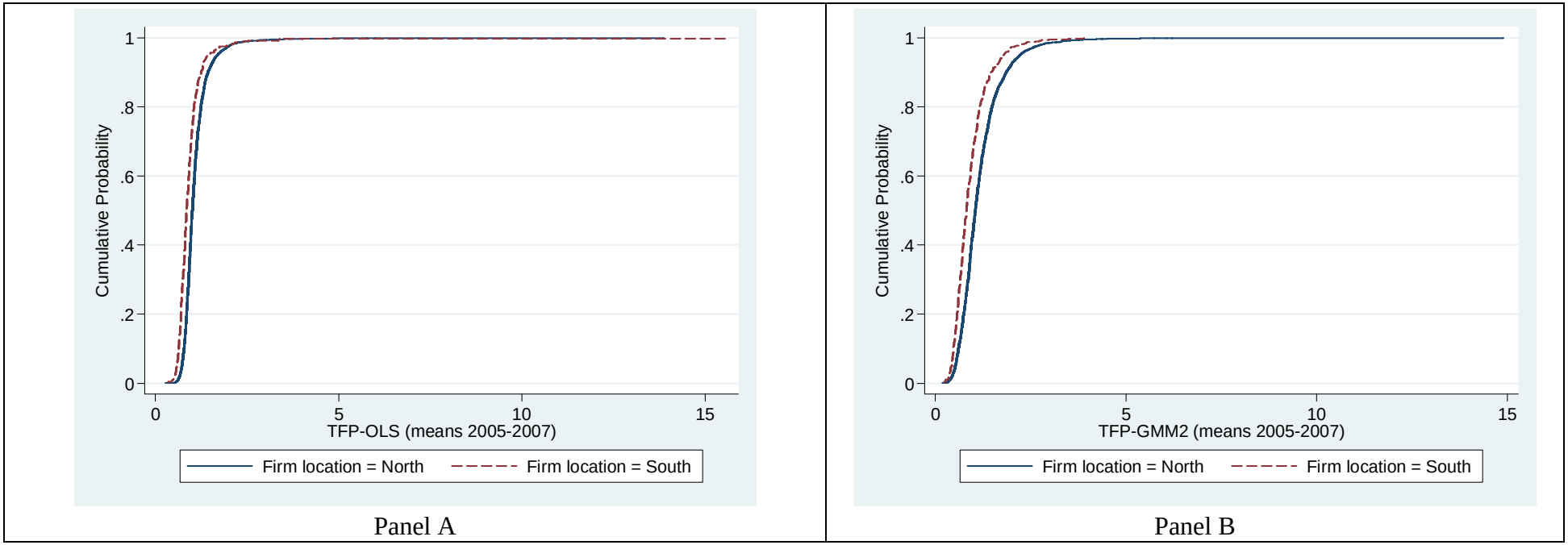

FIGURE 2: Cumulative distribution of TFP estimates (panel A = OLS estimates, panel B=GMM2 estimates), by geographical localization of firms (i.e. North = 0 and South=1).

Source: MET 2008 survey and AIDA Bureau Van Dick database; author's elaborations.

Annex 1 – The MET survey 2008 and the representativeness of our database

The universe of Italian private firms were stratified by MET according to the standard procedures using the following variables: region (NUTS 2 level), size class (1-9 employees, 10-49 employees, 50-250 employees, more than 250 employees) and industries.

In order to define the sample size, the following choices were made:

- all firms with more than 250 employees were surveyed;
- remaining firms were divided into 3 layers identified by the remaining 3 size classes: 1-9 employees, 10-49 employees, 50-250 employees;
- for each layer, *a priori* fixed number of units to be surveyed was established, varying from region to region, depending on the number of firms same region.

The questionnaire covers a large number of information on firm activity: R&D, export, innovation performance, etc. etc. Unfortunately, the MET survey was completed in 2008, therefore several variables in the MET dataset are likely to be measured successively (or at best simultaneously) with respect to our TFP estimates.

TABLE A1.1: Distribution of firm-level employment by region (NUTS 2 level): original MET sample data and retained firms.

Region	Our sample	Original MET sample sata
Piemonte	7.8	9.5
Valle D'Ao	0.4	0.5
Lombardia	12.8	15.4
TN-BZ	1.8	2.9
Veneto	21.2	16.1
Friuli-Ven	1.6	2.4
Liguria	0.8	1.6
Emilia Romagna	18.4	16.0
Toscana	13.3	7.9
Umbria	2.0	1.7
Marche	2.7	1.8
Lazio	5.1	13.6
Abruzzo	1.0	1.3
Molise	0.3	0.3
Campania	2.7	2.2
Puglia	5.2	3.7
Basilicata	0.5	0.6
Calabria	0.4	0.5
Sicilia	1.6	1.4
Sardegna	0.4	0.5
Total	100.0	100.0

Source: MET 2008 survey and AIDA Bureau Van Dick database; author's elaborations.

Note: elaborations based on firm sample used in OLS, FE and Levinsohn-Petrin regressions; for GMM regressions (see tables A.2.1a- A.2.1c) the number of firms is smaller because lagged values of variables have been used as instruments and this is a limitation for firms not having data for years 1998-2002.

TABLE A1.2: Distribution of firm-level employment by class size: original MET sample data and retained firms.

Class size	Our sample	Original MET Data
Micro (1-9)	-	4.4
Small (10-49)	22.5	13.4
Medium (50-249)	66.4	34.6
Large (250+)	10.3	47.6
Total	100.0	100.0

Source: MET 2008 survey and AIDA Bureau Van Dick database; author's elaborations.

Note: elaborations based on firm sample used in OLS, FE and Levinsohn-Petrin regressions; for GMM regressions the number of firms is smaller because lagged values of variables have been used as instruments and this is a limitation for firms not having data for years 1998-2002.

Annex 2 – Total Factor Productivity estimations

We estimate a separate production function of each industry group. Due to data constraint, we aggregated some of the 22 ISTAT-ATECO two digit manufacturing codes into 11 broader gropupings. According to Roodman (2009) there is a danger associated with having many instruments relative to observations. Therefore, we decided to report instruments count for all estimates and we add GMM2 results, in which we keep the instrument count down using a collapsed instrument set, as suggested by Roodman (2009). Concerning GMM results, Table A2.1 also report the Arellano-Bond test to verify autocorrelation in difference residuals and the Sargan-Hansen test for over identification. As showed in the results, residuals are not autocorrelated and models are correctly identified.

TABLE A2.1a: Production function estimates for industry groups.

Industry group	Method	Labour	Capital	Materials	Period dummies	N	Firms	AR(2)	AR(2) p-value	S_Ha	S-H p-value	STRU
1	OLS	0.240***	0.062***	0.674***	No	3513						
1	FE	0.158***	0.037***	0.601***	No	3513	431					
1	GMM1	0.174*	0.078***	0.481***	Yes	2958	424	1.508	0.132	297.487	0.239	297
1	GMM2	0.058	0.006	0.574***	Yes	2958	424	1.329	0.184	61.588	0.315	73
1	LP	0.211***	0.016	0.803***		3513						
2	OLS	0.406***	0.017**	0.476***	No	2566						
2	FE	0.275***	0.033***	0.423***	No	2566	297					
2	GMM1	0.191***	0.090**	0.239***	Yes	2196	294	0.535	0.593	265.969	0.703	295
2	GMM2	0.083	-0.03	0.278**	Yes	2196	294	0.874	0.382	54.503	0.569	73
2	LP	0.362***	0	0.919***		2566						
3	OLS	0.407***	0.062***	0.456***	No	2593						
3	FE	0.273***	0.047***	0.434***	No	2593	325					
3	GMM1	0.332***	0.128***	0.265**	Yes	2180	319	1.077	0.282	257.468	0.806	294
3	GMM2	0.199*	0.141**	0.277***	Yes	2180	319	1.061	0.288	63.932	0.246	73
3	LP	0.301***	0.022	0.513***		2593						

Note: group 1 = ISTAT-ATECO 15--food products and beverages; group 2 = ISTAT-ATECO cod.17--textiles; group 3 = ISTAT-ATECO cod.18--wearing apparel; dressing and yeing of fur; ISTAT-ATECO cod.19--Tanning and dressing of leather; luggage, handbags, saddlery, harness and footwear; Abbreviations: GMM1 = system GMM estimates (Blundell-Bond, 1998) using the STATA command xtabond2. GMM2 = equivalent to GMM1 but using the option “collapse” to reduce the number of instruments (Roodman, 2009). LP = Levinsohn-Petrin estimates. AR(2) = Arellano-Bond test for autocorrelation in differrence residuals. S_Ha = Sargan/Hansen test for joint validity of the instruments. STRU= number of instruments.

TABLE A2.1b: Production function estimates for industry groups.

Industry group	Method	Labour	Capital	Materials	Period dummies	N	Firms	AR(2)	AR(2) p-value	S_Ha	S-H p-value	STRU
4	OLS	0.562***	0.038***	0.393***	No	3406						
4	FE	0.221***	0.032***	0.424***	No	3406	420					
4	GMM1	0.100**	0.057***	0.189***	Yes	2867	418	-0.343	0.731	285.71	0.411	297
4	GMM2	0.144	-0.01	0.289***	Yes	2867	418	-0.054	0.957	58.455	0.422	73
4	LP	0.496***	0.101	0.209		3406						
5	OLS	0.348***	0.043***	0.598***	No	4186						
5	FE	0.196***	0.022***	0.566***	No	4186	498					
5	GMM1	0.190***	0.005	0.404***	Yes	3559	491	2.748	0.006	316.935	0.069	297
5	GMM2	0.174*	0.011	0.520***	Yes	3559	491	2.486	0.013	66.124	0.191	73
5	LP	0.344***	0.171**	1.000***		4186						
6	OLS	0.410***	0.090***	0.534***	No	2711						
6	FE	0.262***	0.032***	0.528***	No	2711	331					
6	GMM1	0.245***	-0.048	0.454***	Yes	2280	326	1.094	0.274	285.912	0.407	297
6	GMM2	0.256**	-0.052	0.480***	Yes	2280	326	1.086	0.277	60.23	0.36	73
6	LP	0.398***	0	0.688***		2711						
7	OLS	0.429***	0.038***	0.500***	No	7376						
7	FE	0.251***	0.029***	0.438***	No	7376	905					
7	GMM1	0.202***	-0.008	0.320***	Yes	6230	897	2.422	0.015	332.45	0.019	297
7	GMM2	0.067	-0.03	0.383***	Yes	6230	897	2.252	0.024	81.303	0.019	73
7	LP	0.409***				7376						

Note: group 4 = ISTAT-ATECO cod.20--wood and of products of wood and cork, except furniture; articles of straw and plaiting materials; ISTAT-ATECO cod.21--pulp, paper and paper products; ISTAT-ATECO cod.22--Publishing, printing and reproduction of recorded media.group 5 =ISTAT-ATECO cod.23--coke, refined petroleum products and nuclear fuel; ISTAT-ATECO cod.24--chemicals and chemical products; ISTAT-ATECO cod.25--rubber and plastic products; group 6 = ISTAT-ATECO cod.26--other non-metallic mineral products; group 7 = ISTAT-ATECO cod.27--basic metals; ISTAT-ATECO cod.28--fabricated metal products, except machinery and equipment.
Abbreviations: GMM1 = system GMM estimates (Blundell-Bond, 1998) using the STATA command xtabond2. GMM2 = equivalent to GMM1 but using the option "collapse" to reduce the number of instruments (Roodman, 2009). LP = Levinsohn-Petrin estimates. AR(2) = Arellano-Bond test for autocorrelation in differrence residuals. S_Ha = Sargan/Hansen test for joint validity of the instruments. STRU= number of instruments.

TABLE A2.1c: Production function estimates for industry groups.

Industry group	Method	Labour	Capital	Materials	Period dummies	N	Firms	AR(2)	AR(2) p-value	S_Ha	S-H p-value	STRU
8	OLS	0.384***	0.036***	0.548***	No	4327						
8	FE	0.212***	0.034***	0.576***	No	4327	506					
8	GMM1	0.264***	0.044*	0.361***	Yes	3718	501	-0.195	0.845	292.584	0.305	297
8	GMM2	0.295*	0.033	0.439***	Yes	3718	501	-0.459	0.646	57.993	0.438	73
8	LP	0.347***	0.052**	0.343*		4327						
9	OLS	0.414***	0.003	0.528***	No	2789						
9	FE	0.243***	0.032***	0.557***	No	2789	335					
9	GMM1	0.065	0.019	0.362***	Yes	2362	331	0.369	0.712	278.447	0.532	297
9	GMM2	0.19	0.035	0.372***	Yes	2362	331	0.253	0.8	69.311	0.127	73
9	LP	0.395***	0.00	0.793***		2789						
10	OLS	0.404***	0.061***	0.466***	No	1149						
10	FE	0.283***	0.059***	0.546***	No	1149	143					
10	GMM1	0.195***	0.039	0.331***	Yes	965	142	0.871	0.384	134.574	1	287
10	GMM2	0.253**	0.096*	0.255***	Yes	965	142	0.634	0.526	55.473	0.533	73
10	LP	0.339***	0.045	0.041		1149						
11	OLS	0.320***	0.016**	0.629***	No	2107						
11	FE	0.172***	0.016*	0.681***	No	2107	249					
11	GMM1	0.179***	0.043*	0.491***	Yes	1797	246	-0.81	0.418	236.506	0.966	294
11	GMM2	0.05	0.127**	0.535***	Yes	1797	246	-1.566	0.117	57.743	0.448	73
11	LP	0.311***	0.093	1.000***		2107						

Note: ; group 8 = ISTAT-ATECO cod.29--machinery and equip. n.e.c..; group 9 = ISTAT-ATECO cod.30--office machinery and computers; ISTAT-ATECO cod.31--electrical machinery and apparatus n.e.c.; ISTAT-ATECO cod.32--radio, television and communication equipment and apparatus; ISTAT-ATECO cod.33--medical, precision and optical instruments, watches and clocks; group 10 = ISTAT-ATECO cod.34--motor vehicles, trailers and semi-trailers; ISTAT-ATECO cod.35--other transport equipment; group 11 = ISTAT-ATECO cod.36--furniture; manufacturing n.e.c.

Abbreviations: GMM1 = system GMM estimates (Blundell-Bond, 1998) using the STATA command xtabond2. GMM2 = equivalent to GMM1 but using the option "collapse" to reduce the number of instruments (Roodman, 2009). LP = Levinsohn-Petrin estimates. AR(2) = Arellano-Bond test for autocorrelation in differrence residuals. S_Ha = Sargan/Hansen test for joint validity of the instruments. STRU= number of instruments.