JOURNAL OF REGIONAL SCIENCE

JOURNAL OF REGIONAL SCIENCE, VOL. 55, NO. 5, 2015, pp. 774–800

FIRM PRODUCTIVITY AND INSTITUTIONAL QUALITY: EVIDENCE FROM ITALIAN INDUSTRY*

Andrea Lasagni

Department of Economics, University of Parma, Sezione di Economia Agroalimentare, Via Kennedy 6, 43100 Parma, Italy. E-mail: andrea.lasagni@unipr.it

Annamaria Nifo

Department of Economics and Law, University of Sannio, 82100 Benevento, Italy. E-mail: nifo@unisannio.it

Gaetano Vecchione

Department of Political Science, Second University of Naples, Viale Ellittico, 81100 Caserta, Italy; and IPE Institute. E-mail: gaetano.vecchione@unina2.it

ABSTRACT. This paper aims to contribute to the debate on the determinants of differentials in firms' productivity. We test the hypothesis that macro factors, especially the quality of local institutions, play a central role in explaining firm productivity in Italy. To this end, we construct measures of Total Factor Productivity (TFP) for about 4,000 firms by means of different estimation techniques, and a province-level index of institutional quality. Then, we estimate the relationship between institutional quality and firm-level TFP. Our results show that the existence of better local institutions might help firms to become more productive.

1. INTRODUCTION

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

An appealing taxonomy of the determinants of productivity differentials is that distinguishing between *micro* and *macroeconomic* factors. The former label is used for factors connected to firms' features and managers' or owners' decisions, the latter for those connected to the outside environment rather than insiders' behavior, such as more competitive and contestable markets, a context more favorable to innovation, interfirm cooperation and positive spillovers, and so on. Often, a positive and important *macroeconomic* factor is also recognized in the good quality of institutions in the geographical area where the firm is located, because it is argued to enhance the ability of a region to capture

*We would like to thanks the participants in the XV International Academic Conference on Economic and Social Development (HSE, Moscow, April 1–4, 2015), three referees and *JRS* Co-Editor Gianmarco Ottaviano for helpful comments and suggestions. We also wish to thank Domenico Scalera for his comments on a previous version of the paper. The usual disclaimer applies.

Received: March 2013; revised: February 2015; accepted: March 2015.

 DOI: 10.1111/jors.12203

development opportunities (North, 1990; OECD, 2001), a mechanism which may emerge through increases in local firms' productivity. When firms' productivity differentials are evidently connected to different geographical locations, the *macro* factors, such as local institutional quality, are expected to be especially significant to explain the observed interfirm diversity. The case of Italy, in this respect, looks particularly interesting, for the substantial and long-lasting productivity gap between industrial firms located in the regions of the south *vis-à-vis* those in the rest of the country.

Development accounting exercises have shown that the observed per capita income differences across countries can be explained by both variations in production inputs (Caselli, 2005) and changes in Total Factor Productivity (TFP), i.e., the regression residual that Abramowitz called "the economists' measure of ignorance." An extensive empirical literature has emphasized the role of institutions[1] in affecting both inputs (physical and human capital) and TFP, thus pointing out the existence of a further effect of institutions on per capita income (through TFP changes) beside the indirect effect operating through capital accumulation.

This paper focuses on the effects of institutions on firms' productivity, aiming in particular at evaluating the impact on TFP of institutions as a whole and of single components of a synthetic Institutional Quality Index (IQI). Our working hypothesis is that differences in local institutional quality endowments are crucial in shaping interfirm productivity differentials in Italian industry. To test this hypothesis, we build a unique dataset by matching two sources: the MET (2008) survey[2] containing information collected through direct interviews to a large representative sample of manufacturing companies, and the AIDA Bureau Van Dijk databank containing balance sheet information for the same firms. As a result, we obtain a rich dataset for an unbalanced panel of about 4,000 units over the period 1998–2007. Estimation of TFP and its determinants is carried out by employing several different estimation techniques (Ordinary Least Square [OLS], Fixed Effects [FE], General Method of Moments [GMM], and Levinsohn-Petrin [LP]). Our results are robust and consistent with most of the existing literature: after controlling for a number of individual variables, we find that local institution quality does matter, as it proves to be one of the main drivers of firms' productivity differentials.

The novelty of our contribution to the extant literature is twofold. First, we use as a proxy measure of the role of institutions the Nifo and Vecchione (2014) IQI index including five ample dimensions of institutional quality (regulatory quality, rule of law, government effectiveness, corruption, voice, and accountability) rather than single aspects of it, as it is customary in the previous literature (Kneller and Misch, 2011; Haggard and Tiede, 2011; Salinas-Jiménez and Salinas-Jiménez, 2011).Second, we contribute to provide new evidence on the relationship between the endowment of institutional quality and firm productivity in Italian provinces. Although a number of previous studies (Del Monte and Giannola, 1997; Scalera and Zazzaro, 2010; Erbetta and Petraglia, 2011; Nifo, 2011; Aiello, Pupo, and Ricotta, 2014) have argued that even at subnational-level productivity differences might be explained on the basis of differences in institutional quality, very few have tried to prove this relationship through an econometric investigation.

[1]Cross-country regressions have shown that institutions are highly correlated with income per capita; and that institutions can explain up to 30-fold per capita income differences between developed and developing countries (Knack and Keefer, 1997; Hall and Jones, 1999; Acemoglu et al., 2001; Easterly and Levine, 2003; Acemoglu and Robinson, 2008).

[2]MET (Monitoring Economy and Territory) is a private research institute periodically collecting data through direct interviews on a large representative sample of about 25,000 Italian firms operating in both manufacturing and service sectors. The sample is selected and stratified in order to guarantee representativeness at size, regional, and industry level.

The paper is organized as follows: after this introduction, Section 2 provides an overview of the literature on macroeconomic 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 results, hinging on specific robustness analysis. Section 4 summarizes the main conclusions.

2. MACROECONOMIC DETERMINANTS OF FIRM PRODUCTIVITY: A LITERATURE REVIEW

The idea that social, historical and cultural factors, institutions, and the political and administrative context may play 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 extensively considered by the economic literature, from the perspective of both national and regional growth and 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, Johnson, and Robinson, 2001; Easterly and Levine, 2003; Kim and Law, 2012) have provided theoretical ground and extensive empirical evidence supporting the role of macroeconomic factors (such as institutional quality, openness to international trade, and geographical 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, which can be affected by the operating environment through a variety of channels. Syverson (2011) and Chanda and Dalgaard (2008) identify the presence of spillovers and the degree of competition as the main channels through which the macroeconomic factors impinge on the level of business productivity. In this interpretation, spillovers basically operate through *incentive mechanisms*: they encourage companies to innovate and adopt new technologies (Nguyen and Jaramillo, 2014) and to invest more in R&D (Griffith, Harrison, and Van Reenen, 2007), shorten the technology distance (Bloom, Schankerman, and Van Reenen, 2007), and accelerate the process of convergence to the productivity levels of the leader in the domestic market (Bartelsman, Haskel, and Martin, 2008). Other related studies (Eslava et al., 2004, Bernard, Bradford, and Schott, 2006; Fernandes, 2007; Verhoogen, 2008; Bloom and Van Reenen, 2010) 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 (Aghion and Howitt, 1998). An additional effect of greater competition on firms' productivity may stem 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 (Bridgman, Shi, and Schmitz, 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, Nicoletti, and Scarpetta, 2008), or privatization programs in Eastern European countries (Brown, Earle, and, Telegdy, 2006).

Looking more specifically at the role of institutions, it is at least since the work of Douglass North (1990, p. 3), for whom "institutions are the rules of the game in a society," that institutions have been acknowledged to crucially contribute to forming the set of incentives underlying behavior and individual choices. The importance of institutional quality as a basic determinant of economic growth and TFP in the long term is illustrated by many authors: the seminal paper by Mankiw et al. (1992) emphasizes the importance of the impact of institutions on investment in human and physical capital and thus in turn on per capita income. In the same vein, Eicher Garcia-Penalosa, and Teksoz (2006) and Ketterer and Rodriguez-Pose (2012) point out that institutions have a large impact on human and physical capital accumulation, which in turn affects firms' productivity. In particular, Rodrik, Subramanian, and Trebbi (2004) highlight the important role that institutions play in preventing expropriability of property, a basic incentive to invest and accumulate physical capital. Following Hall and Jones (1999), other contributions (Acemoglu et al., 2001; Grigorian and Martinez, 2002; Easterly and Levine, 2003; Rodrik et al., 2004; Kaufmann, Kraay, and Mastruzzi, 2011) point out that, beside the effect on capital accumulation, institutions exert an impact on TFP and output through other channels. For example, McGuinness (2007), Acemoglu and Robinson (2008), Chanda and Dalgaard (2008) have shown how better institutions create a favorable business environment and a legal structure which directs investments toward activities able to ensure higher and more rapid economic growth. Good institutions encourage firms to use better technology, invest in knowledge creation and transfer (Loayza, Oviedo, and Serven, 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). Many 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 interregional comparisons (Heliwell and Putnam, 1995; Barro and Sala-i-Martin, 1995; Arrighetti and Seravalli, 1999; Dall'Aglio, 1999), find evidence of significant correlations between measures of institutional quality and various indicators of economic performance.

Concerning more closely to the case of Italy, many observers have explained the economic divide between northern and southern regions with reference to the different regional endowments of institutional quality. For example, Nifo (2011), Aiello et al. (2012) attach a crucial role to macroeconomic factors in accounting for the significant and persistent productivity dispersion across Italian firms. In particular, concerning institutions, Del Monte and Giannola (1997) claim that institutional factors have contributed to creating an unfavorable business environment; Scalera and Zazzaro (2010) argue that public policies have been undermined by a poor institutional context, while Erbetta and Petraglia (2011) emphasize the crucial role of institutions and public capital in determining the Italian firms' productivity differentials. All these papers point out the negative impact exerted on the economic performance of Italian firms (particularly those located in the South), by poor institutional quality, business environment, corruption, excessive bureaucratization, poor or inefficient organization of public services, a lower endowment of infrastructures, and the lack of security. The shortage of reliable micro data has, however, seriously curbed empirical investigations on these aspects. This paper aims at contributing to fill this gap.

3. EMPIRICAL INVESTIGATION

Dataset

We use two main sources to build our firm-level dataset.[3] We merge the data of the MET survey carried out in September 2008 with additional information obtained from the AIDA Bureau Van Dijk database, collecting balance-sheet and financial data on private companies throughout Italy.[4] The advantage of using MET data is in the availability of information on variables (i.e., group membership) not considered in the AIDA dataset. The data obtained from AIDA are used to reconstruct the 1998–2007 time series of balance-sheet data for firms surveyed by MET.

To obtain our final dataset, some cleaning procedures are first performed. First, we drop all firms in the MET survey not reported in the AIDA database for the years 2005–2007. In practice, this amounts to considering only firms with at least 10 employees, since private nonlimited-liability microenterprises (one to nine employees) are not required to provide their balance-sheet data 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 check the data for outliers and gaps in the available time series. Finally, in order to reduce anomalies, 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 comprises about 4,000 firms for the period 1998–2007 (more than 36,000 observations). Our estimations of TFP are obtained from a panel of firms (between 1998 and 2007).[5]

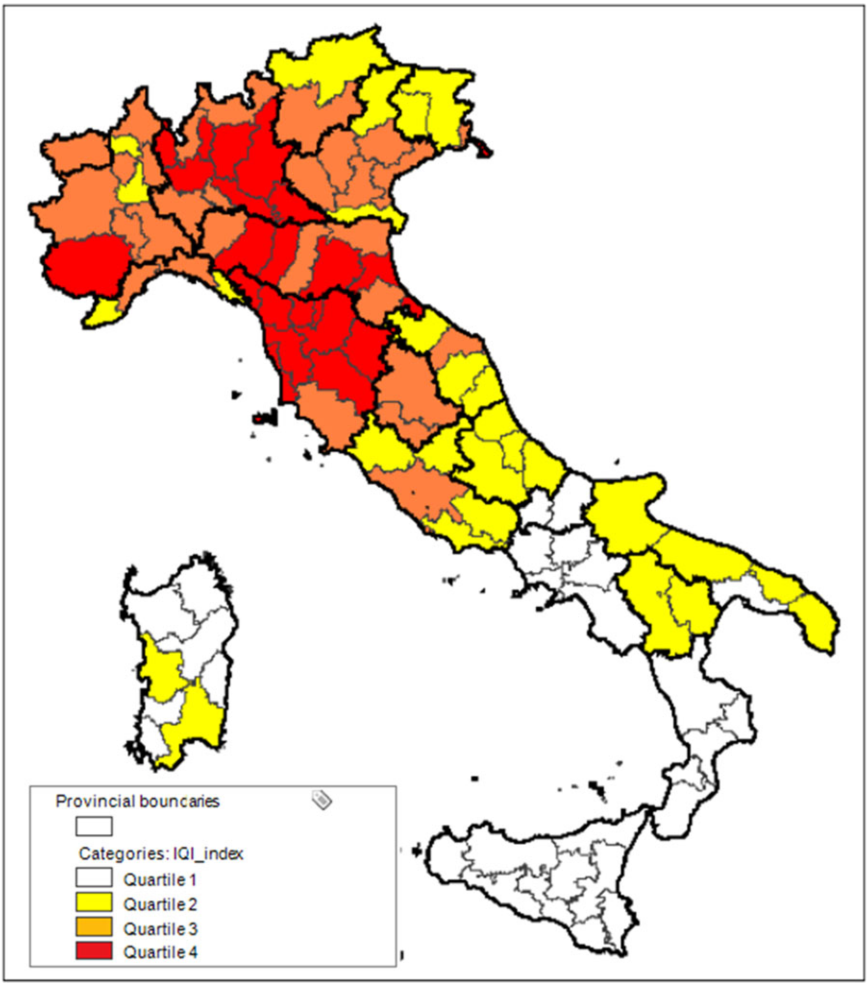
Concerning the measure of institutional quality, we follow the common practice to represent it by a weighted average of some social, political, and administrative indicators (for example, degree of corruption, good or bad definition of property rights, trial times, administrative capacity of local, and regional governments—concerning, for example, health and social policies and waste management—market competitiveness and barriers to entry, tax evasion, and the size of the shadow economy, endowment of social and economic infrastructures, and so on). In particular, we resort to the Nifo and Vecchione (2014) IQI, inspired to the framework proposed by World Governance Indicator (Kaufmann et al., 2011), and structured into 24 elementary indexes aggregated in five dimensions regarding some major characteristics of a governance system (regulatory quality, rule of law, government effectiveness, corruption, voice, and accountability). The values of simple indexes are gathered from official sources and surveys conducted by public, private, and nongovernmental institutions covering the early-2000s. Then, IQI is normalized so as to assume values included from 0 to 1, where the extreme values respectively represent the lowest and highest institutional quality.[6] Figure 1 illustrates the geographical pattern of IQI in Italy, emphasizing a clear institutional quality divide between the north and south of the country.

[3]See Table 1 in Appendix A, for a complete description of variables and data sources.

[4]The original source of the AIDA database is the National Business Register. All companies in Italy must be registered in the National Business Register, and periodically supply the required data.

[5]Additional details on the 2008 MET survey and tables with summary statistics can be found in Tables A2 and A3 in Appendix A.

[6]Further details on IQI and data sources are given in Appendix B.



Source: Nifo and Vecchione (2014).

FIGURE 1: Geographical Distribution of IQI.

Measuring Productivity

To test whether institutional quality affects the productivity of Italian firms, we resort to a two stage estimation strategy, controlling for a number of firm individual factors. In the first stage, proxies for firm-level productivity are obtained by estimating TFP with different techniques commonly used in the literature. In particular, our estimation of TFP yields an output-based productivity measure, since it measures how much extra output the firm produces conditional on its (extra) input use. This well known approach is based on a simple production model embedded in the following Cobb Douglas production function:

$$Y_{it} = A_{it} K_{it}^{\alpha_k} L_{it}^{\alpha_l} M_{it}^{\alpha_m}, \quad (1)$$

where A is firm specific time-variant term, Y the firm's revenue, K our measure of physical capital, namely the value of tangible fixed assets as reported in the balance sheet, L

our measure of employment level, and M raw materials expenditures, i.e., the value of expenditures for the purchase of material goods (as suggested in Van Beveren, 2010). The values (natural logs) of all variables are observed for the ith firm ($i = 1, \ldots, 4{,}053$) in different years t ($t = 1, \ldots, 10$).[7]

Taking the natural logarithm and considering α_0, w_{it}, ε_{it}as respectively: a constant fixed term, a firm-specific time varying term (our proxy for the TFP), the error measurement term, Equation (1) becomes:

$$y_{it} = \alpha_0 + \alpha_i i + \alpha_k k_{it} + \alpha_m m_{it} + w_{it} + \varepsilon_{it}. \tag{2}$$

We estimate separate production functions for 11 different groups of industries.[8] In this way we 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" and therefore it is necessary to compare TFP "indexes." For this purpose, 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 (two-digit ISTAT ATECO code).

As mentioned above, there are different methods to estimate TFP. In our paper four of them are considered in estimating Equation (2): OLS, FE, Blundell-Bond System GMM, and LP. The OLS approach assumes that the inputs in the production function are exogenous, i.e., independent ofthe firm's efficiency level, thus ignoring the simultaneity problem emphasized by the methodological literature on TFP estimation.There are still some major drawbacks in the FE estimator, as explained by Arnold (2005). First, a substantial part of the information in the data is left unused. A fixed-effect estimator uses only variability across time, which tends to be much lower than cross-sectional variability. 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 the "system" GMM proposed by Arellano and Bover (1995) and further developed by Blundell and Bond (2000). The system GMM uses a system of equations where lagged levels of variables serve as instruments for an equation in first differences and lagged first differences are used as instruments for an equation in levels.[9] A fourth, widely employed method is that proposed by Levinsohn and Petrin (2003) using intermediate inputs to control for unobserved productivity. This latter technique is very close to the semiparametric Olley and Pakes approach, but it has the advantage of requiring fewer data at firm level.[10]

In our estimation of the production function (Table A4 in Appendix A), elasticities come out to be not statistically significant only in some cases, ranging between 0.10 and 0.56 (with respect to labor) and between 0.018 and 0.14 (with respect to capital). For materials, the variance of elasticity is somewhat larger, as it takes value between 0.09 and 0.89; in few cases the LP procedure estimates a materials coefficient equal to

[7]To control for inflation effects, we deflate our original data on firms' revenues by using the ISTAT index of producer prices in different sectors (ISTAT ATECO codes for the detail at two-digit level). The data for physical capital and the purchase of material goods are also deflated by using the ISTAT index of producer prices for capital goods.

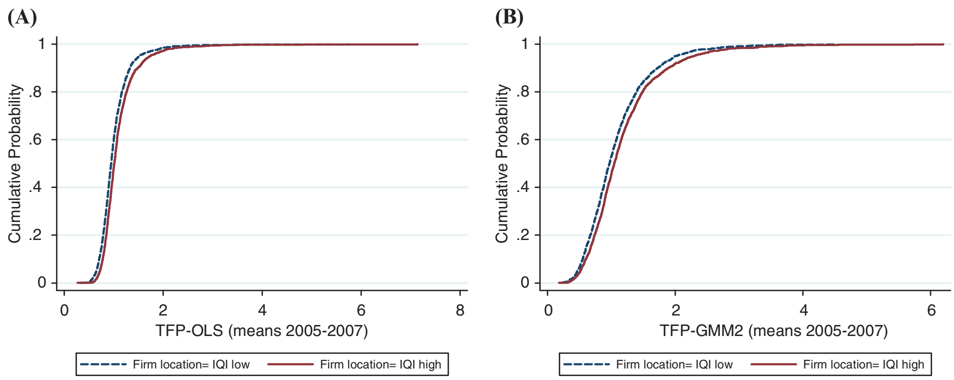
[8]For details on industry groupings, see Table A4 in Appendix A. The same approach (i.e., estimating separate production functions for different sectors) is used by Alvarez and Lopez (2008), Lu, Lu, and Tao (2010), and Hagemejer and Kolasa (2011).

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

TABLE 1: Correlation Table of TFP Measures

Estimation Method	No. of Firms	(1)	(2)	(3)	(4)	(5)
(1) OLS	4,052	1				
(2) FE	4,052	0.868	1			
(3) GMM1	3,909	0.570	0.842	1		
(4) GMM2	3,909	0.591	0.860	0.966	1	
(5) LP	4,052	0.514	0.623	0.660	0.620	1

Note: GMM2 refers to estimates of the production function performed with fewer instruments with respect to GMM1 (see table in the Appendix).
Source: MET 2008 survey and AIDA Bureau Van Dijk database.



Note: Panel A = OLS Estimates, Panel B = GMM2 Estimates, IQI Low = Below the Median Level, and IQI High = Above the Median Level.
Source: MET 2008 Survey and AIDA Bureau Van Dijk database.

FIGURE 2: Cumulative Distribution of TFP Estimates by Level of IQI Index.

one.[11] Table 1 reports the correlation matrix for the different TFP estimators we use, showing that the different methods yield remarkably high correlation in TFP estimates (like in Van Biesenbroeck, 2007, and Van Beveren, 2010).

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 2). Regardless of the estimation method, the TFP distribution for firms localized in provinces (NUTS 3 level), where the quality of local institution is relatively higher (IQI index is above the median level), lies always above (and to the left of) the TFP distribution for firms localized in provinces where the quality of local institution is relatively low (IQI index is below the median level).

All in all, at the end of this stage we arrive at reasonably robust firm-level TFP estimates. These are used in the second step, when we study the effect of institutional quality on firm productivity.

Explaining Productivity: Does Institutional Quality Matter?

The second stage of our estimation consists in using firm-level estimated TFP obtained in the first stageas a dependent variable to assess the role of institutional quality as an explanatory factor for firms' productivity. As argued in Section 2, the effect of institutions on firms' productivity can be connected to both the stimulus to factor accumulation and the increase in TFP taking place through several incentive mechanisms:

good institutions foster innovation and research; direct investments toward more productive activities; encourage firms to use better technology, invest in knowledge creation and transfer, produce on a larger scale and operate with a long-time horizon. Since many of these incentive mechanisms can hardly be measured and represented by suitable variables, employing a synthetic indicator of institutional quality as an explanatory variable of firm TFP may serve to account for a variety of channels through which institutions impact on firms' productivity, often neglected by the literature.

To gauge the role of istitutions in explaining firms' TFP, we estimate five econometric models, one for each estimation of TFP (OLS, FE, GMM1, GMM2, and LP). In each model, to reduce the short-time shock bias, we regress three-year average firm-level TFP (over the period 2005–2007) on IQI (or alternatively a subindex of IQI) and a set of controls. IQI is constructed on values of elementary indexes referred to years prior to 2004.The regression equation is:

$$\text{TFP}_i = \beta_0 + \beta_{1j} X_{ij} + \beta_2 \text{IQI}_{Ii} + \beta_3 \text{EPO}_i + \beta_4 R\&D_i + e_i, \tag{3}$$

where X_{ij} is a vector including: firms' age in years (AGE), a categorical variable corresponding to firms' class size (size class) categories,[10] a group membership dummy (GROUP), Pavitt and regional dummies.[11] In addition, there are two additional explanatory variables measured at local level: EPO, i.e., the number of patents filed to the European Patent Office per 1 million inhabitants of the province and R&D, i.e., the total (public and private) expenditure in Research and Development as percentage of regional GDP. It is worthwhile to notice that controlling for these latter variables allows to single out the effects of institutional quality on TFP other than those operating through the incentives to innovation and research. Table 2 reports the correlation matrix of the main regressors.

The results of the first set of regressions are reported in Table 3. In each column, coefficients and standard errors are referred to estimations carried out by using TFP estimates obtained with different methods. The evidence displayed in Table 3 shows that the local institutional quality does matter for firm's productivity. In fact, parameters of IQIcome out to be always positive and statistically significant, in both specifications with and without EPO and R&D controls.This ensures that the influence of institutions on TFP goes beyond the incentives exerted on innovation and research and operates also through other avenues.[12]

[10]Size classis a categorical variable assuming the following values: Size class 1 = 10–49 employees, Size class 2 = 50–249 employees, Size class 3 = more than 249 employees (see Table A1 in Appendix A).

[11]Pavitt taxonomy includes the following firm categories: (1) supplier dominated, (2) scale intensive, (3) specialized suppliers, (4) science based.

[12]This conclusion is corroborated by a couple of exercises we made in order to single out direct and indirect effects of IQI on firms' productivity. In the first one, we estimate the equations $\text{TFP} = a_1 + b_1\text{IQI} + u_1$, $\text{TFP} = \alpha_{2j} + b_{2j}z_j + u_{2j}$, and$z_j = \alpha_{aj} + b_{aj}\text{IQI} + u_{aj}$, where z_j is alternatively EPO or R&D. Then, we employ $\hat{b}_1 = \frac{\partial\text{TFP}}{\partial\text{IQI}}$and $\hat{b}_{3j} = \frac{\partial z_j}{\partial\text{IQI}}$ in the definitory equations $\frac{\partial\text{TFP}}{\partial\text{IQI}}\frac{\partial z_j}{\partial\text{IQI}} + \omega_j$*,stating that the total impact of IQI on TFP is equal to the sum of the effects of IQI operating through the "intermediate" variable z_j (EPO or R&D) and the residual effects ω_j For all the different estimations of TFP (OLS, FE, GMM1, GMM2, LP, LP2), the residual effect of IQI on TFP (i.e., the effect not going through EPO or R&D) comes out to be always pretty large relative to overall impact, giving evidence of a substantial direct impact of institutions on productivity. In the second exercise, which follows the valuable suggestion of a referee, we run a two-stage regression procedure. In the first stage, we estimate the impact of institutions on R&D; in the second stage, we measure the impact of estimated R&D on TFP (estimated by OLS, FE, GMM1, GMM2, LP, and LP2) with usual controls. Comparing the estimated effect of R&D on TFP with the impact of IQI on TFP net of the effects through other regressors (i.e., $\hat{\beta}_2$in Equation (3), we verify that IQI exerts effects on TFP additional to those operating through R&D. Further details on these exercises are available from the authors upon request).

TABLE 2: Correlation Table of Main Variables Included in the Model for Explaining TFP at Firm Level

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
(1)	Age of firm (log)	1								
(2)	IQI index	0.130	1							
(3)	IQI-Control-corruption	0.080	0.665	1						
(4)	IQI-Regulatory quality	0.091	0.697	0.670	1					
(5)	IQI-Rule of law	0.049	0.668	0.385	0.322	1				
(6)	IQI-Government effectiveness	0.145	0.811	0.423	0.478	0.275	1			
(7)	IQI-Voice and accountability	0.083	0.691	0.333	0.394	0.238	0.496	1		
(8)	Nr. EPO patents (province)	0.147	0.472	0.389	0.435	−0.011	0.526	0.449	1	
(9)	R&D over GDP (region)	0.042	0.118	−0.007	−0.242	0.394	−0.107	0.210	−0.021	1

Note: for a complete description of variables, see Table A1.
Source: MET 2008 survey, AIDA Bureau Van Dijk database and Nifo and Vecchione (2014).

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 mostly evident for the smallest firms with less than 50 employees (about 20 percent of our sample; see Table A2 in Appendix A). This result is consistent with the previous literature on Italian industry (see, for example, Castellani and Giovannetti, 2010, or Aiello et al., 2014), where productivity premia for large and medium-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 show significantly higher levels of TFP than other firms. Finally, the age of firm seems to play a role only when TFP is estimated *via* GMM1 or GMM2.In sum, controlling for various firm- and territorial-level effects, our findings show that the quality of local institutions is a significant positive determinant of firms' productivity.

An interesting question is whether the positive relationship between IQI and firm-level TFP can be specifically attributed to one or more of the factors included in the synthetic index.To evaluate the possibly different effects of each subindex composing the IQI, we run five additional sets of regressions by using in turn one of the IQI subindexes as regressors in place of the synthetic index.

In Table 4 we summarize all regressions included in the second set of results, showing only coefficients for the IQI subcomponents. All in all, we consider these results as confirmative: local institutions do matter for TFP at firm level in Italy. However, inspection of Table 4 reveals that only some IQI subindexes have a statistically significant impact on firm TFP productivity. In particular, we find that firm-level TFP is higher where IQI-Government Effectiveness and IQI-Voice and Accountability are higher, whereas it comes out to be negatively correlated with IQI-Corruption. Since each IQI subindex has a different pattern of variance across provinces, it is possible that these latter results might be determined to some extent by a purely statistical effect.

TABLE 3: Effect of IQI (Institutional Quality Index) on Firm-Level TFP (Mean Value 2005–2007): OLS Regressions

	Y = TFP – OLS (1a)	Y = TFP – OLS (1b)	Y = TFP – FE (2a)	Y = TFP – FE (2b)	Y = TFP – GMM1 (3a)	Y = TFP – GMM1 (3b)	Y = TFP – GMM2 (4a)	Y = TFP – GMM2 (4b)	Y = TFP – LP (5a)	Y = TFP – LP (5b)
Size class 1 (d)	0.020	0.023	–0.501***	–0.497***	–1.345***	–1.343***	–1.300***	–1.298***	–0.801***	–0.797***
	(0.05)	(0.05)	(0.07)	(0.07)	(0.15)	(0.15)	(0.16)	(0.15)	(0.14)	(0.14)
Size class 2 (d)	–0.005	–0.004	–0.280***	–0.279***	–0.904***	–0.905***	–0.844***	–0.845***	–0.533***	–0.531***
	(0.05)	(0.05)	(0.07)	(0.07)	(0.15)	(0.15)	(0.16)	(0.16)	(0.14)	(0.14)
Group (d)	0.039**	0.041**	0.065***	0.067***	0.129***	0.131***	0.110***	0.112***	0.140**	0.143***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.03)	(0.03)	(0.03)	(0.03)	(0.05)	(0.05)
Age of firm (in logs)	–0.013	–0.016	0.007	0.003	0.028**	0.023*	0.026**	0.022*	0.021	0.016
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.02)
IQI index	0.369**	0.452***	0.329**	0.434***	0.260	0.383**	0.257*	0.383**	0.432*	0.477*
	(0.14)	(0.14)	(0.14)	(0.14)	(0.18)	(0.19)	(0.15)	(0.15)	(0.24)	(0.25)
Nr. EPO patents over pop. (province)		–0.018		–0.028		–0.03		–0.033		0.006
		(0.02)		(0.02)		(0.02)		(0.02)		(0.04)
R&D over GDP (region)		0.417***		0.459***		0.566***		0.553***	0.432*	0.432***
		(0.05)		(0.04)		(0.08)		(0.06)	(0.24)	(0.13)
Constant	0.698***	0.399***	1.061***	0.726***	1.711***	1.301***	1.711***	1.311***	1.144***	0.851***
	(0.09)	(0.11)	(0.11)	(0.12)	(0.19)	(0.20)	(0.19)	(0.19)	(0.23)	(0.25)
Pavitt dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firms	4,052	4,052	4,052	4,052	3,909	3,909	3,909	3,909	4,052	4,052
R^2 Adj.	0.034	0.039	0.136	0.141	0.242	0.245	0.260	0.263	0.068	0.069

Note: (d) indicates 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 and Size class 3 = 250 employees and more (reference category). "Age of firm" is in logs. Note: the dependent variable for "Y = TFP – GMM2" is different from "Y = TFP – GMM1", since the estimates of the production function were obtained with fewer instruments (see table in the Annex 2).

TABLE 4: Effect of IQI Subindexes on Firm-Level TFP (Mean Value 2005–2007): OLS Regressions

	Y = TFP - OLS (1a)	Y = TFP - OLS (1b)	Y = TFP - FE (2a)	Y = TFP - FE (2b)	Y = TF P- GMM1 (3a)	Y = TFP - GMM1 (3b)	Y = TFP - GMM2 (4a)	Y = TFP - GMM2 (4b)	Y = TFP - LP (5a)	Y = TFP - LP (5b)
IQI-Corruption	−0.239**	−0.204*	−0.227**	−0.194**	−0.215**	−0.175*	−0.161	−0.124	−0.203	−0.15
	(0.12)	(0.10)	(0.11)	(0.10)	(0.11)	(0.09)	(0.10)	(0.08)	(0.13)	(0.11)
IQI-Regulatory quality	0.014	0.045	0.030	0.064	0.170**	0.215***	0.107	0.149***	0.076	0.112
	(0.08)	(0.08)	(0.08)	(0.07)	(0.07)	(0.06)	(0.07)	(0.06)	(0.14)	(0.13)
IQI-Rule of law	-0.338	−0.215	−0.364	−0.197	−0.494	−0.274	−0.498*	−0.279	0.026	0.135
	(0.26)	(0.25)	(0.25)	(0.24)	(0.30)	(0.29)	(0.27)	(0.26)	(0.39)	(0.43)
IQI-Government effectiveness	0.402***	0.409***	0.377***	0.394***	0.247	0.267	0.272*	0.296**	0.319	0.296
	(0.14)	(0.14)	(0.14)	(0.14)	(0.17)	(0.17)	(0.14)	(0.14)	(0.20)	(0.21)
IQI-Voice and accountability	0.134***	0.144**	0.112**	0.129**	0.090	0.110	0.088*	0.110**	0.165	0.159
	(0.05)	(0.05)	(0.05)	(0.05)	(0.06)	(0.07)	(0.05)	(0.05)	(0.10)	(0.10)

Note: Table reports only IQI subindexes and not full results (available from the authors upon request). Standard errors in parentheses, clustered by province (NUTS3) groups. $^{*}P < 0.10$, $^{**}P < 0.05$, $^{***}P < 0.01$. Others not included variables are: (1) firm size class variables, (2) group membership variable, (3) firm age, (4) Nr. EPO patents over population only for columns 1b, 2b, 3b, 4b, and 5b, (5) R&D over GDP (region), only for columns 1b, 2b, 3b, 4b, and 5b, (6) Pavitt and Regional dummies, (7) constant.

TABLE 5: Effect of IQI Subindexes on Firm-Level TFP (Average for Years 2005–2006): OLS Regressions

	Y = TFP – OLS (1)	Y = TFP - FE (2)	Y = TFP - GMM1 (3)	Y = TFP - GMM2 (4)	Y = TFP - LP (5)
IQI index	0.438***	0.429***	0.358*	0.356**	0.435*
	(0.15)	(0.15)	(0.18)	(0.15)	(0.25)
IQI-Corruption	−0.220**	−0.217**	−0.194**	−0.131	−0.160
	(0.10)	(0.10)	(0.09)	(0.08)	(0.10)
IQI-Regulatory quality	0.059	0.08	0.248***	0.192***	0.163
	(0.08)	(0.07)	(0.06)	(0.06)	(0.11)
IQI-Rule of Law	−0.294	−0.293	−0.342	−0.351	0.124
	(0.25)	(0.24)	(0.31)	(0.27)	(0.41)
IQI-Government effectiveness	0.388***	0.379***	0.228	0.250*	0.268
	(0.15)	(0.14)	(0.17)	(0.14)	(0.21)
IQI-Voice and accountability	0.150***	0.141**	0.113	0.110*	0.13
	(0.06)	(0.05)	(0.07)	(0.06)	(0.10)

Note: Table reports only IQI subindexes and not full results (available from the authors upon request). Standard errors in parentheses, clustered by province (NUTS3) groups. $^{*}P < 0.10$, $^{**}P < 0.05$, $^{***}P < 0.01$. Others not included variables are: (1) firm size class variables, (2) group membership variable, (3) firm age, (4) Nr. EPO patents over population, (5) R&D over GDP (region), (6) Pavitt and Regional dummies, (7) constant.

Summarizing, the results of our regressions confirm that Italian industrial firms' individual productivity is strongly affected by the institutional quality of provinces where they are located. This conclusion supports the view that the firms' performance is significantly undermined by institutional weakness, which poses additional constraintson firms' efforts to improve productivity and competitiveness.

Robustness Analysis

To check the robustness of the main results presented in the previous section, in what follows we discuss an additional set of findings obtained by modifying some characteristics of Equation (3). First, we estimate our baseline model using as the dependent variable the level of TFP index for different time periods, namely the years 2005, 2006, and 2007 separately, or the averages 2005–2006 (see, for example, Table 5), and 2006–2007. Once again, the results we find are very similar to the ones of previous section for the IQI index and each dimension.

As a second robustness check, we replace our Pavitt dummies with 11 industry group dummies. Even this change does not affect significantlyour baseline results. As a further check, we use labor productivity (instead of TFP) as dependent variable, testing different time periods (average 2005–2007, or average 2005–2006). Again, results do not change, as shown in Table 6.

Finally, we introduce additional interaction terms among regressors. In the model of Table 3, we include (Age*IQI) and also other subindexes separately. This is done to test whether local institutional quality have different effects on TFP depending on the age of the firm. Also, in another regression we include (Group*IQI) and other subindexes separately. In this latter case, we aim at assessing the impact exerted by IQI on firm's TFP conditional on being part of a business group or not. In both cases interaction (Age*IQI) and (Group*IQI) come out to be not significant.[13]

[13]Further details on these robustness checks are available from the authors on request.

TABLE 6: Effect of IQI Subindexes on Firm-Level labor Productivity (Mean Value 2005–2007): OLS Regressions

	Y = LABPRO -av2005–2007 (1)	Y = LABPRO -av2006–2007 (2)	Y = LABPRO -2007 (3)	Y = LABPRO -2006 (4)	Y = LABPRO -2005 (5)
IQI index	0.263*	0.269**	0.253	0.290**	0.248*
	(0.14)	(0.13)	(0.16)	(0.13)	(0.14)
IQI-Corruption	−0.033	−0.033	−0.034	−0.062	−0.004
	(0.07)	(0.06)	(0.09)	(0.06)	(0.06)
IQI-Regulatory quality	0.142**	0.144**	0.139*	0.160**	0.128**
	(0.06)	(0.06)	(0.07)	(0.07)	(0.06)
IQI-Rule of law	−0.147	−0.141	−0.16	−0.229	−0.052
	(0.29)	(0.28)	(0.32)	(0.29)	(0.28)
IQI-Government effectiveness	0.104	0.128	0.058	0.127	0.129
	(0.12)	(0.11)	(0.13)	(0.12)	(0.11)
IQI-Voice and accountability	0.102*	0.092*	0.121*	0.114**	0.07
	(0.05)	(0.05)	(0.06)	(0.05)	(0.05)

Note: Table reports only IQI subindexes and not full results (available from the authors upon request). Standard errors in parentheses, clustered by province (NUTS3) groups. *P < 0.10, **P < 0.05, **P < 0.01. Others not included variables are: (1) firm size class variables, (2) group membership variable, (3) firm age, (4) Nr. EPO patents over population, (5) R&D over GDP (region), (6) Pavitt and Regional dummies, (7) constant.

4. CONCLUDING REMARKS

This paper explores the hypothesis that differences in institutional quality endowments may be relevant in shaping interfirm productivity differentials. For this purpose, we built a unique dataset of about 4,000 Italian manufacturing companies over the period 1998–2007 to estimate individual TFP and its determinants by employing several different estimation techniques (OLS, FE, GMM, and LP).

The robust result, in line with our hypotheses, is consistent with most of the existing literature that ascribes a key role to the business environment and institutional context in determining firms' productivity: institutions do matter, as they prove to be one of the main drivers of TFP differentials. Firms' productivity, as measured by TFP, appears to be affected by institutional features, suggesting that future research should 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 are among the main channels through which macroeconomic factors positively impact on the investment climate and firms' competitiveness.

In addressing the multidimensionality of the institutional structure, this paper also provides a more nuanced analysis of the institutional determinants of firms' productivity.

From a policy perspective our results indicatethat institutional and regulatory reform may enhance the ability of lagging regions to capture development opportunities, for example, by specializing in higher valued products and seeking to reap benefits from international integration.

This analysis was performed prior to the 2008 international crisis. Further studies to extend the analysis of the correlation between institutional quality and productivity during and after the crisis, would certainly be both interesting and desirable.

APPENDIX A: VARIABLES AND THE MET SURVEY 2008 DATASET

TABLE A1: Variables Included in the Study. Description and Data Source

Variables	Description	Data Source
Firm level		
TFP-OLS, TFP-FE, TFP-GMM1, TFP-GMM2, and TFP-LP	Estimated index of TFP (average 2005–2007)	Own computations on sample of MET firms matched with AIDA balance sheet data
Size class 1 (d), Size class 2 (d), Size class 3 (d)	Size class 1(d): dummy variable equal to 1 if the firm size is 10–49 employees, and 0 otherwise, Size class 2(d): dummy variable equal to 1 if the firm size is 50–249 employees, and 0 otherwise.	AIDA database
Group (d)	Dummy variable equal to 1 if the firm has declared a business group membership, and 0 otherwise.	MET survey data
Age of firm	The age of the firm	Own computations on MET survey data
Local level		
IQI index	see Nifo and Vecchione (2014)	Nifo and Vecchione (2014)
Corruption	see Nifo and Vecchione (2014)	Nifo and Vecchione (2014)
Regulatory quality	see Nifo and Vecchione (2014)	Nifo and Vecchione (2014)
Rule of law	see Nifo and Vecchione (2014)	Nifo and Vecchione (2014)
Government effectiveness	see Nifo and Vecchione (2014)	Nifo and Vecchione (2014)
Voice and accountability	see Nifo and Vecchione (2014)	Nifo and Vecchione (2014)
	see Nifo and Vecchione (2014)	Nifo and Vecchione (2014)
Nr. EPO patents (province)	Number of patents filed to European Patent Office per 1 million inhabitants of the corresponding province (average 1995–2000). The data are broken down territorially based on the postcode of residence of the inventor.	ISTAT Territorial Indicators Database
R&D over GDP (region)	Total (public and private) R&D expenditure as percentage of regional GDP (year 2000).	ISTAT Territorial Indicators Database

Notes: The universe of Italian private firms was stratified by MET according to the standard procedures by using the following variables: region (NUTS 2 level), size class (1–9 employees, 10–49 employees, 50–250 employees, more than 250 employees) and industry. In order to define the sample size, the following choices were made: all firms with more than 250 employees were surveyed; the remaining firms were divided into three layers identified by the remaining three size classes: 1–9 employees, 10–49 employees, 50–250 employees; for each layer, an *a priori* fixed number of units to be surveyed was established, varying from region to region, depending on the number of the firms in the same region.

TABLE A2: Distribution of Firm-Level Employment by Class Size: Original MET Sample Data and Retained Firms

Class Size	Our Sample	Original MET Sample
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

Note: Elaborations based on firm sample used in OLS, FE, and Levinsohn-Petrin regressions; for GMM regressions (see Tables A4a–A4c) the number of firms is smaller because lagged values of variables were used as instruments, which excludes firms not providing data for the years 1998–2002.

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

TABLE A3: Distribution of Firm-Level Employment by Region (NUTS 2 Level): Original MET Sample Data and Retained Firms

Region	Our Sample	Original MET Sample
Piedmont	7.8	9.5
Valle D'Aosta	0.4	0.5
Lombardy	12.8	15.4
TN-BZ	1.8	2.9
Veneto	21.2	16.1
Friuli-VG	1.6	2.4
Liguria	0.8	1.6
Emilia Romagna	18.4	16.0
Tuscany	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
Sicily	1.6	1.4
Sardinia	0.4	0.5
Total	100.0	100.0

Note: Elaborations based on firm sample used in OLS, FE and Levinsohn-Petrin regressions; for GMM regressions (see Tables A4a–A4c) the number of firms is smaller because lagged values of variables were used as instruments, which excludes firms not providing data for the years 1998–2002.

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

TABLE A4a: Production Function Estimates for Industry Groups

Industry Group	Method	Labor	Capital	Materials	Period Dummies	N	Firms	AR(2)	AR(2) P-Value	S-H	S-H P-Value	STRU
Group 1	OLS	0.241***	0.061***	0.674***	Yes	3,513						
Group 1	FE	0.148***	0.025***	0.589***	Yes	3,513	431					
Group 1	GMM1	0.174*	0.078***	0.481***	Yes	2,958	424	1.508	0.132	297.487	0.239	297
Group 1	GMM2	0.058	0.006	0.574***	Yes	2,958	424	1.329	0.184	61.588	0.315	73
Group 1	LP	0.212***	0.002	0.828***	Yes	3,513						
Group 2	OLS	0.408***	0.018**	0.477***	Yes	2,566						
Group 2	FE	0.280***	0.037***	0.431***	Yes	2,566	297					
Group 2	GMM1	0.191***	0.090**	0.239***	Yes	2,196	294	0.535	0.593	265.969	0.703	295
Group 2	GMM2	0.083	-0.03	0.278**	Yes	2,196	294	0.874	0.382	54.503	0.569	73
Group 2	LP	0.364***	0.000	0.888***	Yes	2,566						
Group 3	OLS	0.408***	0.062***	0.455***	Yes	2,593						
Group 3	FE	0.276***	0.045***	0.424***	Yes	2,593	325					
Group 3	GMM1	0.332***	0.128***	0.265**	Yes	2,180	319	1.077	0.282	257.468	0.806	294
Group 3	GMM2	0.199***	0.141**	0.277***	Yes	2,180	319	1.061	0.288	63.932	0.246	73
Group 3	LP	0.300***	0.004	0.557***	Yes	2,593						

Note: We estimate a separate production function for each industry group. Due to data constraints, we aggregated some of the 22 ISTAT-ATECO two-digit manufacturing codes into 11 broader groups. According to Roodman (2009) there is a danger associated with having many instruments relative to observations. Therefore, we decided to report instrument counts for all estimates and we add GMM2 results. Concerning GMM results, Tables A4a–A4c also report the Arellano-Bond test to verify autocorrelation in difference residuals and the Sargan-Hansen test for overidentification. As shown in the tables, residuals are not autocorrelated and models are correctly identified.

Legend: 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 dyeing 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 difference residuals; S-H = Sargan/Hansen test for joint validity of the instruments. STRU = number of instruments.

TABLE A4b: Production Function Estimates for Industry Groups

Industry Group	Method	Labor	Capital	Materials	Period Dummies	*N*	Firms	AR(2)	AR(2) *P*-value	S_Ha	S-H -value	STRU
4	OLS	0.564***	0.038 ***	0.392 ***	Yes	3,406						
4	FE	0.217 ***	0.027***	0.406***	Yes	3,406	420					
4	GMM1	0.100**	0.057***	0.189***	Yes	2,867	418	-0.343	0.731	285.71	0.411	297
4	GMM2	0.144	−0.01	0.289***	Yes	2,867	418	−0.054	0.957	58.455	0.422	73
4	LP	0.496***	0.00	0.529**	Yes	3,406						
5	OLS	0.351***	0.042***	0.598***	Yes	4,186						
5	FE	0.206***	0.022***	0.559***	Yes	4,186	498					
5	GMM1	0.190***	0.005	0.404***	Yes	3,559	491	2.748	0.006	316.935	0.069	297
5	GMM2	0.174*	0.011	0.520***	Yes	3,559	491	2.486	0.013	66.124	0.191	73
5	LP	0.345***	0.035**	0.196***	Yes	4,186						
6	OLS	0.412***	0.088***	0.534***	Yes	2,711						
6	FE	0.271***	0.030***	0.520***	Yes	2,711	331					
6	GMM1	0.245***	−0.048	0.454***	Yes	2,280	326	1.094	0.274	285.912	0.407	297
6	GMM2	0.256**	−0.052	0.480***	Yes	2,280	326	1.086	0.277	60.23	0.36	73
6	LP	0.400***	0.00	0.00	Yes	2,711						
7	OLS	0.427***	0.037***	0.503***	Yes	7,376						
7	FE	0.251***	0.029***	0.438***	Yes	7,376	905					
7	GMM1	0.202***	−0.008	0.320***	Yes	6,230	897	2.422	0.015	332.45	0.019	297
7	GMM2	0.067	−0.03	0.383***	Yes	6,230	897	2.252	0.024	81.303	0.019	73
7	LP	0.404***			Yes	7,376						

Note: We estimate a separate production function for each industry group. Due to data constraints, we aggregated some of the 22 ISTAT-ATECO two-digit manufacturing codes into 11 broader groups. According to Roodman (2009) there is a danger associated with having many instruments relative to observations. Therefore, we decided to report instrument counts for all estimates and we add GMM2 results. Concerning GMM results, Tables A4a–A4c also report the Arellano-Bond test to verify autocorrelation in difference residuals and the Sargan-Hansen test for over-identification. As shown in the tables, residuals are not autocorrelated and models are correctly identified.

Legend: 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 difference residuals; S-H = Sargan/Hansen test for joint validity of the instruments.

TABLE A4c: Production Function Estimates for Industry Groups

Industry group	Method	Labor	Capital	Materials	Period dummies	N	Firms	AR (2)	AR(2) P-value	S_Ha	S-H P-value	STRU
8	OLS	0.400***	0.034***	0.540***	Yes	4327						
8	FE	0.246***	0.030***	0.525***	Yes	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	0.362***	0.0	0.0	Yes	4327						
9	OLS	0.419***	0.001	0.525***	Yes	2789						
9	FE	0.223***	0.024***	0.523***	Yes	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	0.400***	0.00	0.440***	Yes	2789						
10	OLS	0.406***	0.060***	0.465***	Yes	1149						
10	FE	0.275***	0.050***	0.521***	Yes	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	0.340***	0.047	0.091	Yes	1149						
11	OLS	0.321***	0.016**	0.628***	Yes	2107						
11	FE	0.169***	0.016*	0.682***	Yes	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	0.312***	0.042	0.567**	Yes	2107						

Note: We estimate a separate production function for each industry group. Due to data constraints, we aggregated some of the 22 ISTAT-ATECO two-digit manufacturing codes into 11 broader groups. According to Roodman (2009) there is a danger associated with having many instruments relative to observations. Therefore, we decided to report instrument counts for all estimates and we add GMM2 results. Concerning GMM results, Tables A4a–A4c also report the Arellano-Bond test to verify autocorrelation in difference residuals and the Sargan-Hansen test for overidentification. As shown in the tables, residuals are not autocorrelated and models are correctly identified.

Legend: 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 difference residuals; S-H = Sargan/Hansen test for joint validity of the instruments.

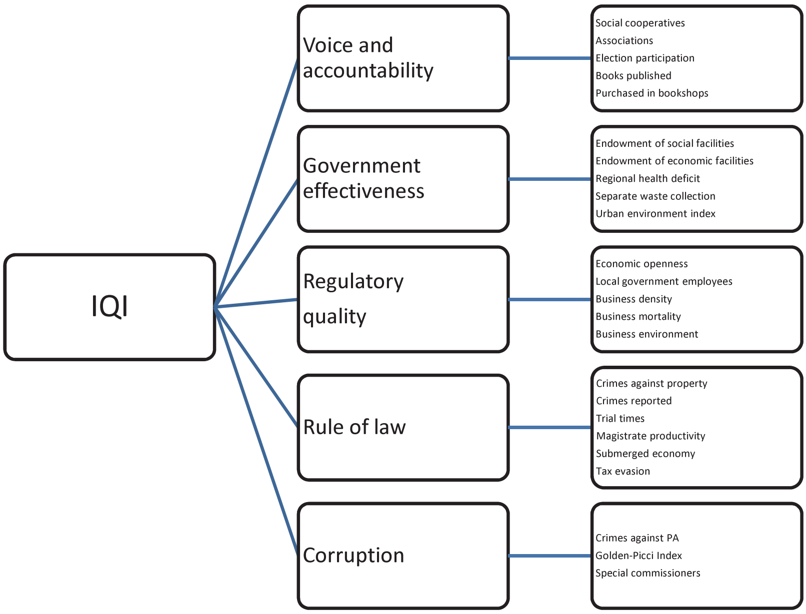


FIGURE B1: Structure of the Institutional Quality Index (IQI).

APPENDIX B: THE IQI (INSTITUTIONAL QUALITY INDEX)

The aim of this Appendix B is to supply additional details on IQI, i.e., the main explanatory variable of firm's TFP used in our econometric investigation. The IQI index is inspired to the World Governance Indicator (WGI) proposed by Kaufmann, Kraay, and Mastruzzi (2011)[14] in the context of the *Knowledge for Change Programme* promoted by the World Bank. The WGI is a complex indicator conceived to measure the quality of governance in 213 countries in the period 1996–2010; it is structured into six dimensions which concern some major quality characteristics of a national system, i.e., (1) voice and accountability, (2) political stability and absence of violence and terrorism, (3) government effectiveness, (4) regulatory quality, (5) rule of law, (6) control, and corruption.

The IQI is constructed following a scheme similar to that of WGI, in particular, the hierarchy framework illustrated in Figure B1, for which each index derives from aggregation of indexes of a lower rank. The main differences between WGI and IQI are that this latter: (1) is based on provincial rather than national data; (2) considers only five of the six dimensions of the WGI, insofar as the dimension "Political stability and absence of violence and terrorism," which captures phenomena such as the frequency of coups or terrorist attacks and the presence of the military in politics, is not relevant to the situation in Italian provinces, and (3) adopts different procedures for weighting, normalization, and aggregation of elementary indexes.[15]

The data we use for the elementary indexes constituting the IQI are released by institutional sources, research institutes and professional registers, and refer to the period 1991–2009. Table B1 reports details of all the elementary indexes used for each dimension:

[14]Kaufmann, Kraay, and Mastruzzi (2011), "The Worldwide Governance Indicators: Methodology and Analytical Issues," Policy Research Working Paper Series, No. 5430, The World Bank.

[15]Full technical details on these aspects are given in Nifo and Vecchione (2014), "Do Institutions Play a Role in Skilled Migration? The Case of Italy," *Regional Science*, DOI: 10.1080/00343404.2013.835799.

TABLE B1: Structure of Elementary Indexes

Index	Value	Source (Details in Notes)	Year
Voice and accountability			
Social cooperatives	Absolute value[1]	ISTAT	2001
Associations	Absolute value[1]	ISTAT	2004
Election participation	Turnout percent[2]	Interior ministry	2001
Books published	Absolute value[3]	ISTAT	2007
Purchased in bookshops	Index[4]	Sole24Ore	2004
Government effectiveness			
Endowment of social facilities	Index[5]	Tagliacarne	2001
Endowment of econ. facilities	Index[6]	Tagliacarne	2001
Regional health deficit	Absolute value[7]	MEF and MH	1997–2004
Separate waste collection	Separate/total[8]	Tagliacarne	2007
Urban environment index	Index[9]	Legambiente	2004
Regulatory quality			
Economy openness	Index[10]	Tagliacarne	2001
Local government employees	Absolute Value[11]	ISTAT	2003
Business density	Index[12]	Tagliacarne	2008
Business start-ups/mortality	Registration/cessation[13]	Tagliacarne	2003–2004
Business environment	Index[14]	Confartigianato	2009
Rule of law			
Crimes against property	Absolute value[15]	ISTAT	2003
Crimes reported	Absolute value[16]	ISTAT	2003
Trial times	Trial lengths I, II, III[17]	Crenos	1999
Magistrate productivity	Magistrate Trials[18]	Ministry of Justice	2004–2008
Submerged economy	Index[19]	ISTAT	2003
Tax evasion	Index[20]	Revenue Agency	1998–2002
Corruption			
Crimes against PA	Index[21]	Interior Ministry and ISTAT	2004
Golden-Picci Index	Index[22]	Golden and Picci (2005)	1997
Special Commissioners	Municipalities overruled[23]	Interior Ministry	1991–2005

Notes: [1]Social cooperatives per 100,000 residents, provincial level. ISTAT: "Le cooperative sociali in Italia" (2006) and "Le organizzazioni di volontariato in Italia" (2005); [2]2001 general election, provincial level. Interior Ministry: "Archivio storico delle elezioni" http://elezionistorico.interno.it/; [3]Books published, in absolute value, provincial level. ISTAT: "La produzione libraia" (2007); [4]Purchased books over resident population, provincial level. Il Sole24Ore "Dossier sulla qualità della vita" (2004); [5]Includes education, healthcare and leisure facilities, provincial level. Tagliacarne Institute "Atlante di competitività delle province italiane" (2001); [6]Includes the following networks: roads, railroads, ports, airports, energy, ICT, banking, provincial level. Tagliacarne Institute

TABLE B1: Continued

Notes: "Atlante di competitività delle provincie italiane" (2001); [7]Regional health deficit per capita 1997–2004, regional level. Elaboration on Ministry of Economy and Finance and Ministry of Health data from "Relazione generale sulla situazione economica del Paese" (1997–2004); [8]Share of separate waste collection on total waste collection, provincial level. Tagliacarne Institute "Atlante di competitività delle province italiane" (2001); [9]Includes 25 indexes relative to: air quality, water quality, purification plants, waste management, public transportation, energy consumption, Public parks, Eco management, provincial level. Legambiente "Ecosistema Urbano 2004" (2004); [10]Import + Export on the gross domestic product, provincial level. Tagliacarne Institute "Atlante di competitività delle provincie italiane" (2001); [11]Public servants over resident population, regional level. ISTAT: "Indicatori statistici sulle amministrazioni centrali e locali" (2003) http://dati.statistiche-pa.it/; [12]Number of firms for 100 residents, provincial level. Tagliacarne Institute "Atlante di competitività delle province italiane" (2008); [13]Firms registration/mortality, provincial level. Tagliacarne Institute "Atlante di competitività delle province italiane" (2003–2004); [14]Includes 39 indexes relative to: entrepreneurship, job Market, tax system, market competition, banking, bureaucracy; public services to firms, firms' cooperation, provincial level. Confartigianato: "L'indice Confartigianato—Qualità della vita dell'impresa" (2009); [15]Number of crimes against property over resident population, provincial level. ISTAT: "Indicatori territoriali per le politiche di sviluppo" (2003); [16]Number of crimes reported over resident population, provincial level. ISTAT: "Indicatori territoriali per le politiche di sviluppo" (2003); [17]Average length of judicial process, regional level. CRENOS "Data-base on crime and deterrence in the Italian regions (1970–1999)"; [18]Number of completed civil and criminal trials for magistrate, regional courts level. Ministry of Justice, statistics: "Graduatoria rispetto agli esauriti per magistrato presente" (2004–2008); [19]ISTAT estimation, provincial level. ISTAT: "Le misure dell'economia sommersa secondo le statistiche ufficiali" (2003); [20]Based on the difference between the estimated added value by national accounts and tax system (IRAP and individual income tax returns), provincial level. Agenzia delle entrate: "Analisi dell'evasione fondata su dati IRAP, Anni 1998–2002" (2006); [21]Number of crimes against the public administration over number of public servants, regional level. ISTAT: "Indicatori territoriali per le politiche di sviluppo" (2004); [22]Difference between the amounts of physically existing public infrastructure and the amounts of money cumulatively allocated by government to create these public works, provincial level. Golden and Picci (2005); [23]Absolute value of the overruled municipalities on total municipalities, regional level. Interior Ministry: "Relazione sull'attività svolta dalla gestione straordinaria dei Comuni commissariati" (1991–2005).

Voice and accountability is made up by the participation rate in public elections, the number of associations and of social cooperatives and cultural liveliness measured in terms of books published and purchased in bookshops; *Government effectiveness* measures the endowment of social and economic structures in Italian provinces and the administrative capability of provincial and regional governments in terms of health policies, waste management and environment; *Regulatory quality* concerns the degree of openness of the economy, indicators of business environment, business density and the rate of firms mortality; *Rule of law* summarizes data on crime against persons or property, magistrate productivity, trial times, tax evasion and shadow economy; *Corruption* summarizes data on a crimes committed against the Public Administration, the number of local administrations overruled by the federal authorities and the Golden-Picci Index, measuring the corruption level on the basis of "the difference between the amounts of physically existing public infrastructure (. . .) and the amounts of money cumulatively allocated by government to create these public works" (Golden and Picci, 2005, p. 37).

The criterion which steered the choice of elementary indexes, albeit in the framework proposed by WGI, took account of the objectives of the analysis and the actual availability of data on a provincial basis. As regards the reference time period, the values of the elementary indexes are calculated in most cases for the years immediately prior to 2004, consistent with the fact that the data refer to firms total factor productivity measured in 2005–2007. Only very few cases the elementary indexes refer to years after 2004. However, the heterogeneity of the time reference does not pose major problems, insofar as it is reasonable to assume that the processes of institutional change occur slowly, and that appreciable changes in institutional quality take place only in the medium-long term.

TABLE B2: Ranking of Provinces by Institutional Quality Index (IQI)

Rankk	Region	Province	Area	IQI	Rank	Region	Province	Area	IQI
1	Tuscany	FIRENZE	Centre	1	55	Abruzzo	TERAMO	Centre	0.630
2	Tuscany	PISA	Centre	0.923	56	Abruzzo	CHIETI	Centre	0.626
3	Friuli V. G.	TRIESTE	North	0.920	57	Marche	MACERATA	Centre	0.618
4	Lombardy	MILANO	North	0.904	58	Friuli V. G.	UDINE	North	0.613
5	Tuscany	LIVORNO	Centre	0.900	59	Liguria	LA SPEZIA	North	0.612
6	Tuscany	LUCCA	Centre	0.870	60	Veneto	ROVIGO	North	0.605
7	Tuscany	SIENA	Centre	0.856	61	Marche	PESARO URBINO	Centre	0.588
8	Lombardy	VARESE	North	0.852	62	Abruzzo	L'AQUILA	Centre	0.583
9	Tuscany	PRATO	Centre	0.852	63	Abruzzo	PESCARA	Centre	0.573
10	Emilia R.	RAVENNA	Centre	0.812	64	Marche	ASCOLI PICENO	Centre	0.562
11	Tuscany	AREZZO	Centre	0.809	65	Friuli V. G.	PORDENONE	North	0.562
12	Lombardy	BERGAMO	North	0.808	66	Veneto	BELLUNO	North	0.549
13	Emilia R.	BOLOGNA	Centre	0.804	67	Lazio	LATINA	Centre	0.538
14	Emilia R.	RIMINI	Centre	0.792	68	Puglia	BARI	South	0.515
15	Lombardy	CREMONA	North	0.792	69	Liguria	IMPERIA	North	0.502
16	Lombardy	LECCO	North	0.786	70	Sardinia	CAGLIARI	South	0.473
17	Tuscany	MAS-CARRARA	Centre	0.785	71	Lazio	VITERBO	Centre	0.458
18	Tuscany	PISTOIA	Centre	0.783	72	Lazio	FROSINONE	Centre	0.427
19	Lombardy	BRESCIA	North	0.778	73	Lazio	RIETI	Centre	0.424
20	Lombardy	MANTOVA	North	0.776	74	Basilicata	POTENZA	South	0.424
21	Emilia R.	REGG NELL'EMILIA	Centre	0.774	75	Puglia	LECCE	South	0.415
22	Piedmont	CUNEO	North	0.770	76	Sardinia	ORISTANO	South	0.402
23	Emilia R.	PARMA	Centre	0.769	77	Basilicata	MATERA	South	0.398
24	Tuscany	GROSSETO	Centre	0.761	78	Puglia	FOGGIA	South	0.397
25	Veneto	PADOVA	North	0.760	79	Puglia	BRINDISI	South	0.385
26	Emilia R.	FORLÌ-CESENA	Centre	0.758	80	Puglia	TARANTO	South	0.383
27	Piedmont	NOVARA	North	0.757	81	Sardinia	SASSARI	South	0.379
28	Piedmont	TORINO	North	0.738	82	Sardinia	OLBIA-TEMPIO	South	0.359
29	Lombardy	COMO	North	0.734	83	Campania	SALERNO	South	0.356
30	Lombardy	PAVIA	North	0.733	84	Campania	AVELLINO	South	0.326
31	Lazio	ROMA	Centre	0.725	85	Sardinia	MEDIO CAMPID.	South	0.317
32	Veneto	TREVISO	North	0.723	86	Molise	CAMPOBASSO	South	0.311

(*Continued*)

TABLE B2: Continued

Rankk	Region	Province	Area	IQI	Rank	Region	Province	Area	IQI
33	Valle d'Aosta	VALLE D'AOSTA	North	0.709	87	Campania	CASERTA	South	0.295
34	Emilia R.	FERRARA	Centre	0.706	88	Campania	BENEVENTO	South	0.294
35	Friuli V. G.	GORIZIA	North	0.706	89	Campania	NAPOLI	South	0.283
36	Emilia R.	MODENA	Centre	0.705	90	Sardinia	NUORO	South	0.276
37	Trentino A.A.	TRENTO	North	0.701	91	Sicily	MESSINA	South	0.263
38	Piedmont	BIELLA	North	0.697	92	Sicily	SIRACUSA	South	0.262
39	Umbria	PERUGIA	Centre	0.697	93	Sicily	RAGUSA	South	0.253
40	Veneto	VICENZA	North	0.692	94	Sardinia	CARB-IGLES	South	0.250
41	Liguria	SAVONA	North	0.691	95	Sicily	CATANIA	South	0.249
42	Veneto	VENEZIA	North	0.689	96	Molise	ISERNIA	South	0.239
43	Liguria	GENOVA	North	0.686	97	Sicily	TRAPANI	South	0.228
44	Lombardy	SONDRIO	North	0.686	98	Sicily	PALERMO	South	0.226
45	Veneto	VERONA	North	0.684	99	Sicily	CALTANISSETTA	South	0.183
46	Piedmont	VERB-CUS-OSS	North	0.683	100	Calabria	REG DI CALABRIA	South	0.159
47	Emilia R.	PIACENZA	Centre	0.669	101	Calabria	CATANZARO	South	0.156
48	Marche	ANCONA	Centre	0.663	102	Calabria	COSENZA	South	0.154
49	Piedmont	ASTI	North	0.661	103	Sardinia	OGLIASTRA	South	0.153
50	Lombardy	LODI	North	0.660	104	Sicily	ENNA	South	0.109
51	Piedmont	ALESSANDRIA	North	0.659	105	Sicily	AGRIGENTO	South	0.077
52	Umbria	TERNI	Centre	0.645	106	Calabria	CROTONE	South	0.028
53	Piedmont	VERCELLI	North	0.634	107	Calabria	VIBO VALENTIA	South	0
54	Trentino A.A.	BOLZANO	North	0.632					

TABLE B3: Descriptives Statistics for IQI Subindexes

	IQI-Control -Corruption	IQI-Government Effectiveness	IQI-Regulatory Quality	IQI-Rule of Law	IQI-Voice and Accountability	IQI Index
Mean	0.7521	0.2969	0.5055	0.6379	0.3957	0.5632
Standard deviation	0.1991	0.1612	0.2135	0.2084	0.1765	0.2355
Coeff. Variation	0.2647	0.5428	0.4223	0.3267	0.4459	0.4181

Source: Nifo and Vecchione (2014).

The IQI assumes, by construction, values in the range[0, 1]. Table B2 reports the ranking of Italian provinces classified on the IQI basis.

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