TOTAL FACTOR PRODUCTIVITY IN ITALIAN MANUFACTURING: DOES LOCATION MATTER?

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1. Introduction

In 2013 a well-known article dubbed Italy "the sleeping beauty of Europe - a country rich in talent and history, but suffering from a long-lasting stagnation". At the root of stagnation lay the "great unlearning" – the process whereby the productivity in manufacturing, after having largely outpaced that of other countries (Germany in the first place) throughout the '70s and '80s, from the mid-'90 on turned sluggish and then fell, never to recover ever since (Hassan Ottaviano, 2013).

While there is general consensus around the main causes of Italy's productivity slowdown - failure to adopt the ITC revolution, bad market regulation, low R&D expenditure, low investment - less attention has been devoted to the spatial aspects of the problem. In fact, although the disparity between an efficient North and a lagging South, with the Centre lying somewhere in-between, is largely acknowledged, not enough studies address the problem from a spatial point of view.

This paper aims at deepening these studies. Starting from firm-level data, it estimates total factor productivity (henceforth TFP) for over 190,000 Italian manufacturing firms during 2008-20. The estimated TFP is then aggregated with reference to a rather fine territorial breakdown, that of NUTS-3 provinces, and to sectors' technology content, according to the Ateco classification. Estimates are used to analyse spatial interdependence, spillovers and networks and to investigate the presence of clusters among administrative units and/or manufacturing sectors. The analysis is directed at assessing whether provinces' TFP performance differs significantly across units, if it is possible to trace common patterns moving towards TFP convergence, and what is the role, if any, of geographic location vis à vis sectoral specialization. The results seemingly point to a relatively strong influence of location in determining the level and performance of provincial TFP.

The paper is organized as follows: Section 2 presents a brief survey of the literature on Italian regional disparities; Section 3 describes the data and methodology. The results of the analysis are reported in Sections 4, where spatial correlation and TFP convergence is tested, and 5, that addresses the role of specialization. Some concluding remarks follow (Section 6).

2. Literature review

Economic and social dualism is a long-standing feature in Italy's history. Since the country's unification (1861) it has been the object of vast debate. The literature has often focused on the relevance of economic variables, of initial conditions and of local features. Economic growth and spatial convergence are viewed as the result of a process of capital accumulation, often strengthened by a parallel accumulation of human and social capital.

Within this framework, economic policy and public investment are viewed as key elements to create the best conditions for growth. The latest significant episode of North-South convergence (1951-73) was led by a strong cycle of public investment in infrastructure and heavy industry which brought the South to register a higher average rate of capital accumulation than the North. The situation changed radically in the '70s, when the average net rate of capital accumulation in the South progressively declined (Iuzzolino et al., 2011).

A recent strand of the literature focuses on the role of social and institutional factors (see Asso, 2021, for a review). The basic idea is that local features – including institutions – determine the incentives for investments and are essential for creating innovative entrepreneurial systems. Many socio-economic indicators measure the impact of social disparities on capital accumulation and on the quality of institutions (Felice, 2011; Lasagni et al., 2015; Pipitone Seta, 2017). Moreover, in the South transaction costs are higher also due to illegality: "in the historically slow growing regions of Southern Europe, poor quality government, historically pervasive corruption, collusion and lack of trust are more of a barrier for development than a shortage of assets" (Charron et al., 2015).

While a big array of new data-sets is available, there is growing consensus on the fact that no unique variable can account for the lack of convergence between the North and the South of Italy. On the contrary, the persistence of disparities appears to be linked to a number of interconnected factors (Daniele et al., 2018; Viesti, 2021). Southern regions appear to be blocked in a typical "intermediate development trap" featuring premature de-industrialization, demographic shocks (Pipitone et al., 2022), an inefficient public sector, low productivity and hence low competitiveness at the firm level (Giordano et al., 2015).

One of the most recent strands of the literature discards the notion of a uniformly under-developed South trapped in unchanged economic performance[1]. This idea is applied also to study local TFP (Aiello Scoppa, 2000, Byrne et al., 2009); in this

[1] "No mistake could be bigger than to think that the long-standing issue of the Mezzogiorno simply means that nothing has ever changed in Italian regional disparities" (translated from Iuzzolino et al., 2011). See also Asso et al., 2021.

respect, research aims at identifying the micro-foundations of the social processes and of the changes that lead to innovation and growth for firms in under-developed, constrained areas (Asso Trigilia, 2010, 2013; Asso Pipitone, 2013).

From the point of view of TFP, one of the key issues is that of analysing, alongside to firms' individual features (size, sector of activity, R&D), also the role of variables that are external to the firm but are linked to the territorial dimension in which it operates (the availability of infrastructure, the quality of public institutions and of services) in an attempt to evaluate each one separately (Aiello et al. 2014).

3. Data and methodology

Data cover the period 2008-20 and are taken from Bureau van Dijk - AIDA database that reports information from Italian firms' unconsolidated balance sheets. For each firm we retrieve value added, the wage bill (as a proxy for the number of workers), materials (as a proxy for intermediate inputs) and the book value of total tangible fixed assets[2]. The data is then deflated by the annual average of ISTAT's monthly 4-digit Industrial Production Price Indexes for sectors from 11 to 33 (at the 2-digit level) in the ATECO classification. Wages are deflated by the annual average of ISTAT's monthly sectoral deflators defined on the basis of collective wage agreements. Outliers are removed by eliminating the 1st and the 99th percentile from each deflated variable. This leaves a sample of 194.821 firm-year observations.

TFP is estimated by means of the semi-parametric, two-step estimation procedure introduced by Olley Pakes, 1996, that explicitly accounts for firms' entry (exit) decisions. This method is preferred over traditional estimation methods (pooled OLS, fixed effect estimation) that notoriously give rise to biased coefficients due to endogeneity and selection problems[3].

Convergence is estimated with reference to the non-linear time-varying factor model defined by Phillips Sul, 2007, 2009. By tracking the convergence path of each unit, the model allows to identify convergence clubs, or clusters, endogenously, each moving to a specific steady-state position. Moreover, this method does not relate uniquely to growth theories and can thus be successfully used to study the convergence of variables other than output[4].

[2] We also retrieve the depreciation of tangible fixed assets (as a proxy for investment), the date of firm creation (to derive age), the number of workers (to derive specialization) and other codes to identify location, sectors and so on.

[3] A full discussion of the features and methodological issues that arise when estimating TFP is beyond the scope of the present paper. References can be found, among others, in Van Briesebroeck, 2008.

[4] For a description and discussions of the Phillips Sul model, see Apergis et al., 2018.

4. Clubs and spatial correlation

As a first step, Fig. 1 shows the evolution of the average TFP (in logs) over 2008-20 for Italy's four NUTS-1 macro-regions: North-West, North-East, Centre and South (including the two islands of Sicily and Sardinia)[5]. A number of observations are immediately evident: first, as expected, the two northern areas show higher, and faster growing, average TFP with respect to the Centre and the South; second, TFP performance in the North-West and the North-East are strongly correlated[6], to the extent that henceforth they will be grouped together in North. Third, while the Centre appears to follow the performance of the North fairly closely, the South shows a somewhat a differing behaviour, especially in the crises of 2008-9 and 2019-20. Finally, the gap between the highest and the lowest TFP is smaller in 2008 than it is in 2018[7]. This can be taken as a *prima facie* indication of growing divergence in TFP levels across Italian macro-regions, at least after the Great Recession and until 2019.

The hypothesis is tested more rigorously at the provincial level by applying, as already mentioned, the econometric method of Phillips Sul (2007, 2009). We first calculate the log-t test to analyse overall convergence in mean TFP across provinces, the null hypothesis being that provinces converge to a common, long-run TFP (absolute convergence). Results reported in Tab. 1 reject the null, suggesting absolute divergence in TFP across provinces.

We then test for the presence of local convergence clubs. Tab. 2 shows that the null hypothesis of local convergence is not rejected at the 5%. It is thus possible to identify four convergence clubs: with the exception of the diverging province of Fermo, Italy's remaining 106 provinces all converge towards multiple local TFP levels, conditional on each's initial economic structure and features . The two largest clubs (club 1 and club 3) show transitional, or temporary divergence (negative, but significant coefficients). The two smaller ones (club 2 and 4) present conditional convergence, i.e. convergence in TFP growth (positive and significant coefficients).

[5] North-West includes the (NUTS-2) regions of Piemonte, Valle d'Aosta, Liguria and Lombardia, for a total of 25 NUTS-3 provinces; North-East groups the two autonomous provinces of Trieste and Bolzano, and the regions of Veneto, Friuli-Venezia-Giulia and Emilia-Romagna (22 provinces); Centre counts Toscana, Umbria, Marche and Lazio (22 provinces); finally, South and Isles count Abruzzo, Molise, Campania, Puglia, Basilicata, Calabria, Sicilia and Sardegna (36 provinces). Over time provinces have been considerably re-organized; a number of new ones has been introduced and, in some cases, later abolished. This paper refers to the classification in force in 2020, for a total of 107 provinces.

[6] Pearson's correlation coefficient is positive and high (0,994).

[7] And also, notably, in crisis period 2009-13. According to Ciani et al., 2018, this resulted from a two-fold effect: a selection bias eliminating the most inefficient firms and a competitive stimulus, according to which surviving firms are obliged to improve TFP.

Figure 1 – *Mean TFP (in logs), by macro regions (2008-20).*

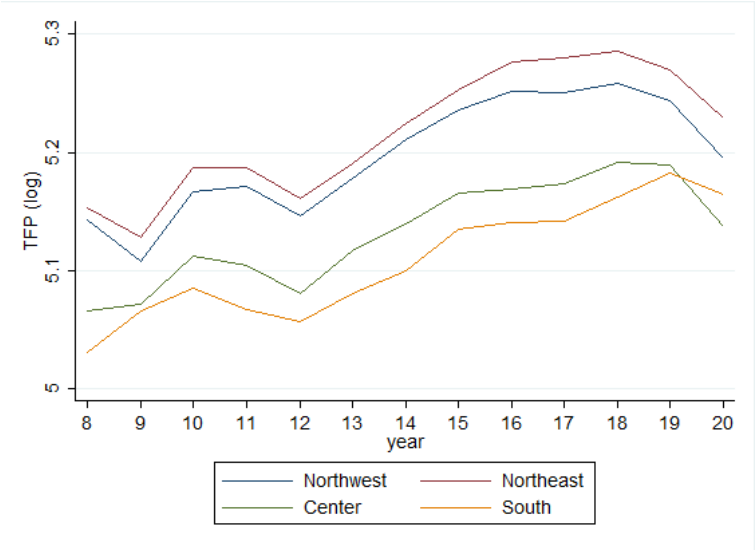


Table 1 – *Log-t convergence test.*

	Coeff	SE	T-stat
log(t)	-0.9499	0.0096	-99.3462

Table 2 – *Converge clubs.*

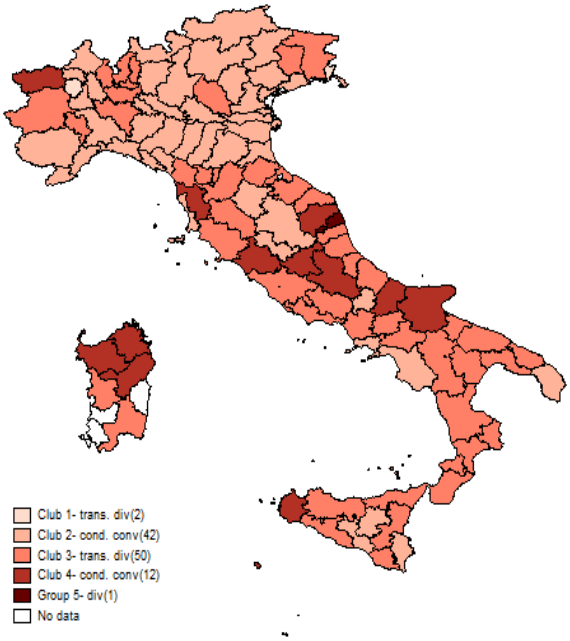
	Club 1	Club 2	Club 3	Club 4
Coeff	-2.939	0.049	-0.032	0.410
T-stat	-1.155	0.695	-0.492	5.710

All clubs are shown in Fig. 2, that also reports the number of provinces in each club.

Fig. 2 points to an evident North-South divide in TFP levels and dynamics. This is further investigated by means of Moran's I statistic that tests for the presence of global spatial autocorrelation. As expected, the statistic is positive and significant, ruling out the hypothesis of a random distribution of TFP and pointing rather to positive correlation. Over 2008-18 spatial effects generally strengthen – the statistic goes from 0,173 in 2008 to 0,220 in 2018 (the highest value in 2008-20) - but falls in 2019-20. In general, it tends to grow in good years and weaken in bad ones (Moran's I = 0,050 in 2020). The scatterplot in Fig.3 (derived from 2018 data) shows a positive slope and confirms a global clustering pattern. This points to high TFP

provinces tending to border high TFP neighbours (high-high), and low TFP provinces generally having low TFP neighbours (low-low).

Figure 2 – *The spatial distribution of convergence clubs.*



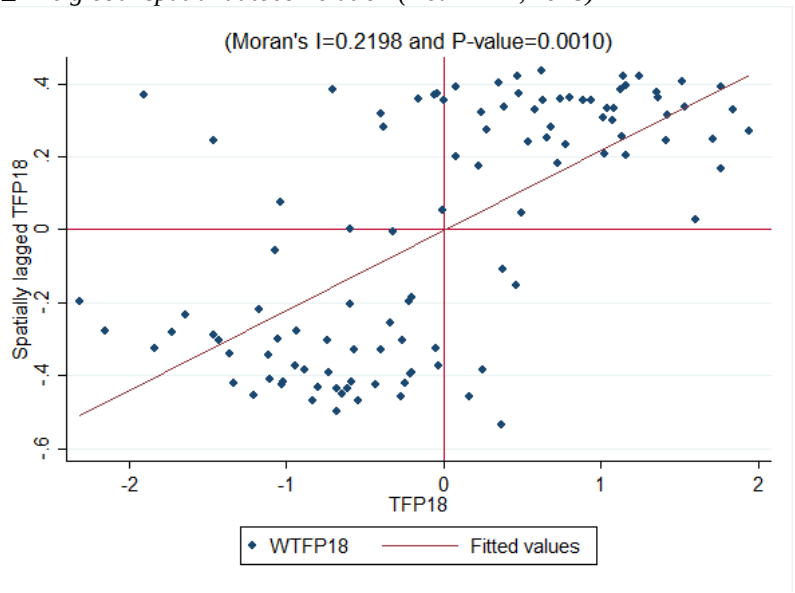
Mapping Moran's I quadrants shows – as expected - a neat divide between northern provinces, mostly high-high, and southern ones, mostly low-low (see Fig. 4). Even if not all the provinces located in the high-high or low-low quadrants are statistically significant, local spatial autocorrelation points to a far lower presence of territorial links across southern provinces throughout the period. Moreover, a breakdown by NUTS-1 macro-regions reports positive and significant autocorrelation among provinces in the North and Centre, in sharp contrast with the negative, non significant one for the South, suggesting a random distribution[8]. This points to far weaker spatial ties (spillovers, networks, positive externalities, linkages etc.) for southern provinces. However, what Fig. 4 shows is that in the North and in the Centre provinces, both high-high and low-low, tend to cluster together. In the South, instead, high performing areas appear to be randomly distributed.

[8] This holds true even when the two major islands – which could reasonably have weaker spatial links with provinces in the mainland - are not included in the sample.

5. The role of specialization

The results reported in paragraph 3 point to a seemingly strong pattern of spatial distribution of TFP between northern and southern provinces. TFP, however, could be linked to factors differing from geographic location. Among these, sectoral specialization could play a prominent role. We thus investigate the impact – if any - of specialization in explaining the territorial pattern of TFP across Italy's provinces.

Figure 3 □ *The global spatial autocorrelation (mean TFP, 2018)*

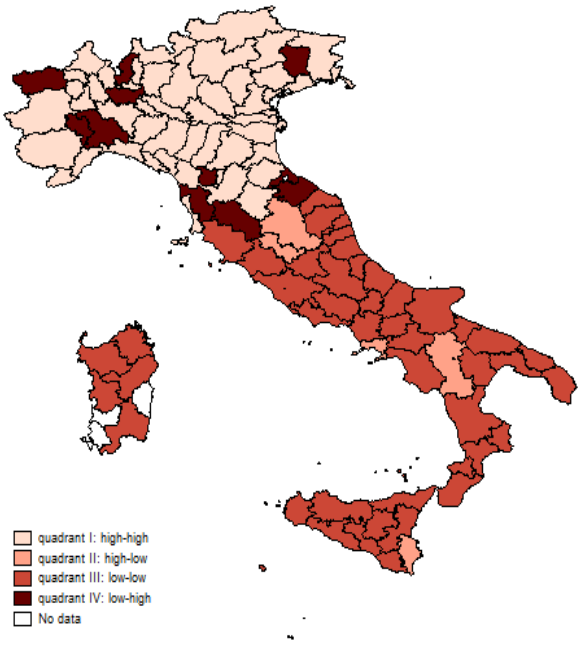


To this end, we refer to the classification provided by Eurostat that groups Ateco/Nace manufacturing sectors on the basis of their technology content[9]. This allows to distinguish among high-tech sectors (HIT); medium-high tech (MHT); medium-low tech (MLT) and low-tech (LOT) ones. We then calculate a modified Krugman specialization index that compares the ratio between the employees in the sector over the employees in all sectors in the province to the same ratio calculated for Italy[10]. We classify a province as specialized in a macro-sector when the index is >1. Note that provinces may specialize in more than one macro-sector.

[9] For details, see https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Glossary:High-tech

[10] By contrast, the well-known Krugman index is calculated as the sum of the absolute differences between the two ratios over all sectors in the location (region, province, city). For details, see Palan, 2010.

Figure 4 – *Moran scatterplot map (2018).*



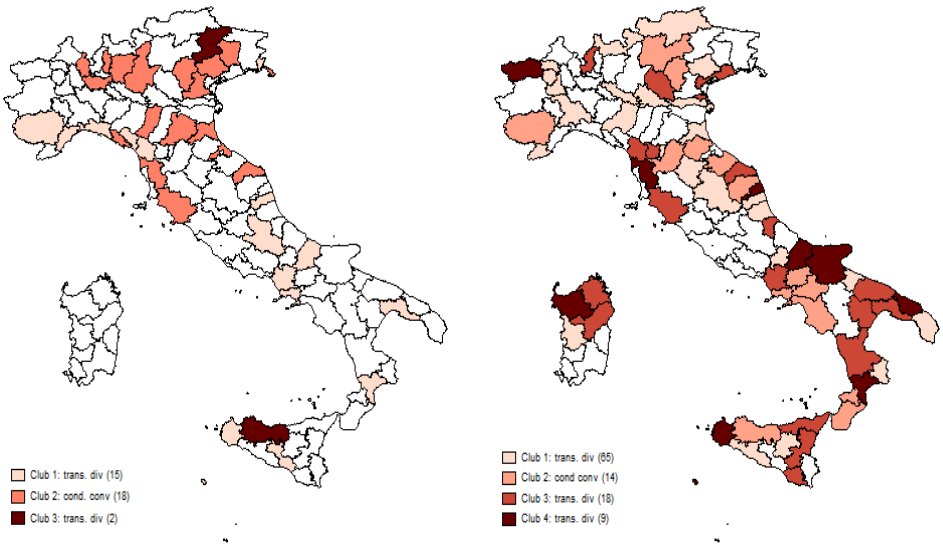
We run again the Phillips Sul model to check for the presence of clubs among the provinces that specialize in a given macro-sector. We refer to the results obtained for 2018[11]; in general, however, these hold for the entire period. All macro-sectors diverge, but all contain a number of converging, or temporarily diverging, clubs. After running the post-estimation merging procedure the number of clubs ranges between 3 (MHT and MLT) and 4 (HIT and LOT)[12]. As expected, specialization leads HIT and MHT clubs to mostly group provinces from the North. In addition, in these sectors clubs are: (i) very stable over time in terms of membership; and (ii) show higher convergence (or lower transitional divergence) speed than in other sectors. The clubs that group provinces specialized in MLT and LOT sectors, instead, include many territories of the Centre and the South. In general, (i) membership is less stable over time than in the other macro-sectors, i.e. there is high intra-club mobility; (ii) clubs show far lower convergence speed, implying weaker convergence. In addition, many clubs record transitional divergence (i.e. negative, but significant, convergence coefficients).

[11] We select 2018 as our reference year inasmuch as it is the time-period in which spatial correlation is at its highest, as shown in Fig. 1 and confirmed by Moran's *I*.

[12] For HIT no merge was possible. Throughout the period a diverging group with only two members (two southern provinces, Aquila and Catania) was present in the sector as well.

Figure 5 – *Convergence clubs in selected macro-sectors (2018).*

(a) MHT clubs (36 provinces) *(b) LOT clubs (65 provinces)*



The picture, however, is more articulate than that. In fact, MLT and LOT clusters include also provinces from the North, especially from the North-East; in turn, MHT and also HIT clubs feature some Centre-South members. Yet, HIT and MHT provinces in the South do not join northern convergence clubs. Rather, they form small groups that follow separate paths; moreover, they do not show any territorial link. This contrasts with Northern provinces, which tend to cluster in large groups across neighbouring regions, showing strong territorial links in all macro-sectors. This may be verified by comparing the two maps in Fig. 5 that shows club membership respectively for medium-high technology (MHT) and low technology (LOT) provinces in 2018[13].

6. Conclusion

Our results point to what appears to be a significantly different behaviour of firms' TFP across Italy's provinces and is essentially linked to a territorial dimension. Thus, northern areas (and central-northern ones, to some extent) show strong geographical patterns which pointing to the presence of spillovers, linkages and networks, with positive outcomes in terms of TFP performance. Southern (and

[13] We show the spatial distribution of MHT provinces instead of that for HIT ones, given the relatively small number of provinces specialized in the latter macro-sector (only 27 in 2018).

central-southern) provinces instead form clubs that follow idiosyncratic paths, especially in high and medium-high technology sectors, implying that good practices do not spread to neighbouring areas. MLT and LOT clubs do show some evidence of territorial links also for southern members, but these occur mainly within NUTS-2 regions (this may be traced for provinces in Campania, Sicily and Sardinia) and do not extend across regions.

Moreover, when it comes to determining an area's performance in terms of TFP, geographic location appears to be more important than sectoral specialization. Put differently, it could be claimed that location does matter.

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SUMMARY

This paper investigates the sluggish, or falling, productivity of Italian manufacturing firms which began in the mid-90s and carried on well into the Two Thousands, to recover slowly only in 2013-19. While there is general consensus on the main determinants of Italian firms' sluggish performance -- failure to adopt the ITC revolution, rigidities -- less attention has been devoted to the spatial aspects of the problem.
Starting from firm-level data, the paper estimates total factor productivity (henceforth TFP) for over 190,000 Italian manufacturing firms during 2008-20. TFP is estimated with reference to the method suggested by Olley Pakes (1996). The estimated TFP is then aggregated with reference to Italy's NUTS-3 provinces, and to the Ateco manufacturing breakdown. The presence of clubs is identified by means of the dynamic, nonlinear factor model developed by Philips Sul (2007, 2009) that allows to identify groupings endogenously. Finally, the relative strength of sectoral specialization against that of geographic location is tested with respect to the creation of clusters.

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