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Supply and demand-side determinants of productivity growth in Italian regions

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ABSTRACT

The objective of this paper is to identify the long run determinants of productivity growth for the manufacturing sector of the Italian regions. Demand and supply-side factors are considered: on the demand side, we refer to the estimation of the Verdoorn effect, while, on the supply side, we explore the role of *R&D* expenditures and transport infrastructure endowments. Our estimation methodology consists of both pooled cross-section *OLS* and time series *LIML* estimators using data collected by *CRENoS* and *Istat* covering the period 1964–2009. We find evidence of a statistically significant Verdoorn effect. Labor costs, *R&D* and railway infrastructure have a positive impact on productivity growth.

1. Introduction

In the recent economic literature, a number of studies attempt an estimation of the long-term determinants of productivity growth. An important reason justifying the interest on this subject is the existence of large and persistent productivity gaps both within and between countries (Fiaschi and Lavezzi, 2007; Van Ark et al., 2008; Quatraro, 2009).

The argument that differences in aggregate productivity can be mainly attributed to the process of structural transformation – the secular reallocation of labor across sectors – has been empirically verified in a number of recent papers (Paci and Pigliaru, 1997; Duarte and Restuccia, 2010; Araujo, 2013; Roncolato and Kucera, 2014). Focusing on within-sector productivity, a number of studies underline the long-term importance of factors with supply-side implications, such as human and social capital, labor costs, *R&D*, infrastructures and personal security.

Another strand of literature refers to the so-called *cumulative causation*, or Kaldorian, models (Myrdal, 1957; Kaldor, 1966; Dixon and Thirlwall, 1975). The cumulative causation hypothesis suggests the existence of increasing returns to scale and virtuous circles between demand and productivity growth (Verdoorn, 1949). The documented evidence of non-convergent, or even divergent, productivity levels is consistent with the implications of such a theory.

Current literature has mainly emphasized supply-side factors, while less attention has been devoted to demand-side factors, typical of the post-Keynesian approach. Even fewer papers have considered conjunctly the contribution of both demand and supply-side factors in explaining productivity differences.

Of particular interest is the case of the Italian peninsula. First, we observe persistent differences in productivity across regions and are aware of the long lasting and unsolved economic dualism between the two macro-areas of North-Centre and South (Mezzogiorno). In addition, in the last two decades, Italy has systematically experienced lower GDP and productivity growth with respect to other countries with similar economic, demographic and geographical characteristics.

In this study, we estimate a reduced form equation where a number of candidate determinants of productivity growth are

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conjunctly examined for the case of the Italian regions in the years 1964–2009. We find that both demand and supply-side factors are important to determine long-term productivity growth. Specifically, we find a positive long-term relationship between output growth and productivity growth. Our estimate of the Verdoorn effect (with value of about 0.5) is in line with the literature and is stable across all estimation techniques. Moreover, following the approach by Alexiadis and Tsagdis (2010), we test whether the cumulative growth process in manufacturing productivity may slow down as productivity increases. Our estimates suggest that cumulative growth is persistent.

The supply-side variables taken into account are expenditure for *R&D*, indexes for transport infrastructures, direct foreign investments, human and social capital accumulation, and indexes on efficiency of the justice administration. We find that *R&D* is a statistically significant determinant of productivity growth. As far as concerns infrastructures, we consider an index for the average time taken to reach a destination by means of railway (train) or road (cars and truck). We find some evidence of a positive effect of railway infrastructures on productivity growth.

The work is structured as follows. Section 2 reviews the literature. Section 3 introduces the model. Section 4 describes the econometric strategy, while Section 5 shows main results and robustness analysis. The final section concludes.

2. Literature and contribution of this study

2.1. Literature on R&D, infrastructure and productivity

Apart from the structural change explanation of productivity differentials, a number of studies devote considerable attention to the role of *R&D* (Griliches, 1979; Ha and Howitt, 2007; Hall et al., 2010; Doraszelski and Jaumandreu, 2013). For instance, some papers focus on the Shumpeterian distinction between, on the one hand, *product innovation/technological competitiveness* and, on the other hand, *process innovation/cost competitiveness* (Färe et al., 1994; Griffith et al., 2004; Crespi and Pianta, 2008). Other papers try to identify the contribution of innovation with respect to the catching-up or imitation phenomenon (Duarte and Restuccia, 2010; Bogliacino and Pianta, 2011). Finally, other studies investigate the role of agglomeration economies and spillovers (Bronzini and Piselli, 2009; Keller and Yeaple, 2009; Medda and Piga, 2014). Recent evidence from Italian regional data on the relationship between productivity and *R&D* is provided by Bronzini and Piselli (2009), Quatraro (2009) and Marrocu and Paci (2010).

Some authors concentrate on infrastructures as a source of economic and productivity growth through their contribution to technical change (among others, Yeaple and Golub, 2007; Agénor, 2008; Farhadi, 2015). Lower production and distribution costs induced by transport improvements can in turn induce scale effects and foster competition levels. As summarized in a meta-analysis by Melo et al. (2013), the productivity effects can vary across industry groups, tend to be higher for the US economy than for European countries, and are higher for roads compared to other modes of transport. Regarding the Italian case, evidence of a positive effect of transport infrastructures on productivity is found by Picci (1999), Bronzini and Piselli (2009) and Destefanis and Sena (2009).

2.2. Literature on the Kaldor–Verdoorn law

On the demand-side, the determinants of productivity have been stated by Kaldor (1966), building on the evidence provided by Verdoorn (1949). Verdoorn's law involves the relation between the growth of manufacturing output and the growth of labor productivity. Kaldor relates this empirical regularity to the increasing returns to scale. The division of labor boosts skills and know-how of the employees, promotes technical innovation and changes the sectoral structure of the economy. According to the Kaldorian view, aggregate productivity is mainly driven by the dynamics of the manufacturing sector. Extensive empirical literature based on data from different countries documents the validity of the Kaldor–Verdoorn law.[1] Evidence in favor of the law is also found with data on the Italian economy (Bianchi, 2002; Gambacorta, 2004; Ofria, 2009; Coad et al., 2011; Fazio et al., 2013).

2.3. Contribution of this study

The study differs from other studies on Italian regional data for a number of reasons summarized here as follows.

Firstly, no previous study considers data on the Italian regions covering such a long period of time (1964–2009). Ofria (2009) employs the *IV* estimator on the time series of the two macro-areas of Italy for the interval 1951–2006. Gambacorta (2004) presents a cointegration analysis using national data for the period 1970–2002. Bianchi (2002) uses a partial adjustment model on national data for the period 1951–1997. Coad et al. (2011) use data on Italian manufacturing firms for the time interval 1989–1997. Fazio et al. (2013) estimate the dynamic Verdoorn law in a multilevel-setting, using data on firms and regions for the period 1999–2005.

Secondly, some previous attempts to estimate the Kaldor–Verdoorn law suffer from a number of estimation problems. For instance, some previous estimates do not distinguish the short-term (within business cycle) relationship between employment and production (Okun's law) from the long-term Kaldor–Verdoorn law. Also, *OLS* with time series data suffer from the simultaneity problem, i.e., the possibility that estimates are influenced by the feedback of the dependent variable on the independent. Even the *IV* estimator is biased in finite samples, and the problem becomes particularly severe when instruments are weak. Moreover, some studies suffer from model misspecification as they fail to control for physical and human capital endowment. Finally, those studies which estimate the static version may encounter the estimation problems suggested by McCombie and Roberts (2007). Thus, following and refining the recent improvements in the literature on this subject, we consider the traditional dynamic version of the Kaldor–Verdoorn law, adopt two consistent estimation methodologies and compare results. We use in particular the pooled cross-section *OLS* estimator and the Limited Information Maximum Likelihood (*LIML*) estimator on each regional time series. As we discuss in the sections below, the *LIML* allows us to address the simultaneity bias problem with the time series model, while four-year averages are employed with the pooled *OLS*.

Thirdly, we build a model accounting for both factors with a demand-side and supply-side interpretation to conjunctly consider their effect on productivity growth. While this approach is new to the literature on the Italian regions, few papers compare the role of the demand with innovation, technology or profit share of income using other data sets (Castellacci and Álvarez, 2006; Naastepad, 2006; Crespi and Pianta, 2008; Hein and Tarassow, 2010). Crespi and Pianta (2008) investigate the impact of both demand and innovation, distinguishing between cost competitiveness and product competitiveness. Combining insights from the Kaldorian and Schumpeterian traditions, they find that productivity

[1] Influential studies focusing on the estimation of the Verdoorn law are those by Targetti and Foti (1997), Harris and Lau (1998), Harris and Liu (1999), Leòn-Ledesma (2002), Pieper (2003). More recent evidence is provided among others by Alexiadis and Tsagdis (2010) and Millemaci and Ofria (2014). See also Bairam (1987) and McCombie et al. (2002) for extensive reviews.