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Modeling the incidence of international trade on Italian regional productive efficiency using a meta-frontier DEA approach

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ABSTRACT

Although there continues to be considerable debate about the impact of European integration on the EU regions, studies in this field have mainly investigated the convergence-divergence issue, while the effect of trade on regional performance has attracted few empirical studies. A bootstrapped DEA metafrontier framework used in this study, as a first stage of analysis, is exploited to account for the heterogeneity between the Italian regions in the whole period and in two distinct time frames before and after EMU implementation. In a second stage, using a partial least squares model, the technology gaps estimated for each period are regressed, investigating factors related mainly to R&D efforts and trade behavior that may have affected regional performance. Our findings reveal a significant improvement for the Italian regions since 1993, a paradoxically unchanged behavior for efficiency performance in the Center-North regions, and clear identification of which regions performed better in terms of the technology gap. Inclusion of variables related to international trade performance in the model indicates that trade is of major importance for better regional performance. In addition, the technology gap is negatively influenced by R&D expenditures, denoting the catching-up phenomenon for the technology level of Italian regions.

1. Introduction and motivation

Productive performance differentials at country and regional level have drawn increasing attention in recent years. Classical explanations include factors of production and human capital (Dettori et al., 2012), degree of openness (Rodrik, 1988; Gambardella et al., 2009), public capital (Mastromarco and Woitek, 2006), innovation efforts and patents (Porter, 2003), and R&D intensity (Fagerberg et al., 1997). Since the differences in productivity turn out to depend on efficiency levels and access to technology, it becames clear that narrowing the technology gap is considered as the most promising avenue for regions to convergence in a common place. Arguably, the effect of trade openness on firms' productivity in developed countries has been widely investigated in the international literature, which has shown the major dynamic benefits from productivity improvement effects of openness. In particular, Melitz (2003) emphasizes the selection mechanism by which, in the face of trade liberalization, resource reallocation across firms leads to productivity growth. Several studies for developing countries have also disclosed a positive relationship between trade liberalization in and productivity growth.

At the level of regional productivity performance, the issue has also attracted considerable attention in recent years. However, studies in this field mainly investigate the convergence-divergence issue (e.g. Azomahou et al., 2011; Panzera and Postiglione, 2014) recognizing the existence of significant technology gaps (Fagerberg, 1987), and few deal with the effect of openness on productive performance. There is also considerable interest in, and discussion about, economic integration and the impact of this integration on regional performance in the EU. Moreover, while some studies focus on innovation and local infrastructure as determinants of regional benefits little attention has been attributed to the role of trade. Hence, the Italian regions seem to be the appropriate unit of analysis of the effects of trade on productivity growth. Generally speaking, the EMU countries should share a similar interest in improving productivity growth at the regional level in order to maintain their competitiveness in a rapidly changing world market.

Italy is an interesting case study because its market share of worldwide exports and imports is at eighth place in 2017 with a great variety of export lead regions especially in the Centre-North. However, Italy has accumulated a significant gap in terms of innovation and growth

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over most of its European partners within the last two decades. Even before the global economic crisis of 2008, Italy complained of significant GDP-per-capita gaps compared to other OECD countries. Given the dynamic transformation of Italian regions through economic integration and the globalization of the world economy, key questions have arisen concerning their technology capacity, competitiveness and productive efficiency.

In this respect, recent empirical research has shifted the focus with regard to international trade from countries and their industries to regions, companies and their products. It is thus of great interest to analyze the effects of international trade on productivity performance at regional level (Bernard et al., 2007). New economic theories on trade are able to explain, in a more accurate and precise way, some events that remain unexplained by the traditional models. Winters (2004) for instance, on the subject of trade liberalization, argues that "while there are serious methodological challenges and disagreements about the strength of the evidence, the most plausible conclusion is that liberalization generally induces a temporary (but possibly long-lived) increase in growth. A major component of this is an increase in productivity".

In this paper we contribute to this literature by empirically investigating the productive efficiency of Italian regional growth over the period 1993–2011. On the other hand, we also estimate productive efficiency performance using the well-established distinction in the literature between Northern and Southern regions, the so-called Italian divide. To this aim, we analyze any possible changes on the regional productive efficiency that can derive from the launch of the European Monetary Union (EMU). We also seek to explain technology gaps using a metafrontier framework before and after EMU adoption, focusing on a set of traditional determinants augmented with trade and R&D efforts variables. Our main contribution is due to the fact that Italian regions technology gaps, unlike technical efficiency measures, are defined in a metafrontier framework, capturing productive performance differentials conditional on specific aspects of the North-South divide, and therefore mirrors the micro-components level of technology. In addition, we will test the hypothesis that first trade, under different levels of competitiveness, and secondly R&D intensity may have a positive impact in reducing technology gaps. This is important since, to the best of our knowledge, there is no comparable study that investigates the technological gap in productivity performance related to international trade and R&D efforts for the case of Italian regions. In addition, this paper extends the period of study up to the year 2011 as compared to the previous studies, thus taking into account the effect of the latest financial and economic crisis and its effects on Italian regional productive efficiency. The latter, within the same national framework, are important and challenging at the same time.

Finally, in the current competitive economic environment the traditional model of producing to export is no longer sufficient to withstand the global market challenge. National fiscal policy associated with different regional policies could have different impacts on different groups of regions. The full recovery of the worldwide economy will depend heavily on productivity and on international trade, which is nowadays considered one of the flywheels of economic growth. Therefore, for policy makers, it would be of great interest to distinguish the regional differences in mean efficiency levels and to determine whether the regions share some characteristics.

The rest of the paper is organized as follows: section 2 reviews the empirical literature review on this topic. Section 3 details the meanings of group and metafrontiers as well as technology gap ratios. Section 4 presents the empirical model to be used in this study. Section 5 describes the empirical results. Finally, conclusions and policy implications are detailed in section 6.

2. Literature review

In this section, we present a brief, non-exhaustive overview of some of the work that has been done on the non-parametric measure of relative efficiency regional growth, technological gaps and trade.

In the efficiency literature there are two broad methods ud for arriving at measures of relative efficiency (Coelli et al., 2005). Data envelopment analysis (DEA) as a non-parametric technique, and stochastic frontier analysis (SFA) as a parametric approach that assumes a functional form for the benchmark frontier, have been mostly used in assessing the performance of many decision making units (DMUs). However, a typical DMU may face different production possibilities. The recently analytical metafrontier approach (Battese and Prasada Rao, 2002, 2004) inspired by the work of Hayami and Ruttan (1970, 1971) and developed by O'Donnell et al. (2008) provides an alternative methodological approach to the two DEA or SFA approaches, to evaluate and compare the efficiency of DMUs that belong to different groups (Feng et al., 2017). Moreover, the introduction of a metatechnology ratio or technology gap indicates the improvement made by its DMU in order to use the best practice technology, as has been defined by the technology of all DMUs participating in the sample. The present study extends analogous research on metafrontiers to a temporal framework linking the measurement of regional efficiency growth over time for 20 Italian regions. In this context, it would be of some interest to examine how the different Italian regions perform with respect to the national technological frontier. It is worth noting that all the mentioned studies derived their decompositions under the assumption that all the countries/regions in a group operate under a common technology (Italian metatechnology). This study extends previous research by considering two groups of Italian regions working under different technologies (North-Center and South), thus relaxing the common technology assumption, as well as explicitly accounting for temporal effects, which measures productivity and efficiency changes over the period 1993–2011.

Studies examining regional efficiency have focused on specific issues that may influence efficiency and/or production performance. For example, Bronzini and Piselli (2009) examined the role of R&D, human capital (Tzeremes, 2014) and public infrastructure on regional performance while Percoco (2004) sought to unravel the public capital puzzle on regional productivity, suggesting that infrastructure plays an important role for Italian regions. Along the same line, Destefanis and Sena (2005) found a significant impact of public capital, focusing their research on the industrial sector while Maudos et al. (2013) using a DEA approach for Spanish regions showed the importance of productive specialization and sector inefficiencies. Moreover, Enflo and Hjertstrand (2009) using a bootstrap DEA approach discuss the labor productivity decomposition effect on efficiency and technological change and capital accumulation. Finally, Dettori et al. (2012) denoted the role of human capital but also of social and technological capital on total factor productivity for a significant dataset of European regions while Lin and Chiang (2011) examined the information technology paradox for a variety of countries.

On the other hand, in the economic literature, several channels are discussed through which trade can affect economic growth (i.e Soukiazis and Antunes, 2011). Grossman and Helpman (1991), and Sala-i–Martin and Barro (1997), assert that trade is a vehicle through which technological innovation as well as knowledge is spread among different economic areas. Moreover, higher degrees of openness, as pointed out by Vickers and Yarrow (1991) and Wacziarg (2001), also increase competition in the regional/local market, which in turn increases productive efficiency and economic growth.

The experience of the last three decades seems to strengthen the position in favor of free trade. Since 1982, the size of the trade sector has roughly doubled. Although the protectionist position continues to benefit from extensive credibility among political leaders and in the media, it receives little support among economists. In general, previous empirical studies tended to give contradictory results. Some of them, like Bleaney (1999) and Ahmed (2000), showed that countries which became more open improved their export performance. However, other studies have found little evidence of this relationship.