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**EXPLORING THE DETERMINANTS OF LABOUR
PRODUCTIVITY GROWTH IN ITALIAN REGIONS:
A KALDORIAN PERSPECTIVE**

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Exploring the determinants of labour productivity growth in Italian regions: a Kaldorian perspective

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Abstract. The promotion of regional convergence is at the heart of the European cohesion policy, although how to stimulate it still is a debated question in the economic theory. Endorsing a Kaldorian perspective, we investigate the determinants of labour productivity in Italian regions by applying Panel Structural VAR modelling to 1981-2013 data. By explicitly considering the endogeneity among the studied variables, we find that labour productivity is stimulated by output growth and capital accumulation. Our findings bear important implications in terms of policy advice, leading to the conclusion that considerable public investment is necessary to stimulate economic growth and productivity especially in economically depressed areas, like the Italian Mezzogiorno.

Keywords: Labour productivity; Technical progress; Investment; Regional differentials;
Panel SVAR

JEL Codes: C33, O18, O47, R11

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1. Introduction

One of the objectives of the European cohesion policy is to achieve economic convergence among its regions, which still feature intense disparity in terms of economic growth and per capita income levels (European Commission, 2010; 2018). According to standard economic theory, such gaps should have been translated into opportunity to catch-up for lagging behind regions (Barro and Sala-i-Martin, 1991; Baumol, 1986). However, that has not happened so far. The ‘missing convergence’ problem still represents a challenge, so that the evidence of increasing spatial disparities continues to motivate the development of novel economic perspectives on growth – see for instance, the so-called New Economic Geography approach on the core-periphery polarization (Krugman, 1991; Krugman and Venables, 1996; Ottaviano and Thisse, 2005).

Italy is the archetypical example of such missing convergence due to the ‘Southern Question’, that is the view of the *Mezzogiorno* – a term used to denote the Southern area of the country¹ – as an unsolved social, economic, and financial problem (Arestis et al., 2017; Cannari et al., 2019). As a matter of fact, today the Southern economy still lags behind from many points of view. In 2018, unemployment in Southern regions attained an average of 18.7% (with Calabria, Sicilia, and Campania exceeding 20%), affecting nearly 1,400,000 individuals. Nothing comparable happens in other areas of the country, where unemployment attains 9.6% in the Centre and 6.7% in the North.² Spatial disparities in terms of youth unemployment are even more dramatic: among individuals under 29 years of age, unemployment is as high as 39.8% in the South – 20 percentage points higher than in the rest of the country (Cannari et al., 2019). Southern regions are also home to the highest proportions of young people who qualify as NEET (not in employment, education, or training), with Sicilia and Calabria reaching NEET rates as high as 40% (Tosi, 2018). Finally, GDP per capita in the South is 56.1% that of the Centre-North (SVIMEZ, 2017) (see Figure 1), and labour productivity is

¹ The Mezzogiorno area includes the following regions: Abruzzo, Molise, Basilicata, Campania, Puglia, Calabria (i.e., South), and Sicilia and Sardegna (i.e., Islands). The Mezzogiorno area will also be called “South” or “Southern area” throughout this article.

² Unemployment rate among individuals aged 15-64 years, [Istat data](#) last extracted on December 31, 2019.

still well below the country average (Istat, 2019). Regarding labour productivity, evidence shows sizeable interregional differences in terms of both levels and growth rates.

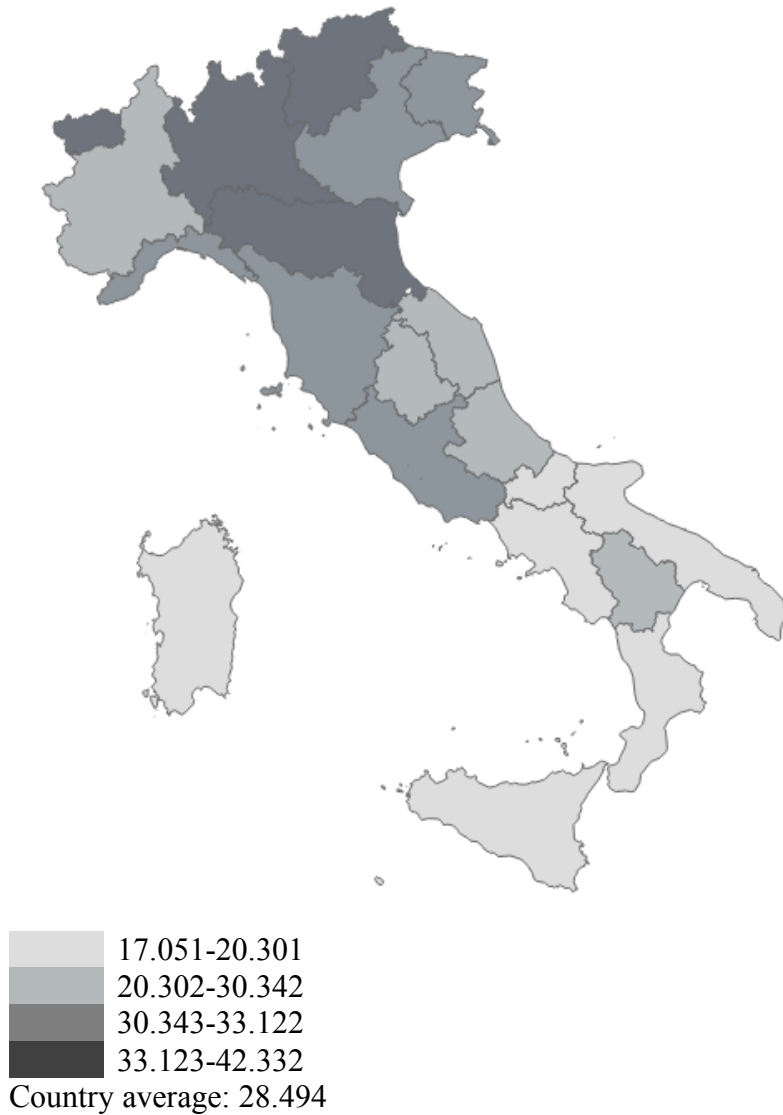


Figure 1. Per capita Gross Domestic Product by region. Data are in current Euros and refer to year 2017. Source: our elaboration on Istat.

On average, the annual value added per person employed is about 50,000 Euros in the Centre-North, while it is about 33,000 Euros in the Mezzogiorno. Lombardia, the richest region of the country, shows productivity levels of 57,400 Euros, which is almost twice as much as compared to Calabria (see Table 1). The picture does not change when growth rates are considered instead of

levels: while between 1980 and 2013 productivity growth attained an annual average of 1.5% in the Centre-North, it was as high as 1.2% in Southern regions.

Regions	Value added per person employed (in thousand Euros)
<i>NUTS-1 Regions</i>	
North-West	54.1
North-East	49.4
Centre	46.1
South	34.0
Islands	32.4
Italy	46.6
<i>NUTS-2 Regions</i>	
Piemonte	48.4
Valle d'Aosta / Vallée d'Aoste	44.4
Lombardia	57.4
Trentino Alto Adige / Südtirol	53.2
Provincia Autonoma Bolzano / Bozen	57.1
Provincia Autonoma Trento	49.0
Veneto	48.2
Friuli-Venezia Giulia	46.5
Liguria	46.1
Emilia-Romagna	50.5
Toscana	43.5
Umbria	37.2
Marche	39.0
Lazio	51.5
Abruzzo	38.3
Molise	31.7
Campania	35.0
Puglia	32.2
Basilicata	37.5
Calabria	29.1
Sicilia	31.7
Sardegna	34.1

Table 1. Value added per person employed in Italian regions. Source: *Annuario Statistico Italiano*, Istat (2019, p. 512). Data refer to year 2016.

Studies on regional economic disparities commonly focus on productivity differentials and their relationship with economic (or output) growth (see Enflo and Hjertstrand, 2009; Ramajo and Hewings, 2018). This, however, is far from being a theoretically incontrovertible matter. The

literature distinguishes two main approaches. The first one assumes economic growth to be shaped by the pace of labour productivity, which in turn is mainly influenced by exogenous factors, especially institutional characteristics (Acemoglu, 2006), labour market regulation (Saint-Paul, 2000; Bassanini and Ernst, 2002; Nicoletti and Scarpetta, 2003) and spatial misallocation (Papageorgious, 2014). Within this framework, endogenous growth models (Arrow, 1962; Romer, 1994; Barro and Sala-i-Martin, 2004) allow for a certain degree of endogeneity of technical progress by considering productivity growth to be influenced by the pace of investment in human and social capital (Baumol, 1990; Becker et al., 1990; Barro, 2001), and by the level of firms' expenditure in R&D (Romer, 1990; Aghion et al., 2001; Preenen et al., 2017). Empirically, the Southern Question has been often analysed in the same fashion, by putting great emphasis especially on the gaps in technology endowment, capital accumulation, total factor productivity (TFP), and labour productivity (Aiello et al., 2015; Bank of Italy, 2019; Filippetti and Peyrache, 2015; Gitto, 2017; Locatelli et al., 2019; Piacentino and Vassallo, 2009).

Conversely, endorsing a Kaldorian perspective (Kaldor, 1966; 1967; Verdoorn, 1949) the second approach reverses such relationship, assuming that labour productivity growth depends on both output growth – e.g., through the channel of increasing returns to scale (Kaldor, 1957; Fingleton, 2000) – and capital accumulation. This perspective has recently gained momentum in the international debate, unveiling the demand-led nature of economic growth (McCombie, 2002; McCombie and Spreafico, 2015; Tridico and Pariboni, 2018; Deleidi and Mazzucato, 2019; Deleidi et al., 2019). Several studies (Soro, 1985; 1986; Ofria, 1997; 2009; Fazio et al., 2013; Millemaci and Ofria, 2016) empirically analyse the case of diverging Italian regions through the lens of the Kaldorian approach. However, they typically rely on single equation modelling techniques that do not allow to explicitly consider the endogeneity among labour productivity, GDP growth and capital accumulation (Deleidi et al., 2019).

Investigating both theoretically and empirically the nature of territorial differentials is thus crucial to clarify how to boost economic development in lagging behind areas – including the Italian

Mezzogiorno. This translates into determining what drives labour productivity and economic growth – an issue presenting relevant challenges depending on the considered level of spatiality³ and, more importantly, the theoretical approach to be used.

This paper aims at disentangling the determinants of labour productivity growth in the Italian macro-regions by endorsing a Kaldorian perspective. Empirically, we apply Panel Structural Vector Autoregressive (P-SVAR) modelling (Pedroni, 2013) to National Institute of Statistics (Istat) and Organisation for Economic Co-operation and Development (OECD) time series data on labour productivity growth, GDP growth, and the rate of capital accumulation per worker for years 1981–2013. The approach used in this paper presents elements of novelty in that, through the use of structural equation modelling, it allows to jointly identify the different contributions to labour productivity stemming from (i) output growth; and (ii) the process of capital accumulation. By explicitly considering the endogeneity among the said variables, the use of structural equations represents an advancement compared to the existing literature.

Identifying the theoretical relationship between labour productivity and output growth is relevant from a policy perspective, because it could provide clarification on what are the channels through which local development can be stimulated and the territorial gaps can be filled. For instance, in the longstanding debate on the causes of the Italian North-South divide (see e.g. Graziani, 1978), one main disagreement concerns the role of public investment and the way it should be distributed among country areas in such a context of territorial polarization.⁴ For almost forty years, additional resources have been devoted to the development of Southern regions through the *Cassa del Mezzogiorno*, a public fund aimed at filling the economic and social gap between the South and the rest of the country. Since its establishment in the 1950s and through the 1970s, the South experienced

³ A fast-growing body of research highlights the need to elaborate on the determinants of productivity at the regional level (OECD, 2017). First, because regional productive districts and local networks are the most likely dimension where spill-over effects may take place (Keeble and Wilkinson, 1999; Paci and Usai, 2000; Rodríguez-Pose and Crescenzi, 2008; Rodríguez-Pose, 2018) and where learning-by-doing and connections between know-how and skills engender virtuous cumulative causation effects. Secondly, because of the challenges posed to local development by interregional labour and skilled mobility (Impicciatore and Tosi, 2019; Tosi et al., 2019).

⁴ See the special issue on the development of the Mezzogiorno published in *Politica economica / Journal of economic policy* (Vol. XXXV, Issue 2, August) in 2019.

sustained growth and economic convergence (Felice, 2013; Graziani, 1978; Iuzzolino et al., 2011; 2013).⁵ Different institutional initiatives have since then followed in order to promote the development of the South.⁶ However, many today disapprove public intervention targeted to the South due to the overall weak economic performance of the Mezzogiorno during the last three decades. The critics oppose especially expansionary measures – like the currently debated setting of a minimum share of public investment for the South (34%) corresponding to the share of the Southern population in Italy. That happens regardless the actual underfunding experienced by Southern regions in recent times (Pellegrini, 2016; SVIMEZ, 2019; Tortorella, 2019; Viesti, 2013) and the cuts to public spending brought about by austerity measures, which hit disproportionately harder in the Italian Mezzogiorno (Giannola and Giuranno, 2018).

Providing clarification on the role of public intervention for the development of economically depressed areas could thus help to shed light on how to boost regional development in Italy and, possibly, to contribute to the resolution of long-standing dilemmas related to the Italian Southern Question.

The paper is organized as follows. Section 2 presents the theoretical framework. Section 3 reviews the empirical literature analysing the determinants of labour productivity at regional level. Section 4 introduces data, methods and models. Section 5 presents the findings. Finally, Section 6 concludes and discusses the results in the light of some policy considerations.

⁵ Iuzzolino et al. (2013) offer a comprehensive review of the economic history of Italy since national unification in terms of North-South divide, identifying four stylized periods: (i) from unification to the 1880s, the two areas grow at a similar path, with relatively equal levels of the output; (ii) between the 1890s and the 1950s and especially during the two World Wars, the North-West becomes significantly more developed, registering a positive gap in terms of per capita GDP with respect to the rest of the country; (iii) from the 1950s to the 1970s, all Italian regions and areas – especially the South – experience sustained growth and economic convergence; (iv) from the 1970s on, the South observes a discontinuing pattern of slowdown and recovery, registering a harsh setback after the burst of the economic crisis in 2008.

⁶ The *Cassa del Mezzogiorno* was closed in 1984, while *Agensud*, a specialized agency for the promotion and the development of the South born in 1986, ceased its activities in 1992. In 2005, a Ministry for Southern Italy and Territorial Cohesion was created with the aim to target public spending to the Mezzogiorno area.

2. Theoretical framework

In the Kaldorian paradigm, technical progress (that is, productivity growth) is depicted as an endogenous phenomenon where demand expansion, and therefore the rate of growth of the output, are the *primum movens* for determining the pace of productivity (Kaldor, 1966; 1967; Kaldor and Mirrlees, 1962; Lavoie, 2015; Deleidi and Mazzucato, 2019). That occurs through the presence of increasing returns to scale (Kaldor, 1957; Fingleton, 2000) associated with learning-by-doing and division of labour processes, which in turn derive from a higher level of specialization determined by market expansion (Smith, 1776; Verdoorn, 1949). These effects work through the existence of three different mechanisms (Kaldor, 1957; 1961; 1966; 1972; Kaldor and Mirrlees, 1962): (i) specialization processes between and within firms; (ii) spatial positive externalities among local firms, industries, and regions; and (iii) technical progress embodied in newly installed capital goods. The relationship between these mechanisms can be represented as in Equation (1), which is generally known as Kaldor's second law, or Verdoorn's law:

$$\dot{p} = \alpha + \eta \dot{y} \quad (1)$$

where \dot{p} represents the rate of growth of labour productivity, \dot{y} is the rate of growth of the output, and α represents the pace of exogenous technical progress. In this formalization, η measures the relationship between \dot{p} and \dot{y} , representing the dynamic returns to scale mentioned above. Henceforth, we shall refer to the η parameter as the *scale coefficient*, or, in homage to the tradition, as the Verdoorn effect. Kaldor's model also predicts the existence of a virtuous circle (Boyer and Petit, 1991) according to which output growth fosters productivity growth, which in turn leads to additional increases in the output, through the effect of productivity dynamics on external competitiveness.⁷

⁷ In Kaldor's view, this can happen since increasing productivity fosters competitiveness and then exports (Kaldor, 1972). However, this mechanism could work through yet another channel: increased productivity may directly reduce the propensity to import and, by lowering relative prices, it may increase the propensity to consume (Cesaratto et al., 2003).

However, the pace of productivity is not uniquely depending on the Verdoorn effect represented in Equation (1). Of course, among the drivers of technical progress there are also investments and physical capital. Recently, the role of investments in fostering productivity and economic growth has been recalled by institutional research that, with respect to productivity differentials among European regions, has underlined the importance of an investment effort in backward regions (European Commission, 2017). As a matter of fact, this perspective is backed by the Kaldorian framework (Kaldor 1957; 1966), according to which capital accumulation, in addition to the presence of returns to scale, is crucial in shaping labour productivity dynamics as technical progress and more innovative techniques of production are mainly embodied in newly installed capital goods. As shown in Equation (2), Kaldor (1957; 1967) considers the role of investment and capital accumulation as relevant determinants of labour productivity growth by means of his *technical progress function*, which can be drawn as follows:

$$\dot{p} = \alpha + \lambda \dot{k} \quad (2).$$

In Equation (2), α represents “the rate of progress of knowledge”, while \dot{k} aims to capture “the speed with which innovations are introduced” (Lavoie, 2015, p. 429), motivated by the fact that “the use of more capital per worker inevitably entails the introduction of superior techniques” (Kaldor, 1957, p. 595). Moreover, the faster is the capital accumulation, the higher is the rate of technical progress (Nah and Lavoie, 2019).⁸ Henceforth, we shall refer to the λ parameter as the *investment coefficient* or the capital accumulation effect interchangeably.

Following Michl (1985), the two effects can be merged in Equation (3), obtaining a combination of the traditional Verdoorn effect with the Kaldorian technical progress function:

⁸ Also in Kaldor (1966; 1967) the process of capital accumulation is supposed to positively affect productivity growth. However, differently from the original technical progress function (Kaldor, 1957), in Kaldor (1966; 1967) capital accumulation is considered as an endogenous process, mainly affected by demand dynamics.

$$\dot{p} = \alpha + \eta\dot{y} + \lambda\dot{k} \quad (3)$$

where labour productivity growth (\dot{p}) is assumed to be shaped by both the rate of growth of the economy (\dot{y}) and the rate of growth of the capital-labour ratio (\dot{k}).

The Kaldorian framework seems one promising route for analysing and considering both the effects of investment and the presence of increasing returns to scale on labour productivity growth, along with their differentials across regions. In particular, our empirical investigation aims at assessing the validity of Equations (1) and (3), which will be tested for the Italian macro-regions by using Panel Structural Vector Autoregressive (P-SVAR).

3. Empirical literature review

Several applied works find empirical evidence in favour of a positive elasticity of labour productivity with respect to output and capital accumulation. In his original contribution, Verdoorn (1949) estimates a scale coefficient – that is, the elasticity of productivity with respect to the output – of 0.45, while Kaldor (1966) assesses a dynamic version⁹ of Verdoorn’s law, indicating that each additional percentage point of output growth leads a 0.5% increase in productivity. McCombie (1983), Thirlwall (1983), McCombie et al. (2002) and Knell (2004) provide further evidence on the existence of the Verdoorn effect. More recently, Millemaci and Ofria (2014) validate the long-run dynamic version of Verdoorn law in several advanced economies by estimating coefficients ranging from 0.3 to 0.6. Magacho and McCombie (2017) find scale coefficients around 0.5 in a panel of manufacturing industries. Tridico and Pariboni (2018) estimate a Smith-Kaldor scale effect of 0.36 for a panel of OECD countries. Deleidi et al. (2019) validate the Verdoorn law for six European countries. Finally,

⁹ Static (or reversible) increasing returns to scale are simply generated by a decrease in the unit costs (Kaldor, 1972), while dynamic (or irreversible) increasing returns to scale are caused by embodied technical progress, learning-by-doing and specialisation effects. For a discussion, see McCombie (2002) and Bianchi (2002).

Carnevali et al. (2019) estimate a positive scale effect for the Euro area manufacturing industries. Other studies focusing on the Italian economy confirm the existence of a positive and statistically significant Verdoorn effect (Bianchi, 2002; Deleidi and Paternesi Meloni, 2019; Forges Davanzati et al., 2019).

Concerning the meso-level, McCombie (1985) and Bairam (1988) verify the Verdoorn law at the regional level for selected OECD countries.¹⁰ Fingleton (2000), Fingleton and McCombie (1998), and Pons-Novell and Viladecans-Marsal (1998) prove the existence of increasing returns to scale by using European regional data. McCombie and De Ridder (1984), Casetti (1984), Bernat (1996) and Kie (1997) find a significant Verdoorn effect analysing US regional data. Hildreth (1989) and Harris and Lau (1998) and Hansen and Zhang (1996) confirm the existence of increasing returns by using respectively UK and Chinese regional data. Soro (1985; 1986), Ofria (1997; 2009), Fazio et al. (2013) and Millemaci and Ofria (2016) validate the Verdoorn law for Italian regions though rejecting the idea of a homogeneous Verdoorn coefficient among regions. León-Ledesma (1999; 2000) finds similar results for Spanish regions. Finally, McCombie and Roberts (2007) discuss and validate both its static and dynamic version by using cross-regional data. On average, the abovementioned empirical assessments estimate a Verdoorn effect ranging in the 0.3–0.8 interval.

Regarding the effect of capital accumulation on productivity dynamics, the literature typically endorses the neoclassical growth accounting, decomposing labour productivity growth into different contributions (Stiroh, 2001). Among these, the process of increasing capital per unit of labour (or the capital deepening) is proven to be positive and significant. Kumar and Russell (2002) estimate a contribution of capital deepening to productivity growth of 77% for a panel of 57 countries; Jorgenson et al. (2008) and Foda (2017) both estimate a contribution of capital deepening to productivity growth for the US economy of respectively about 53% and 45%. Finally, Antenucci et al. (2019) estimate a

¹⁰ However, these works assume that “differences in technology across regions in a given country must be small (Destefanis, 2002). Clearly, that is not always the case as exemplified by the Italian North-South divide.

positive capital accumulation coefficient for G7 countries by operating in a theoretical framework that is similar to the one used in the present contribution.

4. Data, methods and models

4.1. Data

We estimate our reference model (see Section 2) for both the Italian economy as a whole and its macro-regions for the 1981–2013 period¹¹ by exploiting Istat – providing the GDP, the total number of employees and the gross fixed capital formation times series – and OECD data – providing the level of prices times series. First, by means of the level of prices, we transform all selected variables in real terms. Then, we calculate: (i) output growth (\dot{y}) as the rate of change of GDP; (ii) the rate of growth of labour productivity (\dot{p}) as the rate of change of the ratio between the level of GDP and the total number of employees; and (iii) capital accumulation per worker (\dot{k}) as the rate of growth of the ratio between gross fixed capital formation and the total number of employees.¹² The analysis is applied to the following NUTS-1 regions: North-West (NW), North-East (NE), Centre (C), South (S) and Islands (I).¹³

4.2. Methods and models

To investigate the determinants of labour productivity dynamics through the lens of the Kaldorian perspective, we employ an innovative econometric technique based on Panel Structural Vector Autoregressive (P-SVAR) models (Pedroni, 2013). Compared with the existing literature, our empirical method is based on a P-SVAR modelling strategy, which allows to overcome some of the

¹¹ The selected timespan is dictated by data availability.

¹² As the capital stock broken down by regions is not available for the selected macro-regions, we make use of the rate of growth of investment per person employed. However, it can be demonstrated that the rate of growth of capital stock converges towards the investment growth rate, being investment (the *flow* variable) a reduction in scale of capital (the *stock* variable). For a mathematical explanation, see Freitas and Serrano (2015, footnote 9).

¹³ North-West includes Valle d'Aosta/*Vallée d'Aoste*, Liguria, Piemonte and Lombardia; North-East includes Trentino-Alto Adige, Veneto, Friuli-Venezia Giulia and Emilia-Romagna; Centre includes Toscana, Umbria, Marche and Lazio; South includes Abruzzo, Molise, Campania, Puglia, Basilicata and Calabria; Islands includes Sicilia and Sardegna.

criticisms related to the exogeneity of capital accumulation that are typically observed in empirics using single equation models. In practice, P-SVAR modelling consists in estimating a system of equations to let all considered variables interplay, therefore considering the endogenous nature of investment and capital accumulation.

As a first step, we estimate a reduced-form panel VAR(n) (Equation (4)):

$$x_{i,t} = A_i(L)x_{i,t-n} + u_{i,t} \quad (4)$$

where x is the vector of considered variables, $A_i(L)$ is a polynomial of lagged coefficients and u is the error term of the reduced-form panel VAR. A P-SVAR is obtained by imposing an identification strategy to the reduced-form panel VAR(n) that in turn enables to retrieve a structural model, namely a P-SVAR (Equation (5)):

$$B_{0i}x_{i,t} = B_i(L)x_{i,t-n} + e_{i,t} \quad (5)$$

where B_0 represents the matrix of contemporaneous relationships between the variables included in $x_{i,t}$, B_i is the matrix of autoregressive coefficients, and e_{it} is the vector of serially uncorrelated structural shocks (Pedroni, 2013). The identification of the structural model requires to impose restrictions on B_0 , usually derived from the economic theory (Kilian and Lütkepohl, 2017).

Two models are estimated through the P-SVAR procedure. In Model 1, the standard Verdoorn law is estimated by assessing uniquely the effect on labour productivity growth (\dot{p}) of output growth (\dot{y}), as displayed in Equation (1). Then, Model 2 is augmented by the rate of growth investment per worker (\dot{k}), which enables us to account for the insights of the Kaldorian technical progress function, as shown in Equation (3). Both models are recursively identified – namely, the matrix B_{0i} is lower triangular based on a Cholesky factorisation. In the case of Model 1, we assume the identification summarised in Equation (6):

$$B_{0i}x_{it} = \begin{bmatrix} - & 0 \\ - & - \end{bmatrix} \begin{bmatrix} \dot{y}_{i,t} \\ \dot{p}_{i,t} \end{bmatrix} \quad (6)$$

where ‘-’ indicates an unrestricted parameter and a ‘0’ represents a zero restriction. Following the Verdoorn law, Equation (6) assumes that output growth affects labour productivity within the contemporaneous relationship. Furthermore, in line with Christiano et al. (2005), we assume that productivity growth does not affect the rate of growth of output within the contemporaneous observation t . When we look at Model 2, the implemented identification strategy is summarised in Equation (7):

$$B_{0i}x_{it} = \begin{bmatrix} - & 0 & 0 \\ - & - & 0 \\ - & - & - \end{bmatrix} \begin{bmatrix} \dot{y}_{i,t} \\ \dot{k}_{i,t} \\ \dot{p}_{i,t} \end{bmatrix} \quad (7)$$

In line with the identification strategy implemented for Model 1, in Model 2 we include a second ordered variable, that is the rate of growth of the investment-labour ratio (\dot{k}). In the identification presented in Equation (7), \dot{k} is supposed to be affected within the contemporaneous relationship by \dot{y} and not by \dot{p} . Such an identification allows us to solve a thorny issue raised in the empirical literature grounded of the Kaldorian framework, namely the idea that the process of capital accumulation could be found not significant in single equation model as investment and capital are affected by the output dynamics following the accelerator principle (Deleidi and Mazzucato, 2019). In this way, Equation (7) represents the Verdoorn law augmented by the Kaldorian technical progress function, where labour productivity (\dot{p}) depends on the rate of growth of output (\dot{y}) and on the pace of investment per worker (\dot{k}).

Once those restrictions are imposed, the structural shocks are obtained and the P-SVAR is estimated, impulse response functions (IRFs) are calculated to detect the dynamic effect of the rate

of growth of output and investment-labour ratio on the pace of labour productivity.¹⁴ IRFs are estimated over a period of twenty years and then reported with 95% confidence interval bands estimated by bootstrapping standard errors. Additionally, we also estimate the cumulative effects derived by dividing the cumulated labour productivity growth with the corresponding impulses (Spilimbergo et al., 2009). Such an estimation allows us to assess the effect of a 1% increase in the growth rate of output and investment-labour ratio on the rate of growth of labour productivity. Models 1 and 2 are estimated following a two-step approach. We first fit the models for all the selected macro-regions. Then, we exclude one macro-region at a time. Such a procedure will enable us to provide a robust picture for the Italian economy and its macro-regions by comparing the Verdoorn effect with the capital accumulation one across areas. This empirical strategy is suitable for comparing our findings among the considered macro-regions, therefore shedding light on North-South Italian productivity disparities.

5. Findings

In this section, we start by analysing the IRFs and then we show the cumulative effects. Model 1 simply considers the traditional Verdoorn effect, that is the scale coefficient (η) introduced in Equation (1), while Model 2 is augmented by the process of capital accumulation, as shown in Equation (3).

The IRFs of Model 1 are reported in Figure 2. Results show that an increase in the rate of growth of output (\dot{y}) leads to a rise in labour productivity growth (\dot{p}), both when all macro-regions are considered and when we exclude one macro-area at a time. All estimated impulses ($\dot{y} \rightarrow \dot{y}$) and responses ($\dot{y} \rightarrow \dot{p}$) are found to be significant for the whole considered period of time.

¹⁴ To estimate IRFs, we will use the so-called composite shocks. In addition, P-SVAR allows us to decompose the composite shock between idiosyncratic and common shocks (Pedroni, 2013). While the former is related to shocks which only affect the single units composing the panel, the latter is the shock which simultaneously involves all units included in the panel.

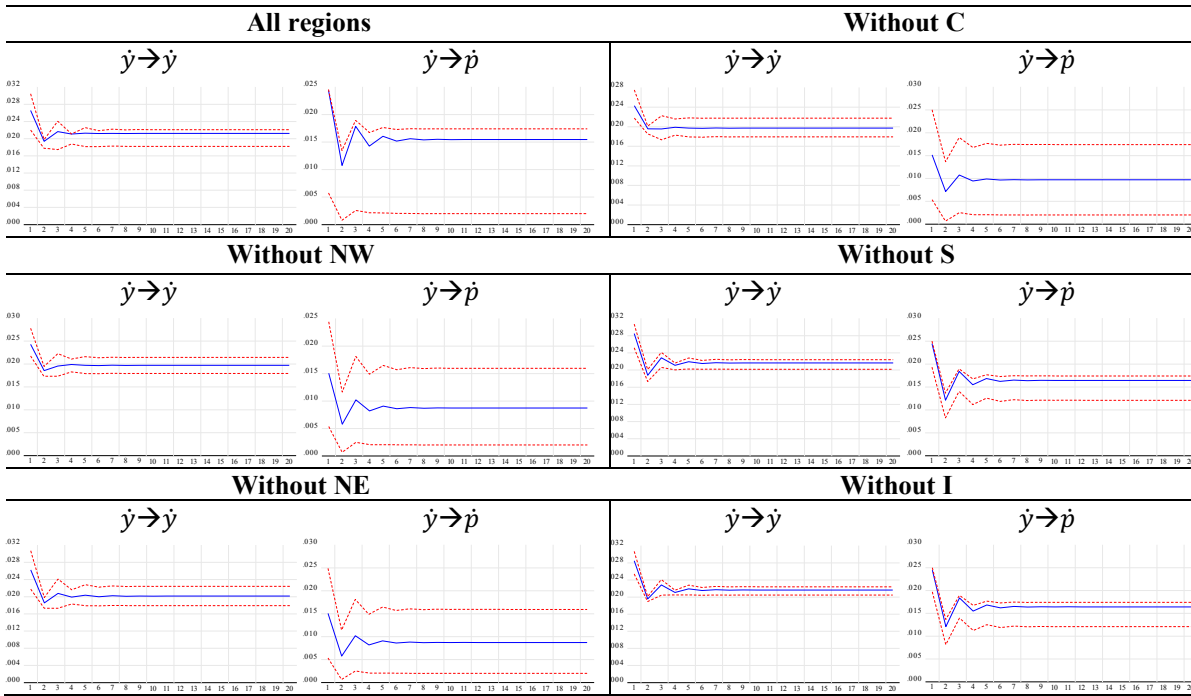


Figure 2. Impulse Response Functions (Model 1). Responses to structural shocks are reported with two-standard error bound (95% confidence interval).

Turning to Model 2, Figure 3 illustrates the estimates of the Verdoorn law augmented by the effect of capital accumulation, namely the investment coefficient (λ) introduced in Equation (3). We can observe that, even when capital accumulation (\dot{k}) is introduced, the Verdoorn law is validated in all regions, as well as when some of the macro-regions are alternatively excluded by our models. Specifically, a positive shock to the rate of growth of the output (\dot{y}) positively affects the rate of growth of labour productivity (\dot{p}). When the effect of capital accumulation per person employed is considered, we find that an increase in the rate of growth of the investment per worker (\dot{k}) generates a positive effect on labour productivity dynamics. All estimated impulses ($\dot{y} \rightarrow \dot{y}$ and $\dot{k} \rightarrow \dot{k}$) and responses ($\dot{y} \rightarrow \dot{p}$ and $\dot{k} \rightarrow \dot{p}$) are significant for the whole considered period.

IRFs reported in Figures 2 and 3 show the dynamic effect at some horizon of the response variable after an initial shock. However, we aim at quantifying the magnitude of the scale coefficient (η) and the investment coefficient (λ) by estimating the so-called cumulative effects (Spilimbergo et al., 2009) representing the response of \dot{p} per a unitary increase in \dot{y} and \dot{k} . These results, reported in

Tables 2 and 3, represent the increase in the rate of growth of labour productivity due to a 1% increase in the rate of growth of the output and the investment per person employed.

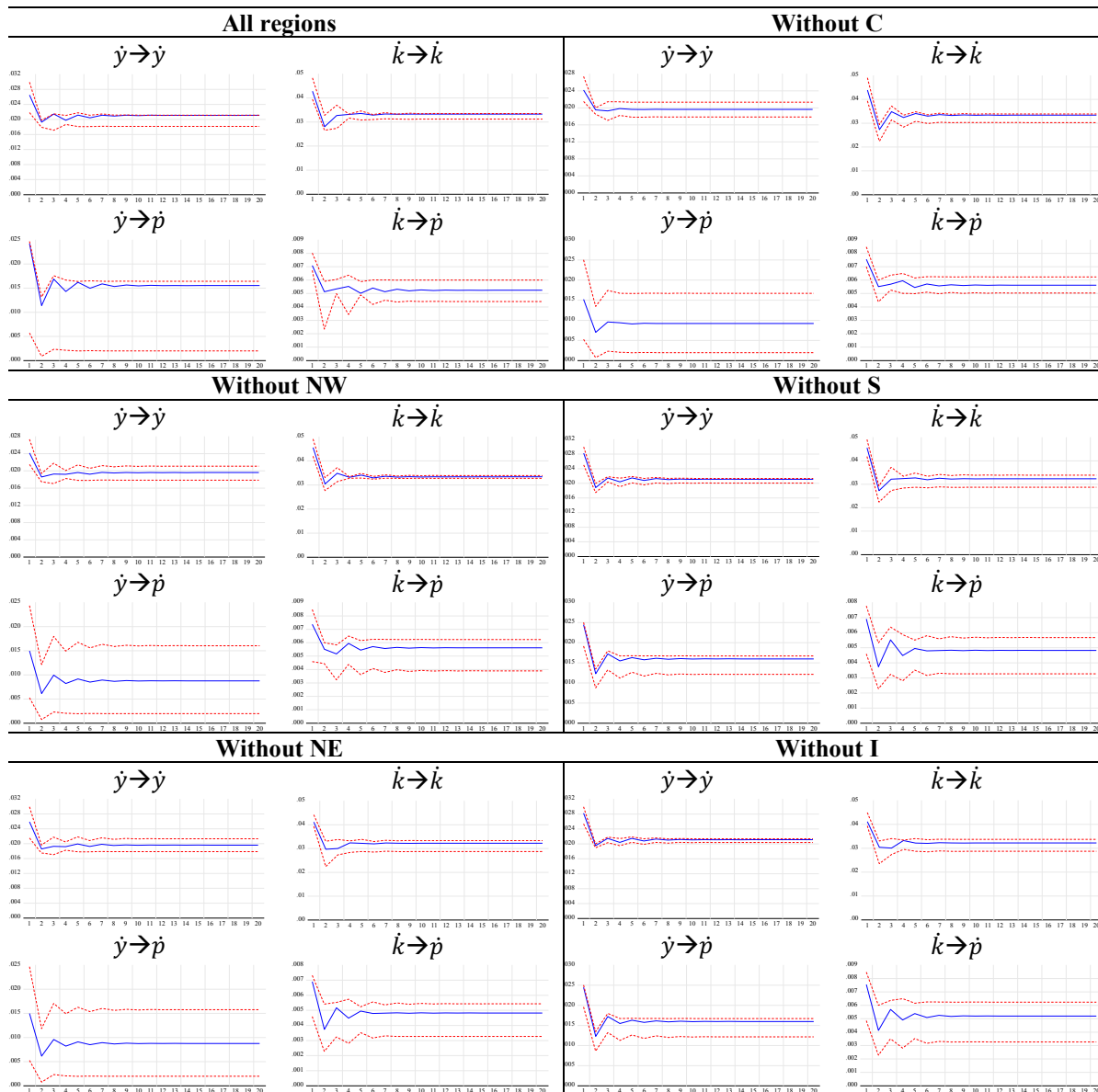


Figure 3. Impulse Response Functions (Model 2). Responses to structural shocks are reported with two-standard error bound (95% confidence interval).

When we look at the cumulative effects of Model 1 (Table 2), the Verdoorn effect is found to be positive and in line with the existing empirical literature, namely ranging in a 0.3–0.8 interval. When we consider all Italian regions, the Verdoorn coefficient attains an average value of 0.732.

		1y	5y	10y	15y	20y	Average
All regions	\dot{y}	0.918	0.755	0.728	0.729	0.729	0.732
Without NW	\dot{y}	0.620	0.461	0.442	0.443	0.443	0.448
Without NE	\dot{y}	0.574	0.446	0.433	0.433	0.433	0.436
Without C	\dot{y}	0.624	0.501	0.492	0.492	0.492	0.494
Without S	\dot{y}	0.859	0.768	0.758	0.759	0.759	0.759
Without I	\dot{y}	0.859	0.768	0.758	0.759	0.759	0.758

Table 2. Cumulative effects (Model 1). 95% significant estimates are reported in bold.

When we re-estimate Model 1 by alternatively excluding each Italian macro-region, the scale effect is found to be lower than at aggregate level. Specifically, the Verdoorn coefficient assumes an average value of 0.448, 0.436 and 0.494 when respectively NW, NE and C are excluded. Conversely, when South (S) and Islands (I) macro-regions are excluded, the scale effect is slightly higher than the one estimated for all Italian macro-regions (respectively, the scale effects are equal to 0.759 and 0.758).

		1y	5y	10y	15y	20y	Average
All regions	\dot{y}	0.914	0.767	0.736	0.737	0.737	0.743
	\dot{k}	0.166	0.150	0.159	0.158	0.158	0.160
Without NW	\dot{y}	0.619	0.467	0.446	0.447	0.447	0.453
	\dot{k}	0.162	0.160	0.169	0.168	0.168	0.168
Without NE	\dot{y}	0.579	0.456	0.446	0.447	0.447	0.450
	\dot{k}	0.168	0.154	0.150	0.150	0.150	0.150
Without C	\dot{y}	0.629	0.463	0.469	0.469	0.469	0.473
	\dot{k}	0.172	0.160	0.169	0.168	0.168	0.171
Without S	\dot{y}	0.867	0.759	0.757	0.757	0.757	0.760
	\dot{k}	0.152	0.152	0.150	0.149	0.149	0.149
Without I	\dot{y}	0.867	0.759	0.757	0.757	0.757	0.759
	\dot{k}	0.184	0.167	0.161	0.161	0.161	0.162

Table 3. Cumulative effects (Model 2). 95% significant estimates are reported in bold.

Findings from Model 2 confirm those found in Model 1 (Table 3). The average value of the Verdoorn coefficient is 0.743, close to the one estimated in Model 1. Additionally, in line with the findings of Model 1, the scale effect decreases when macro-regions NW, NE, and C are excluded from the sample. The estimated average coefficients attain 0.453, 0.450 and 0.473 when respectively

NW, NE and C are excluded. On the contrary, the average estimated values of the Verdoorn coefficients are slightly higher to the one estimated for all regions when macro-regions C and S are not considered, assuming values equal to 0.760 and 0.759, respectively.

Furthermore, in Model 2 the effect of the capital accumulation per worker on labour productivity dynamics assumes a value that is always lower than the Verdoorn effect. However, differently from the Verdoorn effect that varies across space, the investment coefficient is quite stable among macro-regions. The increase of 1% in the rate of growth of the investment per worker affects labour productivity growth by an average value of: 0.160 across all regions; 0.168 without NW is excluded; 0.150 without NE; 0.171 without C; 0.149 without S; and 0.162 without I.

In summary, our findings show that the capital-augmented Verdoorn law is validated for Italian regions, even when selected macro-areas are excluded one at a time from the sample. Moreover, the Verdoorn effect is found to be stronger than the investment effect on labour productivity dynamics both across macro-regions and when macro-regions are alternatively excluded one at time. However, while we find a lower scale effect when Northern macro-areas are not considered in the sample – confirming the heterogeneity of the Verdoorn effect in the Italian economy (Soro, 1985; 1986) – the effect of the rate of growth of the investment per worker assumes a homogeneous positive effect across space.

6. Conclusions and policy implications

The promotion of regional convergence is at the heart of European cohesion policy, although how to stimulate it still is a debated issue. Regions are considered a key level to foster economic growth (Filippetti and Peyrache, 2015). Therefore, appropriate development policies should not be based on spatially-blind interventions, as they would be more effective if grounded on a place-based approach (Barca, 2011; Seravalli, 2015). Economic convergence, however, is far from being achieved in today's Europe. Rather, disparities among regions do not cease to widen. The Italian North-South divide is a paramount example of the missing convergence problem due to the polarization in terms

of economic performance and living conditions. Productivity differentials between the two areas are also blatant, reason why economists have historically put great effort in analyzing the causes of such gap to design possible solutions.

In order to understand how to boost regional development, the standard economic theory has focused on how different exogenous and endogenous variables affect or enhance the capability of regions to grow and converge. So far, such an approach has failed to explain why weaker regions diverge from wealthier ones instead of catching-up. In this framework, one factor assumed to be decisive for economic development is labour productivity because it is typically considered a driving force behind output growth. However, that is far from being undisputed.

In this paper, we claim the need to reconsider the theoretical premises underpinning the theory of regional economic convergence. Instead, we endorse a Kaldor-Verdoorn perspective – which sees labour productivity growth as an endogenous phenomenon driven by (i) output growth, and (ii) investment and capital accumulation – to elaborate on the Italian North-South economic dualism. In the Kaldorian framework, the output effect is mainly channelled by increasing returns to scale, learning-by-doing and division of labour processes; concerning the investment effect, the faster is capital accumulation, the higher is the rate of introduction of more innovative production techniques embodied in newly installed capital goods. Empirically, we tested the existence of such relationships in the Italian macro-regions (North-West, North-East, Centre, South, and Islands) during the 1980–2013 period. As a method, we made use of advanced econometric techniques based on Panel Structural Vector Autoregressive (P-SVAR) modelling (Pedroni, 2013).

Our findings validate the Kaldorian perspective for all the Italian macro-regions by showing that both output growth and investment intensification have a positive effect on labour productivity growth. The Verdoorn effect (or the scale effect) is found to be stronger than the investment effect in all macro-regions, even when they are alternatively excluded one at a time from the analysis. However, we also find the Verdoorn effect to be less intense when Northern macro-areas are excluded from the sample. Conversely, the effect of the rate of growth of the investment per worker on labour

productivity does not vary across Italian areas. One possible interpretation of the non-homogeneity of the Verdoorn effect at the territorial level suggests that Northern local economies are more able to take advantage from increasing returns to scale due to the presence of industrially advanced sectors, of which Southern regional economies fall short. That could in principle exacerbate the existing North-South disparities thus fostering forces of divergence (Fingleton, 2000), leading developed regions to further take advantage of their larger economic structures. On the other hand, because the capital accumulation effect is homogeneously effective throughout the country, the channel of investments could represent the most appropriate instrument to foster Southern economies' catching-up. In addition, it is worth recalling that investments produce a twofold effect: the first one is an increase in the capital stock; the second one is an increase of the output determined by the rising demand for investments.

The debate on how to solve the longstanding Southern Question often revolves around the role of public intervention in the economy of the Mezzogiorno, that is whether the Central Government should sustain it through targeted public investments or not. Some observers maintain that public intervention inhibits the development of the South, especially in terms of productivity and competitiveness. Shedding light on the positive role played by GDP growth and capital accumulation on labour productivity, our results suggest nonetheless that public investments are the most effective channel of growth. Hence, they could be the key to fill the gaps that keep the South lagging behind. Yet, public measures targeted to the Mezzogiorno area have been substantially fewer than those for the richer Centre-North in the last twenty years, both in terms of current and capital expenditure. Figure 4 depicts the trend of per capita government expenditure from year 2000 onwards, indicating a clear and persistent gap between the two areas. The gap is even wider when expenditure from the public sector including majority State-owned companies (the 'broader public sector') is considered.¹⁵

¹⁵ The data from the Italian Agency for Territorial Cohesion allows to break down public expenditure (for current purposes and for investment) at the macro-region level for both the public administration and for the broader public sector, which includes majority State-owned companies.

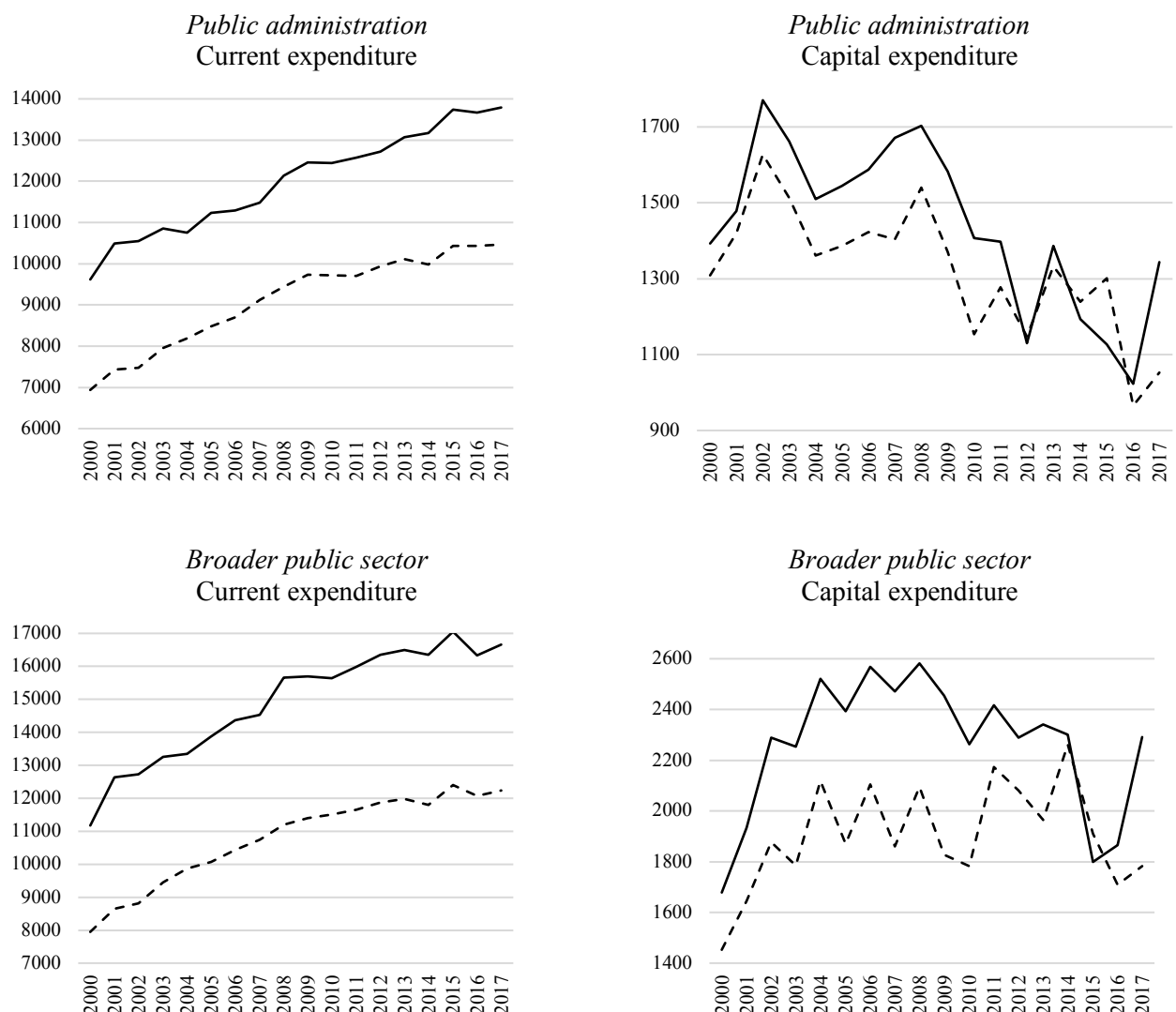


Figure 4. Public current and capital expenditure in Italy by macro-region (2000-2017). Dashed lines indicate the Mezzogiorno area, bold lines indicate the Centre-North. The Broader public sector includes majority State-owned companies. Source: our elaboration on *Conti Pubblici Territoriali*, Italian Agency for Territorial Cohesion.

As clearly emerges from historical data, in the last two decades the share of public investment targeted to the Mezzogiorno area has been systematically under the currently debated 34% threshold (Tortorella, 2019), attaining an average of 32% (see Figure 5). With respect to the broader public sector, the average expenditure for the South between years 2000 and 2010 was even lower (25%). This is even more astonishing if one considers that majority State-owned companies operate in sectors like energy, machinery and transportation, playing a strategic role in enhancing economic and productivity growth (Deleidi and Mazzucato, 2019). In line with the Kaldorian perspective, a public investment boost targeted to the above-mentioned strategic sectors would stimulate labour

productivity growth through a higher specialization determined by market expansion and the introduction of more advanced technologies embodied in new capital goods. Even if our findings do not point at a sharp policy prescription in this sense, we retain that the 34% threshold probably is still not high enough to promote the catching-up of the Mezzogiorno with Northern regions. In fact, during the convergence era of the 1950s and the 1960s, the rate of public investment in the South was nearly twice as much (37%) as that in the Centre-North (21%) (Pellegrini, 2016; Iuzzolino et al. 2011). As a conclusion, the current underfunding of the South with respect to the rest of the country calls for a decisive change of direction in terms of public intervention targeted to the Mezzogiorno, so that it can boost its economy through the most appropriate and effective channels and reverse the tendency to territorial polarization.

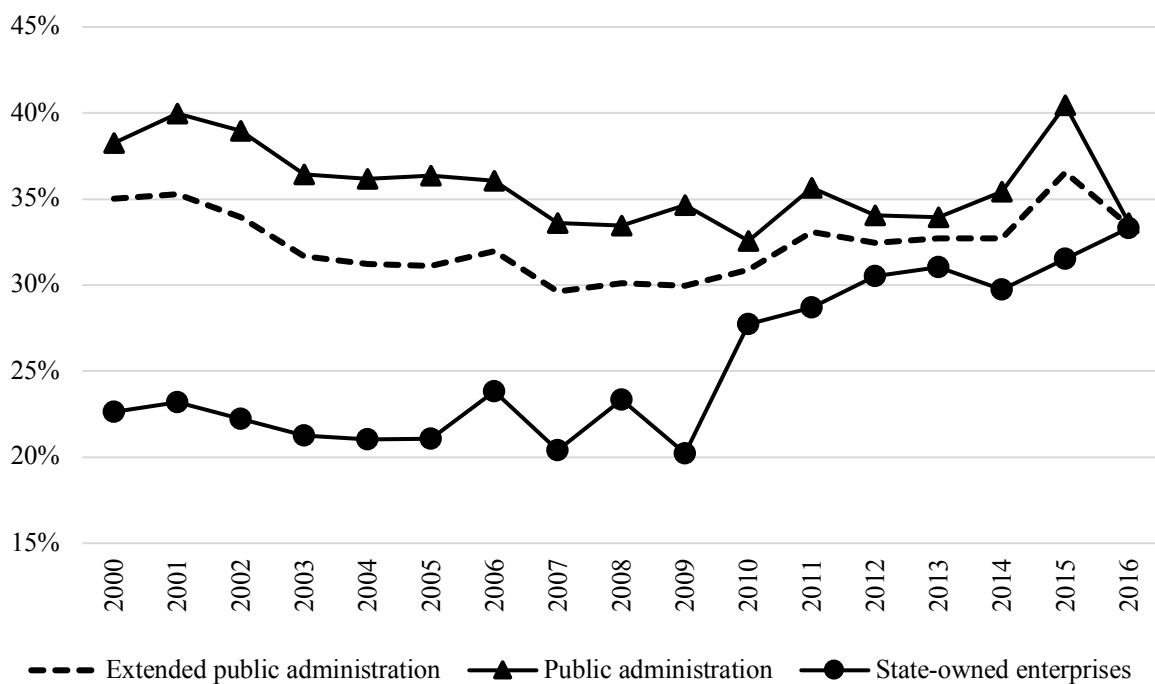


Figure 5. Share of public capital expenditure targeted to the Mezzogiorno, total and broken down by typology (2000-2016). Source: our elaboration on *Conti Pubblici Territoriali*, Italian Agency for Territorial Cohesion.

Finally, one could think that public investments should only be partially responsible for the economic growth of underdeveloped regions and that *total* investments – that is, both public and private ones – should be considered in the policy scenario. Despite that is true in principle, it is

important to bear in mind that private actors are less inclined to invest in less dynamic contexts especially during periods of economic stagnation, and could be hesitant to invest the amounts needed to stimulate economic convergence of lagging behind areas. Public investments, instead, could be instrumental to crowd-in private investors by creating a favorable environment for the economic development and the catching-up of weaker regions, like the Italian Mezzogiorno.

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