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Published Version:
Deleidi Matteo, P.M.W. (2021). Output, investment and productivity: the Italian North–South regional divide from a Kaldor–Verdoorn approach. REGIONAL STUDIES, 55(8), 1376-1387 [10.1080/00343404.2021.1896694].

Availability:
This version is available at: https://hdl.handle.net/11585/816374 since: 2021-03-22

Published:
DOI: http://doi.org/10.1080/00343404.2021.1896694

Output, investment, and productivity:

The Italian North-South regional divide from a Kaldor-Verdoorn approach

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Keywords: Productivity; Investment; Italian Regions; Regional Differentials; Panel SVAR.

JEL Codes: C33; O18; O47; R11.

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Abstract.

This paper elaborates on the Italian North-South divide by endorsing a Kaldor-Verdoorn perspective. To assess the endogenous relationship between labour productivity, capital accumulation, and output growth, Panel Structural VAR modelling is applied to 1980-2017 data on Italian macro-regions and areas. Findings show that territorial disparities exist in both the Verdoorn and the capital accumulation effects throughout the country. Output growth has a larger effect on productivity in the Centre-North, while the investment effect is stronger in the South. That stresses the relevance of public effort in stimulating both output and investment – therefore, productivity – especially in economically depressed areas.

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BACKGROUND AND RATIONALE

Spatial disparities continue to motivate empirical and theoretical research to understand their root causes and provide solutions to address them (see e.g., Krugman, 1991; Krugman and Venables, 1996). Standard economic theory in particular has long preconised that, in the long run, regional differentials would translate into opportunity to catch-up for lagging-behind regions (Barro and Sala-i-Martin, 2004; Baumol, 1986). However, that does not always happen, even in rich capitalist countries. Among advanced economies, Italy represents one of the archetypical examples of territorial polarisation due to the *Southern Question* – a term used to denote the unsolved social, economic, and financial problem of the disparity between the richer Centre-North and the poorer Southern Italy, also called *Mezzogiorno* (Viesti, 2013; Arestis et al., 2017). Today, the Southern Italian economy still lags behind from many points of view compared to the rest of the country. In 2018, unemployment in Mezzogiorno 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, where unemployment attains 9.6% in the Centre and 6.7% in the North according to the National Institute of Statistics (Istat). Spatial disparities in terms of youth unemployment are even more dramatic: among individuals under 29 years of age, unemployment is 39.8% in Southern Italy – 20 percentage points higher than in the rest of the country (Cannari et al., 2019) – with NEET rates as high as 40% (Tosi, 2018). Finally, GDP per capita in the Mezzogiorno area is 56.1% of the Centre-North (SVIMEZ, 2017), and labour productivity is still well below the country average (Istat, 2019) in terms of both levels and growth rates.[i] On average, the annual value added per person employed in the Centre-North is about 50,000 Euros, compared to just 33,000 Euros in Southern Italy. Growth rates convey the same picture: over the last three decades productivity growth attained an annual average of 1.5% in the Centre-North compared to only 1% in Mezzogiorno regions.

Studies on regional economic disparities commonly focus on the relationship between productivity differentials and output growth (Enflo and Hjertstrand, 2009; Ramajo and Hewings, 2018), theoretically explained according to two main approaches.[ii] The first one assumes economic growth to be shaped by the pace of labour productivity, in turn influenced by exogenous factors, especially institutional characteristics (Acemoglu, 2006), labour market regulation (Bassanini and Ernst, 2002; Nicoletti and Scarpetta, 2003), and spatial misallocation (Papageorgious, 2014). Within this framework, some models (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 investment in human and social capital (Barro, 2001), and by the level of firms' expenditure in R&D (Romer, 1990; Aghion et al., 2001). Empirically, the Southern Question has been often analysed in that fashion, by putting great emphasis primarily on the gaps in technology endowment, capital accumulation, total factor productivity (TFP), and labour productivity (Aiello et al., 2015; Byrne et al., 2009; Filippetti and Peyrache, 2015; Gitto, 2017; Piacentino and Vassallo, 2011).

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; Deleidi and Mazzucato, 2019; Deleidi et al., 2020). Several studies (e.g., Ofria, 2009; Fazio et al., 2013; Millemaci and Ofria, 2016) have empirically analysed the case of diverging Italian regions through the lens of the Kaldorian approach. However, they lack an explicit consideration of the endogeneity among labour productivity, GDP growth, and capital accumulation.

This paper aims at filling this gap by shedding light on the determinants of labour productivity growth in the Italian macro-regions. Theoretically, the paper adopts a Kaldorian perspective by considering the fundamental role of both capital accumulation and output growth in shaping the pace of labour productivity. Empirically, we model such theoretical relationships by applying innovative Panel Structural Vector Autoregressive modelling (P-SVAR) techniques to Istat's time series data for years 1980–2017. P-SVAR allows identifying the different contributions to labour productivity stemming from output growth and the process of capital accumulation, while explicitly considering the endogeneity among the said variables. Such an approach also allows estimating Impulse Response Functions (IRFs) to assess the effect of output growth and capital accumulation on labour productivity growth over different time horizons, while accounting for all possible dynamic feedback within the economy. Investigating such relationships is relevant from a policy perspective, because it may contribute to the longstanding debate on the Italian North-South divide (see e.g. Graziani, 1978) by providing elements for policy advice in a context of territorial polarization.

The paper is organised as follows. First, we present the theoretical framework and review the empirical literature analysing the abovementioned determinants of labour productivity, focusing on research conducted at the regional level. Then, we introduce the data and methods used to generate the findings presented in the remainder of the paper. Finally, we conclude and discuss the results in light of some policy considerations.

THEORETICAL FRAMEWORK

In the Kaldorian paradigm, technical progress (that is, productivity growth) is depicted as an endogenous phenomenon where the rate of growth of output is 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 (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) positive spatial externalities among firms, industries, and regions; and (iii) technical progress embodied in newly installed capital goods. The relationship between these mechanisms is represented in Equation (1), generally known as Verdoorn's law:

$$\dot{p} = \alpha + \eta\dot{y} \tag{1}$$

where $\dot{p}$ represents the rate of growth of labour productivity, $\dot{y}$ is the rate of growth of output, α represents the pace of exogenous technical progress, and 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 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.[iii]

As conceived by Kaldor (1957) in his technical progress function, productivity growth also depends on investments since technical progress and more innovative techniques of production are embodied in newly installed capital goods. This can be represented by Equation (2):

$$\dot{p} = r + \lambda\dot{k} \tag{2}$$

where r 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). Henceforth, we shall refer to the λ parameter as the *investment coefficient* or the *capital accumulation effect* interchangeably.

Following Michl (1985), the traditional Verdoorn effect and the Kaldorian technical progress function can be combined in Equation (3):

$$\dot{p} = \epsilon + \eta\dot{y} + \lambda\dot{k} \tag{3}$$

where ϵ condenses α and r from Equations (1) and (2), and labour productivity growth ($\dot{p}$) is determined by the rate of growth of output ($\dot{y}$) and the rate of growth of the capital-labour ratio ($\dot{k}$).

EMPIRICAL LITERATURE

Although the empirical literature on the factors shaping productivity growth is extremely vast and identifies a variety of drivers, we focus our attention on applied explorations that are nearer to our line of inquiry, especially on empirical evidence in favour of a positive elasticity of labour productivity with respect to output and capital accumulation.[iv] Verdoorn (1949) initially estimated a scale coefficient of 0.45, while Kaldor (1966) assesses a dynamic version of Verdoorn's law, indicating that each additional percentage point of output growth leads a 0.5% increase in productivity.[v] Later, also McCombie (1983), Thirlwall (1983), McCombie et al. (2002) and Knell (2004) document the Verdoorn effect finding scale coefficients of similar magnitude for an array of manufacturing economies. Millemaci and Ofria (2014) validate the long-run dynamic version of the 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 scale effect of 0.36 for a panel of OECD countries. Deleidi et al. (2020) validate the Verdoorn law for six European countries, while Carnevali et al. (2019) estimate a positive scale effect for the Euro area manufacturing industries. Other studies focusing on the Italian economy verify the existence of a positive Verdoorn effect (Bianchi, 2002; Deleidi and Paternesi Meloni, 2019; Forges Davanzati et al., 2019).

Concerning the spatial level of analysis, McCombie (1985) and Bairam (1988) verify the Verdoorn law at the regional level, assuming that differences in technology across regions in a given country must be small (Destefanis, 2002), although that is not always the case as exemplified by the case of the Italian North-South divide. Increasing returns to scale are found using European (Fingleton, 2000; Fingleton and McCombie, 1998; Pons-Novell and Viladecans-Marsal, 1999), UK (Harris and Lau, 1998), Chinese (Hansen and Zhang, 1996) and US regional data (McCombie and

De Ridder, 1984; Casetti, 1984; Bernat, 1996; Kie, 1997). Soro (1985), Ofria (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 (2000) finds similar results for Spanish regions. Finally, McCombie and Roberts (2007) document the existence of increasing returns 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, existing research usually decomposes labour productivity growth into different contributions (Stiroh, 2001). Among these, the process of increasing capital per unit of labour (or capital deepening) is positive and significant according to Kumar and Russell (2002) who estimate a contribution of capital deepening to productivity growth of 77% for a panel of 57 countries; and to Jorgenson et al. (2008) and Foda (2017) who estimate a contribution of capital deepening to productivity growth for the US economy of respectively about 53% and 45%. More recently, Antenucci et al. (2020) estimate a positive capital accumulation coefficient for G7 countries by operating in a Kaldor-Verdoorn framework that is similar to the one used in the present contribution.

In sum, the empirical literature suggests the existence of a positive effect of output growth and the pace of capital accumulation on labour productivity growth. Estimated coefficients vary depending on the methods used and the spatial level of the analysis. What the cited literature substantially lacks is: (i) combining the Verdoorn and the capital accumulation effects in exploring the determinants of productivity growth at the regional level; and (ii) considering the endogeneity among productivity growth, output dynamics and capital accumulation. In what follows, an empirical analysis is presented with the scope of filling such gaps with respect to the case of Italian macro-regions and areas. Specifically, the analysis will assess the validity of Verdoorn's law by estimating Equations (1) and (3) using P-SVAR modelling, while explicitly considering the endogenous relationship between investment, output growth and labour productivity.

DATA, METHODS AND MODELS

Data

We estimate our reference model for both the Italian economy as a whole and its macro-regions and areas for the 1980–2017 period. We make use of Istat's time series on real GDP, total employment (expressed in full-time equivalent to avoid biases due to part-time jobs), and gross fixed capital formation (including private and public investment). First, we transform capital formation in real terms by means of a regional GDP deflator (reference year 2015), computed as the nominal to real GDP ratio using NUTS-1 level data.[vi] Then, we calculate: (i) the rate of growth of output ($\dot{y}$), as the annual rate of change of real GDP; (ii) the rate of growth of labour productivity ($\dot{p}$), as the annual rate of change of the ratio between real GDP and total employment; and (iii) capital accumulation per unit labour ($\dot{k}$) as the rate of growth of the ratio between gross fixed capital formation (in real terms) and total employment.[vii]

The analysis is applied to the NUTS-1 macro-regions: North-West (NW), North-East (NE), Centre (C), South (S) and Islands (I). Our spatial scale is in line with Cherubini and Los (2016), who study regional economic patterns at the NUTS-1 level. The chosen spatial scale provides strength to our analysis, as the Verdoorn effect is likely to be more intense when the scale increases. This seems to be the case of most Italian regions, especially in the North, where value chains and productive districts (Chiarvesio et al., 2010) are likely to assume a cross-regional dimension, which may play a key role in benefiting from spillovers and positive externalities.[viii] Moreover, the areas considered are characterized by relatively homogeneous internal production structures and infrastructures endowment (Carlucci et al., 2017).[ix] The analysis is also replicated for the Centre-North (including NW, NE and C) and the Mezzogiorno (including S and I) areas. Descriptive statistics of the considered variables are provided in Table A2 (Appendix A).

Modelling strategy

To investigate the determinants of labour productivity dynamics endorsing the Kaldorian perspective, we apply econometric techniques based on Panel Structural Vector Autoregressive modelling (P-SVAR) (Pedroni, 2013). P-SVAR modelling consists of estimating a system of equations that let all considered variables interplay to account for the endogenous nature of investment and capital accumulation. Compared with the existing literature, our method allows overcoming some of the criticisms related to the exogeneity of capital accumulation typically observed in investigations using single-equation models.[x]

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

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

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. The selected lag is 1 in all models and is obtained through the general-to-specific criteria (Pedroni, 2013). A P-SVAR is then obtained by imposing an identification strategy to the reduced-form panel VAR(n) that in turn enables to retrieve a structural model, as in Equation (5):

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

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

We specify two models through the P-SVAR procedure. In Model 1, the standard Verdoorn law is estimated by assessing the effect of output growth ($\dot{y}$) on labour productivity growth ($\dot{p}$)

uniquely, as in Equation (1). Then, Model 2 is augmented by the rate of growth of investment per unit of labour ($\dot{k}$), to account for the Kaldorian technical progress function, as in Equation (3). Both models are recursively identified through a Cholesky factorisation. In the case of Model 1, we assume the identification summarised in (6):

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

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, and not *vice versa*. Looking at Model 2, the implemented identification strategy is summarised in (7):

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

In Model 2 we include a second ordered variable, that is the rate of growth of the investment-labour ratio ($\dot{k}$). In the system of equations (7), $\dot{k}$ is supposed to be affected within the contemporaneous relationship by $\dot{y}$ and not by $\dot{p}$. That allows us to solve a thorny issue raised in the empirical literature grounded on the Kaldorian framework, namely the idea that the process of capital accumulation could be found not significant in single equation modelling as investment and capital are affected by output dynamics following the accelerator principle (Deleidi and Mazzucato, 2019, 2020). The last equation in (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 unit of labour ($\dot{k}$). Once 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 labour productivity growth. IRFs are estimated over twenty years and reported with 95% confidence interval bands estimated by bootstrapping standard errors. Additionally, we estimate the cumulative effects derived by dividing the cumulated labour productivity growth with the corresponding impulses (Spilimbergo et al., 2009). We first fit Models 1 and 2 for all the selected macro-regions and areas. Then, to increase the robustness and comparability of findings, we refit the models excluding one macro-region at a time and the post-crisis period.

FINDINGS AND DISCUSSION

We start by analysing the IRFs and then we will show the cumulative effects.

IRFs from Model 1 are reported in Figure 1, showing that an increase in the rate of growth of output $\dot{y}$ leads to a rise in labour productivity growth $\dot{p}$. Such evidence holds for all the considered territorial units – that is the five macro-regions and the two areas (Centre-North and Mezzogiorno) – and is robust to the exclusion of one macro-region at a time. All estimated impulses ($\dot{y}$→$\dot{y}$) and responses ($\dot{y}$→$\dot{p}$) are found to be significant for the whole considered time span.

[FIGURE 1 ABOUT HERE]

Turning to Model 2, Figure 2 illustrates the estimates of the Verdoorn law augmented by the investment effect λ. We can observe that positive shocks to the rate of growth of output $\dot{y}$ and the investment per unit of labour $\dot{k}$ positively affect the rate of growth of labour productivity $\dot{p}$. Hence, the augmented Verdoorn law is validated in all macro-regions and areas, also when macro-regions are alternatively excluded one at a time by our models. All estimated impulses ($\dot{y}$→$\dot{y}$ and $\dot{k}$→$\dot{k}$) and responses ($\dot{y}$→$\dot{p}$ and $\dot{k}$→$\dot{p}$) are significant for the whole considered period.

[FIGURE 2 ABOUT HERE]

In addition to IRFs, we aim at quantifying the magnitude of the scale coefficient η and the investment coefficient λ by estimating the cumulative effects, that is the response of $\dot{p}$ per a unitary increase in $\dot{y}$ and $\dot{k}$ (Tables 1 and 2).

Looking at the cumulative effects of Model 1 (Table 1), the Verdoorn effect is found to be positive and in line with the existing literature, ranging in a 0.2–0.6 interval. Considering the whole country as the aggregation of the five macro-regions, the Verdoorn coefficient attains an average value of 0.546. Looking at the areas of Centre-North and Mezzogiorno separately, the Verdoorn coefficient is remarkably high in the Centre-North, where it exhibits a value of 0.604, while it is estimated at 0.205 in the more depressed Southern area of the country. We then re-estimate Model 1 by alternatively excluding one macro-region at a time. The Verdoorn coefficient assumes an average value of 0.428, 0.397 and 0.400 when respectively NW, NE and C are excluded. When S and I are excluded, the scale effect is instead slightly higher than the one estimated for all macro-regions. That indicates the existence of higher economies of scale in the most developed Italian regions, where a more structured and extensive productive system – particularly in the manufacturing and industrial branches – is likely to enhance productivity also through the scale effect. As a robustness check, we also estimate Model 1 on a shorter time span, that is from 1980 to 2007 (see IRFs in Figure A2 in Appendix A) to control for potential effects of the financial and real crisis and to detect how it may have differently impacted on Italian macro-regions. The coefficients reported in Table 1 (lower panel) are generally higher in this subsample than when the entire time span is considered, with the only exception of the Mezzogiorno. Such evidence is not puzzling, since the post-crisis period has been characterized by lower growth rates of the economy, which in turn may have reduced the Verdoorn effect.

[TABLE 1 ABOUT HERE]

[TABLE 2 ABOUT HERE]

We then extend the analysis to the augmented version of Verdoorn's law by including capital accumulation effects (Model 2). Results in Table 2 confirm findings of Model 1 reported in Table 1 for what concerns the average scale effect (0.558 at the aggregate level). Concerning the two areas, estimates of the scale effect for the Centre-North and the Mezzogiorno are in line with the coefficients estimated in Model 1 (0.649 and 0.190). Again, the overall scale effect decreases when macro-regions NW, NE, and C are excluded one at a time from the sample, with estimated average coefficients attaining 0.439, 0.391 and 0.390 respectively. Conversely, estimated average Verdoorn coefficients obtained when macro-regions S and I are not considered are higher than the one estimated for all regions (attaining 0.605 and 0.604). Regarding the assessment of the capital accumulation effect per unit of labour on productivity dynamics, the investment coefficient assumes a value that is generally lower than the Verdoorn one. This finding may relate with the twofold nature of investment, which simultaneously increases output (as a component of demand) and the capital stock (and therefore productive capacity). In this respect, the effect of investment might be underestimated, at least conceptually, as it is partially conveyed by the output effect. Moreover, differently from the Verdoorn effect that is higher in the Centre-Northern area, the investment coefficient is higher in the Mezzogiorno area (0.122) compared to the Centre-North (0.067). Also backed by the robustness check consisting in eliminating one macro-region at a time, these findings suggest that productivity in Southern macro-regions is more responsive to capital accumulation than in the North: this element is likely related to the fact that the productive structure of Mezzogiorno is less developed than that of richer areas. Finally, we re-estimate Model 2 for the pre-crisis period only (see IRFs in Figure A3 in Appendix A). Results reported in Table 2 (lower panel) lead to similar conclusions as those from Model 1: all coefficients tend to be higher than those estimated for the entire time span, further testifying the depressing effect on the pace of productivity of post-crisis lower growth rates of both output and investment. An additional finding emerges in the case of Mezzogiorno. Differently from baseline results, the investment effect turns out to be higher than the Verdoorn effect when only the pre-crisis period is considered.[xi]

CONCLUSIONS AND POLICY IMPLICATIONS

Regional disparities do not cease to widen, even in advanced economies. The Italian North-South divide, also known as the Southern Question, is a prominent example of territorial polarisation, both in terms of economic performance and living conditions. Productivity differentials between the two areas are blatant, reason why economists have historically put great effort in analysing the causes of such gap and to design possible solutions. In this paper, we endorsed a Kaldor-Verdoorn perspective – which sees labour productivity growth as an endogenous phenomenon driven by output growth and capital accumulation – to elaborate on the Italian North-South economic dualism. In such framework, the output effect is mainly channelled by increasing returns to scale, besides 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 and interdependency of such relationships in the Italian macro-regions (North-West, North-East, Centre, South, and Islands) and areas (Centre-North and Mezzogiorno) during the 1980–2017 period by making use of Panel Structural Vector Autoregressive modelling techniques. Our findings validate the Kaldorian perspective for all the Italian macro-regions and areas 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 and areas, even when they are alternatively excluded one at a time from the analysis and when we control for the outburst of the economic crisis. However, we also find the Verdoorn effect to be less intense in the Mezzogiorno. Conversely, the effect of the rate of growth of the investment per unit of labour on productivity turns out to be higher in Southern regions. 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, allowing more developed regions to further take advantage of their larger economic structures. On the other hand, because the capital accumulation effect is higher in the Mezzogiorno than in the North, the channel of investments could represent the most appropriate instrument to boost Southern economies. In fact, the debate on how to solve the longstanding Southern Question often revolves around the role of public intervention in the economy of the Mezzogiorno. Some observers maintain that public intervention inhibits the development of the South, especially in terms of productivity and competitiveness. Private actors, on the other hand, might be less inclined to invest in less dynamic and stagnating contexts and could be hesitant to invest in lagging-behind areas. Therefore, as also suggested by the recent International Monetary Fund's report (IMF, 2020), a public investment plan could be more suitable to help the economic recovery of regions that need it the most, by combining the short-run effects of supporting aggregate demand with the long-run structural transformation effects. However, because Southern Italy has been consistently underfunded with respect to the rest of the country in the last decades,[xii] a rethinking of the economic policy aimed to the creation of a favourable environment for investments and productivity is needed in order to sustain weaker regional economies, like the Italian Mezzogiorno, effectively.

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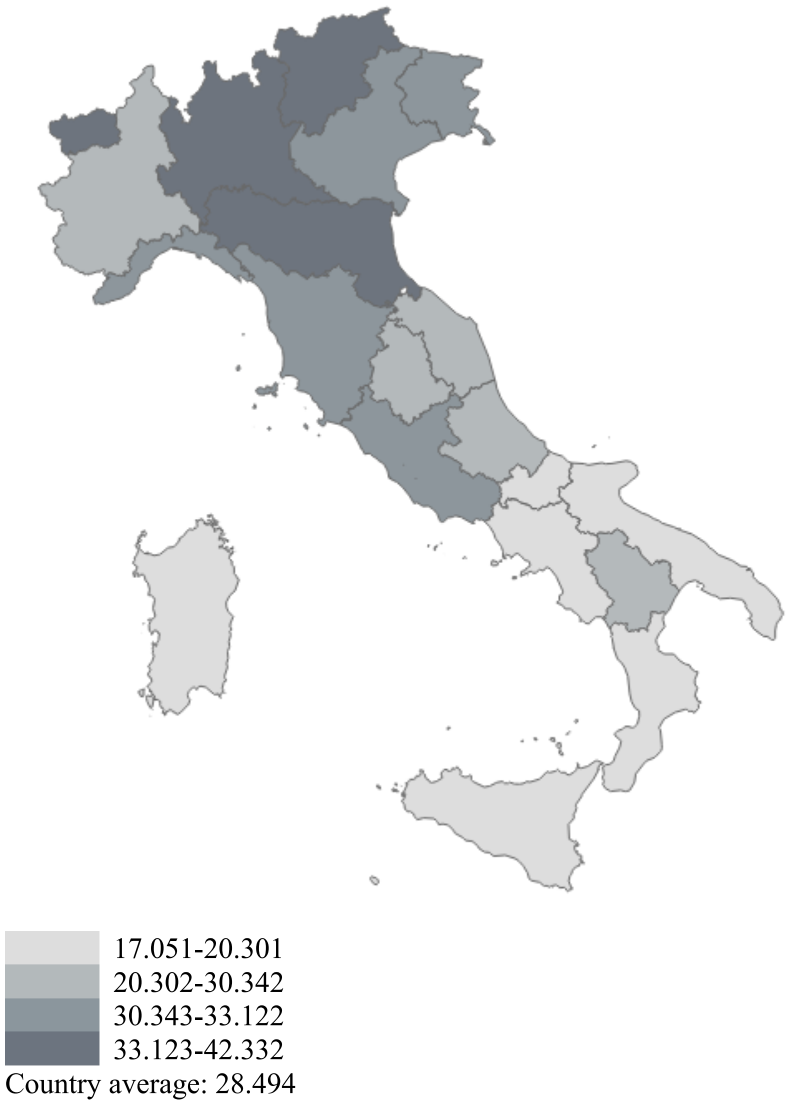
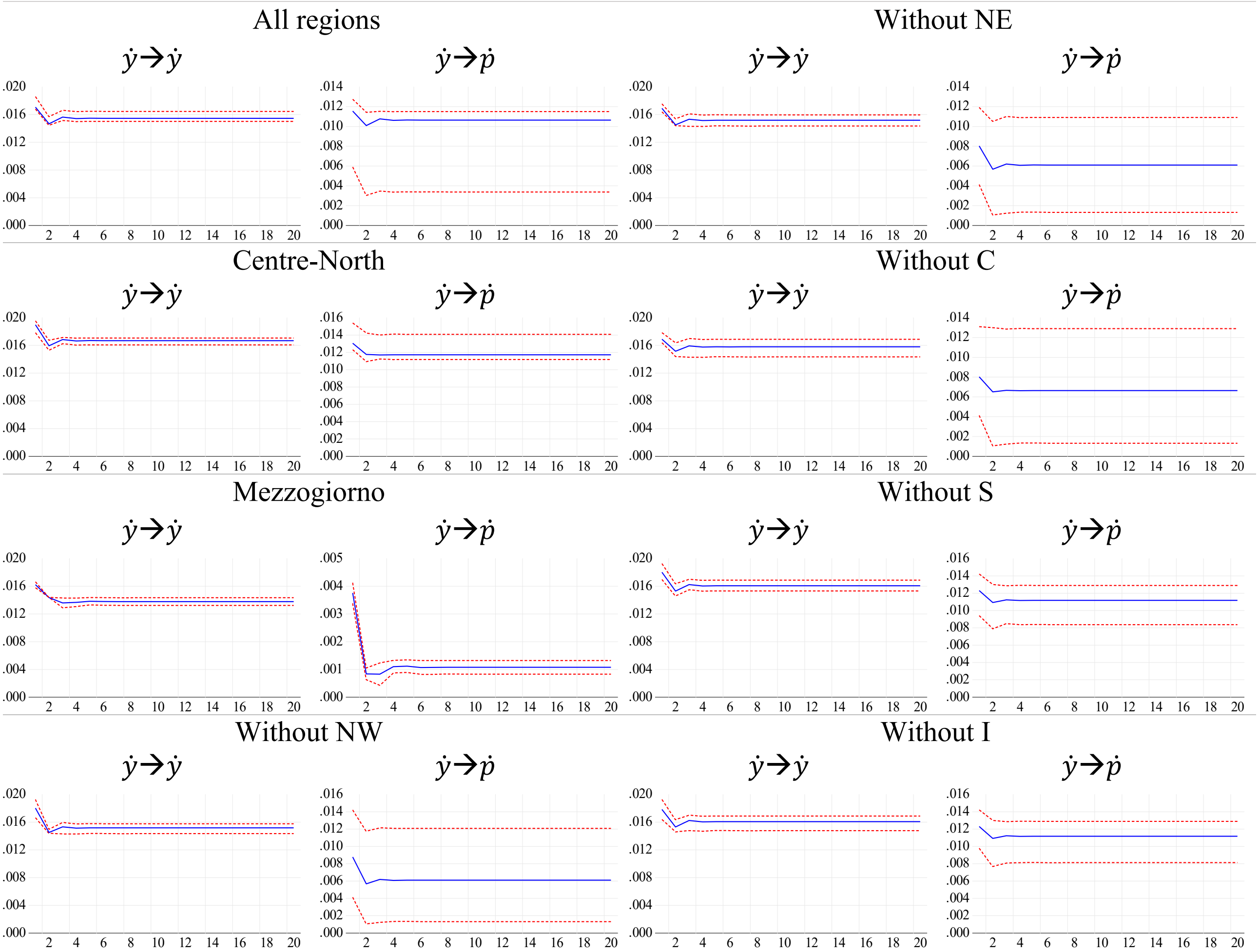
APPENDIX A

Figure A1. Per capita Gross Domestic Product by region.



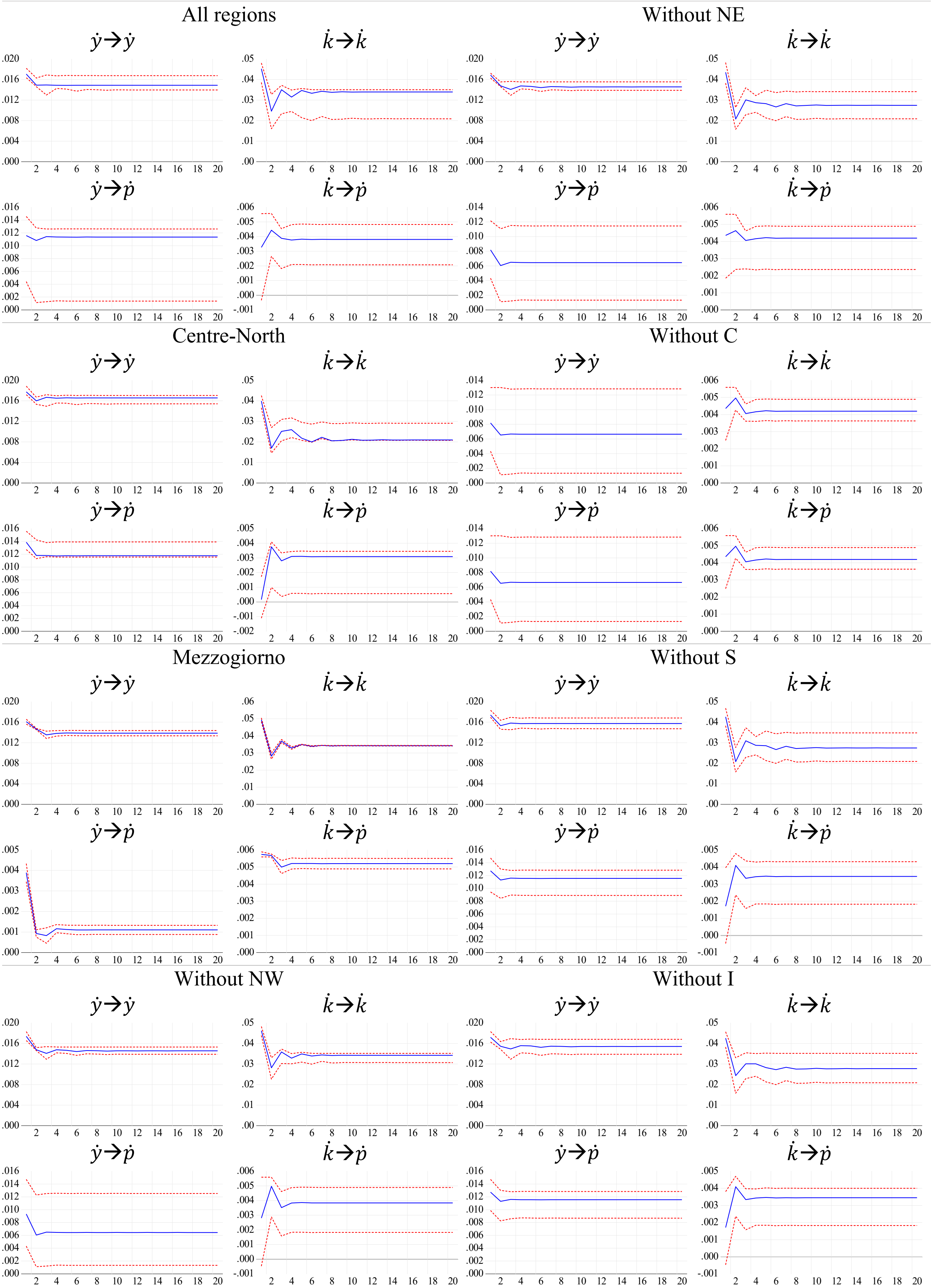
Notes: Data are in current Euros and refer to the year 2017. Source: our elaboration on Istat data.

Figure A2. Impulse Response Functions (Model 1).



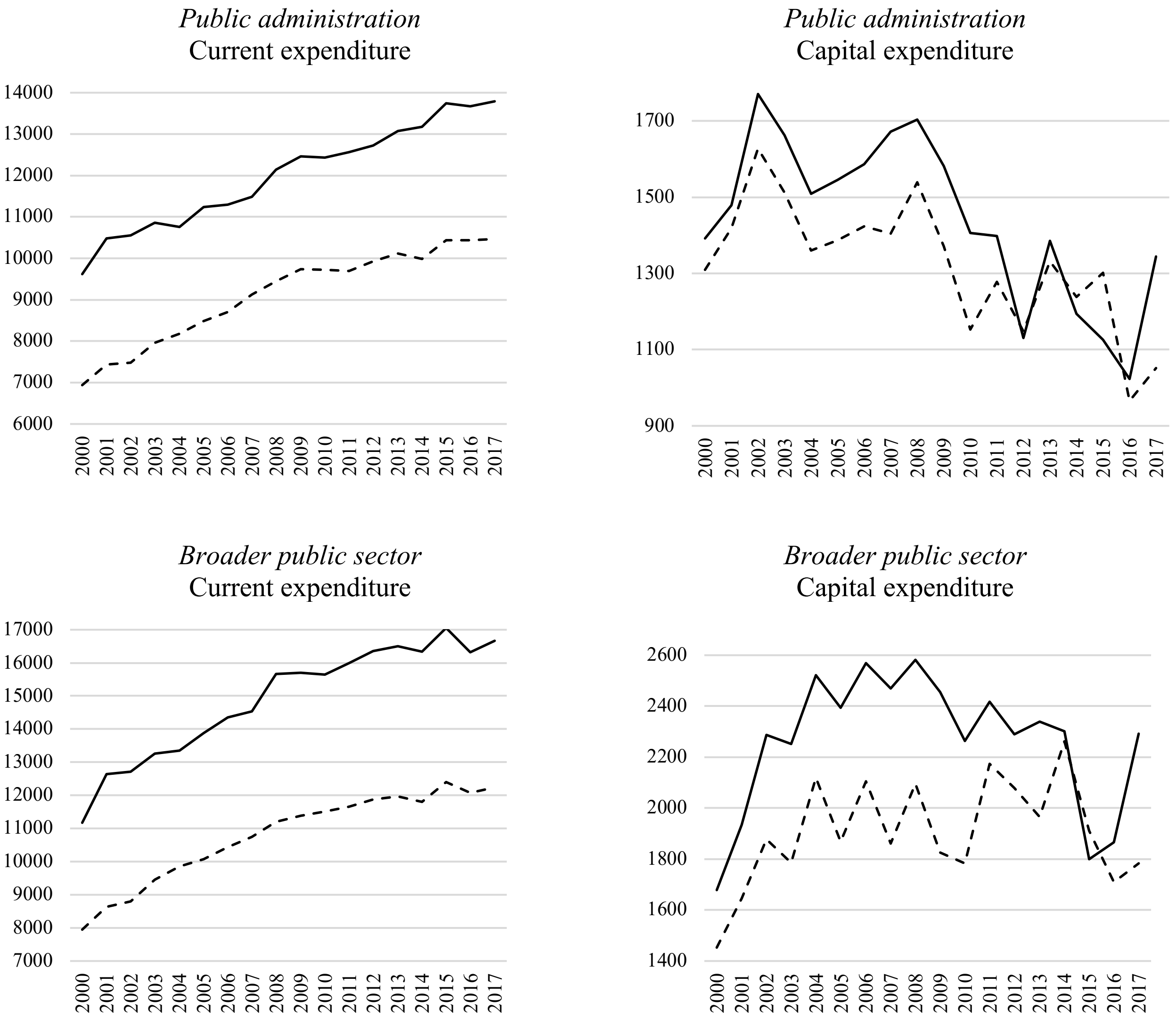
Notes: Responses to structural shocks are reported with two-standard error bound (95% confidence interval). Timespan: 1980–2007.

Figure A3. Impulse Response Functions (Model 2).



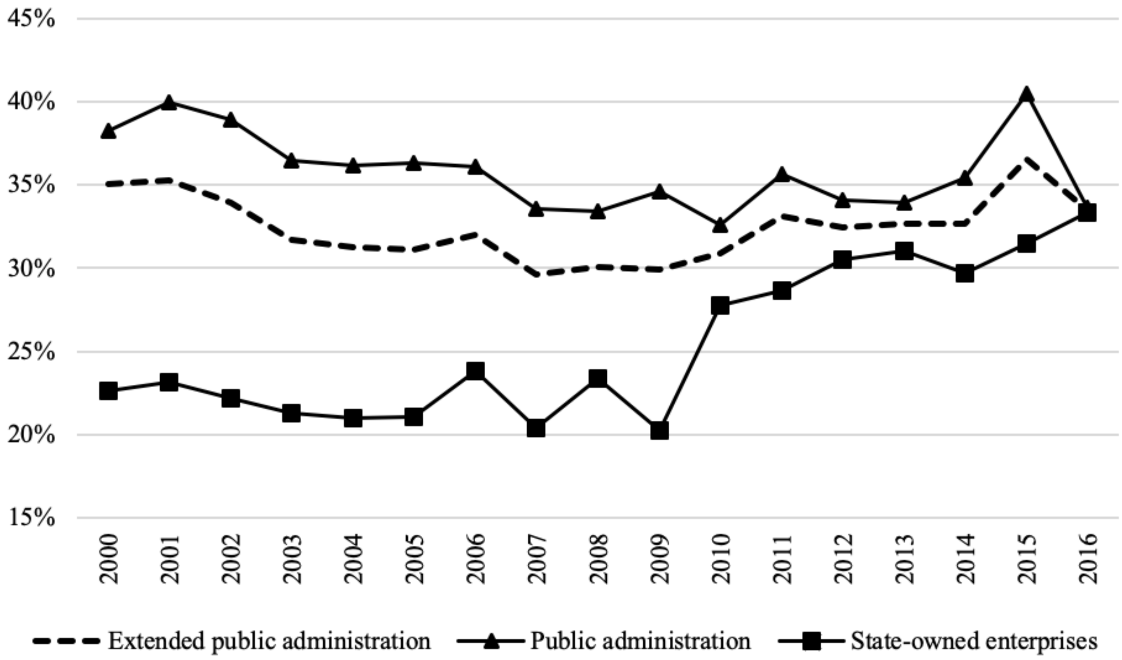
Notes: Responses to structural shocks are reported with two-standard error bound (95% confidence interval). Timespan: 1980–2007.

Figure A4. Public current and capital expenditure in Italy by macro-region (2000–2017).



Notes: 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.

Figure A5. Share of public capital expenditure targeted to the Mezzogiorno by type of expenditure (2000–2016).



Source: our elaboration on *Conti Pubblici Territoriali*, Italian Agency for Territorial Cohesion.

Table A1. Value added per person employed in Italian regions (year 2016).

Territorial unit	Value added per person employed (in thousand Euros)
NUTS-1 Macro-regions	
North-West	54.1
North-East	49.4
Centre	46.1
South	34.0
Islands	32.4
ITALY	46.6
NUTS-2 Regions	
North-West	
Valle d'Aosta / Vallée d'Aoste	44.4
Liguria	46.1
Piemonte	48.4
Lombardia	57.4
North-East	
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
Emilia-Romagna	50.5
Centre	
Toscana	43.5
Umbria	37.2
Marche	39.0
Lazio	51.5
South	
Abruzzo	38.3
Molise	31.7
Campania	35.0
Puglia	32.2
Basilicata	37.5
Calabria	29.1
Islands	
Sicilia	31.7
Sardegna	34.1

Source: *Annuario Statistico Italiano*, Istat (2019, p. 512).

Table A2. Descriptive statistics.

Labour productivity, growth rate ($\dot{p}$)						
Macro-region	Mean	Median	Max	Min	s.d.	Obs.
NW	1.4764	1.0794	6.5726	-4.1567	2.0810	37
NE	1.4420	1.3216	7.9724	-3.2406	2.2315	37
C	1.1978	1.2146	6.8163	-2.3189	1.9918	37
S	1.0551	1.0916	5.2347	-2.0933	1.6150	37
I	0.6144	0.7309	4.3806	-2.6758	1.4708	37
All	1.1571	1.0492	7.9724	-4.1567	1.9052	185
Investment per unit of labour, growth rate ($\dot{k}$)						
Macro-region	Mean	Median	Max	Min	s.d.	Obs.
NW	0.9569	1.6523	9.8134	-9.4822	4.7903	37
NE	0.7422	0.1754	10.6142	-9.0357	4.9261	37
C	0.5229	1.5995	9.8620	-8.6995	4.5996	37
S	-0.7379	-0.5989	6.7646	-2.9784	4.3652	37
I	-1.2876	-1.3765	11.7662	-1.9827	5.0568	37
All	0.0393	0.1269	11.7662	-2.9784	4.7853	185
Real output, growth rate ($\dot{y}$)						
Macro-region	Mean	Median	Max	Min	s.d.	Obs.
NW	1.5938	1.5540	5.7861	-6.9355	2.3893	37
NE	1.7140	1.7394	5.6758	-6.0623	2.3036	37
C	1.6877	1.8687	7.2544	-3.9330	2.2365	37
S	1.1962	1.1705	5.2347	-5.0477	2.2852	37
I	0.7815	0.7228	4.3500	-4.5488	1.9228	37
All	1.3946	1.5661	7.2544	-6.9355	2.2379	185

Notes: Growth rate of labour productivity ($\dot{p}$), growth rate of investment per unit of labour ($\dot{k}$), and growth rate of real output ($\dot{y}$) are broken down by Italian macro-regions (NUTS-1). Values are expressed in percentage points for easier interpretation. Timespan: 1980–2017.

TABLES

Table 1. Cumulative effects estimated for Model 1.

		Model 1 (1980–2017)					
		1y	5y	10y	15y	20y	Average
All regions	$\dot{y}$	**0.630**	**0.540**	**0.550**	**0.550**	**0.550**	0.546
Centre-North	$\dot{y}$	**0.724**	**0.598**	**0.598**	**0.598**	**0.598**	0.604
Mezzogiorno	$\dot{y}$	**0.366**	**0.202**	**0.198**	**0.198**	**0.198**	0.205
Without NW	$\dot{y}$	**0.516**	**0.427**	**0.426**	**0.426**	**0.426**	0.428
Without NE	$\dot{y}$	**0.516**	**0.391**	**0.395**	**0.395**	**0.395**	0.397
Without C	$\dot{y}$	**0.581**	**0.391**	**0.395**	**0.395**	**0.395**	0.400
Without S	$\dot{y}$	**0.681**	**0.570**	**0.575**	**0.575**	**0.575**	0.577
Without I	$\dot{y}$	**0.681**	**0.570**	**0.575**	**0.575**	**0.575**	0.576
		Model 1 (1980–2007)					
		1y	5y	10y	15y	20y	Average
All regions	$\dot{y}$	**0.677**	**0.688**	**0.688**	**0.688**	**0.688**	0.688
Centre-North	$\dot{y}$	**0.688**	**0.701**	**0.702**	**0.702**	**0.702**	0.702
Mezzogiorno	$\dot{y}$	**0.232**	**0.081**	**0.078**	**0.078**	**0.078**	0.084
Without NW	$\dot{y}$	**0.487**	**0.402**	**0.402**	**0.402**	**0.402**	0.406
Without NE	$\dot{y}$	**0.475**	**0.402**	**0.402**	**0.402**	**0.402**	0.405
Without C	$\dot{y}$	**0.475**	**0.420**	**0.420**	**0.420**	**0.420**	0.423
Without S	$\dot{y}$	**0.683**	**0.695**	**0.695**	**0.695**	**0.695**	0.695
Without I	$\dot{y}$	**0.689**	**0.695**	**0.695**	**0.695**	**0.695**	0.695

Note: 1980–2017 and 1980–2007 periods; 95% significant estimates are reported in bold; coefficients are estimated at different years (1y; 5y; 10y; 15y; 20y); the average effect is estimated across 20 years.

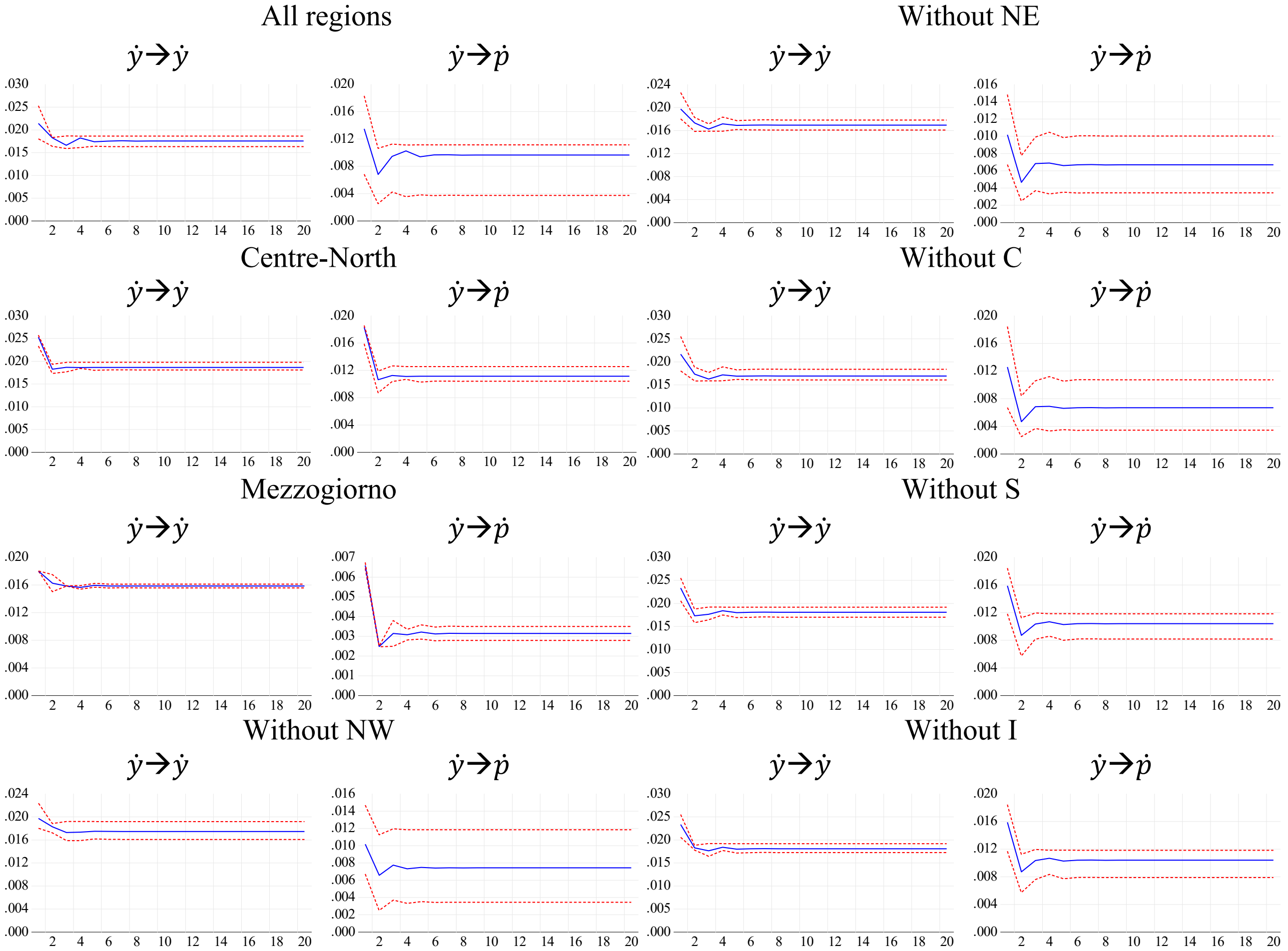
Table 2. Cumulative effects estimated for Model 2.

		1y	5y	10y	15y	20y	Average
Model 2 (1980–2017)							
All regions	$\dot{y}$	**0.686**	**0.541**	**0.558**	**0.558**	**0.558**	0.558
	$\dot{k}$	0.007	**0.076**	**0.069**	**0.069**	**0.069**	0.070
Centre-North	$\dot{y}$	**0.726**	**0.651**	**0.646**	**0.646**	**0.646**	0.649
	$\dot{k}$	0.007	**0.072**	**0.069**	**0.069**	**0.069**	0.067
Mezzogiorno	$\dot{y}$	**0.363**	**0.181**	**0.183**	**0.183**	**0.183**	0.190
	$\dot{k}$	**0.095**	**0.120**	**0.121**	**0.121**	**0.121**	0.122
Without NW	$\dot{y}$	**0.535**	**0.432**	**0.436**	**0.436**	**0.436**	0.439
	$\dot{k}$	0.040	**0.088**	**0.090**	**0.090**	**0.090**	0.089
Without NE	$\dot{y}$	**0.535**	**0.374**	**0.387**	**0.387**	**0.387**	0.391
	$\dot{k}$	**0.063**	**0.109**	**0.115**	**0.115**	**0.115**	0.114
Without C	$\dot{y}$	**0.575**	**0.374**	**0.385**	**0.385**	**0.385**	0.390
	$\dot{k}$	**0.066**	**0.105**	**0.113**	**0.112**	**0.113**	0.112
Without S	$\dot{y}$	**0.708**	**0.596**	**0.603**	**0.603**	**0.603**	0.605
	$\dot{k}$	0.031	**0.087**	**0.090**	**0.090**	**0.090**	0.090
Without I	$\dot{y}$	**0.708**	**0.596**	**0.603**	**0.603**	**0.603**	0.604
	$\dot{k}$	0.031	**0.088**	**0.092**	**0.092**	**0.092**	0.090
Model 2 (1980–2007)							
		1y	5y	10y	15y	20y	Average
All regions	$\dot{y}$	**0.679**	**0.763**	**0.763**	**0.763**	**0.763**	0.757
	$\dot{k}$	0.072	**0.110**	**0.112**	**0.112**	**0.112**	0.114
Centre-North	$\dot{y}$	**0.782**	**0.709**	**0.709**	**0.709**	**0.709**	0.714
	$\dot{k}$	0.004	**0.142**	**0.145**	**0.148**	**0.147**	0.140
Mezzogiorno	$\dot{y}$	**0.242**	**0.081**	**0.080**	**0.080**	**0.080**	0.086
	$\dot{k}$	**0.116**	**0.149**	**0.152**	**0.152**	**0.152**	0.152
Without NW	$\dot{y}$	**0.536**	**0.440**	**0.442**	**0.443**	**0.443**	0.446
	$\dot{k}$	0.061	**0.110**	**0.112**	**0.112**	**0.112**	0.112
Without NE	$\dot{y}$	**0.485**	**0.440**	**0.442**	**0.443**	**0.443**	0.444
	$\dot{k}$	**0.100**	**0.149**	**0.152**	**0.153**	**0.153**	0.152
Without C	$\dot{y}$	**0.485**	**0.423**	**0.423**	**0.423**	**0.423**	0.426
	$\dot{k}$	**0.094**	**0.121**	**0.123**	**0.123**	**0.123**	0.123
Without S	$\dot{y}$	**0.731**	**0.735**	**0.735**	**0.735**	**0.735**	0.735
	$\dot{k}$	0.040	**0.122**	**0.125**	**0.126**	**0.126**	0.124
Without I	$\dot{y}$	**0.740**	**0.745**	**0.749**	**0.750**	**0.750**	0.749
	$\dot{k}$	0.040	**0.123**	**0.124**	**0.124**	**0.124**	0.121

Note: 1980–2017 and 1980–2007 periods; 95% significant estimates are reported in bold; coefficients are estimated at different years (1y; 5y; 10y; 15y; 20y); the average effect is estimated across 20 years.

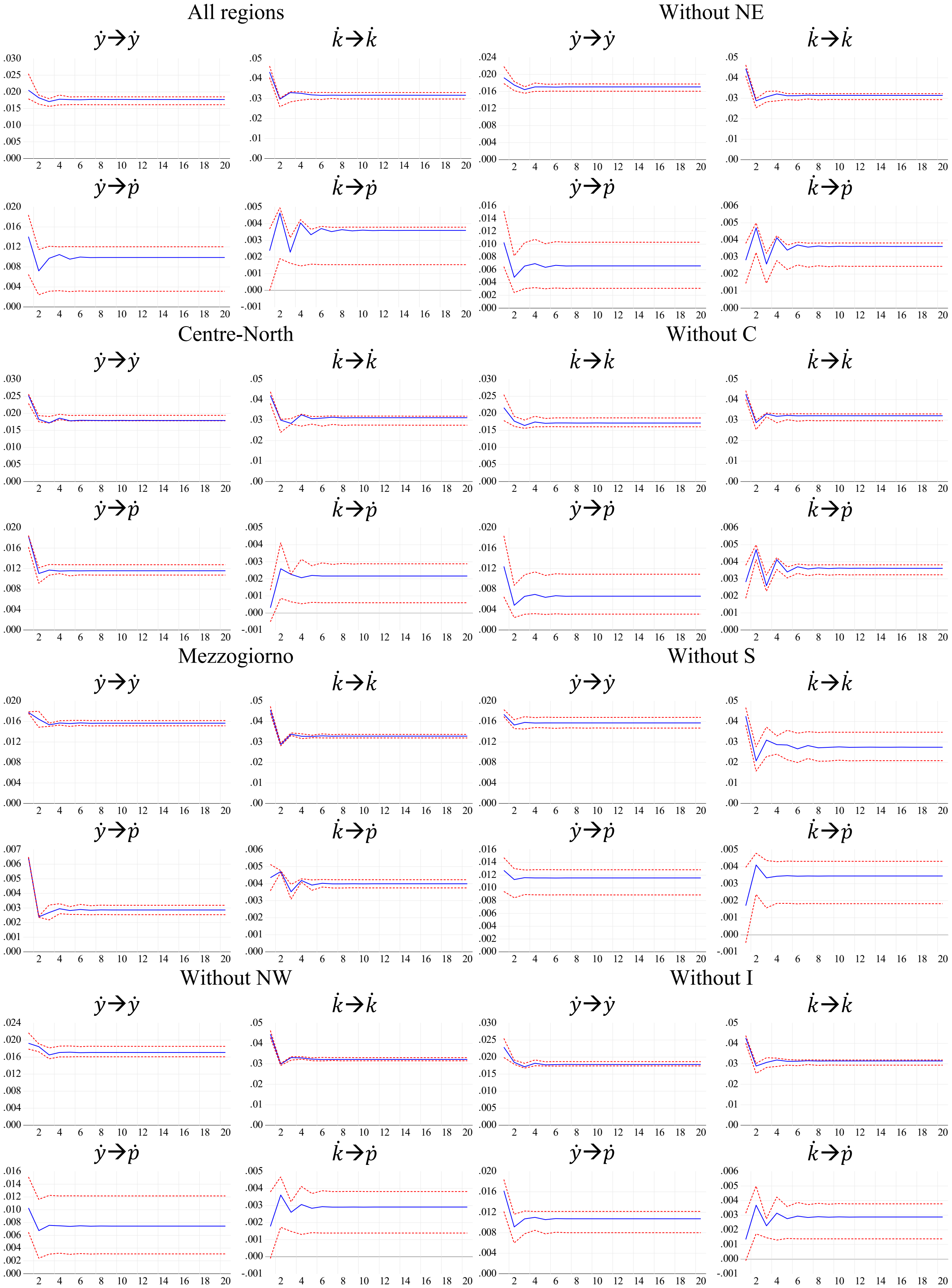
FIGURES

Figure 1. Impulse Response Functions (Model 1).



Note: responses to structural shocks are reported with two-standard error bound (95% confidence interval); timespan: 1980–2017.

Figure 2. Impulse Response Functions (Model 2).



Note: responses to structural shocks are reported with two-standard error bound (95% confidence interval); timespan: 1980–2017.

[i] See Figure A1 and Table A1 (Appendix A, in the online supplementary material) for GDP and productivity levels by region.

[ii] Some recent studies have focused on the process of structural change as possibly causing the slowdown in productivity, with the idea that the shift toward the service sector could reduce the pace of productivity. However, the argument is still debated (see Deleidi et al., 2020; Pariboni and Tridico, 2019).

[iii] In Kaldor's view, that happens since increasing productivity fosters competitiveness, thus exports (Kaldor, 1972). Moreover, increased productivity may reduce the propensity to import and, by lowering relative prices, increase the propensity to consume (Cesaratto et al., 2003).

[iv] We refer the reader to Kim and Loayza (2019) for a review on the drivers of productivity growth.

[v] 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).

[vi] Source: Istat, *Conti economici regionali* (https://www4.istat.it/it/archivio/11519) for the period 1980-1994 and Istat, *Conti e aggregati economici territoriali* (http://dati.istat.it) for the period 1995-2017.

[vii] 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 unit of labour. The rate of growth of capital stock converges towards the investment growth rate as demonstrated in Freitas and Serrano (2015).

[viii] Spatiality takes on special meaning as regional productive districts and local networks are the most likely dimension where spillover effects may take place (Keeble and Wilkinson, 1999; Paci and Usai, 2000; Rodríguez-Pose and Crescenzi, 2008), and connections between know-how and skills engender virtuous cumulative causation effects also via incoming mobility of talents (Impicciatore and Tosi, 2019; Tosi et al., 2019).

[ix] Focusing on NUTS-1 macro-regions also allows considering a longer time span compared with smaller spatial scales (e.g., NUTS-2 level), for which information on capital formation are unavailable before the year 1995.

[x] The main objection to this approach lies in the difficulty of adding further explanatory variables to the model as the number of estimated parameters increases faster than linearly. While controlling for potential endogeneity, our approach does not allow to introduce additional regressors which are usually considered in other research (Romero and Britto, 2017; Magacho and McCombie, 2017; Gabrisch, 2019), among which human capital, innovation variables, research intensity, technological gap and the sectoral composition of output.

[xi] However, attention should be paid to the fact that, in Southern regions, the post-crisis period has been generally featured by pronounced negative productivity growth rates and by an exceptional process of capital shrinkage. After 2007, average capital accumulation per worker was -1% in the North, compared to -3% and -4% in the South and Islands macro-regions, respectively. That contributed to productivity stagnation in Northern regions (0.3% yearly) and a productivity decrease (-0.2% yearly) in the Mezzogiorno.

[xii] See Figures A4 and A5 in Appendix A. Source: our elaborations on *Conti Pubblici Territoriali,* Italian Agency for Territorial Cohesion.