Public Investment and the Economic Development of Southern Italy, 1951-1995

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Abstract

The article analyses, for the first time through an econometric model, the contribution of public investment to growth in southern Italy in the second half of the twentieth century (1951-1995). The period saw the only convergence in modern times of the Mezzogiorno towards the Italian average (1951-1973), followed by slow divergence (1974-1995). Using cointegration analysis we find a statistically significant positive effect of public investment on the growth of the Mezzogiorno in the period 1951-1995. According to our estimates, in addition to public investment, both private investments and technical progress gave an important contribute to economic growth. The Bai-Perron tests suggest that economic growth followed two distinct regimes, the first in the years 1951-1973, and the second in the period 1974-1995. This result is confirmed by the testing procedure of Hansen (1992) that indicates a break in the determinants of GDP per unit of labour in 1974. The estimates of the model on time series of the two periods show statistically significant parameters of public investment in the first regimes, but not in the second regime, when economic growth is sustained by business investment and technical change. These findings add econometric evidence to a growing historical and qualitative literature, stressing the positive role of public intervention in the South during the “golden age” as well as its loss of effectiveness since the 1970s, and may have important implications for policy makers.
1. Introduction

Italy’s regional inequalities, and in particular the origins and evolution of its North-South divide, have been vastly debated since the nineteenth century, in the academy and beyond, arguably with no parallels in any other advanced country – not least, for the international appeal (e.g. Carey and Carey, 1955; Banfield, 1958; Carlyle, 1962; Putnam, 1993). The subject continues to be of the utmost importance: judging from the regions eligible for EU cohesion funds, in the latest cycle (2014-2020) no other Western country presents an internal divide as profound as Italy, where most of the South (Campania, Puglia, Basilicata, Calabria, Sicily) is below the 75% PPP per capita GDP threshold, while the rest of the South (Abruzzi, Molise, Sardinia) is between 75 and 90%.\(^1\) The North-South divide remains, therefore, unbridged.\(^2\)

But does this mean that it is unbridgeable? The available updated estimates of regional GDP tell a different story (Felice, 2005; Daniele and Malanima, 2007; Svimez, 2011; Felice and Vecchi, 2015b; Felice, 2015a). The North-South divide, only mild at the time of unification, increased at a slow pace during the liberal age (1861-1911), much more rapidly in the interwar years. After reaching its peak in the aftermath of World War II, it decreased during the "golden age". With the oil crisis, however, southern Italy stopped converging and even fell back again. The changes observed in the second half of the twentieth century – convergence, then paralysis and (slow) divergence again – took place at the same time when a massive State intervention was carried out to develop the South, through the State-owned agency «Cassa per il Mezzogiorno» (1950-1984), or Cassa: while in the 1950s it focused mainly on infrastructures and agricultural works, in the 1950s, 1960s and early 1970s it concentrated on industrial incentives, which mostly went to capital-intensive sectors through State-owned enterprises (Felice, 2007, 2010; Felice and Lepore, 2016). However, by the mid-1970s it had lost effectiveness due to growing political pressure, so much so that it ended in disrepute, favouring unproductive expenses and even organised crime (e.g. Trigilia, 1992; Bevilacqua, 1993; Cafiero, 1996; Felice, Lepore and Palermo, 2015a). After the Cassa had been wound up, public intervention continued in the South through the short-lived Agensud (1986-1992) and other schemes of public incentives in the era of the Second Republic. Both Agensud and the other incentives, however, have been generally regarded as ineffective (Cafiero, 2000; Barca, 2006; Felice, 2007a; Felice, 2013; Prota and Viesti, 2012).

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\(^1\) See the part about regional policy in the European Commission website: http://ec.europa.eu/regional_policy/fr/ (last access on April 2016). Throughout the paper, the Italian Mezzogiorno is made up of the eight southern regions mentioned above.

\(^2\) Milder though, it can be observed also in social indicators: from human capital to the Human Development Index, to inequality and poverty (Vecchi, 2011; Felice and Vasta, 2015; Felice and Vecchi, 2015a).
Recent qualitative analysis suggests a strong correspondence between both the rise and fall of the Cassa per il Mezzogiorno and the convergence and subsequent falling back of southern Italy (Lepore, 2013; Felice and Lepore, 2016). This suggestion notwithstanding, thus far we lack econometric analyses able to corroborate such a correspondence, via linking empirical evidence to growth theories. The present article aims to fill this gap using the available yearly series of public and private investments in southern Italy for the second half of the twentieth century, as well as the reliable regional GDP series from the same sources (SVIMEZ, CRENoS) for the same period. By inquiring into the role of public investments we, indirectly at least, also investigate the role of the Cassa, given that this agency in its life span financed most of public investments; furthermore, from 1957 to the early 1970s (and to a minor degree in the following years) also private investments in the South received a significant contribution by the Cassa, through soft loans and grants.

The present paper investigates the long-run causal relationship between public and private investments and the real GDP from 1951 to 1995 in the Italian Mezzogiorno by adopting the time series approach of cointegration. We provide the first econometric analysis of the factors of the economic development of southern Italy after World War II. A main feature of this analysis is the focus on structural change in economic growth as suggested by a large literature. The application of the Johansen’s (1991) multivariate methodology supports the presence of one long-run cointegrating equation that includes a linear time trend. The estimation of the Vector Error Correction Model (VECM) highlights the weak exogeneity of the determinants of the output per worker in southern Italy. The estimated equilibrium relationship indicates how both public and business investment Granger cause in the long-run the GDP per worker of southern Italy in the period after World War II. Both effects are remarkable, but that of private sector investments is greater (double) that that of government investment. A significant parameter of the trend hints to an important role for technical progress in the same process. These results are confirmed by the estimates we obtain using two alternative single-equation methods which take into account the potential endogeneity of the right-hand variables: Fully Modified OLS (FMOLS) proposed by Phillips and Hansen, (1990) and Dynamic OLS (DOLS) advanced in Saikkonen, (1992) and Stock and Watson, (1993).

The historical period our analysis refers to allowed us to test the hypothesis of a structural break in the Mezzogiorno’s economic growth. This represents another important contribution of the present work. The application of the methods of Bai and Perron (1998; 2003) highlights two different growth regimes during the period after World War II: that of convergence, 1951-1973, and the following period, 1974-1995, when the gap with the Centre-North widened again. This timing of structural change is confirmed by the implementation of the Hansen (1992) testing methodology to the long-run equation relating GDP per unit of labour to public and business capital accumulation. The
application of FMOLS to the same model on the time series of the two distinct regimes says that during the fifties and sixties the successful model of growth of the Mezzogiorno was led by infrastructure investments jointly with a significant contribution of private investments and technical change, while in the following regime structural public intervention lost its efficacy and the economy relied on the business sector, with lower effects.

In the literature, several papers concentrate on the effect of public capital on economic growth in southern Italy using time series starting after the sixties and different econometric methods (e.g., Picci, 1997 and 1999; La Ferrara and Marcellino, 1999; Acconcia and Del Monte, 2000; Bonaglia et al., 2000; Bronzini and Piselli, 2006). The results of this paper are new for the literature that does not consider the performance of the Mezzogiorno economy in the two decades after World War II and disregards the issue of structural change.

The article is organised as follows. Section 2 provides the historical framework: the main features of southern Italy’s economic growth in the second half of the twentieth century are briefly discussed, and the explanatory variables are also illustrated. Section 3 presents the econometric model, and then Section 4 discusses its main results and concludes by summarising the main findings of our analysis. A brief final appendix provides a brief description of the sources, descriptive statistics and correlations for the variables used.
2. The historical framework: data and variables

The empirical analysis refers to the period 1951-1995. Data on GDP, public and private investments and employment for the Italian Mezzogiorno for the period 1951-1983 were published by SVIMEZ (SVIMEZ, 1985). We extended these time series using the rate of change of each variable derived from ISTAT regional accounts for the period 1960-1996. In this way, we obtained time series for real GDP, real public and private investments at constant prices (1970) in thousand millions of lire.

Figure 1 shows the graph of the time series of GDP per worker (the log of ) of southern Italy in the period 1951-1995. The plot highlights the important process of economic development that dramatically improved the standard of living in the region, particularly in the first decades after World War II. The pattern of the per unit of labour GDP growth rate (hereafter \( \Delta y \)) in the Italian Mezzogiorno in the time span of analysis is shown in Figure 2. It is evident from Figure 2 that the mean GDP growth rate is higher from 1952 to the mid-1970s, and lower in the next period. Needless to say, the divide between the two eras is the economic crisis which began in late 1973. Table 1 below shows the descriptive statistics of \( \Delta y \) for the whole period and for the two sub-periods, 1952-1973 and 1974-1995. The mean in the first period (1952-1973) is much higher than that in the second (1974-1995). For the whole period, the max value is consistently found in the first half, and the min value in the second.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>0.034</td>
<td>0.053</td>
<td>0.016</td>
</tr>
<tr>
<td>Max</td>
<td>0.113</td>
<td>0.113</td>
<td>0.054</td>
</tr>
<tr>
<td>Min</td>
<td>-0.046</td>
<td>0.005</td>
<td>-0.046</td>
</tr>
<tr>
<td>Standard Dev</td>
<td>0.029</td>
<td>0.025</td>
<td>0.021</td>
</tr>
</tbody>
</table>

Sources and notes: see text and Table A.1.

The picture of growth presented in Figures 1 and 2 is partly related to the GDP growth pattern of Italy as a whole: considerably higher during the so-called “golden age” (the 1950s and 1960s), than in the subsequent “silver age” (1970s and 1980s) (Toniolo, 2013; Felice, 2015b). Within this broader national framework, however, it is worth noting that southern Italy performed above the Italian average during the golden age (that is, when the growth rate was also higher Italy-wide) and,

\[ X_t = X_{t-1}(1 + g_t). \]

\[ X_{1984} = X_{1983}(1 + g_{1984}), \]

where \( g_{1984} \) is the rate of growth of \( X \) in the year 1983, that we drew from the ISTAT database on regional accounts, 1960-1996. The values of the time series following \( X_{1984} \) were calculated in the same way: \( X_t = X_{t-1}(1 + g_t) \).

\(^1\) Let us denote \( X_t \) one of the variables with data in the period 1951-1983, available from SVIMEZ (1985). We calculated \( X_{1984} \) using the formula: \( X_{1984} = X_{1983}(1 + g_{1984}) \), where \( g_{1984} \) is the rate of growth of \( X \) in the year 1983, that we drew from the ISTAT database on regional accounts, 1960-1996. The values of the time series following \( X_{1984} \) were calculated in the same way: \( X_t = X_{t-1}(1 + g_t) \).
conversely, below the average in the subsequent phase (that is, when the Italian growth rate was lower) (Felice and Vecchi, 2015b). This pattern of growth can be interpreted looking at the post-war structural dynamics in the Mezzogiorno. Figure 3 shows trends of private and public investment that are consistent with the trend of productivity presented in Figure 1.

Throughout this period, a massive scheme of regional development was carried out by the Italian state – the so-called «extraordinary intervention», mostly coinciding with the lifespan of the State-owned agency «Cassa per il Mezzogiorno» (1950-1984) – which was generally regarded as effective in the first part (from the 1950s to the early 1970s), ineffective and even damaging in the second (from the early 1970s to the 1980s). In the first part of its life, the Cassa devoted most of its resources to «direct interventions», which included general and sector-specific infrastructures (mostly aqueducts, roads, drainage and agricultural settlements), plus other minor interventions (railroads, school construction, education and professional training, development assistance, research and development); from 1957 onwards, subsidies to entrepreneurs (grants to agriculture, tourism, craftsmanship, fishing, but above all to industry) grew in importance, reaching about one third of total expenditures from the mid-1960s to the mid-1970s (e.g. La Spina, 2003; Felice, 2007a; Felice and Lepore, 2016). Therefore, the activity of the Cassa affected both public and private investments. Overall, the total expenditures of the Cassa amounted to 0.69 of total Italian GDP in the years 1950-1965, decreased to an average 0.64 in the years 1966-1970, rose again to an average 0.84 in the 1970s, and then finally decreased to an average 0.61 in the early 1980s (Felice and Lepore, 2017). Although in the 1970s the funds allocated through the Cassa reached their peak, however, they lost effectiveness, having come to be strongly affected by political political pressure and nepotism, which resulted into unproductive uses. In the same period, also the convergence of southern Italy came to a halt, and never resumed.

One question often raised in the literature on the effects of public capital on economic growth is the direction of causation that could also be reversed. Indeed, although the decision to invest in infrastructures is usually made by policy makers, it can be easily argued that as the wealth of a country increases, more resources can be spent on public capital. In the context of the present study, the exogeneity of public investment can be justified by important arguments. It is well known (e.g., Fauri, 2010; D’Antone, 1995; Lepore, 2012a, 2013 and 2016) that in the first phase of its reconstruction after World War II Italy took advantage of the funds from international institutions and the USA. A significant share of these resources was allocated to infrastructures in the Mezzogiorno. This is the case of the financial aid of the World Bank to the Cassa per il Mezzogiorno in the 1950s and mid-1960s, after which a large part of the resources for public investment in southern Italy came from the
national budget. In the empirical analysis, we test the hypothesis of the long-run causality between public investments and GDP.

3. Econometric model and results

The contribution of public capital to the process of economic development in the long-run is usually modelled in the context of production functions. In this paper, we assume the aggregate output \(Y\) depends on the state of technology \(A\) and three inputs - private capital \(K\), public capital \(K_g\) and labour \(N\) - according to the following Cobb-Douglas production function with constant returns to scale:

\[
Y = AK^\alpha K_g^\beta N^{1-\alpha-\beta}.
\]  

(1)

Taking logs on both sides of equation (1) yields the following equation:

\[
\ln(y) = \ln(A) + \alpha \ln(k) + \beta \ln(k_g),
\]  

(2)

where lowercase letters indicate variables in per worker terms.

Equation (2) represents the basic model of our econometric analysis. In this framework, we choose to approximate the two capital stock variables with investment data for two reasons. The first relates to the integration properties of the time series of investment and capital. Indeed, it can be noted in the literature that aggregate capital is usually integrated of the second order, whereas production and investment are integrated of order one (Everaert, 2003; Haldrup, 1998; Otto and Voss, 1996). Hence, the estimation of model (2) on data of stock variables could produce a “spurious regression”. This econometric problem has been noted in several papers closely related to this paper as Sturm et al., (1999); Pereira and Andraz, (2005); Herranz (2007), among others, where investment substitutes for capital stock. The second reason refers to the lack of capital stock time series for southern Italy on the period before 1970. Restricting the analysis to the years after 1969 would preclude any statistical approach to structural change in the economic development of the Mezzogiorno, which is one of the main objectives of this paper.

The empirical analysis is conducted on time series of the Italian Mezzogiorno in the period 1951-1995. The economic variables included in model are Real Gross Domestic Product per unit of labour (hereafter \(y\)) which is used as a measure of the economic performance, Real Gross fixed private investments per unit of labour (hereafter \(priv_inv\)) and Real Gross fixed public investments per unit of labor (hereafter \(pub_inv\)).

3.1 Cointegration analysis

The econometric analysis is based on the following model:
\[ \log(y_t) = \gamma + \alpha \log(\text{priv}_{\text{inv}}) + \beta \log(\text{pub}_{\text{inv}}) + u_t. \] (3)

If the Data Generating Process (DGP) of the variables in equation (3) is characterized by a stochastic trend, a cointegration analysis could show the existence of a long-run relationship that can be interpreted as the causal explanation of productivity of the economy of southern Italy.

Accordingly, preliminarily we test for stationarity and order of integration among all variables. We run two unit-root tests: the augmented Dickey–Fuller (ADF) and the Phillips-Perron (PP) test (Phillips and Perron 1988), for both the level and the first differences of all variables (see Table 2). The null hypothesis of both tests is that the variable contains a unit root, and the alternative is that the variable is generated by a stationary process with or without a deterministic trend.

### Table 2. Augmented Dickey-Fuller and Phillips-Perron unit root tests

<table>
<thead>
<tr>
<th>Variable</th>
<th>Level ADF test</th>
<th>Level PP test</th>
<th>First differences ADF test</th>
<th>First differences PP test</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \log(y) )</td>
<td>-0.95 (0.94)</td>
<td>-0.74 (0.96)</td>
<td>-1.98 (0.02)</td>
<td>-5.53 (0.00)</td>
</tr>
<tr>
<td>( \log(\text{priv}_{\text{inv}}) )</td>
<td>-2.36 (0.40)</td>
<td>-2.89 (0.16)</td>
<td>-2.68 (0.00)</td>
<td>-2.80 (0.05)</td>
</tr>
<tr>
<td>( \log(\text{pub}_{\text{inv}}) )</td>
<td>-0.58 (0.97)</td>
<td>-1.04 (0.93)</td>
<td>-2.82 (0.00)</td>
<td>-7.01 (0.00)</td>
</tr>
</tbody>
</table>

Note: p-values in parentheses. Two lags are used for both the tests. Results are robust to the variation of the lag length. In both ADF and PP tests, the associated regression for all the variables in level contains a time trend.

The test statistics suggest the hypothesis of a unit root in the DGP cannot be rejected for the levels of the three variables, while it can be rejected in the case of their first differences. Hence, the time series are probably integrated of order one, I(1).

In this case, one or two cointegrating equations could represent the long-run relationships among the three variables. We apply the Johansen’s (1991) trace test to determine the number of cointegrating equations in a Vector Error Correction Model (VECM) of the relationships among \( \log(y) \), \( \log(\text{pub}_{\text{inv}}) \) and \( \log(\text{priv}_{\text{inv}}) \). In the Johansen procedure, the VAR optimal lag length of one year has been chosen by the standard information criteria. In the VECM we assume a linear trend in the cointegrating relations.

### Table 3. Johansen multivariate cointegration (CE) test

4 Schwarz’s Bayesian information criterion, and the Hannan and Quinn information criterion both indicate one lag order for the VAR, while the Akaike’s information criterion suggests a lag order of four. To save degrees of freedom we choose one lag in our VECM. Cointegration analysis has been performed using STATA 14 statistical software.
The trace test statistics in Table 3 show we cannot reject the hypothesis of a cointegration rank of one, indicating one cointegrating equation at the 0.05 level. Applying the Johansen’s (1992) maximum likelihood estimation method to the VECM specified assuming one lag order and one cointegrating relation provides the parameters of the long-run equation shown in Table 4.

Table 4. Cointegrating equation

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>log(y)</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>log(pub_inv)</td>
<td>-0.181</td>
<td>0.051</td>
<td>-3.54</td>
<td>0.00</td>
</tr>
<tr>
<td>log(priv_inv)</td>
<td>-0.362</td>
<td>0.041</td>
<td>-8.76</td>
<td>0.00</td>
</tr>
<tr>
<td>trend</td>
<td>-0.019</td>
<td>0.00</td>
<td>-17.42</td>
<td>0.00</td>
</tr>
<tr>
<td>constant</td>
<td>-1.176</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

This equation can be interpreted as an estimate of model (3):

\[
\log(y) = 1.176 + 0.019\text{trend} + 0.181\log(\text{pub_inv}) + 0.362 + \log(\text{priv_inv})
\]

In order to complete the cointegration analysis, table 5 below shows the results of a Lagrange multiplier test for the autocorrelation in the residuals of the VECM that we estimated. The null hypothesis of the test is the absence of autocorrelation that we always accept when the test is performed at lags from 1 to 5.

Table 5: Autocorrelation test

<table>
<thead>
<tr>
<th>lag</th>
<th>Chi²</th>
<th>df</th>
<th>Prob &gt; chi²</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>10.02</td>
<td>9</td>
<td>0.34</td>
</tr>
<tr>
<td>2</td>
<td>10.95</td>
<td>9</td>
<td>0.27</td>
</tr>
<tr>
<td>3</td>
<td>14.81</td>
<td>9</td>
<td>0.10</td>
</tr>
<tr>
<td>4</td>
<td>13.04</td>
<td>9</td>
<td>0.16</td>
</tr>
<tr>
<td>5</td>
<td>7.74</td>
<td>9</td>
<td>0.56</td>
</tr>
</tbody>
</table>
The estimates of the VECM provide further useful information over the long-run relationships among the three variables, and are shown in Table 6. Because the VAR has one lag order, the VECM includes the Error Correction Term (ECT) one year lagged, but does not include the short-run dynamics. The adjustment coefficient of the equation for $\Delta \ln(y)$ is negative and statistically significant with absolute value lower than 1. The same coefficients in the other two equations are not statistically significant. These results have useful implications for the interpretation of the estimated cointegrating equation in terms of causal effects. Indeed, statistical inference suggests the ECT enters significantly the equation of output per unit of labour, but does not contribute to the explanation of the two investment variables. Hence, both variables can be considered weakly exogenous for the long-run cointegrating equation.

Table 6. Adjustment coefficients in VECM estimates

<table>
<thead>
<tr>
<th>Equation: $\Delta \ln(y)$</th>
<th>Coefficient</th>
<th>t-Statistic</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>$ECT_{t-1}$</td>
<td>-0.25</td>
<td>-2.84</td>
<td>0.00</td>
</tr>
<tr>
<td>Equation: $\Delta \ln(pub_inv)$</td>
<td>0.54</td>
<td>1.21</td>
<td>0.22</td>
</tr>
<tr>
<td>$ECT_{t-1}$</td>
<td>0.51</td>
<td>1.38</td>
<td>0.17</td>
</tr>
</tbody>
</table>

The application of the Johansen (1995) framework to cointegration analysis suggests the existence of one equilibrium relationship where both public and business investment Granger cause in the long-run the GDP per worker of southern Italy in the period after World War II. Both effects are remarkable, but that of the private sector investments is greater (double) that that of government investment.

Since the same analysis supports the hypothesis of a single cointegrating equation, in the following we will check the robustness of our results by estimating the equilibrium equation (3) using two alternative methods: Fully Modified OLS (FMOLS) of Philips and Hansen (1990), and Dynamic OLS (DOLS) proposed by Saikkonen, (1992) and Stock and Watson, (1993). The FMOLS estimator corrects the single-equation estimates for simultaneity bias and residual autocorrelation that affect OLS in small samples. The same correction is obtained by the DOLS estimator by adding the leads and lags of the first difference of the regressors in the cointegrating equation. Table 7 presents the results of the estimation of equation (3) with both methods. Overall, the estimates confirm the results we have obtained applying the Johansen’s framework. In this single-equation approach the hypothesis

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5 We performed FMOLS and DOLS estimates using the STATA unofficial command cointreg by Wang and Wu (2012).
of cointegration can be tested by performing a test of stationarity of the error correction term derived from FMOLS and DOLS estimates. Table 7 presents the KPSS (Kwiatkowski et al., 1992) test statistic that shows the null hypothesis of stationary residuals cannot be rejected.

The results of the cointegration analysis of model (3) highlight the fundamental role that both public and business capital accumulation played in the process of development of southern Italy in the period 1951-1995. The private sector seems to lead economic growth with the important contribution of state investments in infrastructures. The statistically significant parameter of a linear trend suggests the Mezzogiorno economy grew following a virtuous circle involving physical capital accumulation and technical progress. This picture is coherent with that offered by the literature on the economic history of Italy, where, however, great emphasis is put on two main phases of the process of development in the post-war era, as already argued above in this paper. One of the main hypothesis advanced in the literature ascribes the transition from the “golden age” to the recent low growth period to the lower efficacy of the government structural policies occurred starting with the “oil crisis”. In the following, we will investigate structural change in the Mezzogiorno economy with the instruments offered by dynamic econometric analysis.

Table 7. Dependent variable: Real GDP per unit of labour. FMOLS and DOLS estimates.

<table>
<thead>
<tr>
<th></th>
<th>(1) FMOLS</th>
<th>(2) DOLS</th>
</tr>
</thead>
<tbody>
<tr>
<td>ln(pub_inv)</td>
<td>0.117***</td>
<td>0.167**</td>
</tr>
<tr>
<td></td>
<td>(2.887)</td>
<td>(2.442)</td>
</tr>
<tr>
<td>ln(priv_inv)</td>
<td>0.390***</td>
<td>0.352***</td>
</tr>
<tr>
<td></td>
<td>(10.267)</td>
<td>(6.256)</td>
</tr>
<tr>
<td>trend</td>
<td>0.021***</td>
<td>0.020***</td>
</tr>
<tr>
<td></td>
<td>(20.321)</td>
<td>(15.269)</td>
</tr>
</tbody>
</table>

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Observations</td>
<td>44</td>
<td>42</td>
</tr>
<tr>
<td>KPSS on residuals</td>
<td>0.231</td>
<td>0.328</td>
</tr>
<tr>
<td>KPSS 5% critical value</td>
<td>0.463</td>
<td>0.463</td>
</tr>
<tr>
<td>R²</td>
<td>0.993</td>
<td>0.996</td>
</tr>
</tbody>
</table>

Note. The lead and lag order in DOLS is 1; t statistics in parentheses. The KPSS statistic tests the null hypothesis that the residuals of the regression are stationary; the maximum lag has been chosen by Schwert criterion; the long-run variance of the time series has been calculated using the Quadratic Spectral kernel. ’ p < 0.10, ” p < 0.05, ”” p < 0.01.

3.2 Structural change in the post-war process of development of southern Italy

The bar chart of the time series of the growth rate of real GDP per worker in southern Italy (Figure 2) shows clear evidence of a break in the early 1970s. Indeed, the average growth performance seems to decrease after the first three decades following the end of World War II. This has been widely
reported by those concerned with the effects of government policy on development in the Mezzogiorno. A widely accepted explanation relates it to a less effective (and progressively lower) State involvement in public capital formation and in providing incentives for industrialisation (Barbagallo and Bruno, 1997; Cafiero, 2000; Felice, 2013; Lepore, 2013; Felice and Lepore, 2016). Given the relevance of this issue to the debate and the aim of this paper, we search for statistical evidence that would corroborate the hypothesis that economic growth in the Mezzogiorno after World War II has been characterized by two regimes. Our strategy first searches for the presence and number of breaks in the time series of the southern Italy’s growth rate, then concentrates on structural change in the model of economic growth, focusing on the role of capital (public and private) accumulation.

3.2.1 Breaks in the time series of the growth rate of GDP per worker

In this section, we search for breaks in the growth rate of GDP per unit of labour in the period 1951-1995. We apply the methodology proposed by Bai and Perron (1998; 2003a) that allows a general modelling framework to determine multiple breakpoints in $\Delta y_t$. Accordingly, we assume the variable $\Delta y_t$ follows the model:

$$\Delta y_t = \mu + u_t , \quad t = 1, \ldots, T,$$

where $t$ is a time index and $u_t$ is the random disturbance that can be autocorrelated and heteroscedastic. Structural change in model (2) means the parameter $\mu$ changes because of $m$ breaks:

$$\Delta y_t = \mu_j + u_t , \quad t = T_{j-1} + 1, \ldots, T_j, \quad j = 1, \ldots, m + 1$$

where $j$ denotes the regime, and the convention that $T_0 = 0$ and $T_{m+1} = T$ is used. According to model (3), the time series of value added per worker can be subject to $m$ changes of the drift parameter $\mu$. This econometric model presents two fundamental questions. The first is the determination of $m$. The second is the estimation of the parameter $\mu_j$ in each regime, and the estimation of the unknown break points $T_j$.

Bai and Perron (1998) propose three tests of structural change. The first, $\sup F_T(k)$, tests the null of no structural break versus the alternative of $m=k$ breaks. The second, called Double Maximum Test, refers to the same null hypothesis against the alternative of an unknown number of breaks given an upper bound $M$. Two versions of the test statistic are proposed: $UDmax$ and $WDmax$. The third, $\sup F_T(l + 1|l)$, can be applied to a sequence of tests for $l$ versus $l+1$ breaks. All these tests allow for serially correlated errors and different distributions for the time series and the errors across regimes. Since these tests do not have a standard distribution, Bai and Perron (1998; 2003b) provide simulated critical values. The whole framework is based on the objective of minimising the sum of squared residuals of the model (3). This optimisation problem is constrained by the restriction that the
segments between two break points define regimes with a minimum length, $h$. This constraint has a technical justification (see Bai and Perron, 1998; 2003a) but is also consistent with intuition and econometric practice.\(^6\)

Table 8 presents the results of the application of this procedure to the time series of the rate of growth of productivity in southern Italy. We allow up to three breaks and assume a trimming percentage of 20%, which implies regimes with minimum length of nine years. Equation (3) is estimated under the assumption of heteroskedasticity and serial correlation of the error in each regime.\(^7\) The three tests suggest the rejection of the null of no structural change in favour of the alternative of one break, at a 1% significance level. The procedure also provides the estimate of the year in which structural change occurs: 1974. The estimated parameters of equation (3) are: $\mu = 0.053$ ($t = 12.37$) for the years 1952-1973; $\mu = 0.016$ ($t = 3.90$) for the years 1974-1995.

<table>
<thead>
<tr>
<th>Test</th>
<th>Statistic Value</th>
<th>Critical Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>$supF_T(1)$</td>
<td>46.31***</td>
<td>11.94</td>
</tr>
<tr>
<td>$supF_T(2)$</td>
<td>24.60***</td>
<td>8.77</td>
</tr>
<tr>
<td>$supF_T(3)$</td>
<td>13.11***</td>
<td>6.58</td>
</tr>
<tr>
<td>$UD_{max}$</td>
<td>46.31***</td>
<td>12.02</td>
</tr>
<tr>
<td>$WD_{max}$</td>
<td>46.31***</td>
<td>13.16</td>
</tr>
<tr>
<td>$supF_T(1</td>
<td>0)$</td>
<td>46.31***</td>
</tr>
<tr>
<td>$supF_T(2</td>
<td>1)$</td>
<td>3.91</td>
</tr>
</tbody>
</table>

Note: Critical values from Bai and Perron, 2003b. *** Significance at the 1% level.

### 3.2.2 Structural change in the model of economic growth

In this section, we investigate structural change in the long-run relationship between public and private investment and output per worker taking into account the results of the Bai-Perron tests. We follow the approach proposed by Hansen (1992) to test the stability of cointegrated regression models. As in Hansen (1992), the estimation method is the fully modified OLS. When the break date is known, the $F$ statistic of Hansen (1992) – that corresponds to the classical Chow test - can be used to test the null hypothesis the parameters of the regression equation do not change. If the timing of the break is unknown, the $SupF$ test statistic can be used to test the same null hypothesis. In this case, the sequence of $F$ statistic is calculated for every break year in a subsample derived after the trimming of a share of the first and last observations. In both cases, if the test rejects the null, the alternative is one break

---

\(^6\) The optimization problem described above implies complex computations that Bai and Perron simplify by proposing a sequential algorithm based on dynamic programming. We performed all computations using Eviews 8.1.

\(^7\) Andrews's framework (1991) is followed to construct a covariance matrix consistent to heteroscedasticity and autocorrelation using a quadratic spectral kernel and the "pre-whitening" of the residuals with a VAR(1) model.
in the parameters. The other two statistics proposed by Hansen – $MeanF$ and $L_{c}$ – test the same null hypothesis, but under the alternative hypothesis both assume the parameters can be modelled as a martingale process.

Table 9. Tests for Parameter Stability

<table>
<thead>
<tr>
<th>Test</th>
<th>Statistic</th>
<th>P-value</th>
<th>Critical value at 5%</th>
</tr>
</thead>
<tbody>
<tr>
<td>$SupF$</td>
<td>34.548</td>
<td>0.01</td>
<td>17.3</td>
</tr>
<tr>
<td>$MeanF$</td>
<td>19.596</td>
<td>0.01</td>
<td>7.69</td>
</tr>
<tr>
<td>$L_{c}$</td>
<td>1.995</td>
<td>0.01</td>
<td>0.778</td>
</tr>
</tbody>
</table>

*Note. P-values and asymptotic critical values from Hansen (1992).*

The results of the application of the Hansen’s (1992)\(^8\) testing procedure to the cointegrating equation that we estimated in the previous section, are shown in Table 9. The three statistics take values much bigger than the 5% critical values. Figure 4 displays the line of the sequence of $F$ statistics that lies above the 5% $SupF$ critical value for a large part of the period, and presents its largest value in 1974. Hence, this testing methods for integrated I(1) time series are consistent with those of Bai and Perron (1998) because both suggest that one structural break in the process of economic growth of southern Italy occurred in 1974.

We investigate structural change with the estimation of two distinct models on data of the first regime, 1951-1973, and of the second, 1974-1995. The application of FMOLS to the time series of the two periods provides two really different equations displayed in Table 10. In both regressions, $KPSS$ test suggests the level stationarity of the error-correction term in the VECM of the three variables, which means they are cointegrated.

Table 10. Dependent variable: Real GDP per unit of labour. FMOLS estimates.

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
</tr>
</thead>
</table>

\(^8\) All the calculations have been performed using the R programs of Bruce Hansen, available at his homepage: http://www.ssc.wisc.edu/~bhansen/progs/jbes_92.html. The trimming region of the time series is [0.2, 0.8].
In the first equation, the estimates of the parameters of public and private investment are positive and strongly statistically significant. The State intervention on infrastructures seem to lead the growth process in the first two decades after World War II: the long-run elasticity of output to public investment is close to 20%, although the private sector shows a comparable contribution to growth. The picture changes dramatically under the second regime, 1974-1995. Indeed, estimates highlight how in the period public capital accumulation strongly loses efficacy – the parameter is not statistically significant – while productivity increases because of private investment, whose parameter is significant but half of that of post-war years. The estimates of the trend parameter seem coherent with the general impression given by the two equations. Indeed, they are both significant and positive with a value in the first equation double than that in the second equation. The overall picture that comes out of the cointegration analysis tells of a period of sustained growth of southern Italy in the first two post-war decades that is driven by all the main components of long-term growth: public infrastructure, business investment, and technical progress. In the early seventies, the economic crisis hits Italy as most of the world. Our regression analysis suggests in southern Italy the crisis means strong inefficiency of State intervention and serious difficulties in the business sector.

### 4. Concluding remarks

The article estimates for the first time the contribution of public and private investments to the economic growth of southern Italy in the second half of the twentieth century (1951-1996). The forty-five years under scrutiny can be divided into two different periods: in the first (1951-1973) the growth of per capita GDP in southern Italy was considerably higher, to the extent that those decades were also the only ones, in the entire history of post-unification Italy, when southern Italy managed to converge to the Italian average (Lepore, 2012b; Felice and Vecchi, 2015b); in the years 1974-1996,
conversely, the growth rate of per capita GDP was lower, and even the convergence of southern Italy came to a halt (even though Italy as a whole was also growing at a much slower pace than before) (Toniolo, 2013; Felice, 2015b). In order to analyse the contribution of public and private investments to GDP growth, we estimate a dynamic econometric model on annual time series of the Mezzogiorno economy. In this model, the main explanatory variables are public and private investments.

Our results confirm, for the first time on quantitative grounds, the important role played by public investments for the economic growth of southern Italy, and are in line with hypotheses put forward by previous historical and qualitative studies (Del Monte and Giannola, 1978; Felice and Lepore, 2016). The econometric analysis of structural change in the economic performance of the Mezzogiorno produces, for the first time in the literature, the estimates of two distinct models of growth before and after the year 1974. In the first period, all the main determinants of economic growth seem to drive southern Italy out of underdevelopment. In this process, state intervention on infrastructures is the leading factor. The same estimates show the dramatic change in the process of growth started with the oil crisis. The main finding of this analysis is the irrelevant effect of structural public policy on the economic performance of the Mezzogiorno, that relied on investments of the business sector.

This broad result has a further, important qualification. When running structural breaks, we observe that there are relevant differences in the effect of public investments between the two periods: it was positive in the first period (1951-1973), not significant in the second (1974-1995). This too is an important finding, confirming on aggregate and econometric terms what a vast literature, based on case studies or from qualitative grounds, has also maintained: that public intervention was effective only during the “golden age”, while from the 1970s onward it lost its effectiveness due to misallocations and unproductive uses. This conclusion has been put forward with particular reference to the Cassa per il Mezzogiorno, which among other things played a significant role in public investments especially in the first period (Felice and Lepore, 2017); now, it is confirmed also for public intervention as a whole.

Our results have important implications also beyond academia, for policy makers, especially when considered together with the main findings from historical or qualitative analyses about public intervention in southern Italy. The main conclusion to be drawn is that public investments can either be positive, ineffectual or even negative for economic growth, crucially depending on the way they are made and the macro-economic setting they operate in. More specifically for Italy, the literature on public intervention and the economic history of the Mezzogiorno in the second half of the twentieth century (e.g. Trigilia, 1992; Felice, 2007a; Felice and Lepore, 2017) provide useful insights not only
into the preconditions for success during the economic miracle – impermeability to clientelistic pressures, separation from and complementariness to ordinary administration, consistency with an encompassing development strategy based on infrastructures and industry – but also into the reasons behind the subsequent ineffectiveness or even counter-productiveness; to these, we had that a further reason could be the decline of extraordinary interventions in favour of ordinary ones. Long-run econometric analyses proposed for other countries, such as that on the role of infrastructural investments for Spain (1850-1935), also confirm that the impact of public intervention may significantly vary according to typology and allocation criteria (Herranz-Loncán, 2007).

It goes without saying that further research would be invaluable in order to corroborate or qualify our findings. At a higher territorial breakdown, it would be possible to replicate the econometric analyses for each region in southern Italy, following recent economic history studies which have pointed out significant differences in the qualities and strategies of public intervention in the second half of the twentieth century (Felice, 2007b; Felice, Lepore and Palermo, 2015b), as well as in the patterns of economic growth among the southern regions.
References


Bom, P. R., & Ligthart, J. E. (2014). What have we learned from three decades of research on the productivity of public capital?. *Journal of economic surveys*, 28(5), 889-916.


Lepore, A. (2013). La Cassa per il Mezzogiorno e la Banca Mondiale. Un modello per lo sviluppo economico italiano. Rubbettino: Soveria Mannelli, CZ.


Appendix

Table A.1. Description and sources of the variables

<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>$pub_{inv}$</td>
<td>Per unit of labour public investments in the Italian Mezzogiorno, 1951-1995 (at constant prices in Italian lire 1970). Sources: SVIMEZ; CRENoS.</td>
<td>Source: SVIMEZ; CRENoS.</td>
</tr>
<tr>
<td>$ln(pri_{inv})$</td>
<td>Per unit of labour private investments in the Italian Mezzogiorno, 1951-1995 (at constant prices in Italian lire 1970). Sources: SVIMEZ; CRENoS.</td>
<td>Source: SVIMEZ; CRENoS.</td>
</tr>
</tbody>
</table>

Table A.2. Descriptive statistics of the variables

<table>
<thead>
<tr>
<th>Variable</th>
<th>No. obs</th>
<th>Mean</th>
<th>SD</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>$ln(y)$</td>
<td>45</td>
<td>0.84</td>
<td>0.47</td>
<td>-0.11</td>
<td>1.42</td>
</tr>
<tr>
<td>$ln(pub_{inv})$</td>
<td>45</td>
<td>-2.71</td>
<td>0.37</td>
<td>-3.49</td>
<td>-2.26</td>
</tr>
<tr>
<td>$ln(pri_{inv})$</td>
<td>45</td>
<td>-0.83</td>
<td>0.49</td>
<td>-2.27</td>
<td>-0.10</td>
</tr>
</tbody>
</table>
**Figure 1.** Per unit of labour GDP of the Italian Mezzogiorno, 1951-1995

**Figure 2.** Per unit of labour GDP growth rate of the Italian Mezzogiorno, 1952-1995

Sources and notes: see text and Table A.1.
Figure 3. Private Investment per unit of labour and Public Investment per unit of labour in the Italian Mezzogiorno, 1951-1995

Figure 4. Hansen tests of structural change in the cointegration equation of GDP per worker