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NETWORK EFFECTS OF PUBLIC TRANSPORT INFRASTRUCTURE: EVIDENCE ON ITALIAN REGIONS

by Valter Di Giacinto[♠], Giacinto Micucci[♦] and Pasqualino Montanaro[♦]

Abstract

This paper contributes to the empirical literature on the magnitude of the network effects of public infrastructures, introducing a novel approach. After estimating the dynamics common to time series for the regional public capital stock, coordinated policy shocks are identified within a properly specified structural VEC model. The findings confirm previous evidence that transport infrastructures exert positive macroeconomic effects in the long run. At the same time, it is shown that this effect is attributable mostly to the impact of coordinated public policy shocks, as the literature on network externalities predicts.

JEL Classification: C32, E61, H54, R42, R53.
Keywords: public capital, transport infrastructure, public policy coordination, network externalities, VEC model.

Contents

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1. Introduction[1]

A massive strand of literature, pioneered by Aschauer (1989a, 1989b), has analyzed the economic impact of public infrastructure. Even though the evidence is somewhat mixed, two shared results have emerged so far: the relevance of public capital as a factor spurring growth and the existence of significant spillover effects between neighboring geographical areas. In their turn, the strong network externalities connoting many infrastructures call for a proper consideration of the coordination issue.

The theoretical literature has pointed out that the overall returns of infrastructure investments may depend on whether investment choices are *coordinated*, i.e. explicitly aimed at achieving greater positive network externalities, or not, hence focusing strictly on local objectives. This feature yields strong policy implications, if one demonstrates that the macroeconomic effects of coordinated expenditure actually outbalance those of local and non-coordinated (idiosyncratic) expenditure, the difference being what we call here *network effects*. In this paper we address this issue with reference to the Italian economy, introducing a novel methodological approach and focusing on public transport infrastructure (owing to its peculiar network nature).

While the theoretical argument is largely undisputed, empirical evidence in this field is still scant. In this paper we contribute to the empirical literature by providing an estimate of the network effects of public investment for the Italian regions. In order to do this, we preliminarily have to define what the "coordinated part" of public capital is and under what conditions it is possible to estimate it.

Integrated and mutually consistent regional investment policies may be observed either when decisions are jointly agreed by different and autonomous local authorities or when investment choices are centralized at the national Government level, as might be the case for major projects of national interest (for Italy, consider the so-called *Grandi opere*, based on Italian Law no. 443 of December 21, 2001). While the institutional arrangements are clearly different in the two cases, the implications for the scope of network externalities are broadly the same, so that they will both be treated as examples of coordinated investment policies in the present paper.

[1] We greatly benefited from valuable comments by Fabrizio Balassone, Sergio Destefanis, Paolo Sestito, Andreas Stephan and other participants at seminars held in the Bank of Italy and at the 50° ERSA Congress held in Jönkoping (Sweden). We are grateful to Andrea Filippone for having provided updated private capital series. The responsibility for the contents of the paper rests with the authors and not with the Bank of Italy. For correspondence: P. Montanaro, Bank of Italy, Regional Economic Research Unit, Branch of Ancona, Piazza Kennedy 9, 60122 Ancona (Italy), tel.: +39 0712285223, fax: +39 0712285276, e-mail: pasqualino.montanaro@bancaditalia.it.

Detailed statistical evidence on the decision process underlying observed public capital expenditure flows is usually not collected and, consequently, time series regarding coordinated and non-coordinated investment policies are not separately available. To overcome this shortcoming, we set forth the following two-stage empirical strategy.

In the first stage, we decompose the individual regional time series of the public transport infrastructure stock into *common* and *idiosyncratic* components, by implementing the common factor methodology recently put forward by Bai and Ng (2004), within their PANIC (Panel Analysis of Non-stationarity in Idiosyncratic and Common components) approach to unit roots and cointegration on panel data.

The common components obtained via the PANIC procedure do not immediately qualify as effective proxies of coordinated capital accumulation policies, as they are clearly affected by other sources of common disturbances, which can be broadly classified in *endogenous* and *spuriously exogenous* comovement effects. Endogenous comovement is mainly related to the response of public policy at the regional level to common macroeconomic fluctuations, while spurious exogenous comovement may arise when autonomous local policy actions happen to occur jointly due to some underlying synchronization mechanism not related to any coordination/centralization of policy decisions.

Identification of coordinated policy actions is obtained in the second stage, when the common components yielded by the PANIC procedure are utilized to estimate a set of properly specified VEC (Vector Error Correction) models for each Italian region. Within regional VEC models, the responses of main macro variables to coordinated and idiosyncratic shocks to public capital are separately identified under largely unrestrictive assumptions.

By comparing the responses of GDP to the two types of policy shocks, some empirical evidence on the existence and the magnitude of network externalities is finally drawn.

Both coordinated and idiosyncratic investments in infrastructure are found out to exert a positive impact on GDP in the long run. However, as predicted by the literature on network externalities, the estimated impact of coordinated investment is substantially higher.

The remainder of the paper is organized as follows. In Section 2 a review of the related literature is presented and more detailed motivations for the opportunity of focusing on the issue of policy coordination are given. In Section 3 the empirical identification strategy is outlined. The two-stage methodological approach is then detailed in Section 4. Section 5 describes the public capital (transport infrastructure) data set utilized in the analysis. Section 6 is subsequently devoted to the empirical implementation of the model and to some robustness checks. Section 7 summarizes and concludes.

2. Related literature and motivations for the research

2.1 The macroeconomic effects of infrastructures

Starting from the idea that the slowdown of the American economy during the seventies and eighties was precipitated by declining rates of public capital investment, Aschauer (1989a, 1989b) and Munnell (1990a) studied the contribution of public capital to productivity and growth. Their studies showed a very large impact of public capital, with a higher marginal productivity compared to private capital. These results seemed implausible and stimulated prompt reactions. Critics charged that the above mentioned analyses overstated the contribution of public infrastructure by not taking into account spurious correlation effects due to common trends in the variables, by omitting some relevant factors and neglecting the complex nexus of directions of causality.

While the first studies by Aschauer and Munnell focused on data aggregated at the national level, subsequent analyses started to exploit panel data at the state and regional level, which allow to control for spatial fixed effects and common time trends, while exploiting samples large enough to produce more reliable estimates. Notwithstanding the variety of results, the studies based on spatially disaggregated data sets consistently reported lower estimates of the returns to public capital investment in comparison with studies based on national time series (Munnell, 1990b; Eberts, 1990; Lynde and Richmond, 1992; Garcia-Milà, McGuire and Porter, 1996).

This evidence has been demanding for an interpretation. A convincing explanation may have to do with spillover effects of public infrastructure, i.e. effects spreading out spatially across states/regions different from those where the infrastructure is located. In a more general economic framework, sign and magnitude of such spillover effects have been shown to depend on the local competition level and the mobility of input factors. It has been argued that infrastructures might eventually generate also negative spillovers on a strictly local basis, when investment in one location draws resources (and therefore production) away from neighboring locations, by enhancing local comparative advantage (Boarnet, 1998).

The measurement of spatial spillovers has been empirically addressed by implementing a number of different approaches. In a first stage, Holtz-Eakin (1994) used an "indirect test" (a definition due to Álvarez, Arias and Orea, 2006), estimating the same model at different levels of geographical aggregation and arguing for the existence of spatial spillovers from the different results obtained. Subsequently, in their seminal work Holtz-Eakin and Schwartz (1995) carried out a statistical test of the hypothesis of the presence of spatial spillovers comparing the estimated public capital coefficient in two models, the second of which includes the spatial lag of public capital, i.e. a measure of the average capital stock in neighboring areas (Álvarez, Arias and Orea, 2006 refer to this test as a "pseudo" one, because there is no way to properly statistically test the equality of the two coefficients). Moving from Holtz-Eakin and Schwartz (1995), empirical models have been progressively enriched by adopting spatial econometric techniques, which explicitly take into account that a specific area may benefit from public capital endowment either in the same area (*internal* capital) or in other areas (*external* capital).

The evidence gained from the literature adopting a spatial econometric framework is somewhat mixed (see also the reviews by Creel and Poilon, 2008, and Jiwattanakulpaisarn, 2008). With regards to the United States, positive spatial spillovers from infrastructure endowments (usually highways) are found by Dalenberg, Partridge and Rickman (1998), Pereira and Andraz (2004); negative by Boarnet (1998), Cohen and Paul (2003 and 2004), Slaboda and Yao (2008), Gillen and Haynes (2001) and Ozbay, Ozmen-Ertekin and Berechman (2007); finally, in a number of cases only insignificant effects are reported (Garcia-Milà and McGuire, 1992; Holtz-Eakin and Schwartz, 1995; Garcia-Milà, McGuire, and Porter, 1996; Kelejian and Robinson, 1997; Berechman, Ozmen-Ertekin and Ozbay, 2006; Monaco and Cohen, 2006). In part, these contrasting results may be attributed to the type of infrastructure analysed. In particular, Cohen and Morrison Paul (2003) show that airport expansion in connected states has a comparable effect across states hosting hub airports and an even greater impact on remaining states. The same authors reaffirm the existence of spatial spillovers in a second paper (Cohen and Morrison Paul, 2004) that analyzes the impact of the highways capital stock. Similar results do not apply for port infrastructure: Monaco and Cohen (2006) study the geographical scope of ports, finding that US states benefit from an increase in their own port infrastructure but they do not gain from a similar expansion in contiguous states. However, apart from being affected by the type of infrastructure analysed (and, of course, by which countries and periods are considered), econometric results also appear to depend on the range of statistical techniques adopted.

A number of empirical studies have focused on European countries. A clear consensus lacks in the case of the Spanish economy, positive spatial spillovers being detected by Mas et al. (1996), Pereira and Roca-Sagalés (2003), Cantos, Gumbau-Albert and Maudos (2005), Ezcurra *et al.* (2005), while not significant coefficients or mixed results are obtained by Álvarez, Arias and Orea (2006), Martinez-Lopez (2006), Delgado and Álvarez (2007) and Moreno and López-Bazo (2007). For Italy, Bronzini and Piselli (2009), adopting a production function approach, find that regional productivity is positively affected by public infrastructure installed in neighboring regions. Finally, Bouvet (2007) finds positive spillover effects for a large sample of European countries.

In parallel with the use of more disaggregated data at the geographical level, researchers have also introduced more advanced econometric techniques, such as the cointegrated vector autoregressive (VAR) models, in order to address the complex nexus of links and feedbacks among the set of endogenous variables. However, these two strands have progressed separately, owing to the difficulty to reconcile VAR techniques with spatial econometrics issues.

The use of VAR models has gradually became standard in the empirical literature in order to study the complex channels through which public capital affects output and growth in a general equilibrium context (Baxter and King, 1993): directly, because investment in public capital is part of GDP; or indirectly, because public capital may influence other inputs, such as labour and private capital. At the same time, private inputs (labour and capital) may also influence public capital formation (e.g. more private investment may increase taxable income, boosting in government resources and consequently public expenditure). The VAR approach does not impose strong a priori restrictions on the dynamics of the process, allowing for both direct and indirect linkages between the model variables. Dynamic feedbacks are essential to better understanding the relationship between public capital and economic performance, since public capital may affect output either directly as an additional input in the production function or indirectly via its effects on private inputs, such as capital and labour. Studies adopting this approach mostly show a positive long-run response of output to a shock in public capital. Kamps (2005), for a group of OECD countries including Italy, find a positive long-run elasticity of public capital with respect to private capital, a negative effect on employment, and a positive albeit not significant effect on GDP. In an analysis of Italian regions, Di Giacinto, Micucci and Montanaro (2010) document a positive contribution of the public capital to output in all geographical areas of the Country.

To our knowledge, so far Pereira and Roca-Sagalés (2003) represents the only study aiming at estimating spatial spillover effects in a VAR framework. They find that the contribution of public capital to GDP growth in Spanish regions may be almost equally traced back to capital installed either within a certain region or in the rest of the country.

The approach of Pereira and Roca-Sagalés (2003) shares a number of features in common with the methodology set forth in the present paper, although we shift the focus on *coordinated* vs. *idiosyncratic* public capital accumulation decisions, instead of *internal* vs. *external* to the region. Our choice is grounded both on theoretical and policy arguments, as detailed in the next subsection.

2.2 The difference between network and spillover effects

The crucial point here is what we intend for *spillover* effects and what for *network* effects. In our view, we have to distinguish between the two concepts, specifically addressing here the latter, which in its turn calls for the issue of coordination (or centralization) of the expenditure decisions.[2]

Since many infrastructures have network characteristics, the intensity of their spatial effects is influenced by the degree of coordination of policy decisions about where and when to invest. As a matter of fact, in absence of coordination the level of investment in public infrastructure might result either too high or too low. As infrastructure investment may alter the distribution of economic activity across regions, certain models emphasize the risk in having an excess of infrastructures in neighboring competing areas (Haughwout, 2002; Romp and de Haan, 2005). Moreover, non-coordinated decisions could probably produce negative effects (negative externalities) on the neighboring regions. On the other side, coordination is needed when aiming at maximizing the overall welfare level, instead of that of single areas (Schiff and Winters, 2002; Cárcamo-Díaz and Goddard, 2007).

The following example may help to clarify the difference between network and spillover effects. Consider two adjacent regions (or Governments) having to decide whether to make an infrastructure (i.e. a road) or not. Each country has the possibility to invest on its own. If the region A decides to invest, it can get a net benefit equal to, say, $\mathbf{W_A}$, while region B reaps an indirect net effect equal to $\mathbf{X_A}$. Symmetrically, if only B makes the infrastructure, it obtains a benefit equal to $\mathbf{W_B}$, while A gains $\mathbf{X_B}$ (see

2 In Italy public expenditure management involves both central and sub-national authorities, even though with differing proportions. At the same time, constitutional reforms aim at providing more resources and decisional powers to sub-national levels of government (*Regioni*). Sub-national competition for economic activity can enhance efficiency, but also be counterproductive and wasteful, so that coordinative frameworks of rules and organizations need to be developed.

Table A). Given that in both cases the regions are assumed to act in an uncoordinated way, the **W** terms may provide a measure of the (net) internal return from strictly *idiosyncratic* investment decisions, while the **X** term may provide a measure of *spillover* effects.

Table A

	Net benefit region A	Net benefit region B
1. Investment only in region A	W_A	X_A
Investment only in region B	X_B	W_B
2. Investment in both regions <u>without</u> coordination	$W_A + X_B$	$W_B + X_A$
3. Investment in both regions <u>with</u> coordination	$P + W_A + X_B$	$P + W_B + X_A$

The above taxonomy mainly and freely draws on Cárcamo-Díaz and Goddard (2007).

There is a second case, in which both regions simultaneously decide to invest on the infrastructure, but *without any coordination scheme*. In other words, each region invests autonomously, without exploring the possibility of acting in concert with the other in order to find a solution yielding a higher utility level to both parties. In this case, the region A would obtain a benefit equal to $\mathbf{W_A}$, i.e. the (net) effect of its own investment (or idiosyncratic component of investment) plus $\mathbf{X_B}$, i.e. the (net) spillover effect of investment made in the neighboring region B. Symmetrically, region B gets $\mathbf{W_B}$ plus $\mathbf{X_A}$ (Table A).

Finally, there is the case of our interest, in which the two regions proceed *in a coordinated way*, *each* exploring the possibility to act in concert with the other in order to select, among the alternative choices, the one with the highest common utility (in the road infrastructure example, they may decide to jointly expand the individual regional networks in a manner that fosters the integration between them). In this case, both regions can now get a higher overall benefit, as the sum of the return they would have received by investing on their own (**W**), plus the spillover effect **X** plus an additional benefit **P** (*coordination premium*), capturing the potential for maximizing positive network externalities that only coordinated action entails (Table A).

It is immediate to notice how the same result can be obtained if the investment decision is conferred to a Central Government which aims at maximizing aggregate investment returns across the regions, an institutional arrangement that is often observed in practice for 'major projects' of national interest. In other words, "centralization" can be thought to provide an equivalent solution to the coordination problem, so that one could refer to **P** as a *centralization premium* too.

For each region, by comparing estimates under cases n. 1 (returns to idiosyncratic infrastructure investment, equal to **W**) and n. 3 (gross return to coordinated infrastructure investment, equal to **P**+**W**+**X**) in Table A, our empirical strategy aims at providing an indirect assessment of the *total network effects* of public infrastructure investment, as the sum of the *coordination/centralization premium* (**P**) and any additional spillover effects (**X**).

Even though it could be theoretically interesting to obtain separate empirical estimates of **P** and **X**, we are not able to provide such a distinction with the methodological approach set forth in the present paper and consequently we leave this development for future research. However, from the policy-maker point of view, the total gain (**P**+**X**) deriving from coordinated/centralized action is actually the relevant measure, as it provides a comprehensive assessment of all the welfare losses that are going to be incurred if proper coordination mechanisms, involving either central or local authorities, cannot be effectively put in place.

3. The empirical strategy

In this section we outline the empirical strategy underlying our approach to the identification of coordinated policy action, moving from observed regional infrastructure expenditure flows. Since coordination implies joint actions of all the regional players, correlation (comovement) of the regional expenditure flows may be deemed to provide some evidence that a coordination mechanism is in place. However, even though coordination is one of the possible reasons why regional public capital series may evolve synchronically, alternative factors can equally explain such occurrence.

As a starting point, consider the following decomposition of the observed regional public capital formation series (referred to as ΔK_{it}^{g}):

$$\Delta K_{it}^{g} = CC_{it} + IC_{it} \tag{1}$$

where the *i* and *t* suffixes refer to the region and the time period, respectively, and where CC_{it} and IC_{it} are two random variables representing the common (*CC*) and the idiosyncratic components (*IC*) of the regional public capital series. The second order moments of the two random components are assumed to have the following properties:

$$
\begin{aligned}
&COV(CC_{it}, CC_{jt}) = \gamma_{ij} \neq 0 \\
&COV(IC_{it}, IC_{jt}) = \psi > 0, \text{ if } i = j \\
&COV(IC_{it}, IC_{jt}) = 0, \text{ if } i \neq j \\
&COV(CC_{it}, IC_{jt}) = 0, \ \forall i, j
\end{aligned}
\tag{2}
$$

stating that CC is correlated across regions, while IC is uncorrelated cross-section and orthogonal to CC by assumption.

In its turn, the common component may be further decomposed into an endogenous component (CC^{end}), reflecting the response of regional public expenditure to macro evolutions at the national or international level, and an exogenous component (CC^{exog}), that is assumed to be unrelated to the former, capturing the share of public infrastructure expenditure which is actually the result of autonomous policy decisions:

$$CC_{it} = CC_{it}^{end} + CC_{it}^{exog} . \tag{3}$$

As an example of common factors that are likely to induce synchronized policy reactions across regions, we may consider the cases of exchange rate fluctuations and changes in the monetary policy refinancing rate or in commodity prices. *GDP* and the tax revenue would be simultaneously affected in all regions and, assuming that local public expenditure does react to changes in macroeconomic conditions, the endogenous response of regional investment to these common shocks may induce a degree of comovement across regional capital expenditures, totally unrelated to any form of policy coordination. Assuming that the endogenous common component can be separately identified, purging CC from such component would thus yield a residual that only reflects *strictly exogenous* policy decisions.

Comovement between strictly exogenous policy actions, however, may be induced by mechanisms other than policy coordination. In order to take this problem into account, we introduce a further decomposition:

$$CC_{it}^{exog} = CC_{it}^{coord} + CC_{it}^{spur} \tag{4}$$

where the first term on the RHS represents the part of the exogenous regional capital expenditure decisions reflecting *strictly coordinated* policy actions and the second term, assumed to be orthogonal to the former, identifies the possible existence of spurious comovement across exogenous regional policy decisions.

An important source of spurious policy comovement may be related to political business cycle effects (PBC; Nordhaus, 1975), which are driven by economic decisions of incumbent politicians aiming at increasing the probability of being re-elected (Dixit, 1996; Drazen, 2000; Persson and Tabellini, 2000; Grossman and Helpman, 2001, Cadot, Roller and Stephan, 2006).

Considering that general and regional elections are commonly held on the same dates within a given country, as long as the political incumbents try to facilitate re-election through an expansion of both current and capital expenditure, the coincidence of election dates across regions may result in comovement across the regional public capital aggregates that is unrelated to any form of policy coordination.

When available, knowledge about the mechanism generating this type of spurious correlation across regional public policies may allow the researcher to design a proper empirical strategy in order to control for such confounding factor. To remain within the political business cycle example, knowledge about the dates of the national and regional polls may provide the additional source of information to be exploited for identification purposes.

In analytical terms, the empirical identification strategy outlined above may be summarized by means of the following two simple equations:

$$CC_{it}^{end} = \theta_i ' \zeta_{it-1} \tag{5}$$

$$CC_{it}^{spur} = \beta_i ' \xi_t \tag{6}$$

Equation (5) identifies essentially a policy reaction function, relating the endogenous response of public capital expenditure to the lagged values of the random variables included in the vector ζ, which is assumed to contain all the relevant information on common macroeconomic disturbances affecting the *i*-th region. A linear functional form is assumed for analytical convenience.

The vector ζ is allowed to contain endogenous variables, namely aggregates like GDP, which are arguably affected by public capital expenditure decisions. Identification of the CC^{end} component thus requires some additional assumptions. Our a priori restriction states that policy reaction takes at least a one period lag to be transmitted to public capital expenditure. Considering the long delays denoting public policy implementation – usually well beyond a single year in the case of public infrastructure investment – this assumption does not appear to be particularly binding and in line with the empirical literature that uses structural vector auto-regressions to estimate the macroeconomic effects of public capital accumulation (see Section 4.2).

One may argue that purging CC from the endogenous component is at risk of removing investment decisions adopted in a coordinated way in response to macro evolutions (for example, when all the regions jointly decide to expand capital expenditure in a negative business cycle). However, since only systematic – and hence predictable – responses are captured by the endogenous component, when regional authorities *discretionally* decide to coordinate investment decisions under specific business cycle conditions, their investment choices could not have been anticipated and hence they are not included in the CC^{end} component.

Identification of the spurious exogenous common component CC^{spur} in the equation (6) is obtained along similar lines, but in this case the vector of auxiliary variables ξ is assumed to contain only strictly exogenous variables. For instance, in the example of PBC effects the ξ variables may be specified as a set of dummy variables marking the years when general or regional elections are held.

Also in this case, one may argue that purging CC^{exog} from the PBC effects is at risk of inducing an over-correction when a part of the coordinated investment is undertaken during electoral years. However, as in the case of the CC^{end} component, it has to be remarked that only the fraction of coordinated infrastructure investment that is related to the PBC in a systematic – and hence predictable – way would be captured by the CC^{exog} component. As a consequence, the risk of over-correction should actually be fairly limited, being largely outbalanced by the gains in terms of a better identification of strictly coordinated policy actions.

Once the CC^{end} and CC^{spur} components have been identified, the coordinated component of CC is identified by equations (3) and (4) and by the orthogonality assumption postulated for all unobservable common components. It can be finally computed as:

$$CC_{it}^{coord} = CC_{it} - CC_{it}^{end} - CC_{it}^{spur} = CC_{it} - \theta_i'\zeta_{it-1} - \beta_i'\xi_t \ . \qquad (7)$$

To implement the empirical strategy outlined in this section, sample estimates of the common components CC are required first. The specification and estimation of an empirical equivalent of equation (7) is subsequently required.

4. The methodological approach

This section details the two-stage methodological approach we propose in order to achieve the identification of coordinated and non-coordinated policy shocks affecting public infrastructure accumulation.

4.1 Extracting the common components

In this section the issue of the estimation of the common components from regional public capital panel data is dealt with by implementing the common factor model recently put forward by Bai and Ng (2004) within their PANIC (Panel Analysis of Non-stationarity in Idiosyncratic and Common components) approach. Among the number of static and dynamic factor models proposed in the literature referring to panel data where both the cross-sectional and time series dimensions are large, the Bai and Ng approach appears to stand out for generality, as no prior assumption is made according to the order of integration of common and idiosyncratic components, and ease of implementation.

Costantini and Destefanis (2009) recently applied the PANIC technique to Italian regional panel data which share many features in common with the data utilized in our empirical analysis. The authors find that a limited number of common factors underlie the dynamics of the regional series of *GDP* and other private sector aggregates.

Following Bai and Ng (2004) we assume the following factor structure for the K^g series:

$$K_{it}^{g} = T_{it} + \lambda_i ' F_t + e_{it}\,, \quad i=1,\dots,N,\ t=1,\dots,T \qquad (8)$$

where:

- T_{it} is a region-specific deterministic trend;
- F_t is an $r \times 1$ vector of common factors ($r < N$);
- λ_i is a corresponding vector of factor loadings;
- e_{it} is an idiosyncratic residual, assumed to be orthogonal to F_t but possibly weakly correlated across regions;
- standard identifying restrictions, like the orthonormality of common factors and the orthogonality of F_t and e_{it}, are assumed.

The term $\tilde{K}_{it}^{g} = \lambda_i' F_t$ identifies the common component of the K_{it}^{g} series and is assumed to account for the comovement across individual regional K_{it}^{g} series. To provide a direct link with the notation introduced in Section 3, note that the common component *CC* of regional public capital formation in equation (1) can be obtained from $\tilde{K}_{it}^{g}$ by simply taking first differences, i.e. $\Delta\tilde{K}_{it}^{g} = CC$.

Even if not directly observable, the vector of common factors F_t in (8) can be inferred from the data conditionally on the correct selection of the number *r* of common factors. The derivation of information criteria allowing for the consistent selection of the dimension of the factors space in a panel data environment where both *N* and *T* are large is dealt with in Bai and Ng (2002). In the context of the PANIC procedure for unit root testing in panel data with a factor structure, Bai and Ng (2004) subsequently derive consistent estimators of unobservable common factors – up to an arbitrary additive constant – and factor loadings by applying principal components analysis to first differences of the data. Asymptotic results are shown to hold when both the cross section and time series dimensions of the panel grow large.

Letting $\hat{F}_t$ and $\hat{\lambda}_i$ denote the Bai and Ng (2004) estimators of F_t and λ_i, the estimated common component of the public capital stock in region *i* can be computed as $\hat{\tilde{K}}_{it}^{g} = \hat{\lambda}_i' \hat{F}_t$.

4.2 *Identifying coordinated and idiosyncratic shocks*

Once consistent estimates of the common components of the regional public capital stock are available, the empirical implementation of the identification strategy outlined in Section 3 hinges on the recent structural VAR (Vector Auto-Regressive) approach to the assessment of macroeconomic effects of public capital expenditure (Pereira, 2000; Pereira and Roca-Sagalés, 2003; Kamps, 2005; Di Giacinto, Micucci and Montanaro, 2010).

In the structural VAR literature the effects of public investment policy are measured by the dynamic response of GDP, employment and private capital to properly identified exogenous shocks to public capital expenditure.

The VAR system usually considered involves four endogenous variables: *GDP* (*Y*), private capital stock (K^p), public capital stock (K^g) and employment (*L*, possibly augmented to allow for human capital accumulation), that are allowed to be cointegrated.

Assuming that the lag order is equal to p>0, the four equations VAR model in levels for *i*-th region can be stated as follows:

$$X_{it} = A_1 X_{it-1} + A_2 X_{it-2} + \ldots + A_p X_{it-p} + \Phi D_{it} + \varepsilon_{it} \qquad (9)$$

where $X_{it} = [K_{it}^g, K_{it}^p, L_{it}, Y_{it}]'$, ε_{it} is a white noise process with covariance matrix $E(\varepsilon_{it}\varepsilon_{it}') = \Omega_i$ and where D_{it} is a set of deterministic variables, possibly including constant and trend terms.

When individual time series are non-stationary – because of the presence of unit roots, but cointegrated – the system is usually written in the equivalent VEC (Vector Error Correction) form:

$$\Delta X_{it} = \Pi X_{it-1} + \Gamma_1 \Delta X_{it-1} + \Gamma_2 \Delta X_{it-2} + \ldots + \Gamma_{p-1} \Delta X_{it-p+1} + \Phi D_{it} + \varepsilon_{it} \qquad (10)$$

where the Π matrix has rank $\rho<4$.

In order to separately identify coordinated and idiosyncratic policy shocks to public capital accumulation, we work with the following extended VEC model:

$$\Delta Z_{it} = \tilde{\Pi} Z_{it-1} + \tilde{\Gamma}_1 \Delta Z_{it-1} + \tilde{\Gamma}_2 \Delta Z_{it-2} + \ldots + \tilde{\Gamma}_{p-1} \Delta Z_{it-p+1} + \tilde{\Phi} D_{it} + \beta' \xi_t + \eta_{it} \qquad (11)$$

where $Z_{it} = [\tilde{K}_{it}^g, K_{it}^g, K_{it}^p, L_{it}, Y_{it}]'$ and η_{it} is a vector of reduced form residuals assumed to evolve as a multivariate *white-noise* process with covariance matrix $E(\eta_{it}\eta_{it}') = \Sigma_i$.

Compared to the standard specification, the VEC model in (11) is extended by expanding the sets of both endogenous and exogenous variables. Endogenous variables now include the common component of the public capital stock along with the overall level of the same variable. At the same time, the set of exogenous variables is augmented by introducing the vector of control variables ξ_t, which, in line with the discussion set forth in Section 3, should contribute to the identification of coordinated policy shocks by purging for the influence of spurious synchronization mechanisms, like those induced in the context of PBC by common electoral dates.

Since the reduced form error covariance matrix Σ_i is not diagonal, the random shocks in the VEC model cannot be given any structural interpretation. Within the VAR/VEC public capital literature, the approach usually advocated in order to identify the structural shocks to public capital accumulation is based on a Choleski decomposition of Σ_i, under the assumption that the K^g series is ordered first in the system (Pereira, 2001; Kamps, 2005). This hypothesis implies that government capital expenditure decisions are predetermined and, as such, they are affected by current unexpected evolutions in the other system variables at least with a period lag. This assumption is generally deemed to be credible, considering the lags usually involved in public policy decision and implementation.[3]

The standard recursive (Choleski) identification scheme can be readily extended to the present context in order to allow for the separate identification of the effects of coordinated and idiosyncratic shocks to public capital. Under the assumption of recursiveness, the set of analytical relations linking structural disturbances to reduced form errors is given by the following triangular system of linear equations:

$$\begin{bmatrix} e_{it}^{\tilde{K}^G} \\ e_{it}^{K^G} \\ e_{it}^{K^P} \\ e_{it}^{L} \\ e_{it}^{Y} \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & 0 & 0 \\ a_{21} & 1 & 0 & 0 & 0 \\ a_{31} & a_{32} & 1 & 0 & 0 \\ a_{41} & a_{42} & a_{43} & 1 & 0 \\ a_{51} & a_{52} & a_{53} & a_{54} & 1 \end{bmatrix} \begin{bmatrix} \eta_{it}^{\tilde{K}^G} \\ \eta_{it}^{K^G} \\ \eta_{it}^{K^P} \\ \eta_{it}^{L} \\ \eta_{it}^{Y} \end{bmatrix} \tag{12}$$

where now $E(e_{it}e_{it}') = diag\{[\tau_1,...,\tau_5]\}$.

The first structural disturbance term $e_{it}^{\tilde{K}^g}$ represents an innovation to the common component of the public capital stock formation. As such, it is orthogonal by construction to the set of both the exogenous and the lagged values of the endogenous variables in the system. The structural shock $e_{it}^{\tilde{K}^g}$ thus appears to be a VEC model-based measure of CC^{coord}, as stated in Section 3.

Apart from the structural identifying restriction implied by the recursiveness hypothesis, two remaining conditions have to be met so that $e_{it}^{\tilde{K}^g}$ actually represent only coordinated policy shocks:

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[3] In order to provide a term of comparison, generalized impulse responses (Pesaran and Shin, 1998) to shocks affecting the common and the total public capital stock series were also computed. A positive network effects appears to stand out also in this case, although the difference between the median responses to the two KG shocks is less pronounced. However, it is important to remark that only a Choleski decomposition approach, where KG-common is ordered prior to KG-tot, allows for the identification of coordinated and idiosyncratic shocks within our extended VEC model, thus providing a clear-cut structural interpretation of impulse responses.

- the set of the past values of the endogenous variables must actually contain all the relevant information entering the policy reaction function given in the equation (5);

- the vector ξ_t must include all the variables that are strictly required to control for spurious synchronization effects of regional capital expenditures.

When bringing the model to the data, some special attention is required at the diagnostic stage in order to check that both the above requirements are met. Once the coordinated structural shocks have been effectively identified, the second structural error term in the system $e_{it}^{K^g}$ – representing a shock to the overall public capital level that is orthogonal by construction to the coordinated shock $e_{it}^{\tilde{K}^g}$ – may be deemed to identify non-coordinated, strictly idiosyncratic policy innovations affecting public capital expenditure at the regional level. This result is tightly related to having ordered the common component first with respect to the overall K^g. Under this assumption, a shock to the common component is allowed to affect the overall K^g level, while a shock to the overall K^g level does not affect the common component *conditional* on the current shock to the common component itself, which is exactly the condition required to define a shock to K^g as strictly idiosyncratic.

Having properly identified structural policy shocks, the macroeconomic returns to public capital expenditure decisions can be assessed as usual, by inspecting the dynamic multipliers relating the *GDP* level to policy innovations. Finally, an empirical measure of the size of network effects associated to coordinated policy action can be obtained by taking the difference of the short and long run *GDP*-response to coordinated and idiosyncratic shocks to K^g. The difference is expected to be positive and can be deemed to provide an overall measure of network externalities of transport infrastructure, as the sum of the coordination/centralization premium (**P**) and other spillover effects (**X**).

5. The public infrastructure data set

As in Bonaglia and Picci (2000) and Montanaro (2003), we obtain annual regional public capital stock estimates by applying the perpetual inventory method (PI) to the time series regional expenditure flows (Istat), measured at 1995 constant prices for the years 1928-2007.[4] The aggregate of Civil

4 In order to estimate this new longer investment series, we apply the dynamics of the regional investment in Civil Engineering Works 1996-2007 as derived from *Conti Pubblici Territoriali* (CPT) database to the series provided by Di

Engineering Works (i.e.: transport infrastructure, pipelines, communication and electricity lines, complex constructions on industrial sites) is considered to this purpose. Among the different capital stock definitions proposed in the literature, we choose to rely on the notion of *productive capital*, which allows us to introduce a decreasing rate of efficiency of surviving assets over time. The productive capital (expressed in terms of standard efficiency units) is a measure of capital services that different types of assets provide to the production process at a given moment in time, and is computed as:

$$K_t^g = \sum_{i \geq 0} s_i e_i I_{t-i} \tag{13}$$

where $K_t^g =$ productive public capital at the end of the period (year *t*)

$I_{t-i} =$ gross investment flows between *t-1* and *t*

$s_i =$ survival rate at *t* of past investment made between *t-i-1* and *t-i*;

$e_i =$ efficiency of an *i*-period old asset, with a hyperbolic function

(see Di Giacinto, Micucci and Montanaro, 2010, for further details on the methodology utilized to compile the public capital stock figures).

Reliable panel data for 18 Italian regions with yearly observations covering the period 1970-2007 were finally obtained. According to our data, real public capital accumulation in Civil Engineering Works has been declining in Italy since the 1970s (see Table 1 for the regional composition across time). After the slight recovery in the 1980s, it began to decline again in the period 1991 to 1995.

Among the different types of public infrastructures included in the aggregate of Civil Engineering Works, we focus on transport infrastructures. Expenditure figures show a progressive decline of investment in transport infrastructure. After the strong rise in the early 1970s, an increasingly feeble trend is observed. In the country as a whole, the share of transport infrastructure to total public capital in Civil Works declined from 49.8 per cent in 1980 to 40.3 per cent in 2007; in the South of Italy[5], it fell from 46.9 to 37.3 per cent.

Giacinto, Micucci and Montanaro (2010) for the period 1928-2001. Investment in transport infrastructures includes not only the Government expenditure, but also that of the *Extended Public Sector* (i.e. railways investment of *Ferrovie dello Stato*).

5 We consider the following four reference geographical partitions: North West (Piedmont and Valle d'Aosta, Lombardy, Liguria), North East (Trentino-Alto Adige, Veneto, Friuli Venezia Giulia, Emilia-Romagna), Centre

Territorial dynamics display some heterogeneity. From 1991 to 2000, the growth of public capital in the South was equal to zero (14.0 in the North West and 11.5 in the North East, 5.9 in the Centre); between 2001 and 2007, it was negative, and transport infrastructure strongly contributed to this result (Table 2). [6]

As witnessed by Table 3, the yearly percentage changes in the capital stock series across Italian regions have been highly correlated along all the period 1980-2007 (roughly 0.79 on average across regions in the Centre-North area and 0.84 across regions in the South). This can be deemed to provide a first evidence of a coordination/centralization mechanism underlying public investment decisions across Italian regions.

Institutional features of the public sector decision-making process in Italy may help explain this empirical evidence. Public investment decisions have traditionally been strongly centralized and managed at the central government level, although a progressive devolution of powers to regional and local authorities has been in place since the seventies. Nonetheless, the correlation of public capital expenditure flows across regions was still very high up to the end of the eighties, reflecting the joint operating of two main factors. The first was the role played by national transport infrastructure policies, as evidenced by the large share of total infrastructure expenditures devoted to this sector (almost 50 per cent at the beginning of the seventies). This policy, aimed at the deployment of an extensive network of motor freeways in order to match the parallel development of the automobile sector and of related means of transportation, was actually very pervasive, spreading its effects across the whole Italian territory (Golden and Picci, 2005).

The second factor was the massive part of investment channeled via the Southern Italy Development Fund (the so-called *Cassa per il Mezzogiorno*) up to the beginning of the nineties. As long as the Fund has been operating, the dispersion across Southern regions – in terms of yearly changes in public capital – was low, while it was relatively high between the South and the Centre North areas.

(Tuscany, Umbria, Marche, Lazio), South and Islands (Abruzzo and Molise, Campania, Puglia, Basilicata, Calabria, Sicily, Sardinia).

6 There is a mismatch between the framework one draws from the expenditure PI approach and the real infrastructure endowment of the different areas of the country (see Alampi and Messina, 2011 and Bronzini, Casadio and Marinelli, 2011): in order to understand this, we must rely on how much infrastructure was actually built with public money. As explained by Golden and Picci (2005), even though policies aimed at mitigating the North-South infrastructure gap emerged soon after Italy's 1861 unification, it is commonly conceded that South's infrastructure endowment is still below that of the North (Bronzini, Casadio and Marinelli, 2011). This consideration leads us to consider a less efficiency in realizing infrastructure in the South as one of the possible explanations of the gap between expenditures and actual infrastructures.

Subsequently, the Southern regions' share of public investment in Civil Works started to decrease (Table 1 and Figure 1) and the differences across regions started to rise (Figure 2), arguably as a result of the less centralized infrastructure policies that were starting to take place.

6. The empirical analysis

6.1 Model specification and estimation

In order to implement the PANIC methodology, prior assumptions about the deterministic component in the factor model have to be advanced. Considering that our public capital stock (in log levels) series display a marked upward tendency over the sample period, a factor model including both constant and trend is specified. The number of common factors identified by means of the BIC3 procedure of Bai and Ng (2002) is equal to 4, the maximum value of r being set to 5. Notwithstanding the relatively small number of common factors, we obtain that the common component accounts for a major part of the overall variance of the growth rate of the regional public capital stock, with an average share of about 87 percent, although with some heterogeneity across regions. The fraction of total variance explained by the idiosyncratic component ranges from 3.7 to 21.5 percent, moving from the first to the third quartile of the distribution (Table 4).

Upon splitting the sample period in two sub-periods, we find evidence of an increase in the contribution of the idiosyncratic component to the overall variance of K^g growth rates, from 11.3 in 1971-89 to 20.6 per cent in 1990-2007, referring to the average value across regions. The dispersion, measured by the interquartile range, increased as well, from 13.5 to 21.3 percentage points. This behavior appears to be in line with the narrative evidence on the increasing decentralization of decisions regarding public infrastructure in Italy over the last twenty years.

Using the sample estimates of $\tilde{K}_{it}^{g}$ yielded by the PANIC procedure, the empirical specification of the extended VEC model was subsequently undertaken. In addition to the two public capital series (the overall level and its common component) as above detailed, the following aggregates were considered: the regional *GDP* level at constant prices (source: Prometeia), the private sector capital stock (K^p; source: Bronzini and Piselli, 2009) and a measure of the labor input given by total employment, in full time equivalent units, augmented by the average educational attainment of the workforce to proxy for the regional human capital endowment (L; source: our elaborations on

Prometeia and Istat data). Yearly data for 18 regions covering the 1970-2007 period are considered in the analysis. All variables are introduced in logs.

As a preliminary step to the cointegration analysis, the degree of integration of the individual series has to be assessed. In this respect, it has to be noticed that Bai and Ng (2004) prove that when the factor model includes a time trend (as in this case), individual augmented Dickey-Fuller tests and their corresponding panel versions do not attain the usual asymptotic distribution. Considering that asymptotic tables of the test critical values under the null hypothesis are unavailable, a proper test of the presence of unit roots in $\tilde{K}_{it}^{g}$ could not be performed. However, observed K_{it}^{g} series were tested and found out to be integrated for all the regions. We hence heuristically decided to maintain a similar assumption also for $\tilde{K}_{it}^{g}$, largely on the basis of the strong similitude between the graphical patterns of the two series.

Based on this assumption, we then proceeded to evaluate the cointegration rank. Like unit root tests, also the asymptotic distribution of the usual Johansen trace test is going to be affected when factor estimates of $\tilde{K}_{it}^{g}$ are substituted for the corresponding unobservable variables, thus making a direct test of the cointegration rank of the extended VEC model given in expression (11) unfeasible. With this limitation in mind, we chose to base the assessment of the cointegration rank on the evidence provided by trace tests applied to the baseline VAR model given model by equation (10), coupled with the a priori assumption that K_{it}^{g} and $\tilde{K}_{it}^{g}$ are cointegrated, i.e. are driven by a single stochastic trend. Under this assumption the total number of independent stochastic trends in the baseline and in the extended VEC systems considered in Section 4 is the same and, consequently, the number of cointegrating relations of the extended VEC model will be equal to the cointegration rank of the baseline system plus 1, due to the cointegration between K_{it}^{g} and $\tilde{K}_{it}^{g}$.

As an implicit consequence of the assumption that K_{it}^{g} and $\tilde{K}_{it}^{g}$ share a single common trend, the difference $K_{it}^{g} - \tilde{K}_{it}^{g}$, i.e. the idiosyncratic component of K_{it}^{g}, is stationary. While we are not able to provide a formal test of this implication, a graphical inspection of the regional idiosyncratic series obtained by the PANIC procedure did not appear to contradict the stationarity assumption.

The results of Johansen trace tests applied to the baseline VEC model for 18 Italian regions and for Italy as a whole are reported in Table 5. The empirical evidence confirms the hypothesis that at least one long-run equilibrium relationship among the system variables does exist, as suggested by both theoretical arguments and several empirical studies. In particular, at the significance level of 1 percent, the procedure identifies the presence of a single cointegrating vector.

Having selected the cointegration rank according to the above procedure, extended VEC models were estimated by maximum likelihood for all the regions. The lag order of the model was selected on the basis of the evidence provided by standard information criteria and taking into account the results of the LM tests for the null hypothesis of serially uncorrelated residuals. With limited exceptions, a first order VEC model represented the preferred specification.

Finally, to control for common political business cycle effects, a set of binary dummy variables taking unit values when in a given a general or regional elections are being held was also included in the set of exogenous variables considered in the empirical VEC specification.

Having obtained parameter estimates, evidence on the impact of a structural shock to local public capital expenditure is obtained by the analysis of impulse-response functions (IRF) and forecast error variance (FEV) decompositions.

Individual response patterns turned out to display considerable heterogeneity across regions, a feature that can be explained on the basis of the consideration that empirical estimates had to be derived from noisy and sometimes erratic regional time series data, especially in the case of the smallest Italian regions. Nonetheless, a central tendency appears to stand out quite neatly. As reported in Table 6 and Figure 3, while the impact is limited in the short run, the long-run response of regional *GDP* to exogenous shocks to public infrastructure capital is positive when we consider on the average or the median of the responses across the 18 regions.

Both coordinated and idiosyncratic shocks are found out to exert a positive impact on *GDP* in the long run. However, as postulated by economic theory stressing the importance of network externalities, the estimated impact of coordinated policy shocks is much higher.

Evaluated at the median of their respective cross-regional distributions, the *GDP* response to a one standard deviation exogenous shock is equal to 0.80 in the case of coordinated policy actions (**P**+**W**+**X**, using the terms introduced in the Section 2.2), an amount that is four times larger compared to the case of idiosyncratic policy shocks (**W**).

The analysis of the responses of private capital and employment provides evidence of the existence of positive and sizeable long-run effects (thus ruling out "crowding in" effects on private investment decisions) and confirms the prevalence of coordinated shocks in determining this result (Table 6).

Having assessed the sign and the relative magnitude of *IRF* coefficients, the results of *FEV* decompositions provide additional information on the respective contributions of coordinated and idiosyncratic shocks to regional *GDP* dynamics both in the short and in the long-run. If we refer again to the median of the results obtained across the 18 regions, the contribution of coordinated shocks to public transport infrastructure appears to be sizeable – more than a quarter of the long-run *GDP*'s variance can be attributed to these structural disturbances – and much larger of the contribution of idiosyncratic shocks (Table 7).

6.2 Identification checks

As stated in Sections 3 e 4, the procedure set forth in the present paper is based on a number of identifying assumptions. The latter imply that coordinated shocks to public capital accumulation should be correlated across regions but orthogonal either to overall macro shocks or to other factors being able to cause spurious correlations across the regional investment flows.

As for the presence of comovement, Table 8 reports the coefficients of bivariate correlation across the regional time series of the coordinated shocks to public capital yielded by the estimation of the full set of regional VEC models. There is clear evidence that the series are positively correlated across regions. At the same time, having controlled for both the effects of common macro shocks and for the presence of synchronized PBCs, the degree of cross-sectional correlation of our VEC-based measures of coordinated policy shocks is far lower on average compared to what is observed for the growth rates of the regional transport infrastructure stock (0.44 versus 0.87; Table 3).

This occurrence can be deemed to provide some preliminary evidence that the proposed methodology is able to effectively control for spurious comovement across regional public capital dynamics. However, it cannot guarantee that identification is achieved.

In particular, evidence of non negligible correlation between our empirical estimates of coordinated public capital shocks and any variable proxying for common macro disturbances may be deemed to contradict identification, mainly because of an omitted variables problem.

To provide a check for the omission of relevant variables, the series of coordinated shocks yielded by the regional VEC models were regressed against a number of macro indicators, including changes in real exchange rate, world trade growth, equity and oil prices dynamics. Besides, at the risk of introducing an explanatory variable that could not be entirely exogenous with respect to regional public capital expenditure, we also considered current unexpected fluctuations in the public budget at the national level as a possible source of spurious comovement. Table 9 shows how the identified common shocks to public capital are orthogonal to all the macro variables considered, essentially confirming the validity of the proposed identification strategy.

As a final control for any remaining spurious correlation effects hindering identification, we ran a panel regression analysis considering again the coordinated shocks to K^g as the dependent variable, but in this case introducing the *GDP* growth rate in the remaining *N-1* regions as the independent variable. The *GDP* coefficient in this regression should be equal to zero if unexpected common shocks to *GDP* are not instantaneously transmitted to coordinated public capital expenditure and – at the same time – current coordinated shocks to public infrastructure affect *GDP* at least with a one period lag.

A significance test of the regression coefficient in this setting can hence be interpreted as providing an over-identification test, as it implies that more restrictions are placed on the covariance matrix of reduced for VEC residual than strictly required for identification. The results of the fixed-effects panel regression are reported in Table 10. As a term of comparison, we first regress the log-changes of public capital in the region *i* on the log-changes in GDP in the aggregate of the remaining *N-1* regions: we obtain a strongly significant positive relationship. When in the same regression we replace VEC-estimates of coordinated K^g shocks as the dependent variable, the positive relationship disappears and the sign becomes even negative and scarcely significant. There is thus evidence that the identified coordinated policy impulses to public capital – unlike the overall public capital dynamics – are not affected by the current aggregate GDP dynamics. Considering that all main sources of common macro disturbances should be reflected in aggregate output fluctuations, this test can be deemed to provide strong support in favour of the proposed identification strategy.

7. Concluding remarks

In the empirical literature on the economic impact of public capital a consensus has emerged on the potential relevance of spatial spillovers across geographical areas, even though there is no agreement on the magnitude, and sometimes even the sign, of these spillover effects.

Considering the undisputed network nature of most infrastructures – especially transport infrastructure, on which our empirical analysis was explicitly focused – we made headways in the direction of analyzing the external effects of public capital from a different perspective. We build on theoretical contributions underscoring how positive network effects of public infrastructure investment may be boosted by coordinated action across the policy-makers involved in the decision process. In all cases public investment decisions taken in given area may have economic consequences in other areas. However, only coordinated (or centralized) action has the potential to maximize positive network effects, while uncoordinated decisions may produce lower benefits at the aggregate level, possibly inducing even negative spillover effects.

Moving from this background, when addressing the issue of the external effects of localized infrastructure investment we chose to abandon the more usual concepts of public capital accumulation *internal* or *external* to a given region, in favor of the distinction between investment decisions that are coordinated or non-coordinated (idiosyncratic) across space.

Our aim was the estimation of the effects on regional GDP of coordinated (or centralized) investment decisions that are unrelated either to macro evolutions or common political business cycles. Lacking any statistical evidence on what type of decision process underlies observed public expenditure flows, we proposed to identify coordinated policy actions starting from the observed correlation across the regional public capital aggregates and subsequently achieving identification by properly controlling for sources of comovement different from policy coordination.

The empirical identification strategy was implemented by properly specifying and estimating a set of structural regional VEC models, paying attention at the diagnostic stage to verify how credibly the model-based technique implemented in the paper identifies coordinated shocks to public capital formation. What we found essentially appears to confirm the robustness of the methodology.

The empirical analysis focused on the macroeconomic impact of the accumulation of public transport infrastructure and was conducted on data for 18 Italian regions covering a time span of about 40 years. The main empirical results are the following. First, we confirmed previous evidence that transport infrastructure exerts a considerable positive influence on macroeconomic aggregates such as GDP and private capital. Second, we found strong evidence that this influence is mostly attributable to the impact of coordinated policy shocks.

These results are clearly relevant from a policy perspective. They suggest that decentralized institutional systems need effective coordination channels across local authorities or government levels in order to fully exploit potential positive network externalities. Concentration of expenditure decisions at the Central Government level may have implicitly provided such coordination mechanism in Italy in the past. As the national institutional set up evolves towards a growing decentralization of public expenditure decisions, alternative coordination mechanisms safeguarding the overall network efficiency will have to be devised.

Tables and figures

Table 1

CIVIL WORKS (INFRASTRUCTURES), PRODUCTIVE PUBLIC CAPITAL

(percentages)

REGIONS	1980	1990	2000	2007
Piedmont and Valle d'Aosta	5.1	5.8	6.6	7.8
Lombardy	9.1	9.9	10.7	11.1
Trentino-Alto Adige	2.5	2.7	3.3	3.8
Veneto	5.6	5.6	6.2	7.1
Friuli Venezia Giulia	2.5	3.0	3.0	2.9
Liguria	4.1	3.6	3.4	3.3
Emilia-Romagna	7.3	6.9	6.8	6.9
Tuscany	6.6	6.3	6.0	6.0
Umbria	2.1	1.8	1.7	1.6
Marche	3.0	2.7	2.6	2.6
Lazio	8.4	8.6	9.1	9.1
Abruzzo and Molise	4.8	4.5	4.2	3.9
Campania	7.7	8.2	7.6	7.0
Puglia	4.6	4.7	5.0	5.1
Basilicata	3.5	3.3	3.0	2.6
Calabria	7.5	6.9	6.1	5.5
Sicily	10.9	10.6	10.0	9.1
Sardinia	4.8	4.8	4.8	4.5
North West	*18.3*	*19.3*	*20.7*	*22.2*
North East	*17.8*	*18.3*	*19.2*	*20.8*
Centre	*20.0*	*19.4*	*19.4*	*19.2*
South and Islands	*43.8*	*43.0*	*40.6*	*37.8*
Italy	**100.0**	**100.0**	**100.0**	**100.0**

Source: based on Istat data.

Table 2

CIVIL WORKS (INFRASTRUCTURES), PUBLIC CAPITAL GROWTH

(changes and percentage points)

REGIONS	1981-1990		1991-2000		2001-2007	
	Transport (1)	Total public capital (2)	Transport (1)	Total public capital (2)	Transport (1)	Total public capital (2)
Piedmont and Valle d'Aosta	15.2	43.6	7.9	21.9	14.9	21.7
Lombardy	10.5	36.5	1.4	14.8	1.2	7.5
Trentino-Alto Adige	11.9	39.2	1.6	27.8	0.7	18.1
Veneto	6.7	27.4	0.4	15.8	7.4	19.8
Friuli Venezia Giulia	25.5	50.2	0.6	6.2	-2.9	1.0
Liguria	1.1	10.3	-9.1	-0.6	-6.5	-0.7
Emilia-Romagna	6.3	19.9	-1.5	3.8	1.5	5.6
Tuscany	6.2	20.0	-4.8	1.4	-0.8	3.0
Umbria	4.2	12.5	-9.4	-2.6	-8.4	-4.5
Marche	5.1	13.3	-6.0	2.3	-2.6	3.1
Lazio	5.9	29.6	7.3	12.1	4.3	3.1
Abruzzo and Molise	7.0	18.0	-4.7	-0.8	-4.9	-3.2
Campania	6.7	34.2	-1.1	-1.1	-1.2	-4.7
Puglia	8.6	29.6	-1.2	10.9	-1.1	6.5
Basilicata	5.2	17.8	-3.9	-4.0	-5.1	-8.9
Calabria	4.9	16.1	-6.3	-6.5	-5.0	-7.4
Sicily	5.6	23.4	-3.9	-0.2	-4.7	-5.5
Sardinia	3.5	26.2	-2.1	4.9	-2.5	-2.4
North West	*9.7*	*32.5*	*1.4*	*14.0*	*4.3*	*10.7*
North East	*9.9*	*29.1*	*-0.1*	*11.5*	*2.6*	*11.6*
Centre	*5.7*	*22.3*	*0.0*	*5.9*	*0.7*	*2.4*
South and Islands	*5.9*	*23.9*	*-3.3*	*0.0*	*-3.4*	*-3.8*
Italy	**7.3**	**26.1**	**-1.2**	**6.0**	**0.1**	**3.3**

Source: based on Istat data. – (1) Percentage points. – (2) Percentage changes.

Table 3

CORRELATION MATRIX IN PUBLIC CAPITAL (TRANSPORT INFRASTRUCTURE) DYNAMICS BETWEEN 1970 AND 2007

(percentages)

Regions	PIE	LOM	TAA	VEN	FRI	LIG	EMI	TUS	UMB	MAR	LAZ	ABM	CAM	PUG	BAS	CAL	SIC	SAR
PIE	1.000																	
LOM	0.827	1.000																
TAA	0.864	0.851	1.000															
VEN	0.882	0.684	0.837	1.000														
FRI	0.652	0.873	0.658	0.508	1.000													
LIG	0.897	0.682	0.865	0.821	0.437	1.000												
EMI	0.801	0.795	0.838	0.737	0.539	0.756	1.000											
TUS	0.902	0.891	0.908	0.874	0.731	0.794	0.877	1.000										
UMB	0.732	0.825	0.756	0.753	0.647	0.602	0.783	0.880	1.000									
MAR	0.848	0.832	0.890	0.855	0.649	0.806	0.845	0.927	0.882	1.000								
LAZ	0.823	0.898	0.834	0.778	0.787	0.712	0.720	0.916	0.887	0.889	1.000							
ABM	0.865	0.895	0.871	0.841	0.742	0.789	0.782	0.945	0.898	0.928	0.958	1.000						
CAM	0.905	0.886	0.827	0.818	0.797	0.810	0.769	0.915	0.768	0.844	0.872	0.914	1.000					
PUG	0.803	0.896	0.746	0.745	0.774	0.636	0.729	0.894	0.918	0.848	0.912	0.940	0.860	1.000				
BAS	0.890	0.858	0.831	0.843	0.679	0.830	0.763	0.906	0.879	0.902	0.925	0.965	0.899	0.916	1.000			
CAL	0.947	0.819	0.892	0.870	0.634	0.949	0.792	0.890	0.741	0.909	0.845	0.906	0.910	0.791	0.931	1.000		
SIC	0.782	0.801	0.800	0.857	0.653	0.665	0.786	0.921	0.952	0.930	0.903	0.937	0.823	0.916	0.896	0.799	1.000	
SAR	0.704	0.927	0.736	0.580	0.914	0.581	0.628	0.809	0.768	0.770	0.887	0.875	0.858	0.875	0.826	0.744	0.762	1.000

Table 4

TRANSPORT INFRASTRUCTURE, VARIANCE DECOMPOSITION

(percentages)

REGIONS	Common Component			Idiosyncratic Component		
	1970-1989	1990-2007	1971-2007	1970-1989	1990-2007	1971-2007
North West						
Piedmont and Valle d'Aosta	78.9	84.0	79.3	21.1	16.0	20.7
Lombardy	54.1	82.3	72.2	45.9	17.7	27.8
Liguria	82.9	52.7	75.8	17.1	47.3	24.2
North East						
Trentino-Alto Adige	96.7	72.0	92.5	3.3	28.0	7.5
Veneto	97.6	96.3	97.0	2.4	3.7	3.0
Friuli Venezia Giulia	78.2	67.5	77.7	21.8	32.5	22.3
Emilia-Romagna	94.8	94.0	94.5	5.2	6.0	5.5
Centre						
Tuscany	87.0	94.5	90.8	13.0	5.5	9.2
Umbria	99.4	94.4	98.6	0.6	5.6	1.4
Marche	99.3	95.8	98.5	0.7	4.2	1.5
Lazio	94.7	38.5	78.2	5.3	61.5	21.8
South and Islands						
Abruzzo and Molise	98.5	92.7	96.9	1.5	7.3	3.1
Campania	67.3	47.3	60.4	32.7	52.7	39.6
Puglia	87.1	75.9	83.1	12.9	24.1	16.9
Basilicata	89.5	79.4	87.2	10.5	20.6	12.8
Calabria	96.4	89.0	93.4	3.6	11.0	6.6
Sicily	99.6	96.7	99.4	0.4	3.3	0.6
Sardinia	95.4	76.0	86.9	4.6	24.0	13.1
Mean	**88.7**	**79.4**	**86.8**	**11.3**	**20.6**	**13.2**
Median	**94.7**	**83.2**	**89.0**	**5.3**	**16.8**	**11.0**
Q1	**83.9**	**73.0**	**78.5**	**2.6**	**5.7**	**3.7**
Q3	**97.4**	**94.3**	**96.3**	**16.1**	**27.0**	**21.5**

Table 5

COINTEGRATION TESTS

REGIONS	Johansen's Trace Statistics				VAR model lag order[a]	Selected cointegration rank[b]
	H_0: $r = 0$	H_0: $r = 1$	H_0: $r = 2$	H_0: $r = 3$		
North West						
Piedmont and VDA	85.93	38.21	16.60	0.94	2	1
Lombardy	98.01	41.46	10.75	3.76	2	1
Liguria	73.65	36.46	16.29	2.57	1	1
North East						
Trentino-Alto Adige	68.69	31.54	15.11	3.84	1	1
Veneto	74.44	34.58	11.96	2.14	1	1
Friuli Venezia Giulia	83.34	46.37	22.15	4.65	1	2
Emilia-Romagna	62.12	31.91	14.02	5.21	1	1
Centre						
Tuscany	64.19	36.91	17.43	4.39	1	1
Umbria	87.01	39.59	12.89	2.62	2	1
Marche	90.55	54.55	32.42	14.91	2	2
Lazio	73.17	33.63	16.14	4.58	1	1
South and Islands						
Abruzzo and Molise	108.10	35.57	18.14	3.30	1	1
Campania	57.12	31.43	16.27	2.31	1	1
Puglia	77.91	35.99	18.36	5.78	1	1
Basilicata	76.67	47.71	25.52	11.07	1	2
Calabria	71.98	42.53	19.49	4.75	1	2
Sicily	103.39	47.67	19.45	4.44	2	2
Sardinia	63.52	39.58	18.67	2.35	2	1
Italy	**69.16**	**36.30**	**12.36**	**2.16**	**2**	**1**
Critical values						
5%	54.64	34.55	18.17	3.74		
1%	61.24	40.49	23.46	6.40		

Notes: the underlying VAR models contain both an intercept and a quadratic deterministic trend; the lag order is set according to AIC/BIC information criteria.

[a] The lag order of the VAR model in first differences was selected on the basis of both the usual information criteria and the presence of autocorrelation among the residuals. In the dubious cases we choose the most parsimonious specification, in order to take account of the short time series available.

[b] At the significance level of 1%, in the Basilicata and Marche cases the trace-tests would rather indicate a cointegration rank equal to 4. This indication, clearly out of line with respect to the rest of the regions, is probably due to more probable fluctuations in the small regions' cases. In this case we assumed r=2. For the Lombardy case, the H_0 r=1 is rejected at the 1%, but only at the margin. Since Lombardy is the biggest Italian region, then we decided to select a model with a cointegration rank equal to 1, in order to follow the same rank we choose at the aggregate level.

Table 6

IMPULSE-RESPONSES FOR ITALY

(means and medians across regions)

STATISTICS	KG →GDP		KG →KP		KG →LH	
	Coordinated shocks	**Idiosyncratic shocks**	**Coordinated shocks**	**Idiosyncratic shocks**	**Coordinated shocks**	**Idiosyncratic shocks**
			At time horizon = 0 years			
Unweighted Means	-0.132	0.174	0.023	-0.005	0.146	0.084
Medians	-0.148	0.121	0.038	0.012	0.115	0.009
			At time horizon = 30 years			
Unweighted Means	0.625	0.330	0.395	-0.059	0.582	0.108
Medians	0.797	0.219	0.433	0.018	0.494	0.186

Table 7

***FORECAST ERROR VARIANCE* (FEV) DECOMPOSITION** (1)

(means and medians across regions)

STATISTICS	KG Coordinated	KG Idiosyncratic	KP	LH	GDP
			At time horizon = 0 years		
Unweighted Means	6.9	5.1	23.9	18.6	45.5
Medians	6.6	2.0	19.4	12.5	59.5
			At time horizon = 30 years		
Unweighted Means	27.9	15.9	17.7	16.5	22.0
Medians	28.2	6.4	14.7	9.7	41.0

(1) Shares of the total GDP variance explained by the reported variables.

Table 8

CORRELATION MATRIX OF THE STRUCTURAL SHOCKS TO COMMON COMPONENT OF PUBLIC CAPITAL

(percentages)

Regions	PIE	LOM	TAA	VEN	FRI	LIG	EMI	TUS	UMB	MAR	LAZ	ABM	CAM	PUG	BAS	CAL	SIC	SAR
PIE	1.000																	
LOM	0.691	1.000																
TAA	0.438	0.365	1.000															
VEN	0.568	0.756	0.429	1.000														
FRI	0.464	0.615	0.080	0.443	1.000													
LIG	0.578	0.676	0.750	0.617	0.305	1.000												
EMI	0.603	0.639	0.662	0.631	0.313	0.732	1.000											
TUS	0.697	0.641	0.549	0.549	0.318	0.743	0.630	1.000										
UMB	0.066	0.137	0.744	0.182	-0.140	0.395	0.338	0.230	1.000									
MAR	0.294	0.443	0.558	0.419	-0.085	0.595	0.656	0.613	0.368	1.000								
LAZ	0.021	0.047	0.748	0.103	-0.197	0.413	0.274	0.238	0.751	0.406	1.000							
ABM	0.163	0.171	0.852	0.230	-0.046	0.509	0.494	0.353	0.743	0.511	0.745	1.000						
CAM	0.514	0.478	0.686	0.523	0.151	0.613	0.636	0.586	0.567	0.545	0.550	0.540	1.000					
PUG	0.383	0.594	0.677	0.590	0.326	0.712	0.588	0.484	0.498	0.409	0.507	0.490	0.690	1.000				
BAS	0.226	0.347	0.777	0.447	-0.043	0.646	0.462	0.503	0.638	0.627	0.758	0.650	0.594	0.569	1.000			
CAL	0.342	0.592	0.561	0.526	0.253	0.738	0.463	0.680	0.386	0.620	0.436	0.443	0.655	0.576	0.620	1.000		
SIC	-0.011	0.078	0.559	0.229	0.119	0.312	0.267	0.067	0.472	0.145	0.583	0.623	0.202	0.345	0.554	0.196	1.000	
SAR	0.343	0.550	0.286	0.623	0.480	0.460	0.519	0.302	0.141	0.410	-0.045	0.063	0.403	0.505	0.208	0.473	0.051	1.000

Table 9

CORRELATIONS BETWEEN STRUCTURAL SHOCKS TO THE COMMON COMPONENT OF PUBLIC CAPITAL AND SOME MACRO INDICATORS

(p-values in brackets)

REGIONS	Real exchange rate (Δ%)	World trade (Δ%)	Equity market (Δ%)	Oil prices (Δ%)	Public finances deficit (as GDP %)
North West					
Piedmont and Valle d'Aosta	-0.197	-0.038	-0.006	-0.103	-0.057
	(0.257)	*(0.831)*	*(0.974)*	*(0.556)*	*(0.744)*
Lombardy	0.114	0.063	0.362	-0.147	-0.037
	(0.515)	*(0.721)*	*(0.033)*	*(0.400)*	*(0.832)*
Liguria	0.228	-0.156	0.079	-0.142	0.002
	(0.187)	*(0.370)*	*(0.652)*	*(0.415)*	*(0.989)*
North East					
Trentino-Alto Adige	0.130	-0.071	-0.104	-0.014	-0.061
	(0.458)	*(0.686)*	*(0.552)*	*(0.938)*	*(0.728)*
Veneto	0.303	-0.286	0.240	-0.110	0.006
	(0.077)	*(0.096)*	*(0.165)*	*(0.531)*	*(0.972)*
Friuli Venezia Giulia	0.160	0.211	0.351	-0.002	-0.123
	(0.359)	*(0.225)*	*(0.039)*	*(0.989)*	*(0.483)*
Emilia-Romagna	-0.026	0.043	0.122	-0.034	-0.074
	(0.880)	*(0.807)*	*(0.485)*	*(0.848)*	*(0.671)*
Centre					
Tuscany	0.033	-0.029	-0.050	-0.294	-0.015
	(0.851)	*(0.871)*	*(0.778)*	*(0.087)*	*(0.933)*
Umbria	0.051	0.026	0.009	0.038	-0.016
	(0.771)	*(0.883)*	*(0.959)*	*(0.830)*	*(0.929)*
Marche	-0.059	-0.100	-0.076	-0.333	-0.020
	(0.738)	*(0.568)*	*(0.666)*	*(0.050)*	*(0.909)*
Lazio	0.277	-0.071	-0.190	-0.077	-0.173
	(0.107)	*(0.687)*	*(0.274)*	*(0.660)*	*(0.320)*
South and Islands					
Abruzzo and Molise	0.057	0.125	-0.063	-0.090	0.004
	(0.747)	*(0.476)*	*(0.719)*	*(0.609)*	*(0.983)*
Campania	0.095	0.037	-0.102	-0.051	-0.080
	(0.587)	*(0.833)*	*(0.561)*	*(0.771)*	*(0.646)*
Puglia	0.351	-0.006	0.095	-0.018	-0.064
	(0.039)	*(0.971)*	*(0.588)*	*(0.916)*	*(0.714)*
Basilicata	0.415	-0.308	-0.131	-0.201	0.001
	(0.013)	*(0.071)*	*(0.452)*	*(0.248)*	*(0.998)*
Calabria	0.305	-0.134	-0.015	-0.200	-0.042
	(0.075)	*(0.442)*	*(0.934)*	*(0.250)*	*(0.809)*
Sicily	0.427	-0.129	0.007	0.002	-0.074
	(0.011)	*(0.462)*	*(0.968)*	*(0.993)*	*(0.674)*
Sardinia	0.156	-0.071	0.222	-0.114	-0.051
	(0.372)	*(0.685)*	*0.199)*	*0.516)*	*(0.773)*

Table 10

ROBUSTNESS CHECKS: PANEL REGRESSION ON REGIONAL GDP DYNAMICS

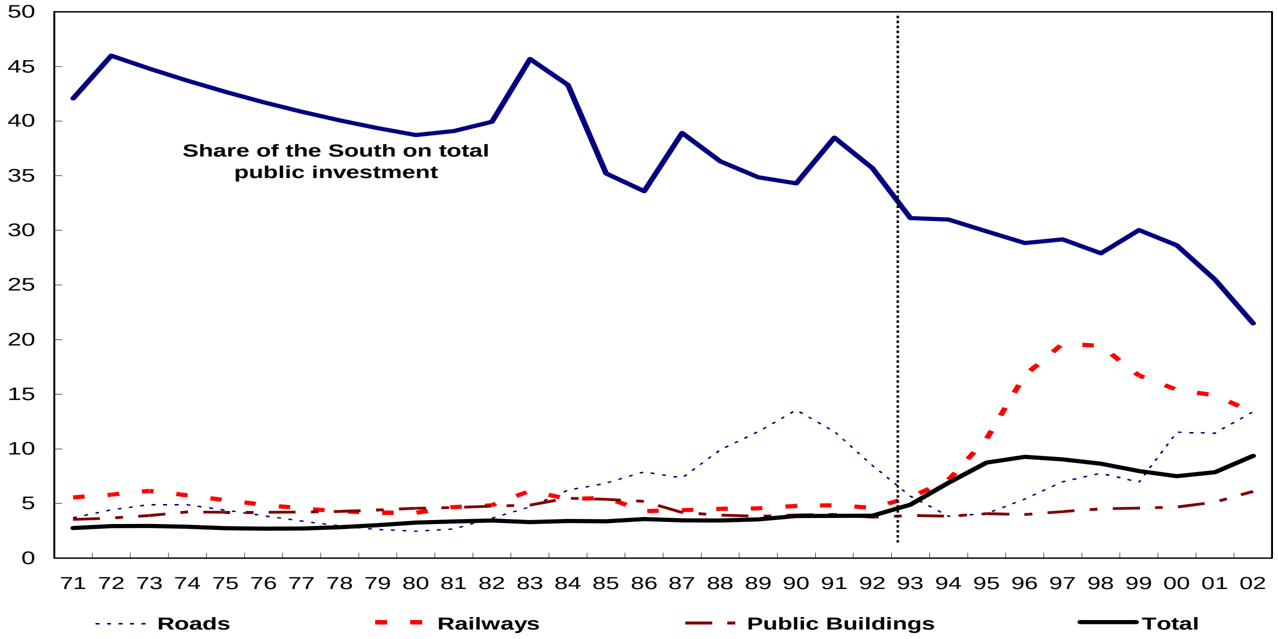
(p-values in brackets)

VARIABLES AND STATISTICS	Dependent variable			
	Rate of growth of the infrastructure stock		**Shocks to the common component of the infrastructure stock**	
GDP growth in the *n-1* regions	0.462	(0.000)	-0.008	(0.098)
Regional fixed effects	Yes		Yes	
Obs.	630		630	
R-sq	0.291		0.005	

Figure 1

DISPERSION IN CHANGES IN PUBLIC CAPITAL

(coefficients of variation; percentages)

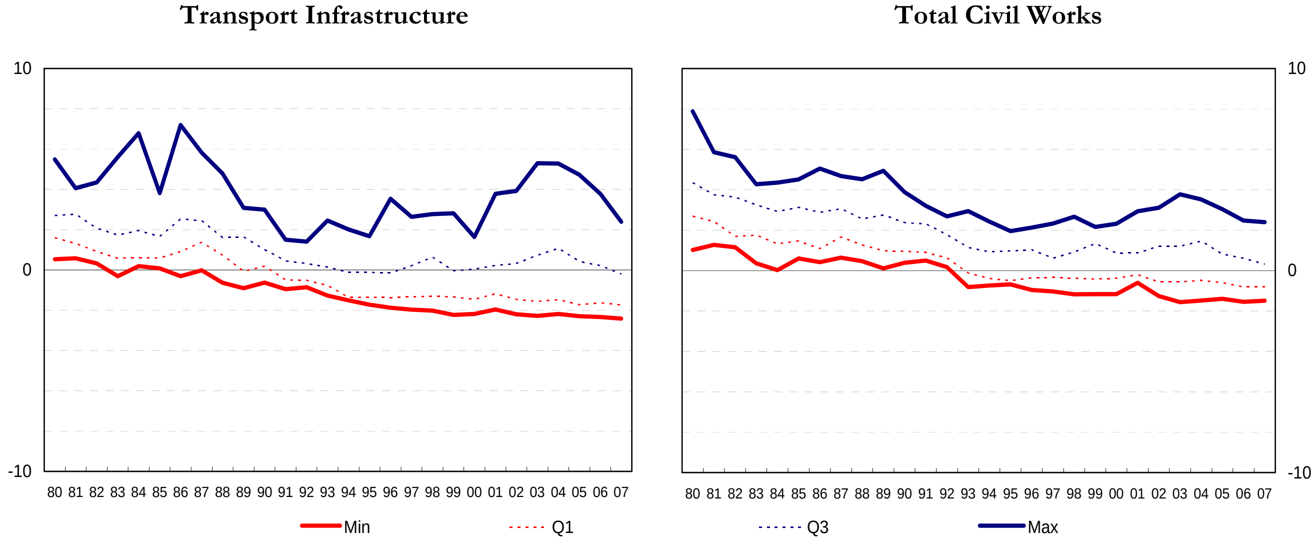


Source: based on Istat data.

Figure 2

DISPERSION IN CHANGES IN PUBLIC CAPITAL

(percentage changes on previous year)



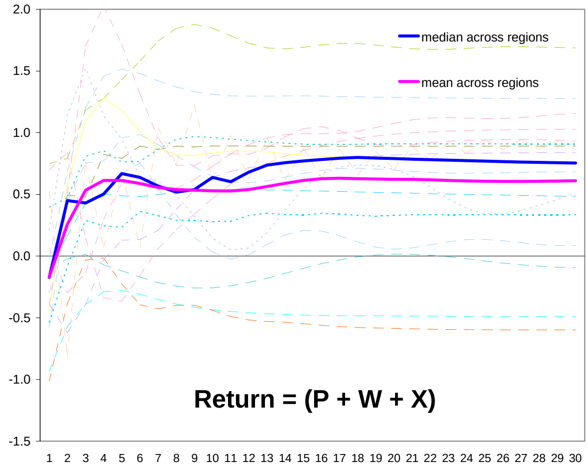
Source: based on Istat data.

Figure 3

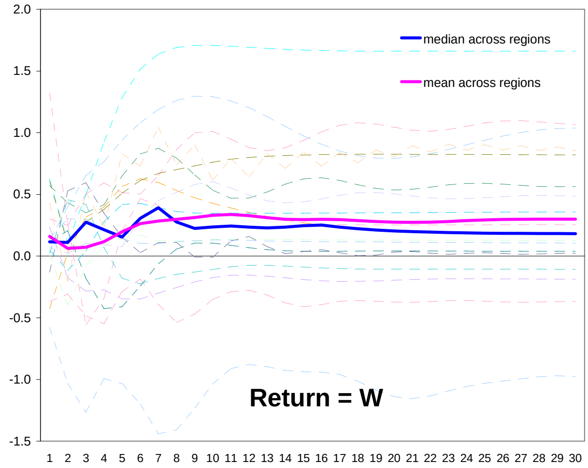
TRANSPORT INFRASTRUCTURES IMPULSE-RESPONSE FUNCTIONS *(IRFs)* (1)

(IRFs, means and medians across regions)

KG Common component → GDP



KG Idiosyncratic component → GDP



(1) The thin-dotted lines indicate the IRFs of the 18 single regions.

REFERENCES

Alampi D, Messina G (2011) Time-is-money: i tempi di trasporto come strumento per misurare la dotazione di infrastrutture in Italia. In: Banca d'Italia (2001)

Álvarez A, Arias C, Orea L (2006) Econometric testing of spatial productivity spillovers from public capital. *Revista de Economia Pública* 178: 9-21

Aschauer D (1989a) Is public expenditure productive? *Journal of Monetary Economics* 23: 177-200

Aschauer D (1989b) Does public capital crowd out private capital? *Journal of Monetary Economics* 24: 171-188

Bai J, Ng S (2002) Determining the Number of Factors in Approximate Factor Models. *Econometrica* 70: 191-221

Bai J, Ng S (2004) A PANIC Attack on Unit Roots and Cointegration. *Econometrica* 72: 1127-1177

Banca d'Italia (2011) *Le infrastrutture in Italia: dotazione, programmazione, realizzazione* (Seminari e convegni, No. 7). Roma

Baxter M, King RG (1993) Fiscal Policy in General Equilibrium. *American Economic Review* 83: 315-333

Berechman J, Ozmen-Ertekin D, Ozbay K (2006) Empirical analysis of transportation investment and economic development at state, county and municipality levels. *Transportation* 33: 537-551

Boarnet MG (1998) Spillovers and the locational effects of public infrastructure. *Journal of Regional Science* 38: 381-400

Bonaglia F, Picci L (2000) *Lo stock di capitale nelle regioni italiane* (Quaderni, No. 374). Università di Bologna, Dipartimento di scienze economiche, Bologna

Bouvet F (2007) *Labor Productivity, Infrastructure Endowment, and Regional Spillovers in the European Union* (Working Paper). Department of Economics, Lewis and Clark College

Bronzini R, Piselli P (2009) Determinants of long-run regional productivity: the role of R&D, human capital and public infrastructure. *Regional Science and Urban Economics* 39: 187-199

Bronzini R, Casadio P, Marinelli G (2011) Quello che gli indicatori territoriali sulle infrastrutture possono, e non possono dire. In: Banca d'Italia (2001)

Cadot O, Roller LH, Stephan A (2006) Contribution to productivity or pork barrel? The two faces of infrastructure investmen. *Journal of Public Economics* 90: 1133-1153

Cantos P, Gumbau-Albert M, Maudos J (2005) Transport infrastructures, spillover effects and regional growth: Evidence of the Spanish case. *Transport reviews* 25: 25-50

Cárcamo-Díaz R, Goddard JG (2007) *Coordination of public expenditure in transport infrastructures: analysis and policy perspectives for Latin America* (Macroeconomía del desarrollo), United Nations

Creel J, Poilon G (2008) Is public capital productive in Europe? *International Review of Applied Economics* 22: 673-691

Cohen JP, Morrison Paul CJ (2003) Airport infrastructure spillovers in a network system. *Journal of Urban Economics* 54: 459-473

Cohen JP, Morrison Paul CJ (2004) Public Infrastructure Investment, Costs, and Inter-State Spatial Spillovers in US Manufacturing: 1982-96. *Review of Economics and Statistics* 86: 551-560

Costantini M, Destefanis S. (2009) Cointegration Analysis for Cross-Sectionally Dependent Panels: The Case of Regional Production Functions. *Economic Modelling* 26: 320-327

Dalenberg DR, Partridge MD, Rickman DS (1998) Public infrastructure: Pork or jobs creator? *Public in Finance Review* 26: 24-52

Delgado MJ, Álvarez I (2007) Network infrastructure spillover in private productive sectors: evidence from Spanish high capacity roads. *Applied Economics* 39: 1583-1597

Di Giacinto V, Micucci G, Montanaro P (2010) Dynamic macroeconomic effects of Public capital: evidence from regional Italian data. *Giornale degli Economisti e Annali di Economia* 69: 29-66

Dixit A (1996) *The Making of Economic Policy: A Transaction-Cost Politics Perspective*. MIT press.

Drazen A (2000) *Political Economy in Macroeconomics*. Princeton University Press.

Eberts R (1990) Cross-sectional analysis of public infrastructure and regional productivity growth (Working Paper, No. 9004). Federal Reserve Bank of Cleveland

Ezcurra R, Gil C, Pascual P, Rapún M (2005) Public capital, regional productivity and spatial spillovers. *Annals of Regional Science* 39: 471-494

Garcia-Milà T, McGuire TJ (1992) *The* contribution of publicly provided inputs to states' economies. *Regional and Urban Economics* 22: 229-241

Garcia-Milà T, McGuire TJ, Porter RH (1996) The effect of public capital in state-level production functions reconsidered. *Review of Economics and Statistics* 78: 177-180

Gillen D, Haynes M (2001) Measuring aggregate productivity benefits from intelligent transportation system applications. *Transport Research Record* 1774: 52-59

Golden M, Picci L (2005) Proposal for a new measure of corruption, illustrated with italian data. *Economics & Politics* 17: 37-75

Grossman GM, Helpman E (2001) *Special Interest Politics*. MIT press

Holtz-Eakin D (1994) Public sector capital and the productivity puzzle. *Review of Economics and Statistics* 76: 12-21

Holtz-Eakin D, Schwartz AE (1995) Spatial Productivity Spillovers from Public Infrastructures: Evidence from State Highways. *International Tax and Public Finance* 2: 459-468

Haughwout AF (2002) Public infrastructure investments, productivity and welfare in fixed geographic areas. *Journal of Public Economics* 83: 405-428

Jiwattanakulpaisarn P (2008) *The impact of transport infrastructure investment on regional employment: an empirical investigation*. Centre for Transport Studies, Department of Civil and Environmental Engineering, Imperial College London, South Kensington, London

Kamps C (2005) The Dynamic Effects of Public Capital: VAR Evidence for 22 OECD Countries. *International Tax and Public Finance* 12: 533-558

Kelejian HH, Robinson DP (1997) Infrastructure productivity estimation and its underlying economic specifications: a sensitivity analysis. *Papers in Regional Science* 76: 115-131

Lynde C, Richmond J (1992) The role of public capital in production. *Review of Economic and Statistics* 74: 37-44

Martinez-Lopez D (2006) Linking public investment to private investment. The case of Spanish regions. *International Review of Applied Economics* 20: 411-423

Mas M, Maudos J, Perez F, Uriel E (1996) Infrastructure and productivity in the Spanish regions. *Regional Studies* 30: 641-649

Monaco C, Cohen JP (2006) *Ports and Highways Infrastructure Investment and Inter-state Spatial Spillovers*. Metrans Transportation Center, California Department of Transportation, California

Montanaro P (2003) Lo stock di capitale pubblico: una stima per Regione e per tipologia di bene. *Rivista economica del Mezzogiorno* 17: 423-461

Moreno R, López-Bazo E (2007) Returns to local and transport infrastructure under regional spillovers. *International Regional Science Review* 30: 47-71

Munnell AH (1990a) Why has productivity growth declined? Productivity and public investment. *New England Economic Review* Jan/Feb: 3-22

Munnell AH (1990b), How Does Public Infrastructure Affect Regional Economic Performance? *New England Economic Review* Sept/Oct: 11-33

Nordhaus W (1975) The Political Business Cycle. *Review of Economic Studies* 42: 169-190

Ozbay K, Ozmen-Ertekin D, Berechman J (2007) Contribution of transportation investments to county output. *Transport Policy* 14: 317-329

Pereira AM (2000) Is All Public Capital Created Equal? *Review of Economics and Statistics* 82: 513-518

Pereira AM (2001) Public Investment and Private Sector Performance – International Evidence. *Public Finance & Management* 1: 261-277

Pereira AM, Andraz JM (2004) Public highway spending and state spillovers in the USA. *Applied Economics Letters* 11: 785-788

Pereira AM, Roca-Sagalés O (2003) Spillover Effects of Public Capital Formation: Evidence from the Spanish Regions. *Journal of Urban Economics* 53: 238-256

Persson T, Tabellini G (2000) *Political Economics: Explaining Economic Policy*. MIT Press

Pesaran HH, Shin Y (1998) Generalized impulse response analysis in linear multivariate models. *Economics Letters* 58: 17-29

Romp W, de Haan J (2005) Public capital and economic growth: a critical survey. In: Välilä T (eds) *Innovative financing of infrastructure. The role of public-private partnerships: Infrastructure, economic growth, and the economics of PPPs*. European Investment Bank Papers 2/2005

Schiff M, Winters A (2002) *Regional cooperation, and the role of international organizations and regional integration* (World Bank Research Working Paper, No. 2872)

Sloboda BW, Yao VW (2008) Interstate spillovers of private capital and public spending. *Annals of Regional Science* 42: 505-518

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2009

F. PANETTA, F. SCHIVARDI and M. SHUM, *Do mergers improve information? Evidence from the loan market*, Journal of Money, Credit, and Banking, v. 41, 4, pp. 673-709, **TD No. 521 (October 2004).**

M. BUGAMELLI and F. PATERNÒ, *Do workers' remittances reduce the probability of current account reversals?*, World Development, v. 37, 12, pp. 1821-1838, **TD No. 573 (January 2006).**

P. PAGANO and M. PISANI, *Risk-adjusted forecasts of oil prices*, The B.E. Journal of Macroeconomics, v. 9, 1, Article 24, **TD No. 585 (March 2006).**

M. PERICOLI and M. SBRACIA, *The CAPM and the risk appetite index: theoretical differences, empirical similarities, and implementation problems*, International Finance, v. 12, 2, pp. 123-150, **TD No. 586 (March 2006).**

R. BRONZINI and P. PISELLI, *Determinants of long-run regional productivity with geographical spillovers: the role of R&D, human capital and public infrastructure,* Regional Science and Urban Economics, v. 39, 2, pp.187-199, **TD No. 597 (September 2006).**

U. ALBERTAZZI and L. GAMBACORTA, *Bank profitability and the business cycle,* Journal of Financial Stability, v. 5, 4, pp. 393-409, **TD No. 601 (September 2006).**

F. BALASSONE, D. FRANCO and S. ZOTTERI, *The reliability of EMU fiscal indicators: risks and safeguards*, in M. Larch and J. Nogueira Martins (eds.), Fiscal Policy Making in the European Union: an Assessment of Current Practice and Challenges, London, Routledge, **TD No. 633 (June 2007).**

A. CIARLONE, P. PISELLI and G. TREBESCHI, *Emerging Markets' Spreads and Global Financial Conditions*, Journal of International Financial Markets, Institutions & Money, v. 19, 2, pp. 222-239, **TD No. 637 (June 2007).**

S. MAGRI, *The financing of small innovative firms: the Italian case*, Economics of Innovation and New Technology, v. 18, 2, pp. 181-204, **TD No. 640 (September 2007).**

V. DI GIACINTO and G. MICUCCI, *The producer service sector in Italy: long-term growth and its local determinants*, Spatial Economic Analysis, Vol. 4, No. 4, pp. 391-425, **TD No. 643 (September 2007).**

F. LORENZO, L. MONTEFORTE and L. SESSA, *The general equilibrium effects of fiscal policy: estimates for the euro area*, Journal of Public Economics, v. 93, 3-4, pp. 559-585, **TD No. 652 (November 2007).**

Y. ALTUNBAS, L. GAMBACORTA and D. MARQUÉS, *Securitisation and the bank lending channel*, European Economic Review, v. 53, 8, pp. 996-1009, **TD No. 653 (November 2007).**

R. GOLINELLI and S. MOMIGLIANO, *The Cyclical Reaction of Fiscal Policies in the Euro Area. A Critical Survey of Empirical Research*, Fiscal Studies, v. 30, 1, pp. 39-72, **TD No. 654 (January 2008).**

P. DEL GIOVANE, S. FABIANI and R. SABBATINI, *What's behind "Inflation Perceptions"? A survey-based analysis of Italian consumers*, Giornale degli Economisti e Annali di Economia, v. 68, 1, pp. 25-52, **TD No. 655 (January 2008).**

F. MACCHERONI, M. MARINACCI, A. RUSTICHINI and M. TABOGA, *Portfolio selection with monotone mean-variance preferences,* Mathematical Finance, v. 19, 3, pp. 487-521, **TD No. 664 (April 2008).**

M. AFFINITO and M. PIAZZA, *What are borders made of? An analysis of barriers to European banking integration*, in P. Alessandrini, M. Fratianni and A. Zazzaro (eds.): The Changing Geography of Banking and Finance, Dordrecht Heidelberg London New York, Springer, **TD No. 666 (April 2008).**

A. BRANDOLINI, *On applying synthetic indices of multidimensional well-being: health and income inequalities in France, Germany, Italy, and the United Kingdom,* in R. Gotoh and P. Dumouchel (eds.), Against Injustice. The New Economics of Amartya Sen, Cambridge, Cambridge University Press, **TD No. 668 (April 2008).**

G. FERRERO and A. NOBILI, *Futures contract rates as monetary policy forecasts,* International Journal of Central Banking, v. 5, 2, pp. 109-145, **TD No. 681 (June 2008).**

P. CASADIO, M. LO CONTE and A. NERI, *Balancing work and family in Italy: the new mothers' employment decisions around childbearing,* in T. Addabbo and G. Solinas (eds.), Non-Standard Employment and Qualità of Work, Physica-Verlag. A Sprinter Company, **TD No. 684 (August 2008).**

L. ARCIERO, C. BIANCOTTI, L. D'AURIZIO and C. IMPENNA, *Exploring agent-based methods for the analysis of payment systems: A crisis model for StarLogo TNG,* Journal of Artificial Societies and Social Simulation, v. 12, 1, **TD No. 686 (August 2008).**

A. CALZA and A. ZAGHINI, *Nonlinearities in the dynamics of the euro area demand for M1,* Macroeconomic Dynamics, v. 13, 1, pp. 1-19, **TD No. 690 (September 2008).**

L. FRANCESCO and A. SECCHI, *Technological change and the households' demand for currency*, Journal of Monetary Economics, v. 56, 2, pp. 222-230, **TD No. 697 (December 2008).**

G. ASCARI and T. ROPELE, *Trend inflation, taylor principle, and indeterminacy*, Journal of Money, Credit and Banking, v. 41, 8, pp. 1557-1584, **TD No. 708 (May 2007).**

S. COLAROSSI and A. ZAGHINI, *Gradualism, transparency and the improved operational framework: a look at overnight volatility transmission*, International Finance, v. 12, 2, pp. 151-170, **TD No. 710 (May 2009).**

M. BUGAMELLI, F. SCHIVARDI and R. ZIZZA, *The euro and firm restructuring*, in A. Alesina e F. Giavazzi (eds): Europe and the Euro, Chicago, University of Chicago Press, **TD No. 716 (June 2009).**

B. HALL, F. LOTTI and J. MAIRESSE, *Innovation and productivity in SMEs: empirical evidence for Italy*, Small Business Economics, v. 33, 1, pp. 13-33, **TD No. 718 (June 2009).**

2010

A. PRATI and M. SBRACIA, *Uncertainty and currency crises: evidence from survey data*, Journal of Monetary Economics, v, 57, 6, pp. 668-681, **TD No. 446 (July 2002).**

L. MONTEFORTE and S. SIVIERO, *The Economic Consequences of Euro Area Modelling Shortcuts*, Applied Economics, v. 42, 19-21, pp. 2399-2415, **TD No. 458 (December 2002).**

S. MAGRI, *Debt maturity choice of nonpublic Italian firms* , Journal of Money, Credit, and Banking, v.42, 2-3, pp. 443-463, **TD No. 574 (January 2006).**

G. DE BLASIO and G. NUZZO, *Historical traditions of civicness and local economic development*, Journal of Regional Science, v. 50, 4, pp. 833-857, **TD No. 591 (May 2006).**

E. IOSSA and G. PALUMBO, *Over-optimism and lender liability in the consumer credit market*, Oxford Economic Papers, v. 62, 2, pp. 374-394, **TD No. 598 (September 2006).**

S. NERI and A. NOBILI, *The transmission of US monetary policy to the euro area,* International Finance, v. 13, 1, pp. 55-78, **TD No. 606 (December 2006).**

F. ALTISSIMO, R. CRISTADORO, M. FORNI, M. LIPPI and G. VERONESE, *New Eurocoin: Tracking Economic Growth in Real Time*, Review of Economics and Statistics, v. 92, 4, pp. 1024-1034, **TD No. 631 (June 2007).**

U. ALBERTAZZI and L. GAMBACORTA, *Bank profitability and taxation*, Journal of Banking and Finance, v. 34, 11, pp. 2801-2810, **TD No. 649 (November 2007).**

M. IACOVIELLO and S. NERI, *Housing market spillovers: evidence from an estimated DSGE model,* American Economic Journal: Macroeconomics, v. 2, 2, pp. 125-164, **TD No. 659 (January 2008).**

F. BALASSONE, F. MAURA and S. ZOTTERI, *Cyclical asymmetry in fiscal variables in the EU*, Empirica, **TD No. 671**, v. 37, 4, pp. 381-402 **(June 2008).**

F. D'AMURI, O. GIANMARCO I.P. and P. GIOVANNI, *The labor market impact of immigration on the western german labor market in the 1990s,* European Economic Review, v. 54, 4, pp. 550-570, **TD No. 687 (August 2008).**

A. ACCETTURO, *Agglomeration and growth: the effects of commuting costs,* Papers in Regional Science, v. 89, 1, pp. 173-190, **TD No. 688 (September 2008).**

S. NOBILI and G. PALAZZO, *Explaining and forecasting bond risk premiums,* Financial Analysts Journal, v. 66, 4, pp. 67-82, **TD No. 689 (September 2008).**

A. B. ATKINSON and A. BRANDOLINI, *On analysing the world distribution of income*, World Bank Economic Review , v. 24, 1 , pp. 1-37, **TD No. 701 (January 2009).**

R. CAPPARIELLO and R. ZIZZA, *Dropping the Books and Working Off the Books,* Labour, v. 24, 2, pp. 139-162 ,**TD No. 702 (January 2009).**

C. NICOLETTI and C. RONDINELLI, *The (mis)specification of discrete duration models with unobserved heterogeneity: a Monte Carlo study,* Journal of Econometrics, v. 159, 1, pp. 1-13, **TD No. 705 (March 2009).**

L. FORNI, A. GERALI and M. PISANI, *Macroeconomic effects of greater competition in the service sector: the case of Italy*, Macroeconomic Dynamics, v. 14, 5, pp. 677-708, **TD No. 706 (March 2009).**

V. DI GIACINTO, G. MICUCCI and P. MONTANARO, *Dynamic macroeconomic effects of public capital: evidence from regional Italian data,* Giornale degli economisti e annali di economia, v. 69, 1, pp. 29-66, **TD No. 733 (November 2009).**

F. COLUMBA, L. GAMBACORTA and P. E. MISTRULLI, *Mutual Guarantee institutions and small business finance,* Journal of Financial Stability, v. 6, 1, pp. 45-54, **TD No. 735 (November 2009).**

A. GERALI, S. NERI, L. SESSA and F. M. SIGNORETTI, *Credit and banking in a DSGE model of the Euro Area,* Journal of Money, Credit and Banking, v. 42, 6, pp. 107-141, **TD No. 740 (January 2010).**

M. AFFINITO and E. TAGLIAFERRI, *Why do (or did?) banks securitize their loans? Evidence from Italy*, Journal of Financial Stability, v. 6, 4, pp. 189-202, **TD No. 741 (January 2010).**

S. FEDERICO, *Outsourcing versus integration at home or abroad and firm heterogeneity*, Empirica, v. 37, 1, pp. 47-63, **TD No. 742 (February 2010).**

V. DI GIACINTO, *On vector autoregressive modeling in space and time*, Journal of Geographical Systems, v. 12, 2, pp. 125-154, **TD No. 746 (February 2010).**

L. FORNI, A. GERALI and M. PISANI, *The macroeconomics of fiscal consolidations in euro area countries,* Journal of Economic Dynamics and Control, v. 34, 9, pp. 1791-1812, **TD No. 747 (March 2010).**

S. MOCETTI and C. PORELLO, *How does immigration affect native internal mobility? new evidence from Italy*, Regional Science and Urban Economics, v. 40, 6, pp. 427-439, **TD No. 748 (March 2010).**

A. DI CESARE and G. GUAZZAROTTI, *An analysis of the determinants of credit default swap spread changes before and during the subprime financial turmoil*, Journal of Current Issues in Finance, Business and Economics, v. 3, 4, pp., **TD No. 749 (March 2010).**

P. CIPOLLONE, P. MONTANARO and P. SESTITO, *Value-added measures in Italian high schools: problems and findings*, Giornale degli economisti e annali di economia, v. 69, 2, pp. 81-114, **TD No. 754 (March 2010).**

A. BRANDOLINI, S. MAGRI and T. M SMEEDING, *Asset-based measurement of poverty*, Journal of Policy Analysis and Management, v. 29, 2 , pp. 267-284, **TD No. 755 (March 2010).**

G. CAPPELLETTI, *A Note on rationalizability and restrictions on beliefs*, The B.E. Journal of Theoretical Economics, v. 10, 1, pp. 1-11,**TD No. 757 (April 2010).**

S. DI ADDARIO and D. VURI, *Entrepreneurship and market size. the case of young college graduates in Italy*, Labour Economics, v. 17, 5, pp. 848-858, **TD No. 775 (September 2010).**

A. CALZA and A. ZAGHINI, *Sectoral money demand and the great disinflation in the US*, Journal of Money, Credit, and Banking, v. 42, 8, pp. 1663-1678, **TD No. 785 (January 2011).**

2011

S. DI ADDARIO, *Job search in thick markets*, Journal of Urban Economics, v. 69, 3, pp. 303-318, **TD No. 605 (December 2006).**

F. SCHIVARDI and E. VIVIANO, *Entry barriers in retail trade*, Economic Journal, v. 121, 551, pp. 145-170, **TD No. 616 (February 2007).**

G. FERRERO, A. NOBILI and P. PASSIGLIA, *Assessing excess liquidity in the Euro Area: the role of sectoral distribution of money*, Applied Economics, v. 43, 23, pp. 3213-3230, **TD No. 627 (April 2007).**

P. E. MISTRULLI, *Assessing financial contagion in the interbank market: maximun entropy versus observed interbank lending patterns*, Journal of Banking & Finance, v. 35, 5, pp. 1114-1127, **TD No. 641 (September 2007).**

E. CIAPANNA, *Directed matching with endogenous markov probability: clients or competitors?*, The RAND Journal of Economics, v. 42, 1, pp. 92-120, **TD No. 665 (April 2008).**

M. BUGAMELLI and F. PATERNÒ, *Output growth volatility and remittances*, Economica, v. 78, 311, pp. 480-500, **TD No. 673 (June 2008).**

V. DI GIACINTO e M. PAGNINI, *Local and global agglomeration patterns: two econometrics-based indicators*, Regional Science and Urban Economics, v. 41, 3, pp. 266-280, **TD No. 674 (June 2008).**

G. BARONE and F. CINGANO, *Service regulation and growth: evidence from OECD countries*, Economic Journal, v. 121, 555, pp. 931-957, **TD No. 675 (June 2008).**

R. GIORDANO and P. TOMMASINO, *What determines debt intolerance? The role of political and monetary institutions*, European Journal of Political Economy, v. 27, 3, pp. 471-484, **TD No. 700 (January 2009).**

P. ANGELINI, A. NOBILI e C. PICILLO, *The interbank market after August 2007: What has changed, and why?*, Journal of Money, Credit and Banking, v. 43, 5, pp. 923-958, **TD No. 731 (October 2009).**

L. FORNI, A. GERALI and M. PISANI, *The Macroeconomics of Fiscal Consolidation in a Monetary Union: the Case of Italy*, in Luigi Paganetto (ed.), Recovery after the crisis. Perspectives and policies, VDM Verlag Dr. Muller, **TD No. 747 (March 2010).**

A. DI CESARE and G. GUAZZAROTTI, *An analysis of the determinants of credit default swap changes before and during the subprime financial turmoil*, in Barbara L. Campos and Janet P. Wilkins (eds.), The Financial Crisis: Issues in Business, Finance and Global Economics, New York, Nova Science Publishers, Inc., **TD No. 749 (March 2010).**

A. LEVY and A. ZAGHINI, *The pricing of government guaranteed bank bonds*, Banks and Bank Systems, v. 6, 3, pp. 16-24, **TD No. 753 (March 2010).**

G. BARBIERI, C. ROSSETTI and P. SESTITO, *The determinants of teacher mobility: evidence using Italian teachers' transfer applications,* Economics of Education Review, v. 30, 6, pp. 1430-1444, **TD No. 761 (June 2010).**

G. GRANDE and I. VISCO, *A public guarantee of a minimum return to defined contribution pension scheme members,* The Journal of Risk, v. 13, 3, pp. 3-43, **TD No. 762 (June 2010).**

P. DEL GIOVANE, G. ERAMO and A. NOBILI, *Disentangling demand and supply in credit developments: a survey-based analysis for Italy*, Journal of Banking and Finance, v. 35, 10, pp. 2719-2732, **TD No. 764 (June 2010).**

G. BARONE and S. MOCETTI, *With a little help from abroad: the effect of low-skilled immigration on the female labour supply,* Labour Economics, v. 18, 5, pp. 664-675, **TD No. 766 (July 2010).**

A. FELETTIGH and S. FEDERICO, *Measuring the price elasticity of import demand in the destination markets of italian exports,* Economia e Politica Industriale, v. 38, 1, pp. 127-162, **TD No. 776 (October 2010).**

S. MAGRI and R. PICO, *The rise of risk-based pricing of mortgage interest rates in Italy*, Journal of Banking and Finance, v. 35, 5, pp. 1277-1290, **TD No. 778 (October 2010).**

M. TABOGA, *Under/over-valuation of the stock market and cyclically adjusted earnings*, International Finance, v. 14, 1, pp. 135-164, **TD No. 780 (December 2010).**

S. NERI, *Housing, consumption and monetary policy: how different are the U.S. and the Euro area?*, Journal of Banking and Finance, v.35, 11, pp. 3019-3041, **TD No. 807 (April 2011).**

V. CUCINIELLO, *The welfare effect of foreign monetary conservatism with non-atomistic wage setters*, Journal of Money, Credit and Banking, v. 43, 8, pp. 1719-1734, **TD No. 810 (June 2011).**

A. CALZA and A. ZAGHINI, *welfare costs of inflation and the circulation of US currency abroad,* The B.E. Journal of Macroeconomics, v. 11, 1, Art. 12, **TD No. 812 (June 2011).**

I. FAIELLA, *La spesa energetica delle famiglie italiane*, Energia, v. 32, 4, pp. 40-46, **TD No. 822 (September 2011).**

R. DE BONIS and A. SILVESTRINI, *The effects of financial and real wealth on consumption: new evidence from OECD countries,* Applied Financial Economics, v. 21, 5, pp. 409–425, **TD No. 837 (November 2011).**

F. CAPRIOLI, P. RIZZA and P. TOMMASINO, *Optimal fiscal policy when agents fear government default,* Revue Economique, v. 62, 6, pp. 1031-1043, **TD No. 859 (March 2012).**

2012

M. PERICOLI and M. TABOGA, *Bond risk premia, macroeconomic fundamentals and the exchange rate,* International Review of Economics and Finance, v. 22, 1, pp. 42-65, **TD No. 699 (January 2009).**

G. ASCARI and T. ROPELE, *Disinflation in a DSGE perspective: sacrifice ratio or welfare gain ratio?,* Journal of Economic Dynamics and Control, v. 36, 2, pp. 169-182, **TD No. 736 (January 2010).**

A. ACCETTURO and G. DE BLASIO, *Policies for local development: an evaluation of Italy's "Patti Territoriali",* Regional Science and Urban Economics, v. 42, 1-2, pp. 15-26, **TD No. 789 (January 2011).**

FORTHCOMING

M. BUGAMELLI and A. ROSOLIA, *Produttività e concorrenza estera,* Rivista di politica economica, **TD No. 578 (February 2006).**

F. CINGANO and A. ROSOLIA, *People I know: job search and social networks*, Journal of Labor Economics, **TD No. 600 (September 2006).**

M. BRATTI, D. CHECCHI and G. DE BLASIO, *Does the expansion of higher education increase the equality of educational opportunities? evidence from Italy,* Labour, **TD No. 679 (June 2008).**

S. MOCETTI, *Educational choices and the selection process before and after compulsory school*, Education Economics, **TD No. 691 (September 2008).**

P. SESTITO and E. VIVIANO, *Reservation wages: explaining some puzzling regional patterns*, Labour, **TD No. 696 (December 2008).**

P. PINOTTI, M. BIANCHI and P. BUONANNO, *Do immigrants cause crime?*, Journal of the European Economic Association, **TD No. 698 (December 2008).**

F. LIPPI and A. NOBILI, *Oil and the macroeconomy: a quantitative structural analysis,* Journal of European Economic Association, **TD No. 704 (March 2009).**

F. CINGANO and P. PINOTTI, *Politicians at work. The private returns and social costs of political connections*, Journal of the European Economic Association, **TD No. 709 (May 2009).**

Y. ALTUNBAS, L. GAMBACORTA, and D. MARQUÉS-IBÁÑEZ, *Bank risk and monetary policy*, Journal of Financial Stability, **TD No. 712 (May 2009).**

A. FINICELLI, P. PAGANO and M. SBRACIA, *Ricardian selection*, Journal of International Economics, **TD No. 728 (October 2009).**

G. BARONE and S. MOCETTI, *Tax morale and public spending inefficiency*, International Tax and Public Finance, **TD No. 732 (November 2009).**

I. BUONO and G. LALANNE, *The effect of the Uruguay Round on the intensive and extensive margins of trade*, Journal of International Economics, **TD No. 835 (February 2011).**

G. BARONE, R. FELICI and M. PAGNINI, *Switching costs in local credit markets*, International Journal of Industrial Organization, **TD No. 760 (June 2010).**

L. MONTEFORTE and G. MORETTI, *Real-Time forecasts of inflation: the role of financial variables*, Journal of Forecasting, **TD No. 767 (July 2010).**

E. COCOZZA and P. PISELLI, *Testing for east-west contagion in the European banking sector during the financial crisis*, in R. Matoušek; D. Stavárek (eds.), Financial Integration in the European Union, Taylor & Francis, **TD No. 790 (February 2011).**

S. NERI and T. ROPELE, *Imperfect information, real-time data and monetary policy in the Euro area*, The Economic Journal, **TD No. 802 (March 2011).**

M. AFFINITO, *Do interbank customer relationships exist? And how did they function in the crisis? Learning from Italy*, Journal of Banking and Finance, **TD No. 826 (October 2011).**

O. BLANCHARD and M. RIGGI, Why are the 2000s so different from the 1970s? A structural interpretation of changes in the macroeconomic effects of oil prices, Journal of the European Economic Association, **TD No. 835 (November 2011).**

R. CRISTADORO and D. MARCONI, *Households Savings in China*, Chinese Economic and Business Studies, **TD No. 838 (November 2011).**