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Methods of evaluation of cohesion policies

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MACROECONOMETRIC APPROACH (1)

- We refer to Bradley et al. (Macro-regional evaluation of the Structural Funds using the ***HERMIN*** methodology framework, SR, 2003)
- HERMIN is a sectorally disaggregated macromodel which is based on a ***small open economy features*** and specifies the mechanism through which Objective 1 regions are connected to the external world (trade, migration,international transmission, inflation)
- HERMIN features***: based on national accounting equivalence*** of output, expenditure and income)
- **Output** is divided into four sectors (agriculture, manufacturing, non-traded market-building,utilities,other market services-, government-health,education,others)
- **Expenditure** is divided into private consumption, public consumption, investment, stock changes, export and imports
- **Income** is divided into private income (household income, corporate income) and public income (public revenue, public expenditure, borrowing requirement, debt accumulation)

MACROECONOMETRIC APPROACH (2)

- Output = f(demand, cost-competitiveness) – both demand and supply forces
- Factor demand = f(relative prices in a CES framework; output)
- Other behavioral equations: consumption function, wage bargaining, etc.)
- At the regional level in the equations we can account for spillovers, linkages, leakages)
- **Closures:** 1) net trade balance is the difference between output and expenditure ; 2) corporate profits are determined from the difference between output and income
- ***Analysis of the impact of structural funds during 1994-99 on some countries and Objective 1 regions*** (Greece, Ireland, Portugal, Spain, Northern Ireland, East Germany)
- 2 programming cycle considered: 1994 to 1999 (103 billion euros) and 2000 to 2006 (213 billion euros- both Structural Funds and Cohesion Fund)
- Since 1999 (Reg.1260/99) the Commission requires the appraisal of the SF impact

MACROECONOMETRIC APPROACH (3)

- The Structural Funds are assumed to increase ***both short-term Keynesian demand and long-term demand*** through increase in physical infrastructure which determines output externality, increase in human capital, which determines factor productivity externality and through aid to private investment
- Model is estimated and then calibrated for 1980-2000 period.
- **Calibration** is necessary because elasticities are often taken from the literature (sensitivity analysis). Very often there is a large variety in the literature about the impact of infrastructure investment on output
- A base year is simulated (in the paper, the year before the planning period, 1993) and a simulation is carried out up to a target year (i.e., 2010).
- Then it is extracted the SF shock and the model is re-simulated
- The ***impact of SF shock is given by the difference between the simulation with the shock and the simulation without the shock***

MACROECONOMETRIC APPROACH (4)

Total (cumulative) ***Effects of GDP are quite high and differentiated across countries***:

	1994	*1999*	*2010*
Greece	2.01	2.16	0.66
Ireland	1.61	2.83	1.00
Portugal	2.72	4.66	2.06
Spain	1.10	1.39	0.58

But is if the SF expenditure is large as a fraction of GDP a large SF impact arises in terms of GDP). Therefore is better to consider the ***ratio of cumulative % increase in GDP/cumulative SF share on GDP***). The multiplier up to 2010 becomes 2.83 in Ireland, 2.55 in Portugal, 1.77 in Spain and 1.07 in Greece, 4.44 in East Germany, 1.48 in Northern Ireland

Main ***limitations***: Lucas Critique, Confounding factors (fiscal policy, monetary policy, industrial, social, labor market policies), full regional interactions, right consideration for supply and crowding out effects

Other question: planned or certified expenditure?

CONVERGENCE GROWTH EQUATION (1)

An alternative approach directly analyses the contribution of SF to the convergence process through the ***estimation of the convergence equation, both conditional*** (Boldrin and Canova, 2001, Cappelen et al., 2003, Ederven, 2002, etc.) and ***unconditional*** (Rodriguez-Pose and Fratesi, 2004)

For Italy, Aiello e Pupo (2009, RIS) analyse the ***impact of SF on growth from 1996 to 2007*** through the estimation of a panel model in which SF are an explanatory variable in the convergence equation

During the period 1996 to 2006 per capita expenditure in the South is 876 euros per year (780 in the Center-North); the South received only 38.7% of capital account expenditure (6,2% of GDP against 3,1% of Center-North). In total 78 billion euros for the South and 32 for the Center-North.

CONVERGENCE GROWTH EQUATION (2)

- The estimated equation is:

$$\log y_{it} = \beta \log y_{it-\tau} + \gamma \log (s_{it}) + \varphi \log (n_{it}+g+\delta) + \theta \log f_{it} + \alpha \log h_{it} + \eta_t + \mu_i + \varepsilon_{it}$$

Where

y_{it} is the per capita income of region i at time t

s_{it} is the ratio between investment and GDP in the region i

n_{it},g,δ are the rate of growth of population, technological progress and depreciation rate

f_{it} is the amount of structural fund expenditure in region i at time t

h_{it} is an index of human capital in region i at time t

η_t,, μ_i , ε_{it} are time effects, regional effects and error term

The equation is estimated with various techniques (OLS,LSDV,GMM)

CONVERGENCE GROWTH EQUATION (3)

- The convergence analysis is carried out for the period 1980-2007 and T is equal to 9 observation by region. Each observation refers to a three-year period.
- A slight different approach consider also annual values but with the inclusion of an ***ECM mechanism***:

$$\log y_{it} = \beta \log y_{it-\tau} + \gamma \log (s_{it}) + \varphi \log (n_{it}+g+\delta) + \theta \log f_{it}$$
$$+ \alpha \log h_{it} + \pi_1 \Delta \log \log (s_{it}) + \pi_2 \Delta \log h_{it} + \pi_3 \Delta \log n_{it} + \pi_4 \Delta \log f_{it} + \varepsilon_{it}$$

The conclusion of the convergence analysis is that among the Italian regions there is conditional convergence during the period of use of SF.

The question is: is this due to SF? ***The value of the estimate of θ gives an idea of the relevance of SF.*** In the estimation, the coefficient of SF ranges from 0,054 to 0,09. This means that a 10% increase of SF determines an increase by 0,9% of GDP.

CONVERGENCE GROWTH EQUATION (4)

- The model also allows to evaluate the ***variation of conditional convergence speed*** with and without FS. The conditional convergence speed is usually 5,1% per year which increases to 5,42% when we consider S.

- However, ***the impact of SF on labor productivity is not significant***, neither as an estimate of θ, nor in terms of improvement of the speed.

- Causes of this may vary from institutional factors, to different impact of national policies, to different development strategies, to difference in the mechanism of resource allocation and efficiency in managing the FS procedures

CONVERGENCE GROWTH EQUATION WITH SPATIAL EFFECTS (1)

Dall'Erba and Le Gallo (2008, PIRS) analyze the impact of SF on the convergence process in a ***spatial econometric setting***. The analysis is conducted on 145 European regions over the period 1989-1999. Over the period, 247 billions of euros of which 17 of Cohesion Funds.

Given the somewhat mixed evidence in favour of a positive impact of SF on GDP also related with difference in the techniques used, in the period analyzed and in the sample (regions) considered, ***they include in a traditional β-convergence equation spatial autocorrelation and spatial heterogeneity*** to allow for geographical spillover effects. Indeed the growth rate of each region depends upon that of its neighbors.

Though in a neo-classical setting public policy may be considered important in determining the increase in the growth rate in the LR, is not clear if financing transportation infrastructure in a poor area guarantees that it will catch up with a more developed areas.

CONVERGENCE GROWTH EQUATION WITH SPATIAL EFFECTS (3)

- The model used is (in matrix terms)
- $g_T = \rho W g_T + \alpha e_N + \beta y_o + \gamma_1 \log(s) + \gamma_2 \log(n+g+\delta) + +X\varphi + \mu SF + \varepsilon = (I- \rho W)^{-1} (\alpha e_N + \beta y_o + \gamma_1 \log(s) + \gamma_2 \log(n+g+\delta) + X\varphi + \mu SF) + (I- \rho W)^{-1} \varepsilon$

where:

g_T = average per capita growth rate between 0 and T;

e_N =unit vector

y_o =log of per capita GDP level at time 0

s = average gross domestic savings rate

n+g+δ = same as before

X = other variables (conditionality)

SF =structural funds

W= NXN spatial weight matrix which contains the spatially weighted average of the growth rates in the neighbouring regions

CONVERGENCE GROWTH EQUATION WITH SPATIAL EFFECTS (4)

- There are ***two types of spillovers***: 1) the growth rate of region I is affected by a marginal change in the explanatory variable in region j; 2) a diffusion effect related to the error process.

Alternatively we may think at a spatial heterogeneity model:

$$g_T = \alpha_C D_C + \alpha_P D_P \ \ \beta_C D_C y_o + \beta_P D_P y_o + \mu_C D_C SF + \mu_P D_P SF + \varepsilon$$

The variance of ε is block diagonal with elements differing by clusters (100 core regions and 45 periphery regions) were considered on the basis of an algorith founded on explanatory spatial data analysis.

The dependent variable is the average growth rate of per capita GDP in the region over 1989-1999. Total payments are considered plus the commitments. Among the control variables we have unemployment, share of employment in agriculture, amount of structural funds as a function of GDP.

The model also tries to detect ***endogeneity*** which may exist because SF are not allocated randomly but conditional on GDP.

In doing so, instruments for the variables potentially correlated with the error terms are firsty introduced. Hausman tests detect the endogeneity of SF and therefore the model is estimated with 2SLS

CONVERGENCE GROWTH EQUATION WITH SPATIAL EFFECTS (5)

- **Four models** are estimated: 1) spatial lag with SF; spatial lag without SF; 3) spatial lag with spatial regimes, groupwise heteroskedasticity, and no SF; 4) spatial lag with spatial regimes, group-wise heteroskedasticity and SF
- The ***convergence process appears to be quite different across regions,*** it is faster for the peripheral regions (3,50%) and slower among the core regions (1,35%).
- However, the ***specific effect of SF is never significant and the steady state appears to be not affected by the SF received.***
- In another exercise Dall'Erba e Le Gallo try to isolate the impact of the funds from the other factors that originate significant interregional spillovers. It appears that ***rich regions diffuse more***
- The nature and the extent of the diffusion properties depends on the characteristics of the regions and not on the amount of SF received. ***The small extent of spillover effects in peripheral regions is responsible, probably, for their backwardness***
- If we measure spillovers through the impact of the shocks targeted in one region on the growth rate of the other region, we have a growth diffusion process only for the core regions

CONVERGENCE GROWTH EQUATION WITH SPATIAL EFFECTS (2)

Why regional impact of SF may be low or insignificant:

1) Regional government design projects that are not necessarily growth-enhancing (rent-seeking)
2) Regional governments may choose low productive projects to remain eligible (moral hazard)
3) European regional funds may crowd out the national expenditure (Additionality)

Due to the spillover effects, indeed, ***rich regions may gain because***:

1) With infrastructure projects, a substantive part of the value added generated goes to another region (spillovers)
2) A particular project is never implemented without additional national financing which is usually bigger in richer regions

INTERREGIONAL IMPACT ANALYSIS (1)

- Perez, Dones and Llano (PIRS,2009) use an ***interregional input-output model*** to estimate the impact of EU structural funds received by the Spanish regions between 1995 and 1999.
- The idea is to explicitly consider interaction between regions which do not only concern spillovers (which may capture productivity gains for a better accessibility) but also ***intermediate sectoral linkages***
- Also, income disparities may be enhanced by the movements of goods and services (perspective of NEG). In Spain, as in many countries, there is a debate about the positive effect of the SF. Also, if the impact is positive, there is a ***trade off between an allocation of funds that increase the convergence process of the nation and another one which reduces income disparity***.
- It is expected that, at least in the SR, a large part of the effects induced by the projects funded in the poorest regions would migrate to the richest areas.

INTERREGIONAL IMPACT ANALYSIS (2)

- The main methodology applies is to refer to the IRIO (interregional input-output) model which starts from defining:

  - ***intraregional input coefficients*** as:

$a_{ij}^{LL} = z_{ij}^{LL}/X_J^{L}$ where z_{ij}^{LL} is the amount of product generate by sector i in the region L that is used by sector j in region L

And:

- ***Interregional input coefficients*** as:

$a_{ij}^{LM} = z_{ij}^{LM}/X_J^{M}$ where z_{ij}^{LM} is the amount of product generate by sector i in the region L that is used by sector j in region M

and, analogously, a_{ij}^{MM} and a_{ij}^{ML}

Then we define $\mathbf{x} = \mathbf{Ax} + \mathbf{f}$

where, in a 2x2 region case $\mathbf{x} = (\mathbf{x}_1\ \mathbf{x}_2)^T$ is the output vector which includes the sectoral outputs of the two regions, $\mathbf{f} = (\mathbf{f}_1\ \mathbf{f}_2)^T$ is a vector of final demand for each sector in the two regions and:

INTERREGIONAL IMPACT ANALYSIS (3)

$$\mathbf{A} = \begin{matrix} \mathbf{A_{11}} & \mathbf{A_{12}} \\ \mathbf{A_{21}} & \mathbf{A_{22}} \end{matrix}$$

is the (partitioned matrix) of technical coefficients which captures interindustry relations inside the regions **(A_{11} and A_{22})** and between the regions **(A_{12} and A_{21}).**

The SF shock is then included by varying the final demand in each region according to the allocation of the funds.

Solution $\mathbf{x} = (\mathbf{I\text{-}A})^{-1}\,\mathbf{f}$ allows to calculate the direct, indirect and induced effects of SF over final output in each sector and region

In Spain, ***an IRIO model has been developed through the interconnection of 18 1995- single region I-O tables*** and allow special procedures (RAS) for updating tables and regionalize information available only at the national level. Of course, more complication concerns the estimation of the commodity flows across regions

INTERREGIONAL IMPACT ANALYSIS (4)

- Final value of the ***funds assigned to each region is given by the sum of regionalized funds and the proportion of non regionalized funds*** referring to each region:

$$tf_t^R = rf_t^R + (gfkf_t^R/\Sigma gfkf_t^R)*nrf_t$$

where tf_t^R are the total funds allocated to the region, rf_t^R are the regionalized funds, nrf_t are the non regionalized and $gfkf_t^R$ is the share of gross fixed capital formation in each region R in year t.

If we look at the allocation in Spain, poor region receives 70% of funds and produce less than 50% of GDP.

Total funds allocated in each region was corrected by the tax effect and by the foreign imports. By appropriate procedures it is ibtained a column impact vector that captures the initial demand shock which is producers in each sector and in each region were likely to have received as a consequence of the funds originally allocated by the EC.

INTERREGIONAL IMPACT ANALYSIS (5)

- Therefore it is possible to calculate:

Total output effect which is:

- **Δx**= (**I-A**)$^{-1}$ **Δd** where **Δd** is the vector of value-added coefficents) changes in final demand imputed to SF (direct effect) . Also, we may calculated:
- **Δo**= **Δx - Δd** as ***indirect effetcs*** and:
- **Δg** = **v^** (**I-A**)$^{-1}$ **Δd** as ***induced effects in terms of value added*** (**v^** is the vector of value-added coefficients) and
- **Δe** = **e^** (**I-A**)$^{-1}$ **Δd** as ***induced effects in terms of employment*** (**e^** is the vector of employment coefficients)

The main results are that **average ratio between the value added and the funds is 0.7 but this value ranges** from 0.3 in the poorest region (Ceuta and Melilla) and 1.8 in Madrid. Also, Objective 1 regions show lower rates than Objective 2 regions. Also almost ¼ of the total EC funds are absorbed by foreign imports and taxes.

INTERREGIONAL IMPACT ANALYSIS (6)

- The ***dependence ratio***, i.e., the ratio between the average contribution of EU funds as a percentage of GDP and the average growth rate of value added is very high (285%) for the poorest region where almost nearly only 8% of income and employment is induced by the SF. Therefore ***the final effect has been much less redistributive than the initial allocation of funds*** (due to spillover and interindustry relationships generated outside the most targeted regions)
- Rich regions are therefore more able to capture induced effects and sectors with higher value added to output ratios
- From this model is possible also to calculate the ***interregional spillover effect*** and which flow is the biggest. It turns out that the biggest interregional spillover flow is between Andalusia and Catalunia and therefore this flow is ***not necessarily related with distance***

REGRESSION DISCONTINUITY DESIGN (1)

- Pellegrini et al. (2013, PIRS) approach the problem of the evaluation of cohesion policy from a different point of view.
- Given that the main problem in evaluating the impact of SF is, apart from data availability and comparability, the ***presence of confounding factors***, the proposed approach is to ***compare the economic scenario under policy with a counterfactual scenario*** in which regions that are eligible for SF under Objective 1 (i.e., GDP per capita below 75% of the EU average) are compared with the non eligible regions (regions that are just above the 75% threshold thus isolating the policy effect in a growth model)
- The method used is a ***sharp regression discontinuity design*** where the average causal effect of the treatment (SF expenditure) is given by:
- $E[y_i(1) - y_i(0)] \mid x_i=c$ where $y_i(1)$ is the potential per capita GDP growth of Objective 1 regions, $y_i(0)$ is the potential per capita GDP growth of the control group defined as above, x_i is the level of per capita GDP which is set equal to 0,75.

REGRESSION DISCONTINUITY DESIGN (2)

- Therefore, units (regions) above the cut-off point are compared with units (regions) just below the cut-off point receiving the treatment. By this way, any ***discontinuity in the conditional expectation of the outcome at the cut-off point is evidence of a causal effect of the treatment.***
- No theoretical framework is assumed. Therefore, the approach is a-priori consistent with many competing models.
- The ***assumption*** is that regions close to cut-off points share the same characteristics and their initial per-capita income (which drives eligibility) is the relevant difference among them. It is assumed that the regions above the 75% threshold cannot manipulate the forcing variable
- After elimination of some units, the regional data set concerns 57 objective regions (treated sample) and 133 non objective 1 regions (non treated). Data concern EU15 and the regional data set is fully coherent with SF regulations for the programming periods 1994-99 and 2000-06. An advantage of this paper is that ***certified expenditure*** for the period 1994-2006 is used.

REGRESSION DISCONTINUITY DESIGN (3)

- The main ***disadvantages of this approach*** are: a) the number of observations close to the threshold may be low;
- b) the regional growth has a high variability with respect to the initial level of per capita GDP. Therefore a wide range of estimators is considered.
- c) the approach does not explain the link between policy intervention and economic growth, i.e., we cannot know which is the cause of differential growth (i.e., quality of institutions, education, infrastructure, public services).
- Structural and cohesion policies amounted to 168 billions in 1994-99 (of which 68% for Objective 1) and to 213 billions for EU15 in 2000-06 (of which 65% for Objective 1 regions). In the paper ***the impact is measures over the period 1995-2006*** with a split for the two planning periods (1994-99) and 2000-06.
- The result of the analysis is that ***EU regional policies have a positive impact and generate a difference of the annual per capita GDP growth equal to a range from 0.6 to 0.9 percentage points over the period*** 1995-2006 depending on the estimation method used.

REGRESSION DISCONTINUITY DESIGN (4)

- The effect are the highest with a ***parametric*** general form equal to:

  $$Y = \alpha + \tau D + \Sigma\beta_i X^i + \Sigma\, \delta_i DX^i + \varepsilon$$

  where Y is the average annual growth rate of regional real GDP, ***D is the dummy indicating Objective 1 treatment*** - no information on intensity) X^i is the level of per capita GDP in PPS. The specification in logs of the parametric equation with lag 1 is the standard convergence equation. Therefore we are estimating if the growth of an Objective 1 region is higher than the convergence because of the treatment concerning SF.
- The estimation is also performed by excluding the lower quarter for the treated regions and the higher quarter for the non treated and the results are basically confirmed.
- Many tests concerning different specification, discontinuity in the conditional density of the forcing variable, jumps in the value of other exogenous covariates at the cut-off point, spatial correlation, country effects etc. confirm the ***robustness*** of the results
- ***In terms of GDP levels the impact*** is equal to 7-10% increase of per capita GDP over the period. However, it will takes 50-75 years to achieve convergence only through SF.

SUMMING UP

- Different approaches (more demand or supply, bottom-up vs top-down, regional vs. multiregional vs interregional)
- Different techniques
- Different research aims (i.e., are we questioning the utility of SF or are we tracing the disaggregated effect of the policy over sectors)
- How we account for spillovers (spatial vs non spatial)
- How to avoid Lucas critique, counterfactual controlling
- Need for comparing the results of the different approaches on the same region/period
- Sensitivity to geographical units

SENSITIVITY TO TERRITORIAL UNITS

- How to evaluate the ex-ante potential impact of the EU investment for regional growth for the period 2007-13 when NEG features are taken into account
- How the geographical detail affects the results
- Evaluation approach more focused on spatial factors and accessibility (locational coordinates of the investment effort)
- For 2007-13, European regulations allowed regional planners to avoid the ex-ante internal allocation of funds at the NUTS 3 or lower geographical level but so-called “large projects” are localized from the start
- More flexible allocation among different sectoral policies (from “budget measures” to “functional categories”)
- More flexibility in policy analysis since money has been allocated during the planning period more easily and the policy maker may be interested in monitoring the effect of the policy

MODEL

- The ***REMI model*** is a multi-sectoral and multi-area dynamic model widely used in the US for policy analysis (*Remi Policy Insight, see* Treyz and Treyz, 1997, Fan, Treyz and Treyz, 2000).
- Adaption of the model to the Italian economy has been done by REMI together with IRPET and used to evalutate the impact of Italian Community Support Framework (CSF) 2000-2006 on the Mezzogiorno regions (Remi-Irpet, 2003).
- In our application NUTS-2 and NUTS-3 levels
- Main features: both demand and supply elements, mainly used for long-run simulations, mixed structure-eclectic model (input-output, econometric, CGE features, NEG framework)
- It makes possible to measure the ***overall impact on the regional economy of a change in accessibility conditions*** for firms and households inside the local and regional economic systems (for instance, to track the effects of reducing transportation cost by looking at its three components, namely the economic cost itself, the cost of a better accessibility and the implicit cost of moving).

SICILY ERDF INVESTMENT PLAN

- Approximately 3,270 billions of euros of European grants (6,44 billions of total grant), covering the period 2007-2013
- The plan is articulated into 7 main priorities
- Main sectors of intervention: transportation and logistics, energy and environment, cultural and environmental tourism, research, innovation and information technology, manufacturing competitiveness, urban investment, government efficiency
- 58 functional categories involved

IMPACT ASSESSMENT-METHODOLOGY (1)

- Objective: estimation of total impact on the regional economic system and on its sectoral and sub-regional (provincial-NUTS3) components by mixing demand (variation of aggregate demand from infrastructure investment) and supply elements (change in the use of productive factors and change in labor and total factor productivity determined by firm subsidies) and also change in consumer preferences following government policy
- In addition, evaluate the impact of a greater accessibility of intermediate products and labor force through the different sectors and make explicit the effects of the reduction of transportation, accessibility and commuting costs. The model can take into account a multiplicity of actions with different sectoral and territorial impact which modify household and firm accessibility conditions.

IMPACT ASSESSMENT – METHODOLOGY (2)

- The total amount of public grants has been divided into different groups of functional categories. On the basis of the amount specified for each category it has been possible to define specific policy areas with sufficiently homogeneous impact type.
- Transportation infrastructure intervention has been divided into five groups (railroad infrastructure, road infrastructure, logistics, port infrastructure and airport infrastructure)
- Analogous division has characterized natural resources (energy plants, gas distribution plans, efficiency in energy use, firm subsidies for stimulating environmental concern, water resource investments, drainage projects, risk prevention, waste disposal projects)

IMPACT ASSESSMENT – METHODOLOGY (3)

- For cultural and environmental projects for tourism we assumed a partition of public expenditure into three components: a first portion (infrastructural) has to do with the effect of exogenous demand for construction, a second portion pertains to firms' subsidies and a third portion aims to modify consumer preferences for specific consumption types (i.e, in favor of recreational and cultural consumption).
- For research and innovation and competitiveness, we grouped the different types of interventions into incentives to firms for using technological inputs, information technology diffusion plans aiming at improving family use, subsidies for machinery equipment, interventions which reduce capital cost for firms, subsidy to tourist firms.
- The financial allocation for each group of projects has been determined by the amount available for the categories involved together with a specific analysis of the Plan, sometimes at the level of a specific action. With such a grouping it has been possible to take into account of the portion of the plan devoted to firm subsidies.
- For urban and government efficiency projects, we have identified three homogeneous types of projects: construction and social infrastructure, diffusion of clean transportation (more related to consumer habits with respect to the use of public versus private transportation) and public administration efficiency.

CHANGE IN ACCESSIBILITY

- For transport infrastructure investments, we assumed that the reduction in transportation costs was accompanied by an improvement in the accessibility to other firms and in consumer accessibility to goods
- Transportation costs reductions were included in the model with a territorial specificity by identifying the provinces (NUTS 3) where transportation cost reductions would mainly apply. This was also possible by looking at the indicative list of the so-called “large projects” included in the plan
- In the simulations, we also assumed generalized changes of the accessibility index of some services and some production factors, especially with respect to research, innovation and ICT

OTHER ASSUMPTIONS

- We assumed a that the temporal distribution of each category was following the same temporal profile of the whole plan
- For transportation infrastructure we assumed a three year lag with respect to the year of expenditure for transportation and related (accessibility and commuting) cost reduction.
- For firm and sectoral aids, we calculated a 100% increase of investment with respect to the amount of the public subsidy with a two-thirds deadweight loss.
- We allow for personal taxes to finance the regional co-financing by incorporating both the 30% regional quota and regional share of the 70% national quota.
- In many cases we also allowed for direct imputed demand effects for specific sectors by simultaneously nullify the indirect effect coming out by the input-output table.

IMPACT ON REGIONAL GDP (2-REGIONS vs NUTS 3 MODEL)

	Type of simulation	***2009***	***2010***	***2011***	***2012***	***2013***	***2014***	***2015***	***2020***	***2040***
1	Only infrastructure demand	0.446 (0.443)	0.475 (0.471)	0.486 (0.482)	0.459 (0.455)	0.476 (0.471)	0.479 (0.474)	0.443 (0.438)	-0.016 (-0.017)	0.003 (0.003)
2	Infrastructure demand and reductions in transportation and mobility costs	0.446 (0.443)	0.475 (0.471)	0.486 (0.482)	1.186 (0.768)	1.326 (0.856)	1.508 (0.954)	1.605 (0.991)	1.581 (0.781)	1.905 (0.966)
3	Total demand and reductions in transportation and mobility costs	0.525 (0.524)	0.569 (0.566)	0.583 (0.579)	1.280 (0.862)	1.422 (0.953)	1.607 (1.052)	1.698 (1.084)	1.582 (0.782)	1.904 (0.965)
4	3+ increase in TFP in private non agricultural industries	1.013 (1.011)	1.111 (1.105)	1.263 (1.254)	2.046 (1.616)	2.262 (1.777)	2.500 (1.927)	2.633 (1.998)	2.609 (1.779)	2.937 (1.963)
5	4+ reduction in the cost of capital	1.459 (1.471)	1.583 (1.589)	1.826 (1.830)	2.648 (2.230)	2.893 (2.420)	3.146 (2.585)	3.289 (2.664)	3.268 (2.448)	3.602 (2.633)
6	5+reduction in production cost	1.685 (1.676)	1.806 (1.791)	2.092 (2.071)	2.933 (2.484)	3.193 (2.687)	3.455 (2.859)	3.604 (2.944)	3.593 (2.734)	3.939 (2.932)
7	6+ increase in accessibility of goods	1.772 (1.763)	1.967 (1.951)	2.327 (2.304)	3.235 (2.783)	3.554 (3.044)	3.868 (3.267)	4.061 (3.394)	4.182 (3.313)	4.603 (3.584)
8	7+ increase in accessibility of labor force	1.797 (1.788)	2.109 (2.003)	2.410 (2.385)	3.348 (2.894)	3.696 (3.183)	4.036 (3.431)	4.253 (3.581)	4.452 (3.574)	4.919 (3.887)
9	8+ change in consumption pattern among categories	1.587 (1.576)	1.822 (1.803)	2.206 (2.179)	3.146 (2.690)	3.494 (2.979)	3.835 (3.228)	4.053 (3.380)	4.253 (3.374)	4.701 (3.668)

IMPACT ON REGIONAL EMPLOYMENT (2-REGIONS vs NUTS 3 MODEL)

N	***Type of simulation***	***2009***	***2010***	***2011***	***2012***	***2013***	***2014***	***2015***	***2020***	***2040***
1	Only infrastructure demand	0.508 (0.509)	0.548 (0.548)	0.563 (0.562)	0.534 (0.533)	0.555 (0.554)	0.561 (0.560)	0.521 (0.519)	-0.016 (-0.017)	0.003 (0.004)
2	Infrastructure demand and reductions in transportation and mobility costs	0.508 (0.509)	0.548 (0.548)	0.563 (0.562)	1.100 (0.722)	1.132 (0.745)	1.213 (0.784)	1.223 (0.769)	0.871 (0.330)	0.963 (0.381)
3	Total demand and reductions in transportation and mobility costs	0.591 (0.591)	0.644 (0.643)	0.660 (0.657)	1.194 (0.815)	1.228 (0.841)	1.310 (0.881)	1.314 (0.859)	0.871 (0.330)	0.962 (0.379)
4	3+ increase in TFP in private non agricultural industries	0.001 (0.004)	0.111 (0.113)	0.248 (0.249)	0.851 (0.474)	0.946 (0.560)	1.070 (0.641)	1.106 (0.649)	0.719 (0.173)	0.723 (0.133)
5	4+ reduction in the cost of capital	0.417 (0.435)	0.559 (0.576)	0.772 (0.792)	1.404 (1.045)	1.516 (1.149)	1.644 (1.235)	1.677 (1.242)	1.246 (0.721)	1.144 (0.571)
6	5+reduction in production cost	0.621 (0.623)	0.770 (0.769)	1,023 (1.019)	1.671 (1.286)	1.796 (1.401)	1.931 (1.493)	1.969 (1.504)	1.539 (0.984)	1.435 (0.833)
7	6+ increase in accessibility of goods	0.623 (0.626)	0.779 (0.779)	1.051 (1.048)	1.719 (1.336)	1.866 (1.473)	2.021 (1.584)	2.077 (1.613)	1.700 (1.147)	1.574 (0.974)
8	7+ increase in accessibility of labor force	0.573 (0.575	0.695 (0.694)	0.947 (0.944)	1.606 (1.221)	1.748 (1.353)	1.902 (1.464)	1.959 (1.494)	1.595 (1.038)	1.451 (0.847)
9	8+ change in consumption pattern among categories	0.472 (0.473)	0.603 (0.601)	0.849 (0.845	1.508 (1.123)	1.650 (1.256)	1.805 (1.367)	1.864 (1.398)	1.499 (0.942)	1.328 (0.722)

IMPACT ON REGIONAL GDP UNDER DIFFERENT CLOSURES (MARKET CLEARING vs NEG)

N	***Type of simulation***	***2009***	***2010***	***2011***	***2012***	***2013***	***2014***	***2015***	***2020***	***2040***
2	Infrastructure demand and reductions in transportation and mobility costs	0.452 (0.446)	0.485 (0.475)	0.500 (0.486)	1.021 (1.186)	1.017 (1.326)	1.053 (1.508)	1.022 (1.605)	0.575 (1.581)	0.775 (1.905)
4	3+ increase in TFP in private non agricultural industries	1.020 (1.013)	1.121 (1.111)	1.276 (1.263)	1.879 (2.046)	1.949 (2.262)	2.038 (2.500)	2.041 (2.633)	1.588 (2.609)	1.787 (2.937)

SECTORAL MULTIPLIERS

Investment type	Bi-regional model	Multiregio nal model
Railroad infrastructures	2.302	2.384
Road infrastructures	4.218	0.860
Logistics	12.471	2.949
Port infrastructure	4.122	2.222
Infrastructures for airport services	7.243	3.801
Energy plants	0.929	0.930
Energy pipelines	0.633	0.636
Efficiency in energy use	5.362	5.370
Firm subsidies for low environmental impact machinery	16.064	15.779
Water resource projects (aqueducts)	0.702	0.704
Water resource projects (dams)	0.745	0.746
Waste disposal projects	0.962	0.962
Reclamation and decontamination projects	0.990	0.924
Risk prevention projects	0.792	0.796
Cultural projects	8.635	8.729
Projects increasing the value of natural and environmental resources	3.361	3.370
Tourism	4.973	4.976
R&D and innovation	11.054	10.921
ICT projects for households	11.775	20.389
Firm subsidies for machinery equipments	2.935	2.893
Measures for credit ease	11.310	11.013
Urban housing	0.976	1.063
Clean transportation	-6.447	-6.475
Local and regional public employment efficiency	14.724	14.482

IMPACT ON GDP BY PROVINCE (NUTS-3 REGIONS)

	2015			2020			2040		
Province	C	T	P	C	T	P	C	T	P
Agrigento	0.333	0.267	1.210	-0.011	-0.087	0.837	0.003	-0.104	0.788
Caltanissetta	0.519	0.513	1.819	-0.026	-0.010	1.307	0.003	0.015	1.375
Catania	0.478	1.367	2.439	-0.019	1.062	2.090	0.005	1.220	2.230
Enna	0.338	0.179	1.176	-0.014	-0.175	0.797	0.003	-0.192	0.774
Messina	0.349	0.743	1.706	-0.011	0.740	1.717	0.003	1.022	2.011
Palermo	0.411	1.451	2.352	-0.014	1.376	2.277	0.002	1.662	2.572
Ragusa	0.698	0.624	1.576	-0.028	-0.083	0.851	0.005	-0.079	0.805
Syracuse	0.465	1.064	2.300	-0.019	1.121	2.402	0.003	1.540	2.874
Trapani	0.425	0.532	1.443	-0.017	0.297	1.185	0.004	0.438	1.305
Rest of Italy	0.006	0.036	0.060	-0.002	0.045	0.055	0.000	0.049	0.055

CONCLUSIONS

- The sensitivity analysis tried to identify the importance of sub-regional detail in assessing the regional impact of an investment policy (i.e., the European programming plan for Sicily from 2007 to 2013)
- Simulation which tend to capture the spatial effect of the reduction in transportation cost on growth may be substantially overestimated in the aggregate model vis-à-vis the more disaggregated one
- Sectoral multipliers are strongly different beween the two models with no clear direction of the effect in favour of an aggregated vs a disaggregated one
- Metropolitan and more industrial provinces (Palermo, Catania, Siracusa) ssem to benefit more than backward policies and the distance between provinces increases with time and if we take more properly into account transportation cost reduction and accessibility (internal spatial effects)
- Therefore a model designed to incorporate new economic geography features at a detailed geographical level quantifies differently the impact of European regional policy. A similar argument has been made for other Italian regions (Tuscany by Gori, Lattarullo and Paniccià, 2007) with respect to the impact assessment of the regional mobility and logistics.