European Union

Assessing the Regional Economic Effects of European Union Investments

Final Report

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The results and analysis of Southern Italy represent the joint work of REMI and IRPET. The staff members who are actively involved in the analysis of IRPET are Renato Paniccia, Roberto Pagni, and Sara Mele.

The key staff members at REMI who contributed to this project include Sherri Lawrence, Nicholas Mata, Jerry Hayes, Jason Laprade, Kyra Comroe, Jeff Waller, Adam Cooper; Sudro Brown II, Pallavi Konwar, Alicia Rodriguez, and Johannah Shinner.

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Introduction and Executive Summary

With limited public resources to stimulate sustainable economic development, the national and regional governments of the European Union must spend their funds in the most effective way possible. Due to the complexity of regional economies, the total short-, medium-, and long-run effects of alternative policies are difficult to determine. Therefore even economic experts need a quantified model that predicts how the direct effects of specific policies affect the total regional economy over time.

REMI's method for estimating a policy's total effects over time, rather than just the apparent direct effects, involves two steps. In the first step, the direct economic effects of public investments that affect the regional economy are estimated or measured, then converted to variables that can change total output in the regional economy (one example is a change that affects production costs, e.g. reduced travel time on roads, increased productivity, increased supply of qualified workers, or an increase in the productive capital stock). The second step is to input these variables into the area's REMI® Policy Insight® model, which calculates the total changes in output due to the policy change (e.g., the region's increased competitiveness or production capacity). These changes in output, in turn, change employment, gross domestic product (GDP), personal real disposable income, and the size and age structure of the population.

This report details the work that Regional Economic Models, Inc. has done to build REMI Policy Insight models for regions and territories in Europe. Two areas are examined in particular and several examples are presented for each area to show the short-, medium-, and long-term effects of alternative public investments. Particular attention is given to the alternative socio-economic returns to public investment and to the E.U. share of those investments. Figure SI.1 below shows the results of simulations done for Southern Italy by REMI and IRPET (Instituto Regionale per la Programmazione Economica della Toscana, Via La Farina 27, 50132 Florence, Italy).

To construct this graph, the detailed direct effects of spending E.U. funds were quantified for five separate projects. In each case, the E.U. funding is leveraged by public funds from the national government of Italy and/or the regional governments in Southern Italy. The direct effects of the total spending are put into the REMI Policy Insight model of Southern Italy to create a new forecast for all of the variables in the model. The baseline forecast is subtracted from the alternative forecast to obtain estimates of all of the direct and indirect effects of the project. These effects on Gross Domestic Product for each one-hundred euros of E.U. Investment from 2000-2006 are shown in Figure SI.1.

Figure SI.1: Southern Italy-Change in GDP per Hundred Euros of E.U. Investment from 2000-2006

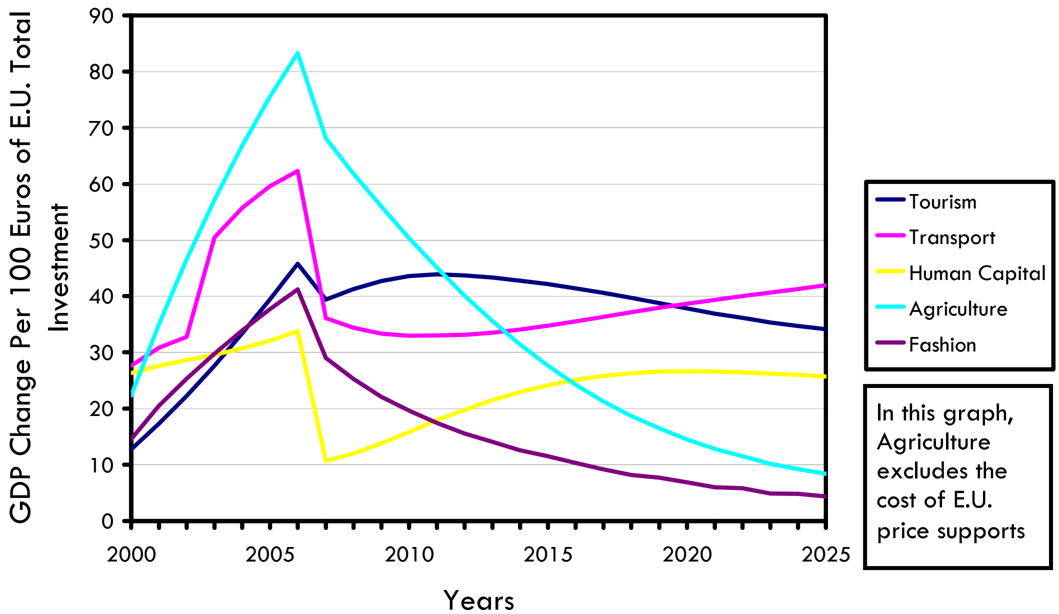


Table SI.1 Present Value 2000-2025 of GDP and of E.U. Investment, from 2000-2006 in the Objective 1 Region of Southern Italy-Time Discount Rate 3%

Concept	Units	Agriculture	Fashion	Tourism	Human Capital	Transportation
1. Present Value of the increase in GDP from 2000-2025	Millions 1999 Euros	1088	153	1615	1201	2935
2. Present Value of E.U. Investment from 2000-2006	Millions 1999 Euros	135	41	224	245	373
3. Increase in Cumulative GDP (1) per E.U. euro Investment (2)	Euros	8	4	7	5	8

The results from 2000-2006 include both the effects of additional direct demand in Southern Italy and the increases in output due to other factors that increase output. After 2006, the results are due only to the long-term effects on competitiveness and output that are the indirect results of the investments on the structure of the economy. In Table SI.1, the present value of each year of extra GDP from 2000-2025 is added up in the first line. In the second line, the present value of the E.U. Investment is calculated. The last line shows the present value of cumulative GDP divided by the present value of euros of E.U. investment. The assumptions leading to these results include the assumption that new capital stock resulting from investment induced by subsidies is not replaced as it depreciates. The direct inputs in the simulations are explained in Chapter I.

In Figure SI.2 and Table SI.2 the same calculations are made for employment. The final line on each table shows the E.U. investment per “job year” created. A job year is one person working one year; thus, a new job that lasts for ten years is counted as an increase of ten job years.

Figure SI.2: Southern Italy-Job Creation per Million Euros of Cumulative E.U. Investment from 2000-2006

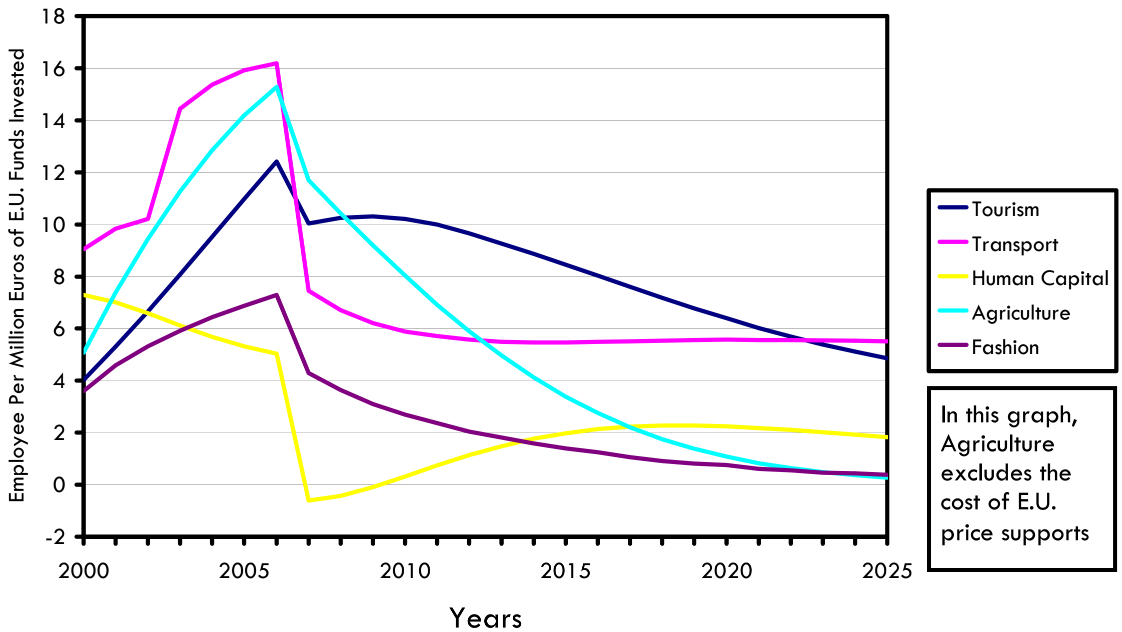


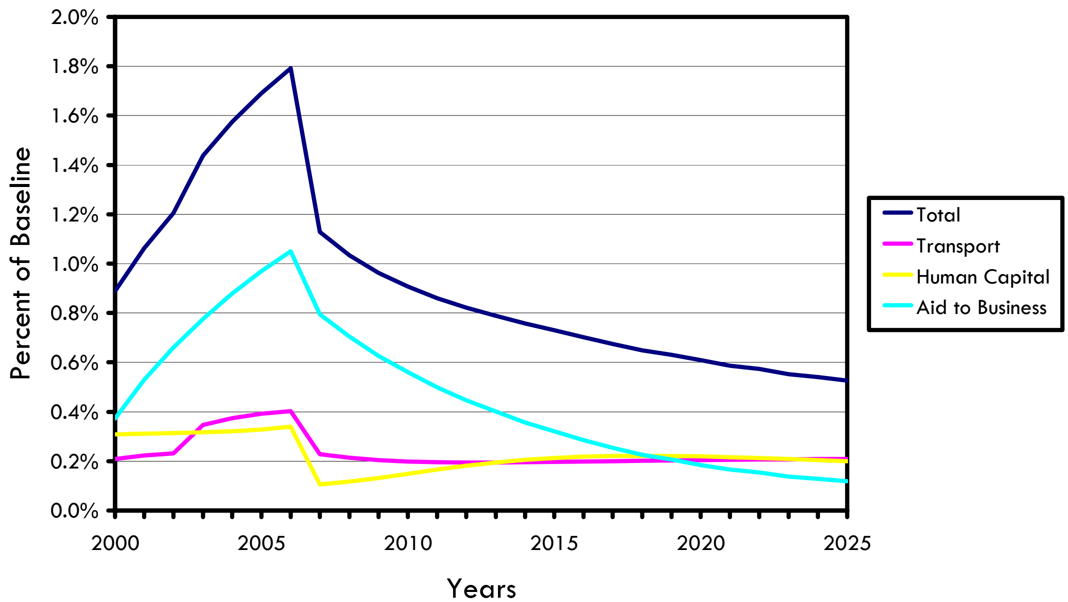
Table SI.2 Present Value 2000-2025 of increases in Employment and of E.U. Investment, from 2000-2006 in the Objective 1 Region of Southern Italy-Time Discount Rate 3%

Concept	Units	Agriculture	Fashion	Tourism	Human Capital	Transportation
1. Present Value of E.U. Investments from 2000-2006	Millions 1999 Euros	135	41	224	245	373
2. Present Value of Job Years from 2000-2025	Job Years	18125	2549	36477	14931	61886
3. Millions of E.U. Investment divided by the increase in the Number of Job Years	E.U. Euros Per Job Year	7460	15986	6132	16439	6029

Finally, the projects studied are assumed to be representative of other projects in their category and are scaled up to represent the entire category. This result is shown in Figure SI.3 for increase in GDP as a percentage of baseline GDP and in Figure SI.4 for the total number of jobs resulting from E.U. investments in Aid to Business, Transportation Infrastructure, and Human Capital.

In Southern Italy, total E.U. investments from 2000-2006 are 21.477 billion euros, which is 8.86% of average GDP from 2000-2006. Out of the total E.U. investment, transportation infrastructure is 15.5%, agriculture and fishing subsidies and other Aid to Business are 45.1%, and human capital is 19.1%, for a total of 79.7% of E.U. investments. For other investments, such as environmental improvement, the evaluations did not report sufficient information for us to input into the model. Using the five simulations that are reported above as representative of the categories to which they belong, we can scale these numbers based on their proportion of the total E.U. spending to show the effects of E.U. investments totaling 7% of average GDP over the 2000-2006 period or of 1% of GDP for each of the seven years. These results are shown in Figures SI.3 and SI.4.

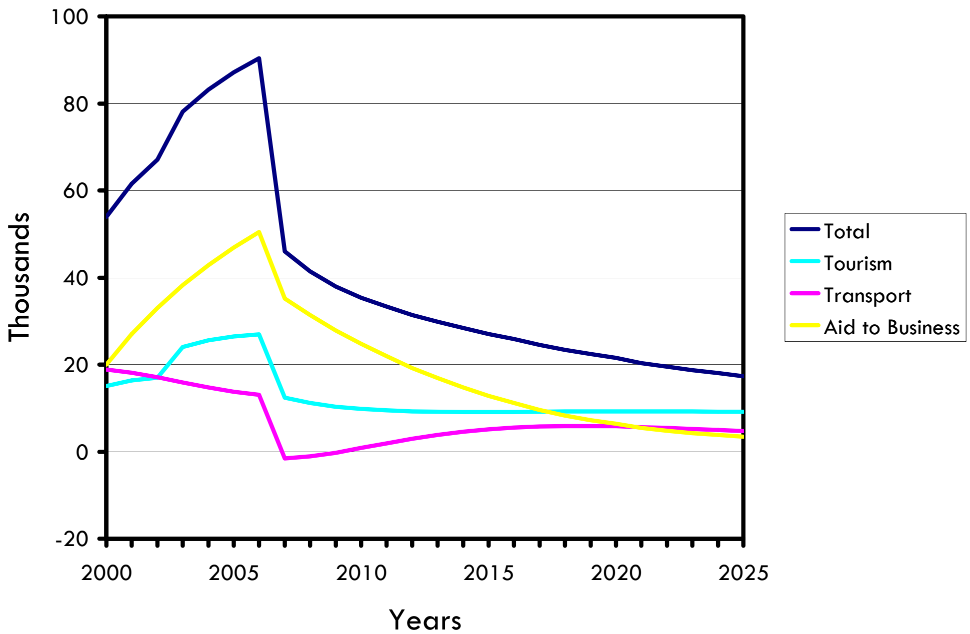
Figure SI.3: Italy-GDP % Change from Baseline due to EU Investments for Aid to Business, Transportation Infrastructure, and Human Capital.*



*These were the result of an E.U. investment of about 1% of GDP per year from 2000-2006.

In the peak year of 2006, when both demand and supply effects are stimulating GDP, the percentage increase in GDP is 1.8% due to E.U. investments. In 2025, the percent increase in GDP drops to about .55% above the baseline.

Figure SI.4: Southern Italy-Total Jobs due to EU Investments for Aid to Business, Transportation Infrastructure, and Human Capital.*



* These were the result of an E.U. investment of about 1% of GDP per year from 2000-2006.

In Figure SI-4 we show the total number of jobs created by E.U. Aid to Business, Transportation Infrastructure, and Human Capital. The total number of jobs peaks at about 90,000 in 2006 and is about 19,000 in 2025. These results include the effects of total public investment leveraged by the E.U. funds. In our simulations the region's share of national public investment and the total amount of the regional contribution are matched by regional personal tax increases.

Next, we turn to Andalucia, which is one of the regions in REMI's four-region model of Spain. These regions interact and add up to the total the nation of Spain. Figure A-1 shows the change in GDP in Andalucia per one-hundred euros of E.U. investment from 2000-2006. Table A.1 shows the present value of the change in cumulative GDP and its return to the present value of cumulative E.U. investment.

Figure A.1: Andalucia- Change in GDP per Hundred Euros of E.U. Investment, from 2000-2006

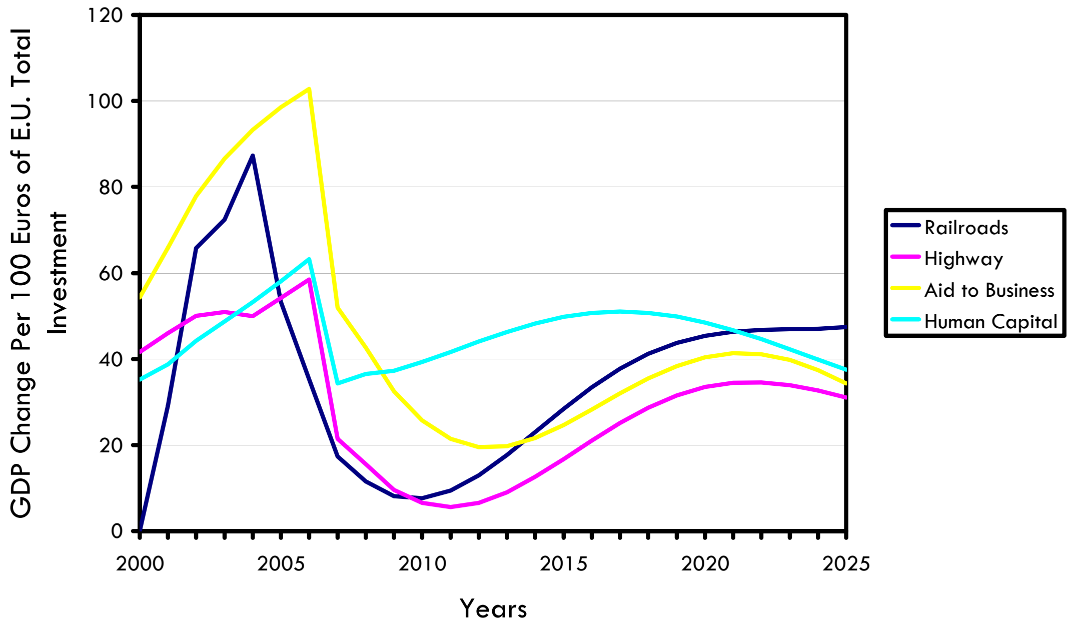


Table A.1: Present Value 2000-2025 of GDP and of E.U Investment, from 2000-2006 in Andalucia- Time Discount Rate 3%

Concept	Units	Railroads	Highways	Tourism/Aid to Business	Human Capital
1. Present Value of Change in Cumulative GDP from 2000-2025	Millions 1999 euros	7789	8032	963	4302
2. Present Value of E.U. Investment from 2000-2006	Millions 1999 euros	1098	1310	96	472
3. Increase in Cumulative GDP (1) per E.U. Euro Investment (2)	Euros	7	6	10	9

Figure A-2 shows the number of jobs created per million of cumulative E.U. expenditures in Andalucia for the four projects. Table A.2 shows the present value of the increase in job years, relative to the present value of the E.U. investment.

Figure A.2: Andalucia-Job Creation per Million Euros of Cumulative E.U. Investment, from 2000-2006

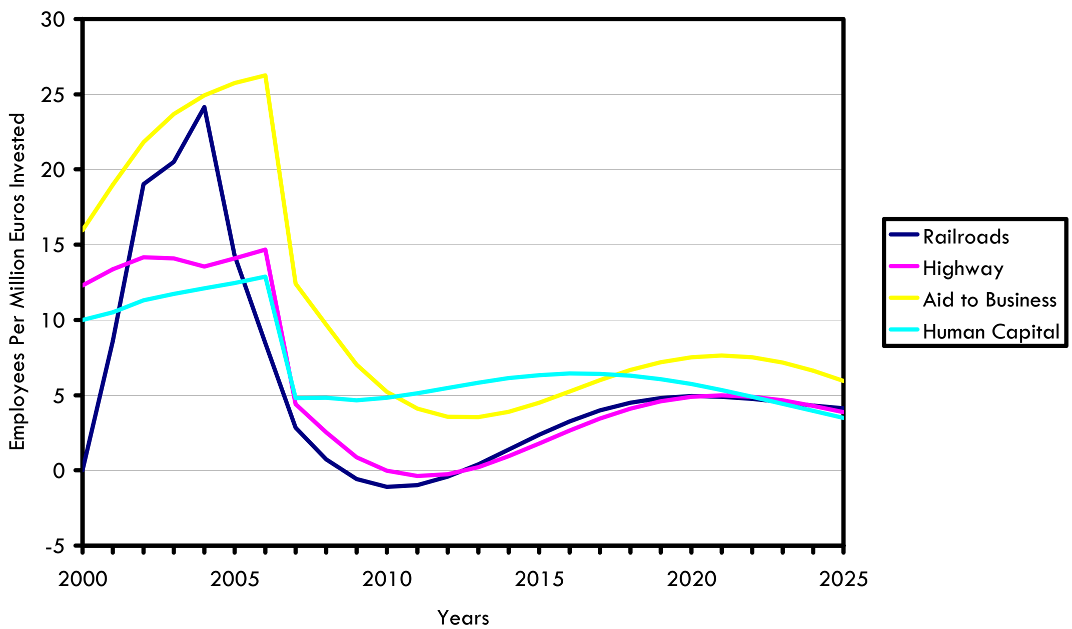
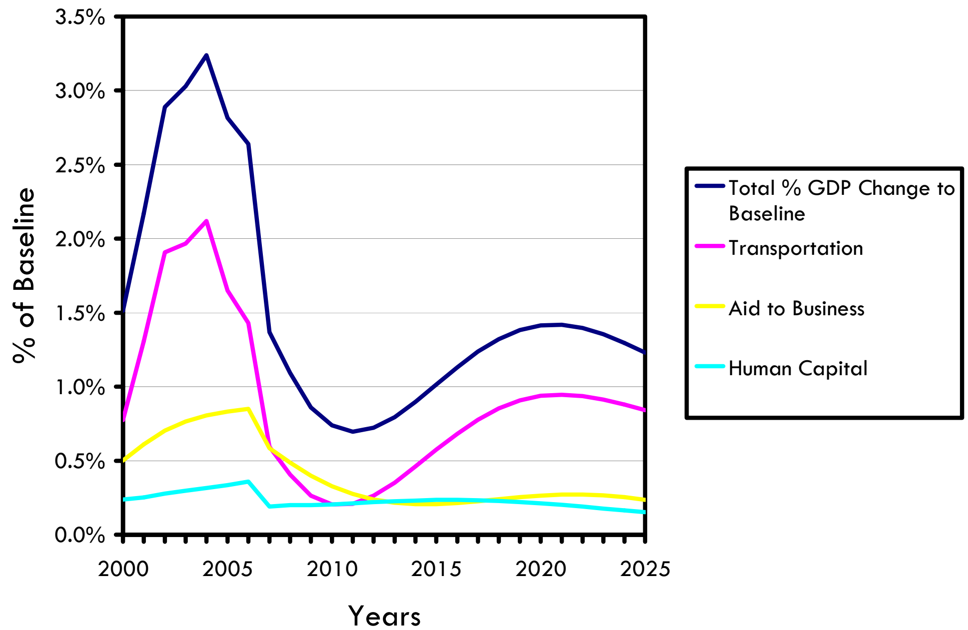


Table A.2: Present Value 2000-2025 of Employment and of E.U. Investment, from 2000-2006 in Andalucia-Time Discount Rate 3%

Concept	Units	Railroads	Highways	Tourism/Aid to Business	Human Capital
1. Present Value of E.U. Investments from 2000-2006	Millions 1999 euros	1098	1310	96	472
2. Present Value of Increases in Job Years from 2000-2025	Job Years	140118	169565	23091	71013
3. Millions of E.U. Investment (1) Divided by Increase in the Number of Job Years (2)	E.U. Euros per Job Year	7836	7728	4168	6644

These programs represent those that are most focused on economic development. They are 54% of total E.U. investments. The other projects did not include estimates of the direct effects such as the quality of life, health benefits, and other results of these policies that might have influenced the economy. As a percentage of average GDP, the cumulative E.U. investments from 2000-2006 were 1.1% for Aid to Businesses, .6% for Human Capital, and 3.3% for Transportation Infrastructure, which yields a total of 5% for all three of these programs, or about .7% of total GDP for each of the seven years. The results of this 54% of E.U. investment, as a percentage of GDP, are shown in Figure A-3.

Figure A.3: Andalucia-GDP % Change from Baseline Due to EU Investment in Aid to Business, Transportation Infrastructure, and Human Capital*

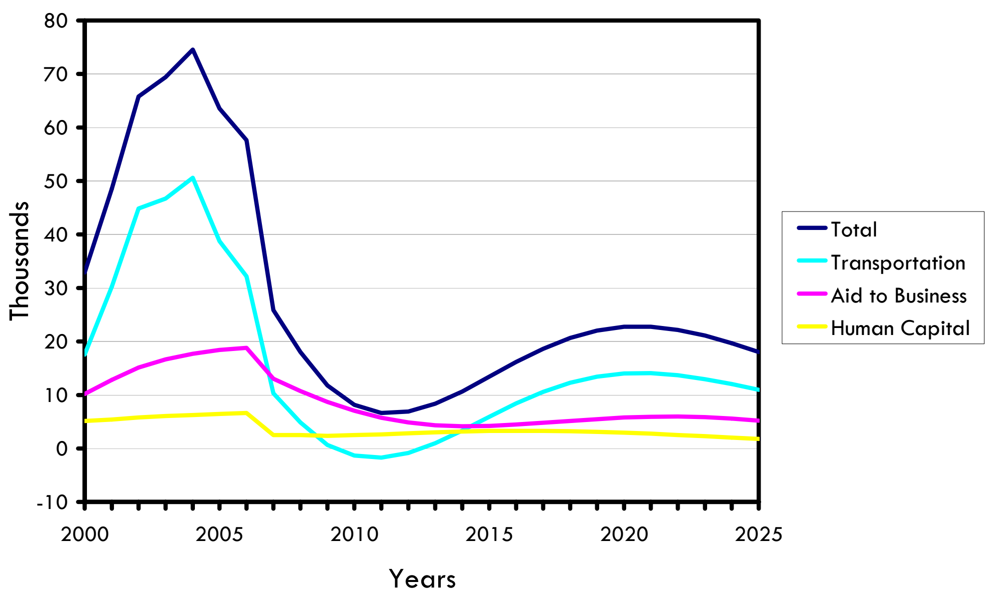


*The investment in these categories is equal to .7% of GDP each year from 2000-2006.

The peak increase in GDP above the baseline is 3.2% and the increase in 2025 is about 1.25%.

The number of jobs generated is shown in Figure A-4.

Figure A.4: Andalucia-Jobs Created Due to E.U. Investment in Aid to Business, Transportation, and Human Capital*



*The investment in these categories is equal to .7% of GDP each year from 2000-2006.

Jobs peak at about 75,000 in 2005 and dip to 19,000 in 2025. Again, the investments analyzed were .7% of GDP for each of the first seven years.

The results shown above for Southern Italy and Andalucia are discussed in more detail in Chapter I. They depend on the predicted or measured direct input effects estimated by REMI and IRPET. Some portions of European Union spending, such as environmental improvement, were omitted from the examples due to a lack of information concerning the necessary direct effects, such as estimates of health benefits and non-monetary quality-of-life benefits, that are required as direct inputs.

In Chapter II, the review of four models used for E.U. investments analysis finds that the Quest II model is used for national analysis and is focused on forward-looking rationality and international trade balance. The Venables & Gasiorek model focuses on micro-economic behavior in space and has been used in a E.U investment analysis for a highway project in Spain. The current HERMIN models focus on special characteristics in different countries and use aggregate relationships derived from aggregate time series. From the limited recent material that is publicly available, it is difficult to determine the role of other equations in the model that tie the published equations into a larger framework. The HERMIN model has been used mostly on broad categories of spending.

REMI focuses on an explicit structure based on the maximizing behavior of actors in response to current conditions and key statistical parameters based on large data sets. The REMI model includes all of the inter-industry relationships in the relevant input-output tables in one of the five blocks in the model. REMI Policy Insight is designed for evaluating the total economic effects of projects, based on the direct or micro-economic effects that are estimated for ex ante projects and measured for ex post projects.

Chapter III is an overview of the REMI Policy Insight model. REMI’s founder, Dr. George I. Treyz, developed the methodology used in REMI’s socioeconomic modeling system in order to improve the quality of research-based decision making in the public and private sectors. A research team currently led by Drs. Frederick and George Treyz continues to enrich and deepen REMI’s powerful dynamic analytic engine. The latest version of the model is based in part on a REMI prototype set forth in the November 2000 issue of the *Journal of Regional Science* (see references pg 103). It is designed for regional areas of varying sizes in the United States, Europe, and Canada.

The forecasting and policy-analysis system includes key econometric estimates and integrates inter-industry transactions, long-run equilibrium features, and the new economic geography. It includes:

- Substitution among factors of production in response to changes in relative factor costs
- Migration responses to changes in expected income and employment opportunity and access to regional and national consumer commodities
- Labor participation rate responses to changes in real wage and employment conditions
- Wage rate responses to labor market changes
- Consumer consumption responses to changes in real disposable income and commodity prices

- Local, regional, and market share responses to changes in regional production costs and in agglomeration economics (distance-weighted, non-homogenous intermediate and factor inputs from all areas to place of use with access-based productivity and consumer utility effects).

The REMI Policy Insight model's unique power is to generate realistic year-by-year estimates of the total regional effects of any specific policy initiative. A wide range of policy variables allows the user to represent the policy to be evaluated, while the explicit structure in the model helps the user to interpret the predicted economic and demographic effects. The model is calibrated to many sub-national areas for policy analysis and forecasting, and is available in single- and multi-area configurations. Each calibrated area (or region) has economic and demographic variables, as well as policy variables so that any policy that affects a local economy can be tested.

REMI Policy Insight® is used in the U.S. and Europe by government agencies, consulting firms, nonprofit institutions, universities, and public utilities. REMI model simulations estimate comprehensive economic and demographic effects in wide-ranging initiatives such as: economic impact analysis; policies and programs for economic development, transportation, infrastructure, environment, energy and natural resources; and state and local tax changes. Articles about the model equations and research findings have been published in professional journals such as the *American Economic Review, The Review of Economic Statistics,* the *Journal of Regional Science,* and the *International Regional Science Review.* Chapter IV presents an explicit technical documentation of the model that shows all of the key equations.

The data sources and model calibration are set forth in Chapter V. Chapter VI describes model forecasts and illustrative simulations. The concluding chapter discusses the conservative nature of the simulation results presented here, since they assume that the effects in the future are directly related to the depreciated value of the investments and do not include a prediction that the assets will be replaced as they depreciate. It also appeals to future studies that look at direct effects to give greater attention to the quantitative results that will have direct effects on the economy and to look for long-term behavior changes that may occur due to the European Union investments. The conclusions note the major gains in our ability to understand and carry out meaningful policy studies that capture the total socio-economic effects, including the agglomeration effects due to access that have only recently been quantified. They also point out that policy studies using REMI Policy Insight make it possible to show the total socioeconomic effects relative to the E.U. or public investments in alternative projects and provide valuable insights that can contribute to the choice of an optimal set of policies. The Appendix includes the specific details of the direct inputs that are used in the simulations.

Chapter I: Evaluating the Regional Economic Effects of European Union Investments Using the REMI® Policy Insight® Model[2]

This chapter presents scenarios to address major types of European Union investments using the REMI macroeconomic model. The purpose is to show how analysts can evaluate the total socio-economic effects of a broad range of programs using a widely available model that is designed to analyze the economies of national and sub-national regions. The results from REMI Policy Insight show the total macroeconomic impacts of direct policy effects.[3]

In this analysis, we examine the total effect of structural measures and public investments on two regional economies. The analysis shows how to conduct a comparative evaluation of the future effectiveness of alternative expenditures of public funds, particularly structural and cohesion funds. These comparisons provide a basis for developing the information needed by policy-makers to predict the relative effectiveness of various public expenditures on major economic development goals. This analysis facilitates decisions about the future efficient allocation of operation program funds.

In this section we provide specific analyses and results for representative European Union investments covering a broad range of programs. These programs include subsidies for the productive sector, investments in transportation infrastructure, human-capital investment, and tourism investment.

Our approach involves three steps. First, we determine the direct effects of a policy. Then, we use these effects as inputs into a macroeconomic model. Finally, we use the model to generate the economic and demographic changes that occur as a result of the policy. The simulation results are reported as the difference in economic activity on an annual basis that is caused by the direct economic change.

A good example of this process is an analysis of a transportation-infrastructure investment. Investing in transportation increases the quality of transportation infrastructure, which has the effect of reducing transportation costs. The direct effects of the transportation investment are based in part on an estimate of the reduction in percentage terms of transportation costs. These transportation cost changes are entered into the Transportation Cost Matrix of the Policy Insight model as a change in travel times within or among the regions in a multi-regional model. The model simulation of this and other direct changes shows the economic effects of transportation improvements.

REMI Policy Insight states the results of the analysis as changes in key macroeconomic and demographic indicators. The inputs for the subsidies to industries, for example, have major effects on international exports, intermediate and final sales, exports to the rest of the nation, output, gross domestic product, employment, unemployment rate, migration, relative production costs, and real disposable income per capita. The subsidy may lead to a long-term location of a firm due to the relative sensitivity in the locations

[2] This section was written by Frederick Treyz, Ph.D. and George Treyz, Ph.D. The results and analysis of Southern Italy represent the joint work of REMI and IRPET. The IRPET staff members who are actively involved in the analysis are Renato Paniccia, Roberto Pagni, and Sara Mele.

[3] This model has been in continual development since 1980 and is well documented in academic literature. See for example, Fan, Treyz and Treyz (2000), Greenwood, Hunt, Rickman and Treyz (1991), and Treyz, Rickman and Shao (1992), and the references for Chapter III.

of fixed capital stock to the initial investment cost. Shares of the local and export markets would increase output. Employment would increase and unemployment would decrease as output increases. The employment and real-wage gains would decrease the outward net migration that was indicated in the baseline forecasts. The model continues to track through all of the causality until a simultaneous solution for each year is found.

To examine structural change, analysts must use a model that explains all of the key cause-and-effect relationships in the economy, which allows them to introduce interventions to change the status quo. If a model does not include labor supply by occupation and/or industry, for example, it is difficult to predict the effects of alternative training programs. Models that do not explicitly include the effects of improved access to labor or intermediate inputs fail to account for the beneficial effect of the availability of a large pool of trained labor and access to specialized intermediate inputs, which are the primary factors that determine regional prosperity. We compare the four primary models available for policy analysis in Chapter II of this report.

The major goal for E.U. Investments and many other public investments is to promote sustainable economic development. Unfortunately, accurate estimates of the relative effectiveness of alternative public expenditures toward meeting this goal are often not available. Thus, allocation of euros may not be optimal.

To determine the relative effectiveness, three steps are required.

1. Examine each of the operational plans in detail. In particular, we must examine the direct effects on the economy in the short and long run. While the direct-demand effects are important in the short run, the long-run supply-and-demand effects are the most important factors in sustainable development.
2. Input these direct effects into a structural, economic-policy-analysis model that includes all of the key chains of causality through which public fund investments will influence the economy.
3. Run the model and calculate the relative effectiveness of the euro expenditure toward accomplishing the major objectives of the public investments.

Some examples of the ways that public policy can directly affect the socio-economic outcomes in the economy are:

Increase the private capital investments in the economy:

Instruments:
- Subsidies
- Tax policies
- Facilitate the working of capital markets

Increase demand on a permanent basis:

Instruments:
- Public investments in tourism promotion
- Infrastructure investments
- Subsidies in hotels and restaurants

Reduce labor and capital costs:

Instruments:
- Reduce non-wage labor costs

- Tax policies
- Increase productivity

Increase productivity:
Investments:
- Technology development
- Labor training
- Increase access to labor and intermediate inputs
- Transportation infrastructure

Make the area a more attractive place in which to live:
Investments:
- Public infrastructure
- Environmental improvements
- Reduce crime
- Improve consumer access to goods and services
- Tax policy

Increase labor supply:
Investments:
- Affect the age structure of the population
- Increase participation rate
- Change tax support for non-workers
- Change attitudes; enable people over 65 to continue to work
- Promote local products
- Add variety by expanding some industries

Increase access to labor and intermediate inputs:
- Transportation infrastructure investments
- Improve internet and communication infrastructure
- Remove barriers to trade and information flows

Analysts must use a model that is able to forecast the effects of the direct inputs on the total regional economy. It must also have a plausible structure that captures all of the key chains of causality through which the public investments' direct effects flow through the community. The REMI model is the only model that meets these requirements.

The remainder of this section is devoted to a description of and preliminary results from one of the two models that REMI has built for the E.U. Directorate-General for Regional Policy Coordination of Evaluation Commission. The model was jointly developed and applied by REMI and IRPET for the portion of Southern Italy eligible for Objective 1 structural funds, which includes the following regions:

- Basilicata
- Calabria
- Campania
- Molise
- Puglia
- Sardegna
- Sicilia

To build our structural model of these regions we gathered data for all areas of Italy and then built a database that included raw data such as wage rates, employment, and detailed demographic data. In addition, using our model structure we were able to generate estimates of relative productivity and other concepts. Figures I.1 through I.5 are maps of Italy that represent various key concepts for the textile industries. Such maps can be helpful in assessing the strengths and weaknesses of a region.

Figure I.1 shows the relative wage rates for the textiles and textile products industry. It shows that comparative wage rates are highest in Piemonte in Northern Italy.

Figure I.1: Italy-Wage Rate-Textiles & Textile Products

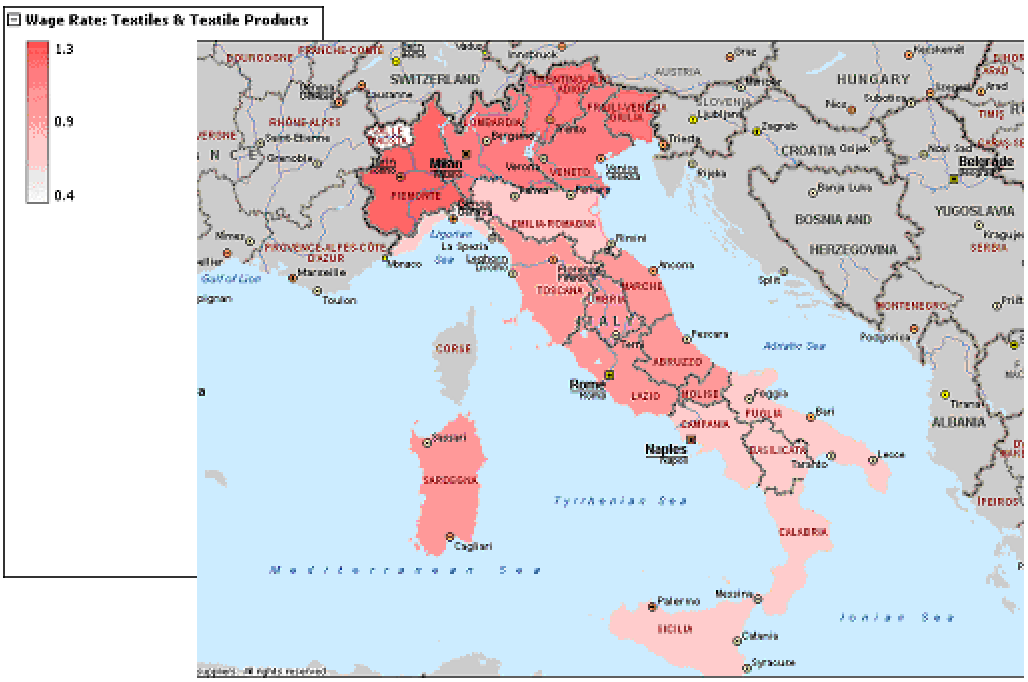


Figure I.2 illustrates labor productivity as we estimate it using the comparative availability of workers to choose from in the textile industry and in occupations used in that industry. In this case, Lombardia has the highest productivity.

Figure I.2: Italy-Labor Productivity-Textiles & Textile Products

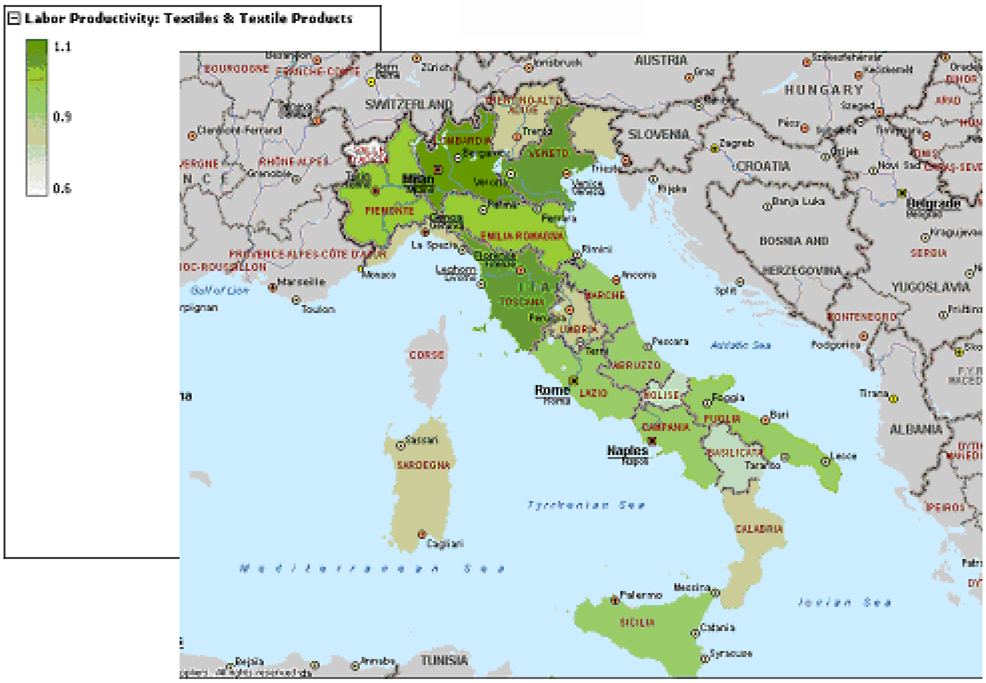


Figure I.3 shows wages adjusted for productivity. The map shows that higher wage rates in some areas are offset by the higher labor productivity in those areas.

Figure I.3: Italy-Wage Rate Divided by Labor Productivity-Textiles & Textile Products

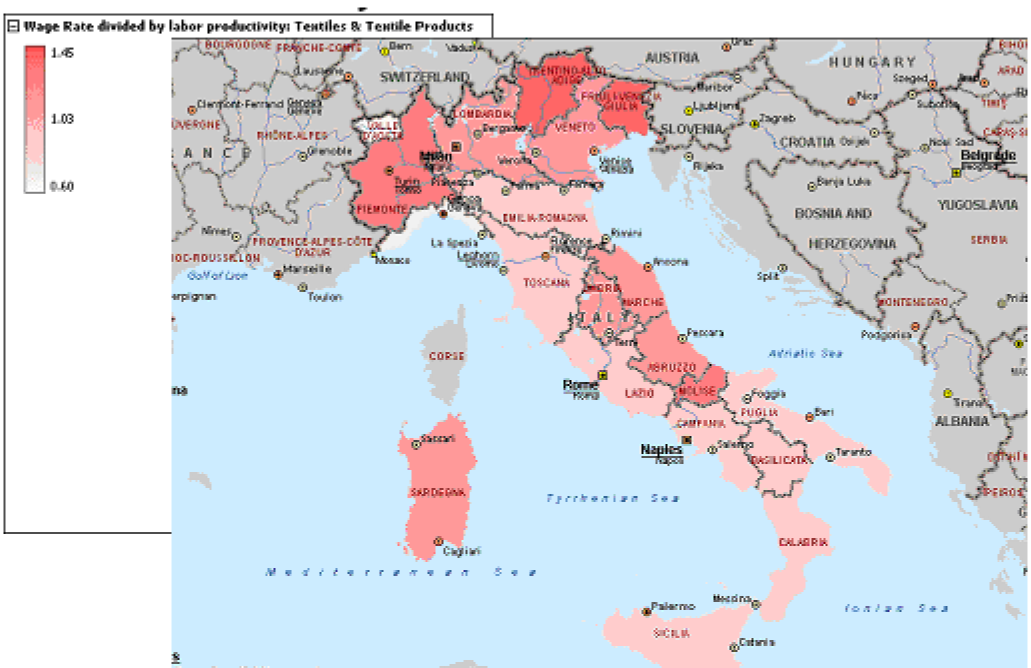


Figure I.4 shows the price of textiles considering both the production cost (see Figure I.5) and the access to variety.

Figure I.4: Italy-Composite Price-Textiles & Textile Products

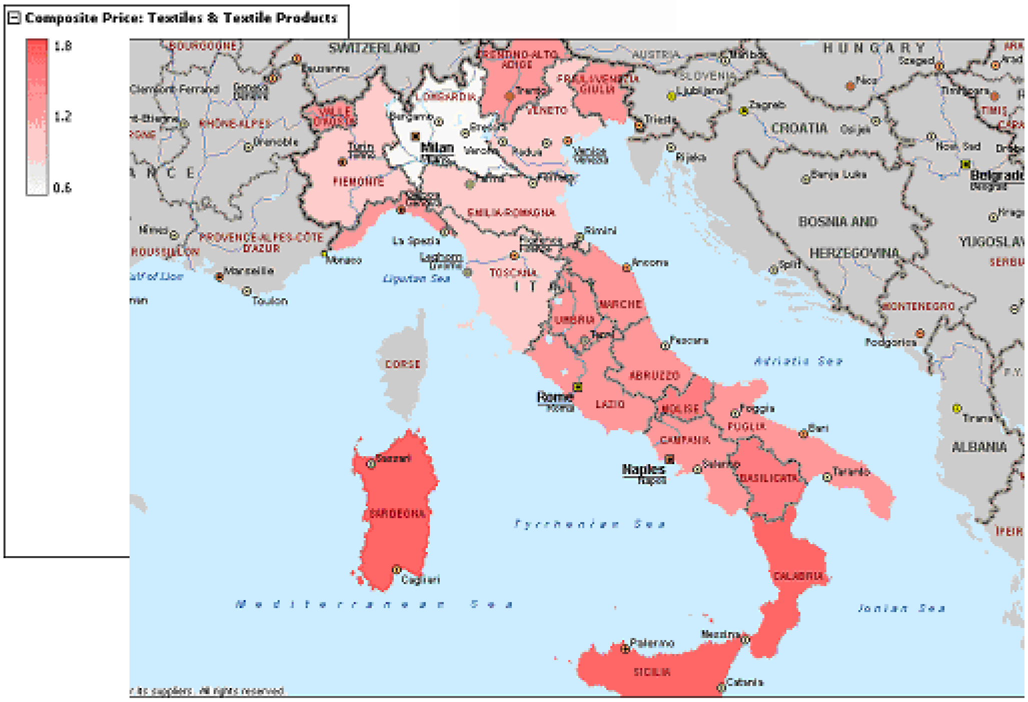
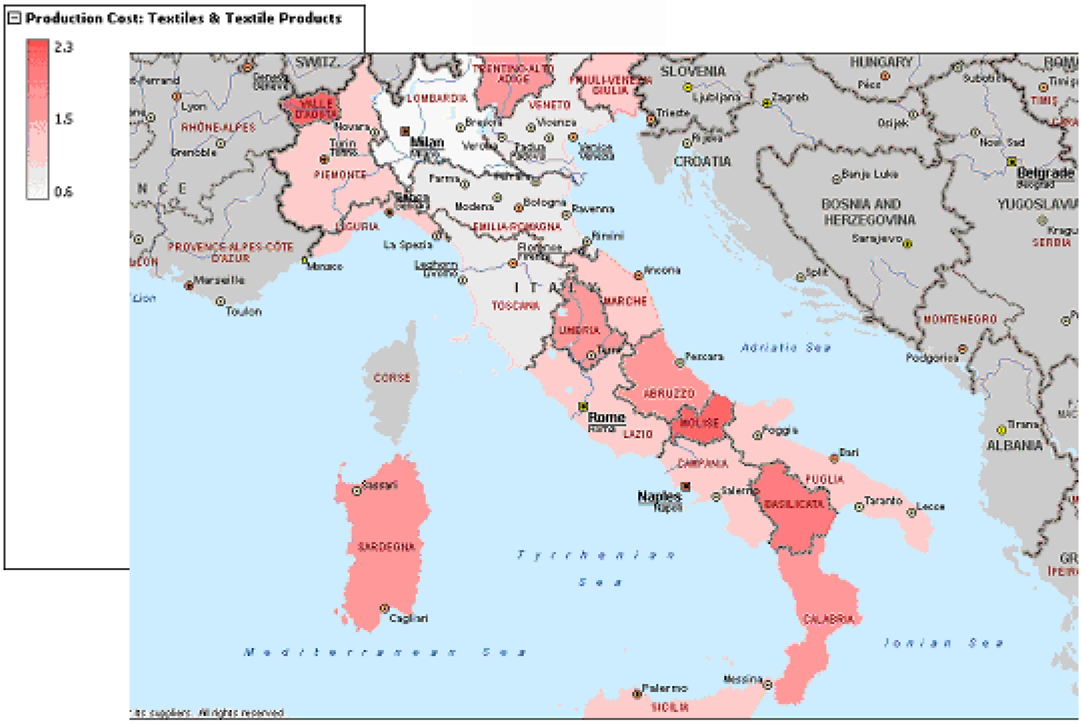


Figure I.5 shows us that production costs are lowest in Lombardia despite the region's relatively high wage rates. These comparatively lower production costs result from the labor productivity effect and the high access to intermediate inputs in Lombardia.

Figure I.5: Italy-Production Costs-Textiles & Textile Products



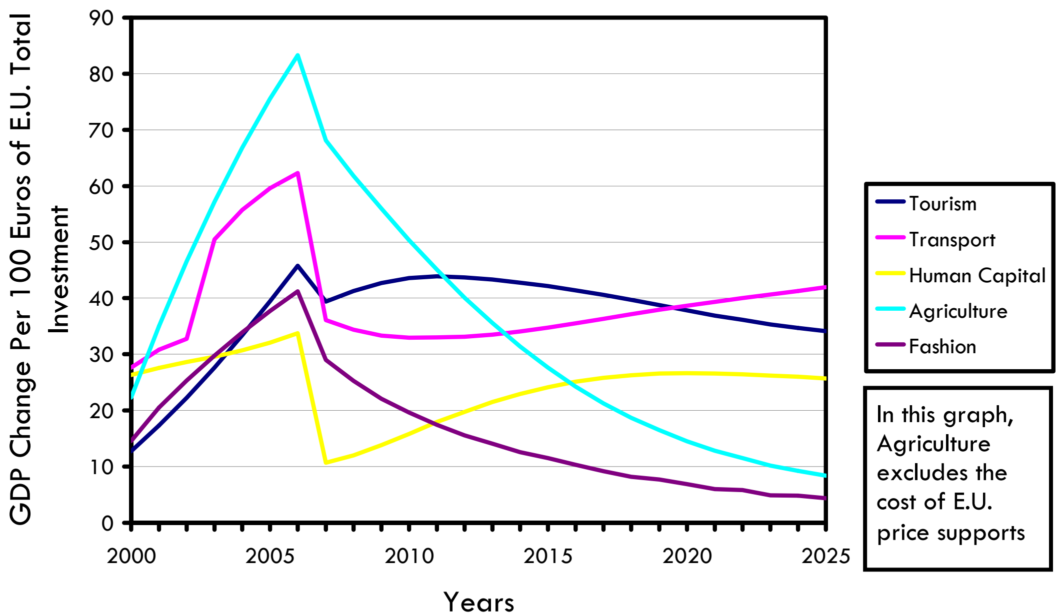
This background information illustrates the structural detail in the REMI model and can be used along with similar data for other industries to select policies to pursue as economic-development strategies.

Southern Italy

Using a REMI-IRPET model of Objective 1 areas in Southern Italy, IRPET and REMI have carried out a number of simulations for selected E.U. expenditures. The total economic effects associated with E.U. investment for five projects in Southern Italy have been generated using direct effects estimated by REMI and IRPET, which are then input into REMI Policy Insight.

Specifically the detailed direct effects of spending E.U. funds were quantified for five separate projects. In each case, the E.U. funding is leveraged by public funds from the national government of Italy and/or the regional governments in Southern Italy. The direct effects of the total spending are put into the REMI Policy Insight model of Southern Italy to create a new forecast for all of the variables in the model. The baseline forecast is subtracted from the alternative forecast to obtain estimates of all of the direct and indirect effects of the project. These effects on Gross Domestic Product for each one-hundred euros of E.U. Investment from 2000-2006 are shown in Figure SI.1.

Figure SI.1: Southern Italy-Change in GDP per Hundred Euros of E.U. Investment from 2000-2006



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3. Increase in Cumulative GDP (1) per E.U. euro Investment (2)	Euros	8	4	7	5	8

The results from 2000-2006 include both the effects of additional direct demand in Southern Italy and the increases in output due to other factors that increase output. After 2006, the results are due only to the long-term effects on competitiveness and output that are the indirect results of the investments on the structure of the economy. In Table SI.1, the present value of each year of extra GDP from 2000-2025 is added up in the first line. In the second line, the present value of the E.U. Investment is calculated. The last line shows the present value of cumulative GDP divided by the present value of euros of E.U. investment. The assumptions leading to these results include the assumption that new capital stock resulting from investment induced by subsidies is not replaced as it depreciates. The direct inputs in the simulations are explained in Chapter I.

In Figure SI.2 and Table SI.2 the same calculations are made for employment. The final line on each table shows the E.U. investment per "job year" created. A job year is one person working one year; thus, a new job that lasts for ten years is counted as an increase of ten job years.

Figure SI.2: Southern Italy-Job Creation per Million Euros of Cumulative E.U. Investment from 2000-2006

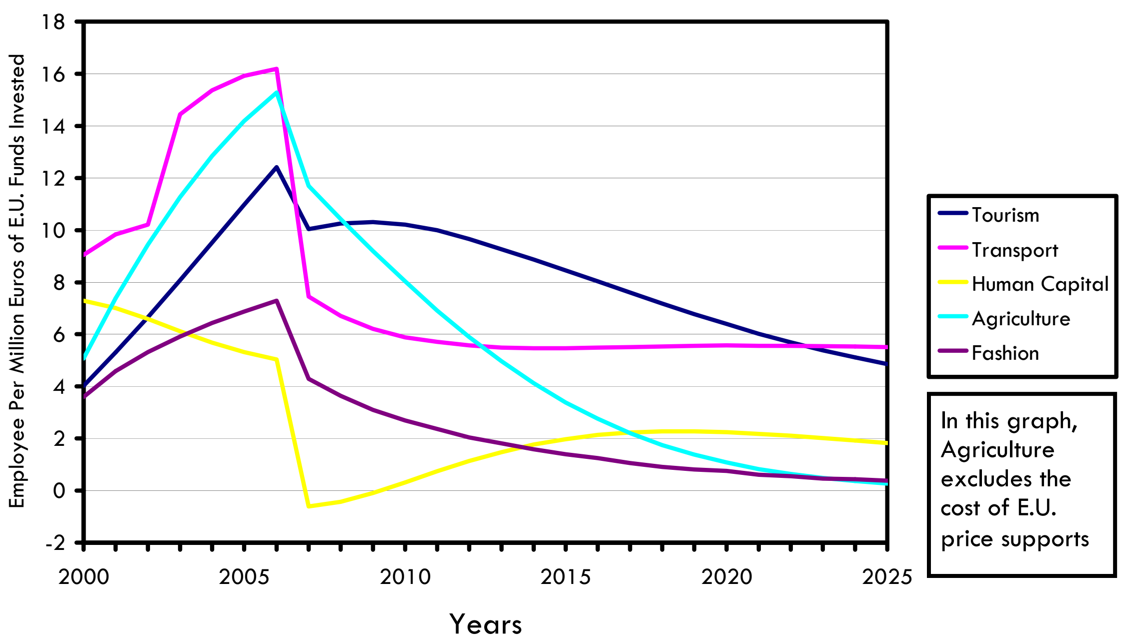


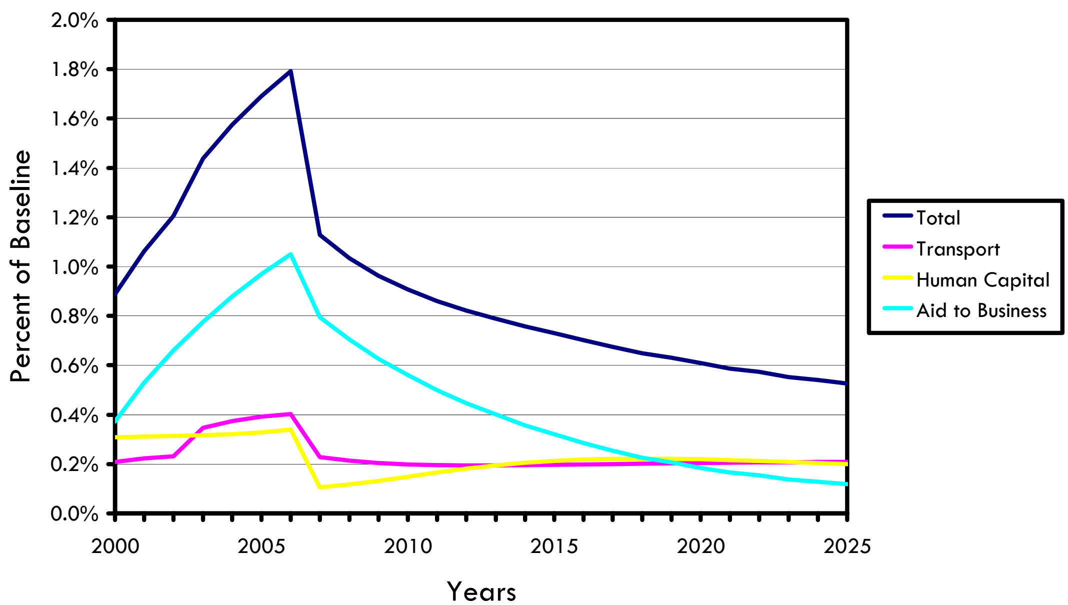
Table SI.2 Present Value 2000-2025 of increases in Employment and of E.U. Investment, from 2000-2006 in the Objective 1 Region of Southern Italy-Time Discount Rate 3%

Concept	Units	Agriculture	Fashion	Tourism	Human Capital	Transportation
1. Present Value of E.U. Investments from 2000-2006	Millions 1999 Euros	135	41	224	245	373
2. Present Value of Job Years from 2000-2025	Job Years	18125	2549	36477	14931	61886
3. Millions of E.U. Investment divided by the increase in the Number of Job Years	E.U. Euros Per Job Year	7460	15986	6132	16439	6029

Finally, the projects studied are assumed to be representative of other projects in their category and are scaled up to represent the entire category. This result is shown in Figure SI.3 for increase in GDP as a percentage of baseline GDP and in Figure SI.4 for the total number of jobs resulting from E.U. investments in Aid to Business, Transportation Infrastructure, and Human Capital.

In Southern Italy, total E.U. investments from 2000-2006 are 21.477 billion euros, which is 8.86% of average GDP from 2000-2006. Out of the total E.U. investment, transportation infrastructure is 15.5%, agriculture and fishing subsidies and other Aid to Business are 45.1%, and human capital is 19.1%, for a total of 79.7% of E.U. investments. For other investments, such as environmental improvement, the evaluations did not report sufficient information for us to input into the model. Using the five simulations that are reported above as representative of the categories to which they belong, we can scale these numbers based on their proportion of the total E.U. spending to show the effects of E.U. investments totaling 7% of average GDP over the 2000-2006 period or of 1% of GDP for each of the seven years. These results are shown in Figures SI.3 and SI.4.

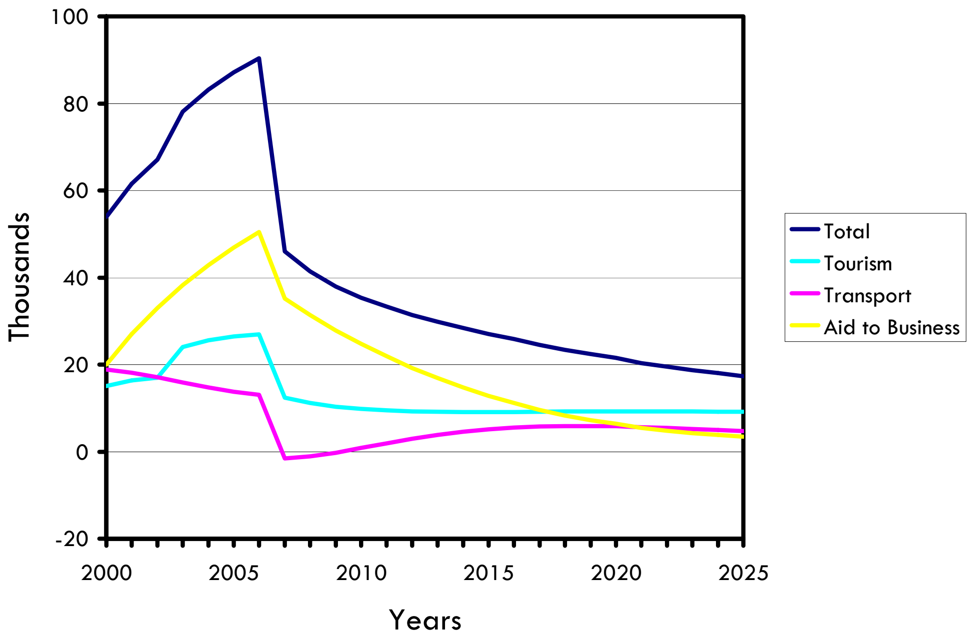
Figure SI.3: Italy-GDP % Change from Baseline due to EU Investments for Aid to Business, Transportation Infrastructure, and Human Capital.*



*These were the result of an E.U. investment of about 1% of GDP per year from 2000-2006.

In the peak year of 2006, when both demand and supply effects are stimulating GDP, the percentage increase in GDP is 1.8% due to E.U. investments. In 2025, the percent increase in GDP drops to about .55% above the baseline.

Figure SI.4: Southern Italy-Total Jobs due to EU Investments for Aid to Business, Transportation Infrastructure, and Human Capital.*



* These were the result of an E.U. investment of about 1% of GDP per year from 2000-2006.

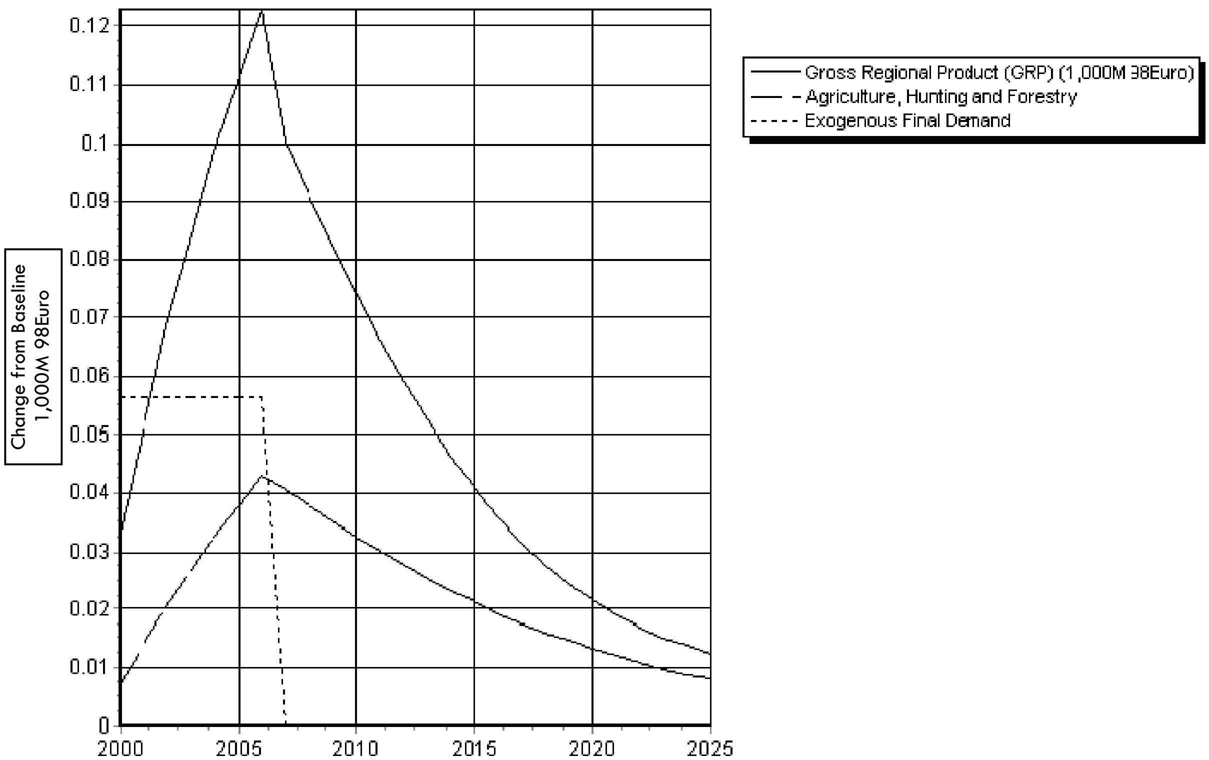
In Figure SI-4 we show the total number of jobs created by E.U. Aid to Business, Transportation Infrastructure, and Human Capital. The total number of jobs peaks at about 90,000 in 2006 and is about 19,000 in 2025. These results include the effects of total public investment leveraged by the E.U. funds. In our simulations the region's share of national public investment and the total amount of the regional contribution are matched by regional personal tax increases.

Explanations of the Predicted Effects of Individual Projects for Southern Italy

Effects of a 50% Public Subsidy of 295 Million Euros for Agricultural and Food Industry Equipment

For this analysis the 50% subsidy for farm equipment is used to purchase Farm Equipment over seven years. Using a typical dead-weight loss of about one-third for purchases that would have been made without the subsidy in equipment, two-thirds of equipment purchases are entered as the net investment due to the subsidy. (For complete details see Appendix pg 133)

Figure I.8: Effects of a 295M Euro Investment in Agricultural Equipment with 50% Public Subsidy



During the period from 2000 to 2006, the purchase of this equipment is shown on Figure I.8 as the amount of the final exogenous demand per year. This demand is fulfilled by local and external sources based on the supply location of the equipment purchases made in Southern Italy. The equipment depreciates at a rate of 10% per year. At this rate, some equipment remains in service in 2025 even though the equipments' average lifetime is 10 years. In the absence of microanalysis of the equipment, one-half of the equipment is allocated to productivity increase and the other half to capacity expansion. For the proportion allocated to productivity, the cost of production is reduced, leading to increases in sales due to increases in competitiveness. For the portion allocated to capacity increase, farm and food sales increase in proportion to the increase in capacity represented by the increased capital stock. The change in GDP peaks in 2006 when the effects of exogenous demand and additional agriculture and food output peak. After 2006, the continuing depreciation of the farm equipment leads to decreases in the difference in farm and food production relative to the baseline. This effect would not occur if we assume that the equipment purchased with subsidies is replaced as it depreciates as a result of the behavioral changes of those who purchased the equipment and the additional income that they earned using the equipment.

Table I.1: Southern Italy-Effects of a 50% public subsidy for agricultural and food industry equipment from 2000 to 2006

	2006	2012	2018	2024
Jobs per Million euros	7.65	2.95	0.88	0.18
Labor force per Million euros	2.30	1.88	1.12	0.69
Population per Million euros	0.54	0.96	1.14	1.16
GDP per euro invested	0.42	0.20	0.09	0.05
Real Disposable income per euro	0.14	0.09	0.05	0.03

* EU contribution is 65% of the public investment subsidy. Therefore multiply by 1.54 to get the return to the EU investment.

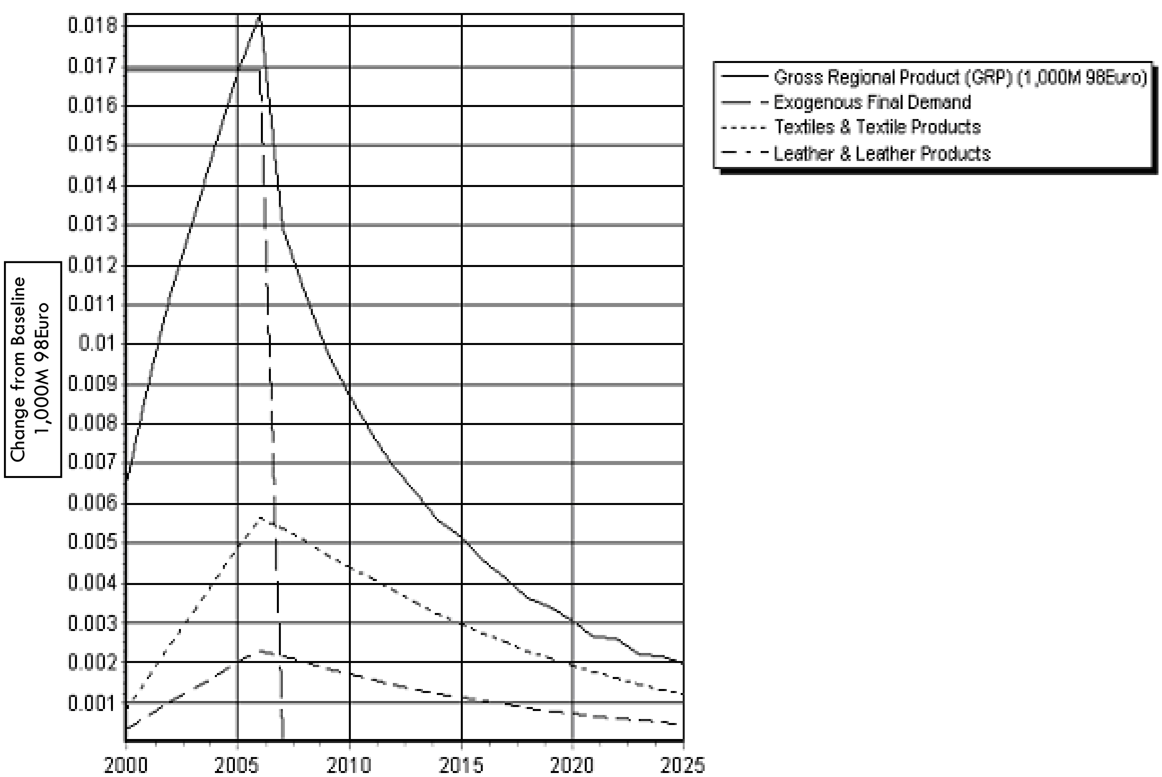
Table I.1 shows the results divided by the amount of public subsidies. It shows that public subsidies paid by the E.U. from 2000-2006 generate about three jobs per million euros in 2012, which implies a return of about one job for each 330,000 euros invested by the E.U. In 2012, the increases in population (about one per million euros of public investment) and labor force (about two per million euros of public investment) over the baseline forecast are due to the improved labor market conditions over the 2000-2012 period. Subtracting the labor force increase from the employment increase shows that, in 2012, unemployment is decreased by about one person per million euros of subsidy relative to the baseline. The real Gross Domestic Product (GDP) per euro of 2000-2006 investments in 2012 is 0.2 euros (20%) while the similar return for personal real disposable income is only 0.09 euros (9%). The personal real disposable income gain is lower than the GDP gain because tax collections are higher and the government transfer payments are lower in the simulation with the subsidy than they are in the baseline.

The importance of using a macroeconomic analysis is illustrated in two alternative simulations that we performed prior to combining them into a single analysis. In the capacity-increase alternative simulation, all equipment purchases are made for capacity increase (not for productivity gain) and any new production is sold at going market prices due to E.U. agricultural policies. In this case, results in 2006 showed almost 20 new jobs per million euros of public funds (excluding agriculture surplus purchase policies) versus about eight jobs in Table I.1 above. In the productivity-increase alternative (i.e. all equipment purchases are designed to boost production), there was a decrease of more than four jobs per million euros of E.U. investment in 2006. The reason for this latter result is that the increase in output in response to more competitive output prices in 2006 was less than the increase in output per worker. In both cases, the GDP return per euro of investment was positive and roughly the same, except for the first year when the capacity-increase GDP return was double the productivity-increase return. These two alternative simulations show how the results of the investment can vary greatly depending on the macro environment in which the policy initiative occurs.

Effects of a 50% Public Subsidy of 88.9 Million Euros for Fashion Industry Equipment

For evaluation of the net effects on the Fashion industry, the analysis reduces new capital purchases by one-third to account for purchases that firms would have made without the subsidy. The two-thirds of the gross subsidized investment is shown in Figure I.9 as exogenous demand. The equipment depreciates at a rate of 11.1% each year, which yields an average equipment lifetime of nine years. Thus, the analysis assumes no replacement investment based on behavioral changes or increased income of fashion industry firms. (For complete details see Appendix pg 142)

Figure I.9: Effects of an 88.9M Euro Public Investment in Fashion Industry Equipment with 50% Public Subsidy



This simulation combines capacity-expanding and productivity-enhancing equipment. One-half of industry and firm sales reflects full utilization of the equipment throughout its lifetime. The other half of the equipment purchases is made for productivity improvement as contrasted with simply increasing capacity. The productivity gain is based on the percentage increase in productivity-improving capital. This improvement means that the same output can be produced with less labor. It also reduces production costs. These lower costs increase sales, as firms are now more competitive in all markets. A substantial share of these sales goes to exports to the rest of Italy and the rest of the world, where the sales gains come at the expense of suppliers that are outside of Southern Italy. Personal taxes are raised to reflect the 15% regional subsidy contribution and the 12% regional share of the 35% national subsidy.

Table I.2: Southern Italy-Effects of a 50% subsidy for fashion industry equipment

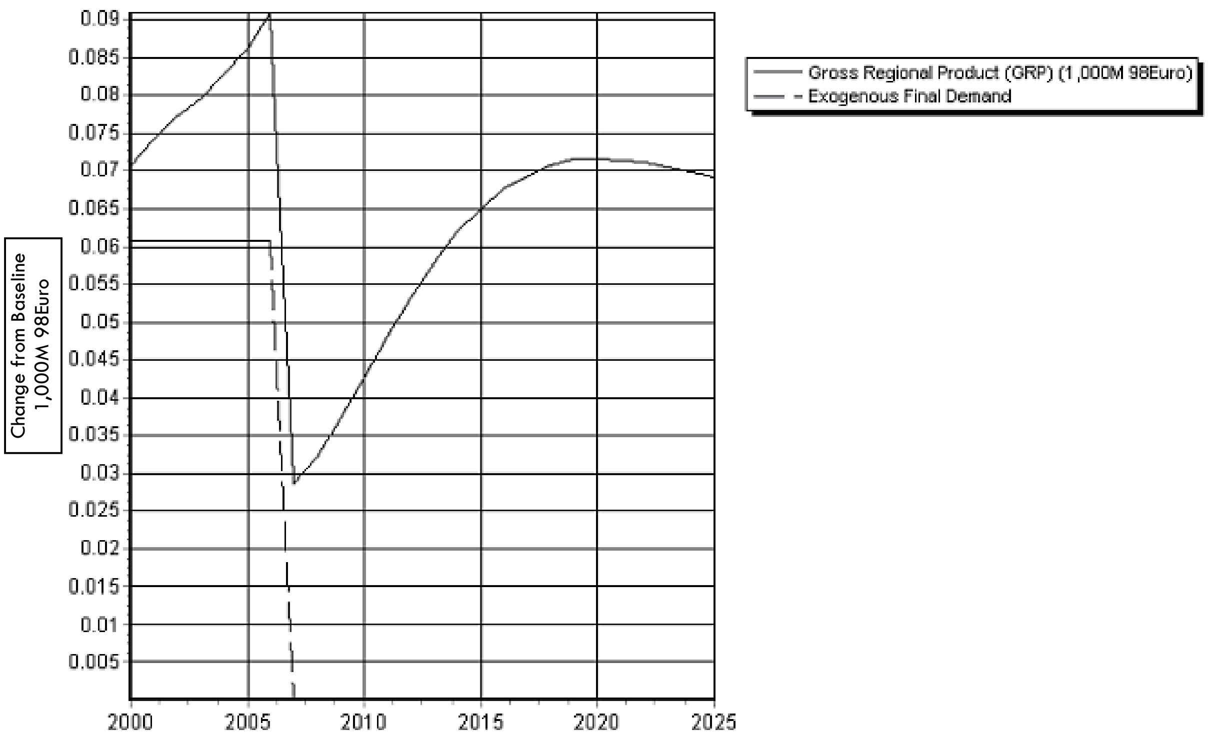
	2006	2012	2018	2024
Jobs per Million euros of public funds	3.65	1.02	0.46	0.21
Labor force per Million euros of public funds	1.04	0.67	0.43	0.30
Population per Million euros of public funds	0.18	0.29	0.37	0.42
GDP per euro invested of public funds	0.21	0.08	0.04	0.02
Real disposable income per euro of public funds	0.04	0.03	0.02	0.01

*The EU subsidy of 25% was matched by other public sources, increasing the total public subsidy to 50%. Therefore, to get the return on the investment by EU, multiply the numbers in Table I.2 above by 2.

Effects of a 100% Public Subsidy of 425 Million Euros for Training

The investment of 6000 euros per trainee as expenditures in the education industry was put into REMI as exogenous final demand. We assumed that the dead weight loss is 80% based on previous studies that compare the subsequent employment rates of those with and without training. Thus, only 20% of the trainees are added to the pool of available blue-collar workers, giving employers a wider variety of workers to choose from. We also assumed that these 20% of the trained applicants displace other applicants for jobs and do not have a higher wage rate, despite their personal increase in productivity due to their training. The productivity gain was calculated to produce a 5% annual return on the investment of 6000 euros in their training. The depreciation rate used for the training for occupational supply is 5% per year due to workers moving, dropping out, aging and being outdated. The extra productivity due to the trained workers is not depreciated due to the lifetime productivity advantage of people with more education. (For complete details see Appendix pg 154)

Figure I.10: Effects of a 425M Euro Public Investment in Human Capital with 100% Public Subsidy



In Figure I.10, the exogenous spending in the education sector lasts through 2007. The additional productivity cuts production costs and therefore increases competitiveness and sales. The extra sales from the increased competitiveness take effect over time and gradually offset the 2% loss of employees until about 2020 when the two effects completely offset each other.

Table I.3: Southern Italy-Effects of a 100% Subsidy for Human Capital: Training from 2000 to 2006

	2006	2012	2018	2024
Jobs per Million euros	3.2	0.7	1.4	1.2
Labor force per Million euros	1.1	0.3	0.5	0.6
Population per Million euros	0.3	0.2	0.2	0.2
GDP per euro invested	0.2	0.1	0.2	0.2
Real disposable income per euro	0.1	0.1	0.1	0.1

EU contributed 63% of the public investment subsidy, national govt. contributed 26%, and regional govt. contributed 11%. Therefore, to get the return on investment by EU, multiply the above numbers by 1.58.

Table I.3 shows that the employment returns per million euros level off in 2024 at about 1.2 employees per million euros invested, which is equivalent to one employee per 830 thousand euros invested. Since the cost per trainee is 6000 euros, this is about one new permanent employee for each 139 trainees. The GDP return per euro of public investment is .15 or 150,000 per million euros invested. This results from the 20% of the trainees (.2*139=28) who are working in place of untrained employees and the 1.2 net new workers. It also reflects the high value added in manufacturing in 2024 per worker as well as the effects of workers re-spending their income in the local economy.

Effects of 78% Public Subsidy of 814 Million Euros for Railroad Improvements in Southern Italy

The exogenous demand for railroad infrastructure was spread over seven years. The distribution of the spending was based on a specific column for railroad construction from the Italian Ministry of the Economy. The savings in the cost of transportation are based on the projected savings in the ex ante proposal for the project. The increase in access cost is 25% of the transportation cost savings. (For complete details see Appendix pg 158)

Figure I.11: Effects of 814M Euro Public Investment in Transportation Equipment with 78% Public Subsidy

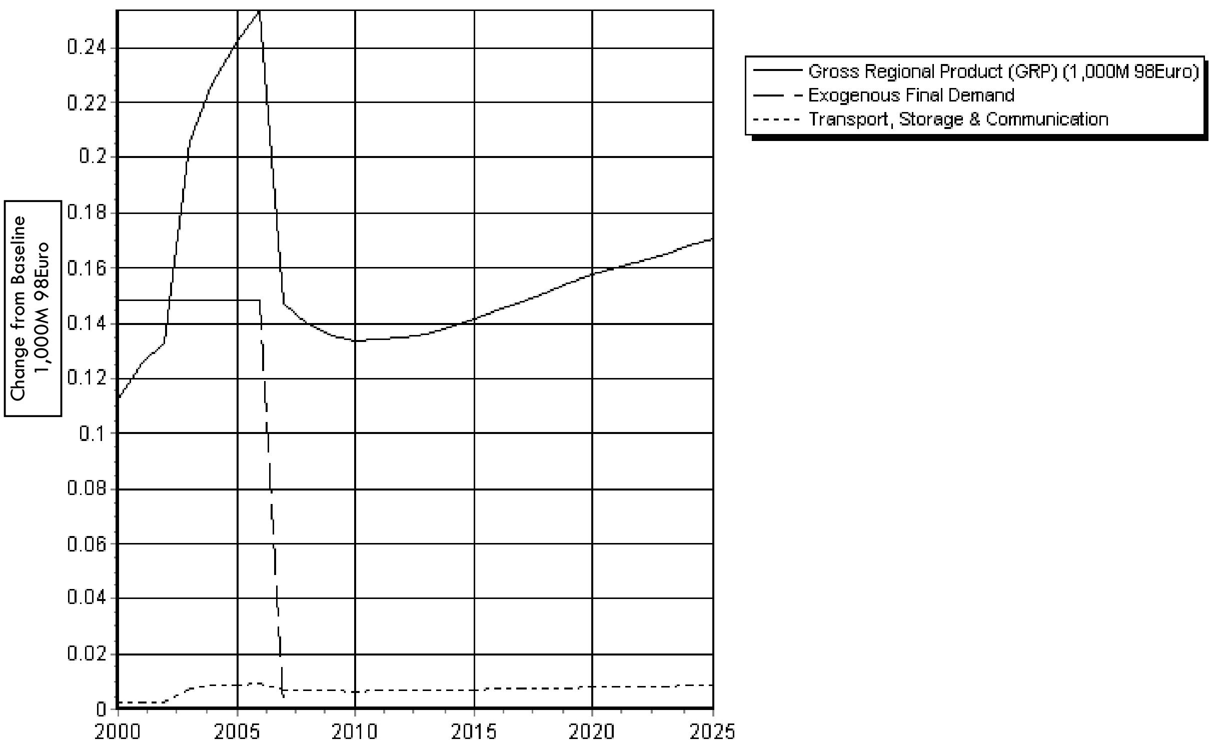


Table I.4: Southern Italy-Effects of a 78% Public Subsidy to Integrated Transport System

	2006	2012	2018	2024
Jobs per Million euros of public funds	8.1	2.8	2.8	2.8
Labor force per Million euros of public funds	2.4	1.6	1.6	1.8
Population per Million euros of public funds	0.6	0.9	1.2	1.5
GDP per euro invested of public funds	0.3	0.2	0.2	0.2
Real disposable income per euro of public funds	0.1	0.1	0.1	0.1

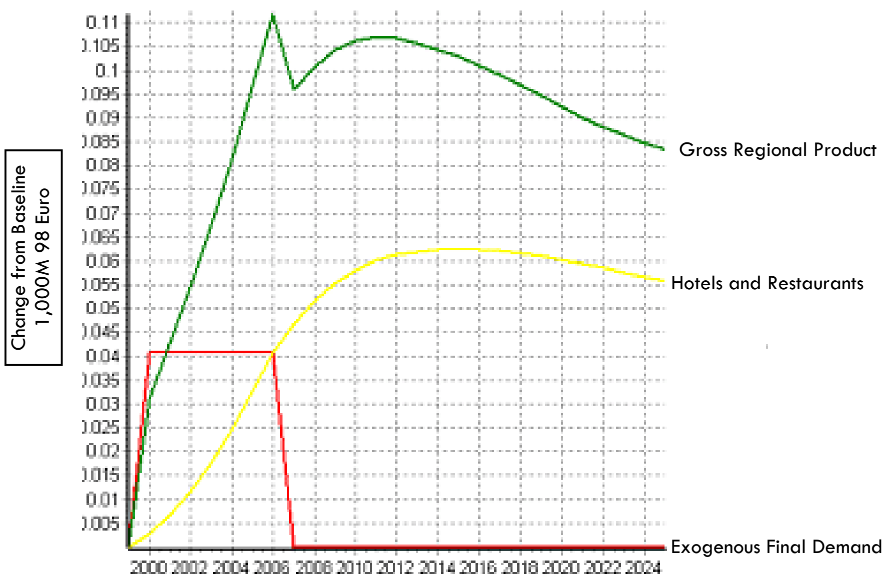
50% of the subsidy is provided by EU. Therefore, multiply the above numbers by 2 to get the EU return.

The gains in 2006, shown in Figure I.11 and in Table I.4, are partly due to building the new transportation infrastructure and partly due to parts of the new infrastructure that are in use. The leveling off after 2006 is due to the responses to the travel-time savings and increased access internally and externally. These effects improve the performance and costs of all industries, which in turn makes Southern Italy more competitive in internal and export markets. The small dip from 2007-2012 is due to the increase in housing and other capital stock that was caused by the 2000-2006 economic stimulus. This increase reduced the need for such investments after 2006. The post-2012 increase in GDP results in additional use of the improved transportation infrastructure. This continuing sales increase is possible due to the ongoing competitive improvement, which is enabled by cheaper transportation and increased access.

Effects of 213 Million Euros Public Investment for a 50% Subsidy to the Hotels and Restaurants Industry (of parts of Priority 1.1 and part of 1.51)

The 213 million euro public subsidy of 50% provided to tourism (modeled as hotels and restaurants) in southern Italy is associated with 426 million euros of investment. Approximately 38% of the investment was allocated to equipment, and the rest of the investment to hotels. Using the standard one-third dead-weight loss due to investment that would have occurred without the subsidy leaves 286 million euros of new net investment over a seven-year period. The gross returns used for hotels and equipment are respectively 10% and 20%. Using a 65-year average life for hotels, the depreciation rate is 1.5% per year. Using an average life of 12 years for equipment, the average depreciation rate is 8.3% per year. Thus, the net return is 8.5% for hotels and 11.7% for equipment. This improvement is represented as a reduction of cost relative to the quality of service rendered. The reduction in costs leads to extra sales by increasing market shares in all markets in proportion to their share of the sales. The final input is to increase personal taxes for Southern Italy to pay for the regional share of the public financing. (For complete details see Appendix pg 162)

Figure I.12: Effects of 213 Million Euros Public Investment in Tourism



The spending of 286 million euros for hotels and equipment over seven years is shown in Figure I.12 as exogenous demand. The increase in hotel and restaurant sales grows in response to current and past price/quality changes. Therefore hotel and restaurant sales continue to grow through 2014 despite depreciation of the hotels and equipment.

The hotel and restaurant sales increases occur in the local market, in the rest of Italy market, and in the international market. The gross regional product (GRP) in Southern Italy grows by more than the direct sales as intermediate inputs are purchased and as increased earnings by hotel employees are re-spent.

Table I.5: Southern Italy-Effects of 213 Million Euros Public Investment in Tourism

	2006	2012	2018	2024
Jobs per Million of euros of public funds	14.2	11.1	8.2	5.9
Labor force per Million of euros of public funds	3.9	4.8	4.5	3.9
Population per Million euros of public funds	0.8	1.8	2.5	3.0
GDP per euro invested of public funds	0.5	0.5	0.5	0.4
Real Disposable income per euro of public funds	0.2	0.2	0.2	0.2

* EU contributed 70% of the public investment subsidy. Therefore, multiply the above numbers by 1.43 to get the return on EU investments.

The results in Table I.5 are the total effects divided by the amount of public investment. These results show long-term employment effects due in large part to the slow depreciation rate for hotels. If the new investment were to increase to restore the loss due to depreciation, these long-term effects would be even larger. The returns in the later years show that approximately six long-term jobs are created per million euros invested from 2000-2006. There is also a long-term 40% GDP return on the investment.

Andalucia

Next, we turn to Andalucia, which is one of the regions in REMI's four-region model of Spain. These regions interact and add up to the total the nation of Spain. Figure A-1 shows the change in GDP in Andalucia per one-hundred euros of E.U. investment from 2000-2006. Table A.1 shows the present value of the change in cumulative GDP and its return to the present value of cumulative E.U. investment.

Figure A.1: Andalucia- Change in GDP per Hundred Euros of E.U. Investment, from 2000-2006

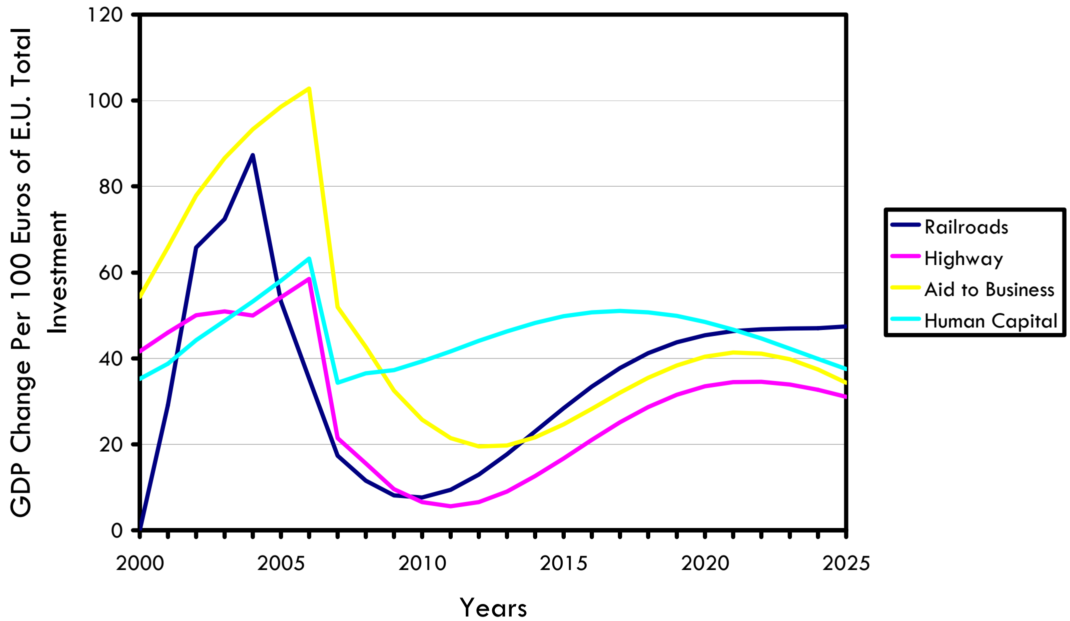


Table A.1: Present Value 2000-2025 of GDP and of E.U Investment, from 2000-2006 in Andalucia- Time Discount Rate 3%

Concept	Units	Railroads	Highways	Tourism/Aid to Business	Human Capital
1. Present Value of Change in Cumulative GDP from 2000-2025	Millions 1999 euros	7789	8032	963	4302
2. Present Value of E.U. Investment from 2000-2006	Millions 1999 euros	1098	1310	96	472
3. Increase in Cumulative GDP (1) per E.U. Euro Investment (2)	Euros	7	6	10	9

Figure A-2 shows the number of jobs created per million of cumulative E.U. expenditures in Andalucia for the four projects. Table A.2 shows the present value of the increase in job years, relative to the present value of the E.U. investment.

Figure A.2: Andalucia-Job Creation per Million Euros of Cumulative E.U. Investment, from 2000-2006

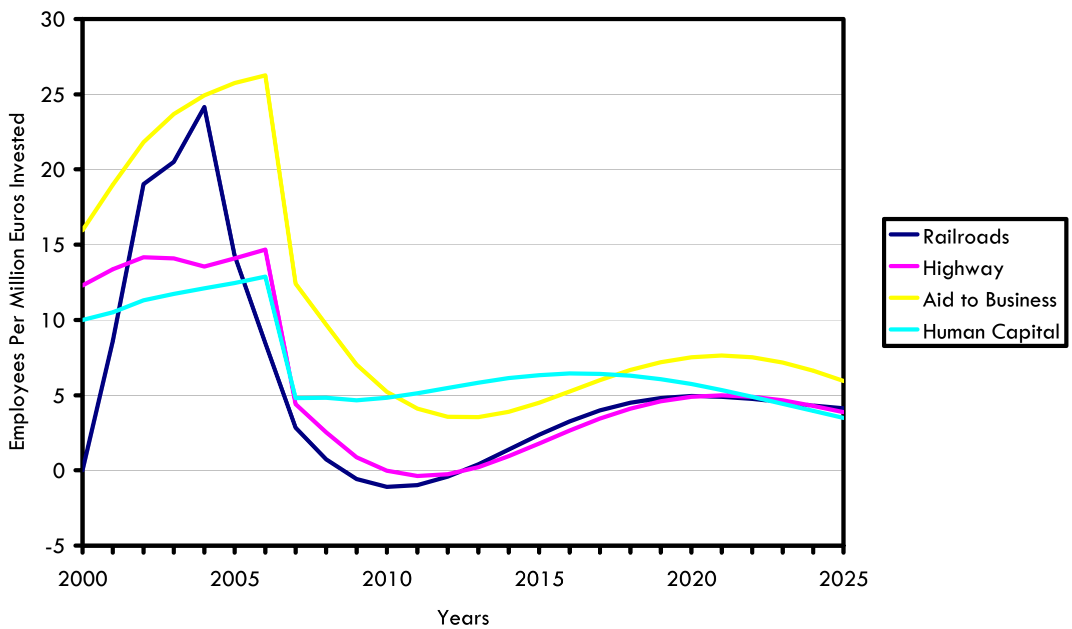
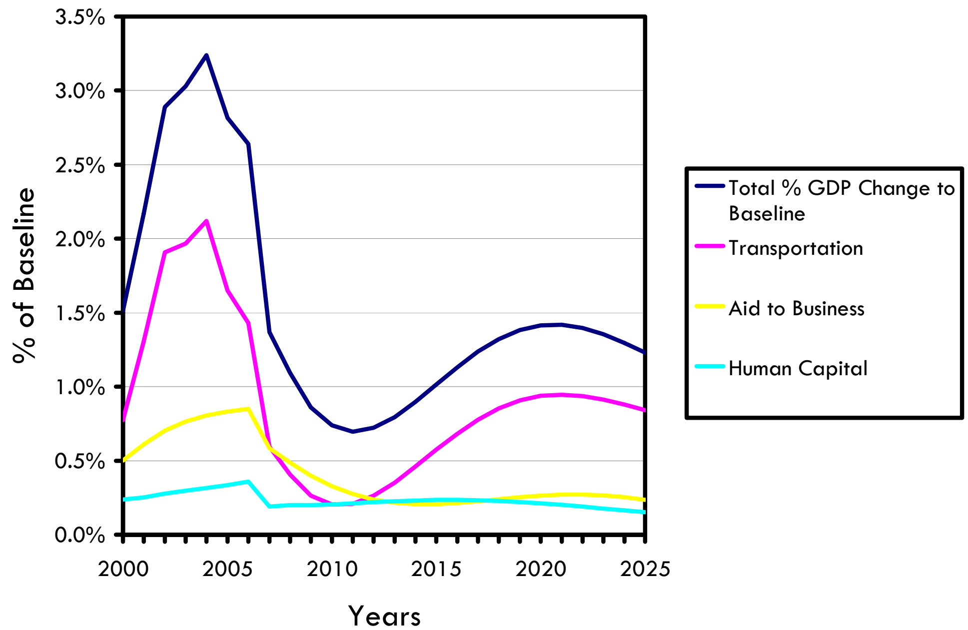


Table A.2: Present Value 2000-2025 of Employment and of E.U. Investment, from 2000-2006 in Andalucia-Time Discount Rate 3%

Concept	Units	Railroads	Highways	Tourism/Aid to Business	Human Capital
1. Present Value of E.U. Investments from 2000-2006	Millions 1999 euros	1098	1310	96	472
2. Present Value of Increases in Job Years from 2000-2025	Job Years	140118	169565	23091	71013
3. Millions of E.U. Investment (1) Divided by Increase in the Number of Job Years (2)	E.U. Euros per Job Year	7836	7728	4168	6644

These programs represent those that are most focused on economic development. They are 54% of total E.U. investments. The other projects did not include estimates of the direct effects such as the quality of life, health benefits, and other results of these policies that might have influenced the economy. As a percentage of average GDP, the cumulative E.U. investments from 2000-2006 were 1.1% for Aid to Businesses, .6% for Human Capital, and 3.3% for Transportation Infrastructure, which yields a total of 5% for all three of these programs, or about .7% of total GDP for each of the seven years. The results of this 54% of E.U. investment, as a percentage of GDP, are shown in Figure A-3.

Figure A.3: Andalucia-GDP % Change from Baseline Due to EU Investment in Aid to Business, Transportation Infrastructure, and Human Capital*

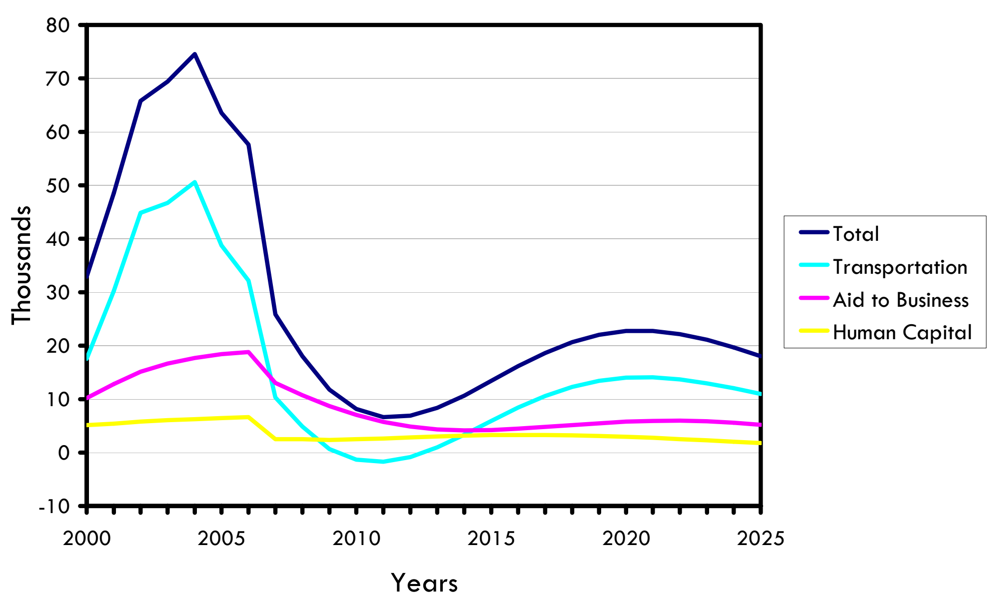


*The investment in these categories is equal to .7% of GDP each year from 2000-2006.

The peak increase in GDP above the baseline is 3.2% and the increase in 2025 is about 1.25%.

The number of jobs generated is shown in Figure A-4.

Figure A.4: Andalucia-Jobs Created Due to E.U. Investment in Aid to Business, Transportation, and Human Capital*



*The investment in these categories is equal to .7% of GDP each year from 2000-2006.

Jobs peak at about 75,000 in 2005 and dip to 19,000 in 2025. Again, the investments analyzed were .7% of GDP for each of the first seven years.

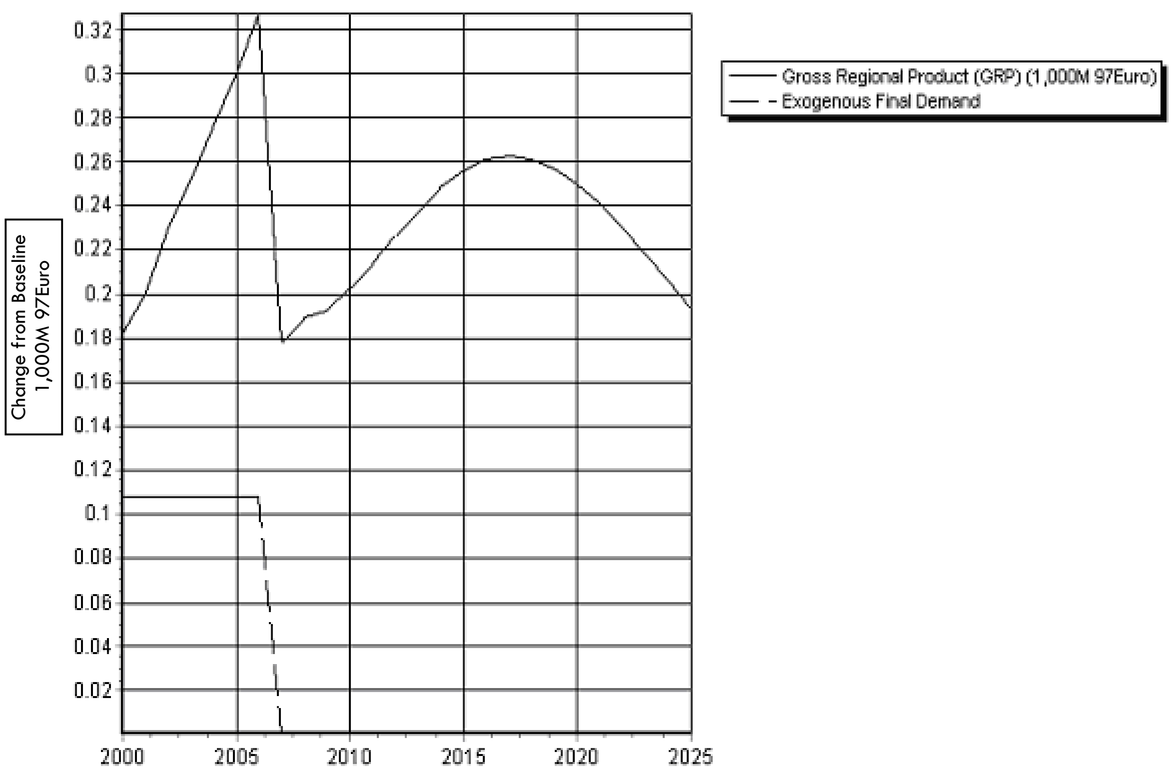
A statement of the assumptions made for each project and an analysis of the results follows. Details for each project simulation are also covered in the Appendix.

Explanations of the Predicted Effects of Individual Projects for Andalucia

Effects of 757 Million Euros Public Investment in Human Capital Training in Andalucia (Priority no. 41)

The investment in vocational training is divided into two portions, one of 286 million euros for infrastructure, and the other of 471 million euros for vocational training. The infrastructure spending is divided into 60% for equipment and 40% for construction. The 471 million euros for training was allocated to education. These direct effects are shown over the years from 2000-2006. They are represented as exogenous demand in Figure I.15. Under this program 81,600 people each receive 340 hours of training at an average public cost of 825 euros per trainee. During the training period, the 32% of the cost borne by Andalucia is input as an increase in personal taxes (For complete details see Appendix pg 166).

Figure I.15: Effects of 757M Euro Public Investment in Training



A study by the Spanish Ministry of Labour and the E.U. Commission[4] finds that the probability of finding a job after completing the training is 8.8% higher than that of the control group. This difference drops to 4.8% for workers who are still working after one year. Based on this finding, 8.8% of the trained people in the relevant occupation are represented as additional occupational supply and depreciated by 5% per year. This increase in occupational supply increases the number and thus the variety of potential employees that the employer can select from. This increased access to variety means that employers are more likely to find an employee that has the specific characteristics that are needed for the job. The access to labor is a key factor in determining labor productivity and is one of the reasons that business in areas

[4] Evaluación de la Estrategia Europea de Empleo. Ministerio de Trabajo y Asuntos Sociales y la Comisión Europea (2002).

where a large qualified labor pool is available can prosper even if wages are higher than in areas with limited labor pools. This study also showed that of the 38% of the people who found a job after training, 58% of them are still working after one year. Multiplying these together shows that 22% of the trainees were successfully employed after one year. This report also indicates that out of the 80% that complete the course, 23% declared that the training significantly increased their professional status. On the basis of this information, a productivity increase based on a 5% annual return to the employer of the cost of the trainees is used for 20% of the trainees. This amounts to 41 euros of additional value to the employer for each of the trainees who are assumed to be working. It is assumed that any return above this modest return is realized by the employee relative to non-trained employees, and therefore is not input into the model. This amount is not reduced over time due to the lifelong gains that have been found for education.

Table I.6: Andalucia-Effects of a 757M Euro Public Investment in Training

	2006	2012	2018	2024
Jobs per Million euros of public funds	8.8	3.7	4.3	2.7
Labor force per Million euros of public funds	2.9	2.0	2.3	2.1
Population per Million euros of public funds	0.6	1.0	1.6	1.9
GDP per euro invested of public funds	0.4	0.3	0.3	0.3
Real disposable income per euro of public funds	0.3	0.2	0.3	0.2

EU contributed 68% of the public investment subsidy. Multiply by 1.47 for E.U. returns

The results of the REMI Policy Insight simulation divided by the public investment (100% in this case) are shown in Table I.6. These results are caused by the increase in sales due to the reduction in the cost of production that leads to lower prices for products produced in Andalucia. These lower prices increase real incomes in Andalucia. The higher real incomes enhance purchasing power and, thus, increase local demand. The other and more significant effect is that lower prices for Andalucian products make them more competitive than they would have been without the program. Therefore, Andalucian goods and services gain an increased percentage of the local market and of export markets. This increase causes additional employment and Gross Domestic Product. The greater output requires more employees, but higher productivity means that there are less employees required per unit of output. In this case, the increase in output exceeds the change in output per worker effect, and thus employment is increased.

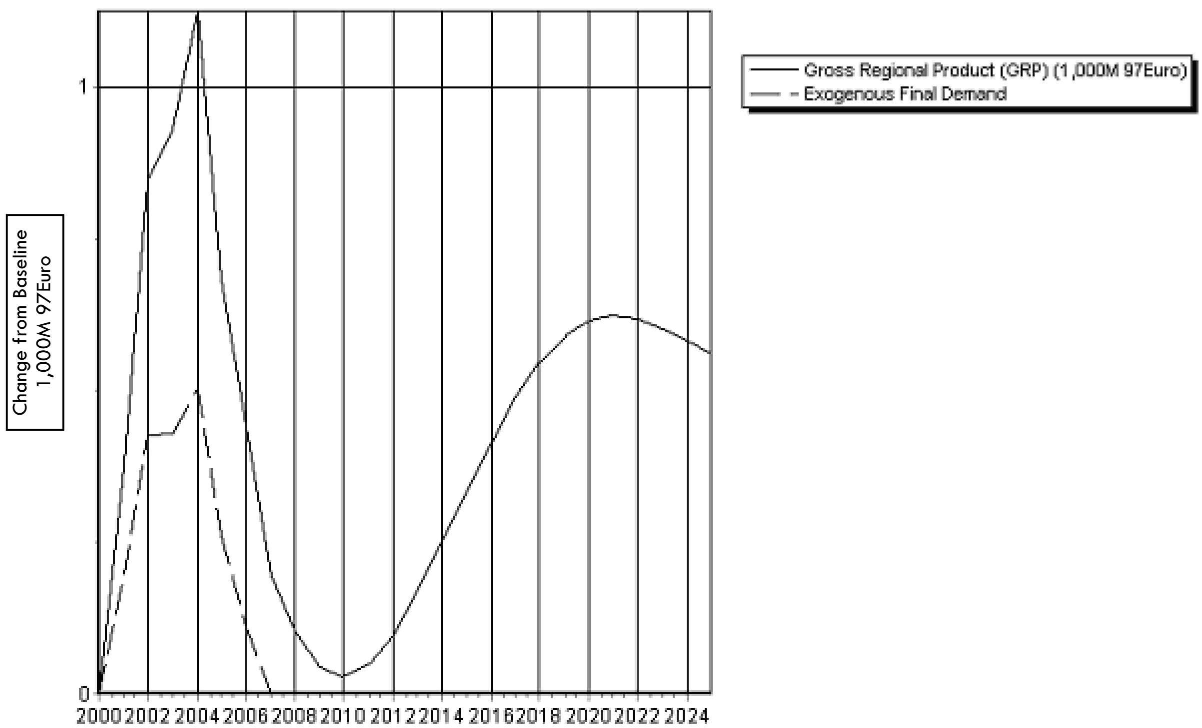
The effects on employment and GDP diminish over time as the occupational supply effect is reduced by 5% per year. However, population responds slowly to the improved real wage and lower unemployment rate. Thus, the retardation of the out-migration from Andalucia continues throughout the simulation, which causes population to continue its increase relative to the baseline throughout the forecast.

The GDP change is fairly stable, as shown in Figure I.15 and Table I.6.

Effects of 2120 Million Euros Railroad Infrastructure Investment in Andalucia with 100% Public Funding (Priority 6.3) and [57% E.U.]

The exogenous spending on railroad construction grows rapidly through 2004 when it reaches 250 million euros, then drops off dramatically as shown in Figure I.16. (For complete details see Appendix pg 171)

Figure I.16: Effects of 1550M Euros Public Investment in Railroad Infrastructure



This stimulus to the Andalucian economy leads to additional non-residential and residential housing investment during the stimulus period (peaking at 495 million euros in 2004) to such an extent that railroad spending drops well below the baseline until 2011 when it is –115 million euros. After that year, the gap between the desired and actual capital stock is restored to its baseline level and the effects of the improved transportation begin to dominate. If the new transportation links lead to the construction of retirement and vacation homes in Malaga by residents of Cordoba and Madrid, this dip would be filled in by the increased demand for housing. Using the results of the cost-benefit study, trip costs within Andalucia are reduced by .33% and by .6% in 2024, while trip costs to and from Madrid are reduced by .2% in 2006 and by.4% in 2024. The cost reductions for Castilla-La-Mancha to and from Andalucia were .13% in 2006 and .23% in 2024. The “rest of Spain” (Madrid) cost reductions to and from Castilla were .02% in 2006 and .04% in 2024. Note that in all cases, trip cost reductions become greater over time. These numbers represent the total savings estimated in the reports cited above, divided into the different types of savings, and then divided by the estimated total transportation costs. The accessibility cost is reduced by one-half of the transportation costs. Finally, a small portion of the savings was allocated to commuters, yielding a .05% cut in commuting costs within Andalucia and to and from Madrid and Malaga.

The favorable effects of all of the above changes influenced the competitiveness in terms of delivered costs relative to the other regions. The net effects of these cost changes reduce imports and increase exports due to competitive factors. They also increase local consumption by stimulating consumption demand with price decreases. Extra economic activity increases both real disposable income and the share of local demand supplied locally.

Table I.7: Andalucia-Domestic Trade Flows (Railroad from Cordoba to Malaga)

Domestic Trade Flows 2018: Wholesale and Retail (% change)

	Andalucia	Castilla-la Mancha	Extremadura	Rest of Spain	Rest of World	Output
Andalucia	0.32%	0.98%	0.44%	1.31%	0.23%	0.49%
Castilla-la Mancha	-0.54%	0.35%	0.26%	0.45%	0.11%	0.33%
Extremadura	-1.03%	0.29%	0.21%	0.32%	0.05%	0.21%
Rest of Spain	-0.28%	0.38%	0.21%	0.33%	0.07%	0.31%
Rest of World	-0.28%	-0.11%	-0.05%	-0.06%	X	X
Demand	0.30%	0.40%	0.20%	0.36%	X	X

Domestic Trade Flows 2018: Computer, Research and Development (% change)

	Andalucia	Castilla-la Mancha	Extremadura	Rest of Spain	Rest of World	Output
Andalucia	0.58%	1.45%	0.66%	1.52%	0.13%	0.45%
Castilla-la Mancha	-0.05%	0.99%	0.58%	0.87%	0.04%	0.70%
Extremadura	-0.44%	0.97%	0.56%	0.79%	0.02%	0.38%
Rest of Spain	0.17%	1.04%	0.56%	0.79%	-0.04%	0.55%
Rest of World	-0.13%	-0.04%	-0.02%	-0.02%	X	X
Demand	0.34%	0.72%	0.39%	0.58%	X	X

As shown in Table I.7, the results are different for different industries. Note that the figures in each column give the change in percentage shares of a particular region's demand satisfied by flows from each of the other regions. Similarly, reading across each row provides an indication of the percentage change in output from a particular region to each of the other regions in turn. In the first part of the table, the percentage changes in domestic trade flows are shown for the wholesale and retail-trade industries. The total demand for this industry increases by .30% as shown in the bottom of the first column. The share supplied by each of the other regions to Andalucia decreases due to the increased competitiveness of Andalucian prices. Also, the first row shows that the Andalucian share increases in all markets as decreased production costs, due to greater accessibility of imports and labor and lower delivered costs due to reductions in delivery costs, affect competitiveness. All areas reduce the shares purchased from the rest of the world as shown in the rest of the world row. It should also be noted that outputs of all areas increase as shown in the last column. This is due in part to the increase in exports (see rest of world column) and decreases in imports from the rest of the world (see rest of world row) for all areas.

The second industry shown is computers, research, and development. The directions of the changes are the same in all cases except for the "rest of Spain row". In this case, reduced delivered cost of this industry, in which the rest of Spain has a larger proportional representation, plus the increase in Andalucian demand, leads to an increase in deliveries from the rest of Spain to Andalucia of the goods and services in this industry.

Table I.8: Andalucia-Effects of 2120M Euros Public Investment in Railroad Infrastructure

	2006	2012	2018	2024
Jobs per Million of euros of public funds	4.8	-0.2	2.6	2.5
Labor force per Million of euros of public funds	2.7	0.6	1.1	1.4
Population per Million euros of public funds	0.7	0.8	0.9	1.1
GDP per euro invested of public funds	0.2	0.1	0.2	0.3
Real Disposable income per euro of public funds	0.1	0.0	0.1	0.2

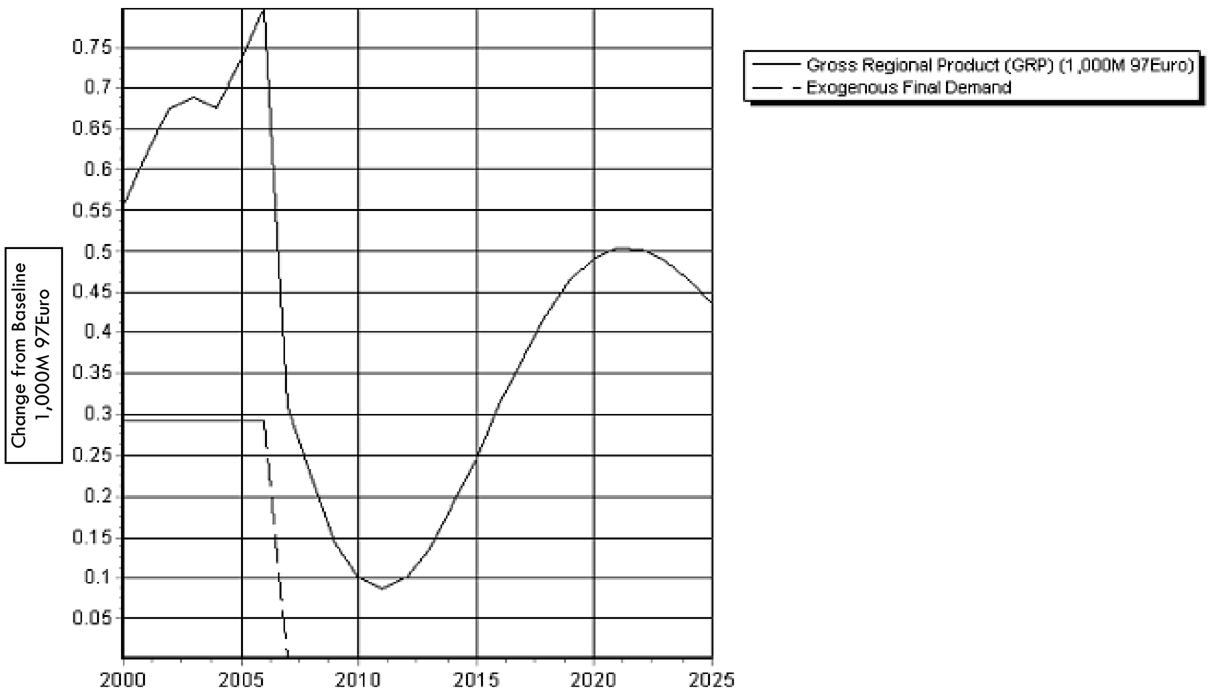
* EU contributed 57% of the public investment subsidy. Therefore, multiply the above numbers by 1.75 to get the return on EU investments.

Finally, Table I.8 shows the return compared to the public investment. As mentioned above, the job drop is not likely to occur if vacation and retirement home construction is induced by the improved passenger rail service to Madrid. Looking at 2024, the 2.5 jobs per million euros imply a cost of 400,000 euros per permanent job and the return of 0.3 GDP per euro invested is a 30% GDP return on the investment. The net public return on the investment would depend on public tax rates and on the extra cost of a slightly increased population.

Effects of a 2042 Million Euros Public Investment in Highway Infrastructure in Andalucia (Priority 6.1)

The spending on construction was done from 2000-2006 and is shown in Figure I.17 as exogenous demand. (For complete details see Appendix pg 177)

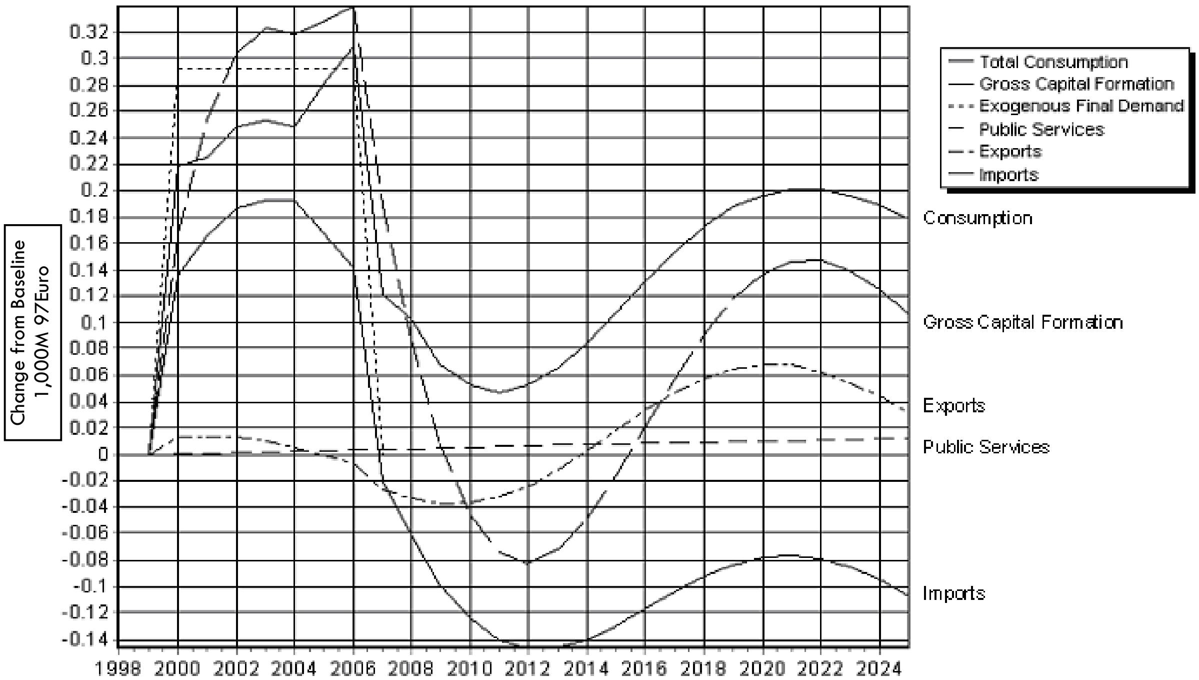
Figure I.17: Effects of 2042M Euros Public Investment in Highway Infrastructure



During that same period the 22% share of the cost borne by Andalucia was added as personal taxes. The highways involved in this investment all represented intra-Andalucian highway improvements. In the absence of a cost-benefit report, the direct return of 6% on this investment in travel-time savings is allocated to business transportation (83%) and to commuters (17%). These are the benefits per euro of spending for the railroad investment discussed above. The savings begin in 2005 and reach their total savings after 2007.

The transportation costs within Andalucia are reduced starting in 2005 to reach their permanent reduction of 1.1% after 2007. The costs to and from the other areas are reduced by .006%. This amount is low since only parts of commuter trips from other areas are in Andalucia and because such trips are a small proportion of their total travel. The accessibility costs are reduced by one-half of the transportation costs since the transportation cost is only one part of accessibility. Commuting costs are reduced by .025%, which represents the time-savings valued at one-half of the wage rate as a proportion of the wage bill, because, in selecting a job, the average worker values his or her opportunity costs at one-half of his or her normal hourly wage. The reduction in commuting costs from adjacent areas is .002%.

Figure I.18: Effects of 2042M Euros Public Investment in Highway Infrastructure



In Figure I.18, imports are substantially reduced due to the lower delivered cost of those goods produced and used in Andalucia. This gain is due to the fact that labor is now more productive, and there is an increased access to a variety of intermediate goods, making producers in Andalucia more productive. Also, shipments within Andalucia are less expensive due to decreased transportation costs. Consumption of locally produced goods is increased more than any other component. The large increase occurs for a few reasons. First, the cost of producing goods in Andalucia decreases relative to other regions increasing the local share. Second, the costs index is reduced in Andalucia, increasing purchasing power. Third, consumption is a large proportion of GDP. Investment is volatile as usual due to its accelerator response to total economic activity, and exports are down and up due to fluctuations in the cost changes in exporting industries. This fluctuation is in response to the cost-reducing changes mentioned above, as well as to cost-increasing changes as labor markets get relatively tighter and land prices go up in response to greater local incomes and population.

Table I.9: Andalucia-Domestic Trade Flows (Highway Improvement in Andalucia)

Domestic Trade Flows: Wholesale and Retail (% change)

2018	Andalucia	Castilla-la Mancha	Extremadura	Rest of Spain	Rest of World	Output
Andalucia	0.29%	0.22%	0.16%	0.24%	0.10%	0.26%
Castilla-la Mancha	-1.98%	0.12%	0.06%	0.13%	0.04%	0.12%
Extremadura	-1.97%	0.13%	0.07%	0.14%	0.05%	0.07%
Rest of Spain	-1.99%	0.11%	0.05%	0.13%	0.05%	0.12%
Rest of World	-0.13%	-0.04%	-0.05%	-0.04%	X	X
Demand	0.27%	0.13%	0.06%	0.13%	X	X

Domestic Trade Flows: Computer, Research and Development (% change)

2018	Andalucia	Castilla-la Mancha	Extremadura	Rest of Spain	Rest of World	Output
Andalucia	0.78%	0.45%	0.28%	0.40%	0.07%	0.57%
Castilla-la Mancha	-1.06%	0.38%	0.22%	0.33%	0.02%	0.27%
Extremadura	-1.06%	0.39%	0.22%	0.33%	0.02%	0.16%
Rest of Spain	-1.06%	0.38%	0.22%	0.33%	-0.02%	0.20%
Rest of World	-0.07%	-0.02%	-0.02%	-0.02%	X	X
Demand	0.31%	0.27%	0.15%	0.24%	X	X

Finally, we repeat the tables of trade share changes for two industries. For an explanation of how to read these numbers, please see the discussion of Table I.7. The major difference between Table I.9 for highway improvements and Table I.7 for railroad improvements is the greater reduction in purchases from other areas stimulated by highway investment as compared to railroad investment. This is due to the greater focus of transportation savings on the local area from *intra*-area highways relative to those savings from *inter*-area railroads. In the highway simulation, the supply of computers, research, and development from the rest of Spain decreased, rather than increasing as in the case of the railroad simulation.

Table I.10: Andalucia-Effects of a 2042M Euros Public Investment in Highway Infrastructure

	2006	2012	2018	2024
Jobs per Million euros of public funds	9.83	-0.13	2.99	2.98
Labor force per Million euros of public funds	3.11	0.84	1.29	1.72
Population per Million euros of public funds	0.67	1.01	1.26	1.47
GDP per euro invested of public funds	0.39	0.05	0.21	0.23
Real disposable income per euro of public funds	0.28	0.05	0.15	0.17

EU contributed 70% of the public investment subsidy. Therefore, multiply the above numbers by 1.43 to get the return on EU investments.

In Table I.10, the effects of highway projects are fairly similar to those in Table I.8 for railroad infrastructure. The employment effects in the construction industry are higher for roads because they have a higher local content than the railroads. Otherwise, the job effects are slightly higher for railroads but the population effect is slightly higher for highways. This is due to the greater effect of local cost reductions on the price index and thus the real wage.

Effects of 150 Million Euros Public Investment for a 50% Subsidy to the Hotels and Restaurants Industry (of parts of Priority 1.1 and part of 1.51)

The subsidy of 50% provided to hotels and restaurants in Andalucia is associated with 300 million euros of investment. One-eighth of the investment was in equipment, and the rest of the investment was in hotels. Using the standard one-third dead-weight loss due to investment that would have occurred without subsidy leaves 200 million euros of new net investment over a seven-year period. The gross returns used for hotels and equipment are respectively 10% and 20%. Using a 65-year average life for hotels, the depreciation rate is 1.5% per year. Using an average life of 12 years for equipment, the average depreciation rate is 8.3% per year. Thus, the net return is 8.5% for hotels and 11.7% for equipment. The investment is for improvement in the quality. This improvement is represented as a reduction of cost relative to the quality of service rendered. The reduction in costs leads to extra sales by increasing market shares in all markets in proportion to their share of the sales. The final input is to increase personal taxes for Andalucia to pay for the regional share of the public financing. (For complete details see Appendix pg 183)

Figure I.19: Effects of 150 Million Euros Public Investment in Tourism

The spending of 200 million euros for hotels and equipment over seven years is shown in Figure I.19 as exogenous demand. The increase in hotel sales during this period is due in part to the increase in local activity as well as responses to price/quality changes. After 2006, the additional sales are mainly due to additional export sales to the other areas of Spain, as well as to the rest of the world.

Table I.11: Andalucia-Effects of 150 Million Euros Public Investment in Tourism

	2006	2012	2018	2024
Jobs per Million of euros of public funds	18.4	2.5	4.7	4.6
Labor force per Million of euros of public funds	6.0	2.7	2.7	3.0
Population per Million euros of public funds	1.3	2.2	2.7	3.0
GDP per euro invested of public funds	0.7	0.1	0.2	0.3
Real Disposable income per euro of public funds	0.6	0.2	0.3	0.3

* EU contributed 70% of the public investment subsidy. Therefore, multiply the above numbers by 1.43 to get the return on EU investments.

The results in Table I.11 are the total results divided by the amount of public investment. These results show long-term employment effects due in large part to the slow depreciation rate for hotels. If the new investment were to increase to restore the loss due to depreciation, these long-term effects would be even larger. The returns in the later years show that more than four jobs are created per million euros invested from 2000-2006. There is also a 20% GDP return on the same investment.

Summary

In this section we have shown how analysis of the returns to E.U. investments increases the efficiency of these invested funds toward achieving their objectives. We have also made the case for using a model that fully represents the structure of the economy to show the macro-economic effects of investments intended to change the structure of the local economy. The simulations performed are based on the conservative assumption that behavioral changes and increased incomes due to subsidized investment would not lead to replacement of depreciated equipment and structures that were funded by the subsidies.

Chapter II: A Comparison of the Available Models

Summary

Market economies are complex systems. To understand how they will react to external interventions, analysts must simplify the system. The authors of the four models presented here have each taken different approaches to this simplification. These differences are due in part to the purposes for which the models were developed. They are also due in part to the background and history of the models' development. Each of the models has made a contribution to policy analysis in the past and will no doubt continue to make contributions in the future.

Quest II

The Quest II model is designed to make short- and long-term projections for countries in the E.U. and to look at the consequences of E.U. interventions on the economies of the E.U. countries. The model is entitled "A Multi Country Business Cycle and Growth Model[5]." In line with its purposes, it gives special attention to the ways that actors in the economy make short- and long-term decisions. This focus on timing draws heavily on neo-classical economic theory, which assumes rational and foresighted decisions by consumers who want to maximize their utility in the short and long run and firms that want to maximize long-term profits. In implementing the model the authors have used their judgment (and statistical evidence) as well as neo-classical theory in restricting some of the equation's coefficients, as well as in specification of some of the functional forms. For example, they partition the consumption function into two parts. The first uses the neo-classical assumption of life-cycle income and financial assets. The second uses current disposable income to explain consumption because many consumers have liquidity constraints that lead them to respond to current income as well as expected lifetime income. This model is limited to National/International analysis and, therefore, does not include some modeling features that are important for explaining behavior in local and regional economies.

Venables & Gasiorek

The second model considered here is a computable general equilibrium model by A.J. Venables and M. Gasiorek[6]. Its focus is on implementing the "New Economic Geography" theories that have been developed in the last decade and are the subject of a book by Fujita, Krugman, and Venables[7]. This new line of thinking about regional economics rests strongly on Dixon and Stiglitz's work on monopolistic competition. It is based on micro-economic assumptions and explains why concentrations of economic activities can be competitive despite higher wages and land costs. In particular, by recognizing that goods or services produced by different firms in an industry are non-homogeneous, it provides an explanation for

[5] Roegers, Werner. "A Multi Country Business Cycle and Growth Model," October 1997.
[6] Anthony J. Venables and Michael Gasiorek, "Section 1: Computable General Equilibrium Models," The Socio-Economic Impact of Projects Financed by the Cohesion Fund, European Communities 1999.
[7] Fujita, Masahisa, Paul Krugman, and Anthony J. Venables. "The Spatial Economy: Cities, Regions, and International Trade," Cambridge, Massachusetts: MIT Press, 1999.

why firms can have lower costs if they have many suppliers to draw upon. Good access improves the probability that firms can buy the supplies or services that exactly meet their needs and thus enhance their efficiency and productivity. The model that Venables and Gasiorek have developed gives special attention to firm size and the idea that as market size grows, profits per firm grow until a new firm can enter. They use the period during which demand in an area has grown but a new firm has not moved in to obtain short-term results while also showing the long term results after firms have moved. In constructing this model based on micro-economic foundations, they have still retained the Armington assumption, which states that firms in different regions produce different varieties. This model has a strong theoretical basis and its building blocks are based on individual firms. It also includes (in its Spanish version) industry trade flows to and from each region to each other region as well as to two ports. In its focus on new economic geography and short and long term equilibrium it has limited the parts of the economy to those aspects that are necessary for explaining the variables that the designers chose for the model.

REMI Policy Insight

The REMI model was initially created in the U.S. twenty-two years ago and has been continuously refined with two major changes, the first in 1993 and the second in 2002.[8] As computers and economic research have advanced and as hundreds of users have given REMI important feedback, the model and database have grown. With the creation of the EMU, much of the development work done by REMI to develop the basic structure of a model for heterogeneous economic regions in a single monetary union for the U.S. provides a good basis for E.U. regional modeling. The model has a fixed structure but is calibrated to the nations, regions or territories that are included for the model in question. The key parameters are estimated with large data time-series sets pooled from as many relevant areas as possible.

The 2002 model has a basis in micro-economic theory as represented in the new economic geography while retaining linkages based on household labor forces, and business behavior based on utility and profit-maximization assumptions. The model structure is the same for all models in market-based economies except for differences in a few key parameters such as the speed of migration response to changes in economic conditions and the response of wage rates to labor market conditions. The regional model parameters are estimated over a large sample of regions and are used for all implementations of the model.

HERMIN

The fourth model considered here is the HERMIN model[9]. "The theoretical underpinning of the HERMIN model is the two-sector small open economy model with a Keynesian role for domestic demand" (Bradley, 'The Impact of Community Support,' p5-6). Unlike the other models its structure is modified from one application to the next. The coefficients are estimated for the country in question and the functional form may be changed from one country to another. For example, output in the traded-goods

[8] Treyz, Frederick and George Treyz. "The REMI Economic Geography Forecasting and Policy Analysis Model." August 1, 2001.
[9] Bradley "The Impact of Community Support Frameworks on Objective 1 Countries: Greece, Ireland, Portugal and Spain 1989-2006." October 5th, 2000.

sector depends on comparative cost, world output, and a time trend for Ireland, but depends on final demand in Portugal and on final demand and cost competitiveness in Spain.

The core of the HERMIN model consists of approximately 20 economic behavioral equations. In general the HERMIN model is disaggregated into four sectors: (1) manufacturing (traded), (2) market services (non-traded), (3) agriculture, and (4) public (non-market). The manufacturing sector includes earnings, a deflator, and demand for employment and investment. The market services sector includes the same components as manufacture except for average annual earnings.

The agriculture sector includes labor, GDP, and investment; the demographics sector has three age cohorts and net migration (for Ireland). The changes in structure are made based on empirical results as well as special considerations of differences or perceived differences in the economies. The public sector in the HERMIN model is constrained by the debt to GNP ratio or other budget constraints. In summary the HERMIN model gives high importance to the results from the available time series data and is flexible in its specification of the model from one country to another.

Detailed Comparisons

The four models described in this comparison are representative of the major types of structural economic models that analysts use to predict the total economic effects of specific policy initiatives on regional and national economies. For other approaches see “The Socio-Economic Import of Projects Financed by the Cohesion Fund: Volumes 1, 2, and 3. The European Communities, 1999.”

Output Block:

Geographic Scope:

The geographic scope of Quest II is international and includes an exchange rate equation and a monetary sector. The other models include national and sub-national modeling applications. In most cases, national models focus on one nation in the European Union. In this case the individual nation is only part of the EMU, and policy changes for the country in question will only have marginal effects on the exchange rate and monetary policy. Thus, a country can be modeled in the framework of an exogenous exchange rate and monetary environment. This simplification means that modeling techniques that have been developed by regional scientists throughout the world can now be applied to national modeling in Europe.

Industrial Disaggregation:

The Quest II model does not include industrial disaggregation, which is in line with its overall macro-economic focus. The HERMIN models have only three sectors: manufacturing, which is treated as a tradable sector, and all other non-agricultural industries as well as agriculture, which are regarded as non-tradable. The Venables & Gasiorek and the REMI models include as many industries as can be supported by the data. They also include a full set of inter-industry and interregional interactions (i.e. intermediate inputs and price linkages in each industry from each region to each other region).

Number of Regions:

The Quest II model includes 18 countries as well as representation of feedbacks from blocks of the other countries in the world. The Venables & Gasiorek and the REMI multi-area models include extensive interregional linkages. In these models every industry in every region trades with every other region. These linkages include price feedbacks that are also dependent on transportation and accessibility costs. The HERMIN models apparently are built as single area models without feedback from other regions within the entity being modeled.

Endogenous Productivity from Agglomeration:

Of the four models, only the Venables & Gasiorek and REMI models include endogenous productivity effects. In the Venables & Gasiorek model they are represented in the calculation of composite prices. In the REMI model there are direct productivity effects for labor and intermediate inputs. These productivity changes affect the cost of production and the quantity of labor and intermediate inputs required. Lower transportation costs and increased access increase the variety of choices available and thus lead to better matching of worker skills and openings as well as increased access to the intermediate inputs that best fit the production needs of firms that use them.

Consumption Equation:

The Quest II model is the only model that is explicitly forward looking, though the Venables & Gasiorek and REMI models use similar functional forms. The REMI model uses a baseline from a national forecast for each of 13 consumption categories. Thus differences in relative costs, per capita income, and population growth drive consumption shifts in high- and low-income elasticity categories. The HERMIN model includes financial wealth (in some countries) as well as current incomes in its consumption function.

Investment:

The Quest II model uses an equation that captures the essential features of the "ideal" equation as closely as is feasible. The REMI equation is based on an estimated adjustment speed for the gap between the optimal and actual capital stock. The HERMIN model uses an explanatory variable derived from government spending and a partial adjustment mechanism that includes output, capital costs, and a time trend.

Government:

Government spending is exogenous in the Quest II model; it is in a balanced budget framework in the Venables & Gasiorek model. In the REMI E.U. model, government spending depends on relative income and trend changes in the demand for government services in a national baseline. In the HERMIN model the endogenous component depends on budget equilibrium and debt repayment.

Exports and Imports:

The Quest II model has short and long-term responses to cost and reconciles international exports with international imports. The Venables & Gasiorek model includes exports and imports from two ports in its flow matrices, including transportation cost. The share of markets depends on relative costs. The REMI model has endogenous domestic demand and relative prices for imports and relative prices and baseline world demand for exports. The HERMIN model depends on final demand and also on relative prices in some instances. Imports also serve as a residual in some cases. Exports depend on traded sector output for Ireland and world demand plus competitiveness in Spain.

Exchange Rates:

Exchange rates are flexible in QUEST II and are fixed in all of the other models.

Labor and Capital Demand Block:

Types of Labor:

Quest II has only one type of employment. Venables & Gasiorek do not explicitly model employment. REMI models labor by industry and by occupation. The link between industrial projection and occupational distribution is an industry/occupation staffing matrix.

Employment:

In all three models that include employment, it is based on production and substitutability between capital and labor.

Productivity Effects of Agglomeration:

Only REMI includes the endogenous effect of greater access to labor in increasing productivity. All of the models with employment implicitly show changes in productivity based on the relative intensity of capital and labor use depending on relative labor/capital costs.

Capital Demand:

In Quest II, REMI, and HERMIN, capital demand depends on capital costs relative to labor costs. In REMI it also depends on differential sectoral capital demands.

Population and Labor Supply Block:

Population:

The only model with explicit population by age and gender is REMI. It includes all demographic processes (births, deaths, and aging) by single year of age and gender (2x100). The endogenous component in emigration responds to relative expected income changes (the probability of being employed multiplied by expected real after tax wage purged of industry mix) and changes in the commodity access index.

Participation Rates and Labor Force:

In the Quest II model the labor force responds to bargaining power, life-cycle income, and financial wealth. Participation rates by age and gender in REMI depend on the unemployment rate (the discouraged worker hypothesis is verified) and real average wages in the economy (the substitution effect of labor for leisure dominates the income effect for all groups except for females of child bearing age). In the HERMIN model for Spain, unemployment affects the participation rate.

Equilibrium Conditions:

The Quest II equilibrium is determined in other blocks. The Venables & Gasiorek posits a short- and long-term equilibrium. In the short run, the number of firms is fixed and thus returns to the monopolistic firm must be either above or below the normal average profits. The equilibrium in this case is when all markets clear at marginal cost prices.

The alternative labor market assumptions are (1) that the wage rate that prevails in each market clears the market for labor (i.e. equal implicit unemployment rates in all areas) or (2) that wages are equal in all regions (i.e. that unemployment rates are different in each region).

In the REMI model each area has an estimated compensating differential expected income based on past-expected earnings and actual migration. Any relative increase in expected income in an area will increase inward migration (or reduce outward migration) to that region. In the U.S. this increased migration rate is much larger than in the E.U. countries. In the U.S. the feedback from higher housing prices and decreased wage rates in response to an increase in inward migration (or a reduction in outward migration), takes over a decade to begin to resolve itself. Given the much lower response speeds in Europe, it takes well beyond our 25-year horizon to substantially work its way out. Of course, this population response also interacts with the movement of firms based on relative costs and demand considerations that determine their location. In the case of firms, they will continue to move as long as relative cost and demand conditions have become more favorable than they would have been without the policy change.

The HERMIN model does not appear to explicitly consider long run equilibrium conditions implied by the structures of its models.

Wages, Production Costs, Prices Block:

Nominal Wage Rates:

In Quest II the bargaining-power index and the reservation wage determine the wage rate. In the Venables & Gasiorek model wage rates are set to clear factor markets by area in the case where unemployment rates will be made equal in all areas by this market-clearing wage. In the case where the wage is set as equal for all areas, it is the implicit unemployment rate that will vary by area. In the REMI model, wage rates respond to a ratio of employment to the synthetic labor force at national baseline participation rates and to changes in demand for occupations relative to the expected demand based on past employment in that occupation. In the HERMIN model the wage rate responds to prices, unemployment, productivity, and in some models, a tax wedge. In Ireland the wage rates in the non-tradable sector respond to wage inflation in the tradable sector.

Price Index:

In Quest II the price index depends on local and import prices. In the Venables & Gasiorek model the price index that is calculated is the composite price index. This takes into account the access to variety as well as the implicit delivered prices. The consumer price index in REMI is based on the average delivered prices of goods and services. The access to variety is not included because spending is related to after-tax real disposable income calculated at the delivered prices in the region in question. These delivered prices are calculated as the relative production cost at the location of production, plus transport costs to the place of use for both domestic and imported goods. An access index is calculated separately to capture the utility advantages of having consumer access to variety. REMI's consumer access index is used in the migration equation to capture the extra utility of having a choice of consumer goods. Prices in the HERMIN models are based on labor costs and profit margins.

Composite Prices:

These prices are computed directly in the Venables & Gasiorek model. They are calculated for industries in the REMI model by dividing delivered prices by the commodity access index for that particular industry.

Cost of Capital:

The shadow price of capital in the Quest II model is based on forward looking real interest rates, profitability, corporate taxes and mark up rates. The Venables & Gasiorek model does not have an explicit cost of capital. In the REMI model the regional cost of capital is the national cost of capital rate adjusted for local construction costs. The cost of capital is exogenous in the HERMIN model.

Market Shares Block:

International Trading Partners:

All of the models have rest-of-the-world trading. Quest II trades with all countries either individually or with Blocks. Venables & Gasiorek has trading with the rest of the world and the rest of the E.U. REMI models either trade with the rest of the E.U. or rest of the nation and rest of the world. In the HERMIN models, tradable goods are traded with the rest of the world.

All Trade Flows:

The Quest II, Venables & Gasiorek, and REMI models all have a complete set of trade flows between all the regional and international areas that they include. For Venables & Gasiorek and REMI the flows are from each industry and from each area to each other area. They are a consistent set so that all outputs are used and all demands are met. HERMIN trade flows are with the rest of the world for tradable goods.

Types of Industries:

The Quest II model has monopolistic competitive firms but does not include an endogenous explanation of agglomeration. Venables & Gasiorek has monopolistic competitive firms in some industries, perfectly competitive firms in other industries and calculates competitive prices that take account of the variety available.

REMI assumes monopolistically competitive firms for all industries. Delivered prices are based on production cost at the source and transportation cost to the place of use. However, in a separate calculation, an access index is calculated that changes the productivity of intermediate inputs, which has the same effect as use of a composite price on costs but also directly reflects the agglomeration effects on productivity. This dichotomy between delivered costs and the access index occurred because elasticities and the distance decay parameters that REMI estimated implied unreasonably high transportation costs. Therefore, REMI uses direct transportation cost for the delivered cost variables, which are also used in calculating real spendable income for the consumption function and, uses the access index to calculate intermediate productivity and consumer variety access.

Determinants of Trade

The determinants of trade in the Quest II model are relative cost changes, exchange rates, and changes in demand. In Venables & Gasiorek the determinants are the Armington Assumption (products produced in different locations have different characteristics) and the relative composite prices. The determinants in REMI are the access to variety and relative delivered prices. In each area the trade in each industry is based on its delivered price relative to the weighted average of the delivered price in that area from all of the other areas that it trades with.

Adjustment Speed

The adjustment in the short run in Venables & Gasiorek holds the number of firms constant and in the long run allows the firms to move. Only these two conditions are calculated. In REMI the adjustment speed is an estimated rate of movement based on a declining geometric weighted function.

Estimation and Methodology

Trade Flow Estimates:

All trade flows between countries or for an individual country to the rest of the world are based on exports and imports reported in the countries' national accounts. For multi-area models the Venables & Gasiorek model and the REMI model estimate the flows. This estimate involves two out of three estimated parameters (price elasticity, transport cost, and distance decay) using the standard new economic geography modeling methodology. The Venables & Gasiorek model uses measured transport costs and an estimated elasticity to find the distance decay parameter in the gravity-equation formulation. REMI uses an estimate of this distance decay parameter and the elasticity of substitution obtained by a pooled time-series approach over a large number of years and areas to estimate access costs. For the delivered cost calculation, REMI uses transportation costs and trade flows.

Accessibility Estimates Based on Agglomeration:

The Venables & Gasiorek estimate is made based on a composite price that utilizes the transportation cost and elasticity. REMI bases the accessibility index on the estimated distance decay parameter and the estimated elasticity. To determine delivered costs, REMI uses the measured transportation cost from the place of production to the place of use.

Elasticity Estimates:

For Quest II short-term econometric estimates are used; in the long run the elasticities are set to one. For HERMIN the response to changes in costs is calculated for the traded sector based on an equation including a cost term and other variables over a single time series for the country in question. In REMI the elasticity estimates are based on an econometric probed time-series approach over many areas. This approach uses the change in market share as the dependent variable and change in costs in the previous period as the independent variable.

Comparison Summary

Model structure is very important if analysts intend to use the model to predict the effects of exogenous government interventions. The structure is especially important if the interventions are intended to change the past course of the economy in question (i.e. in the case where policy changes are exogenous). Likewise, model assumptions must be tested against the evidence of historical data. The assumptions built into models must be simplifications of reality, but these simplifications must not be so extreme that they misrepresent important feedbacks in the economy.

Long-term equilibrium conditions are a good check on model realism if we believe that economic systems that survive neither explode nor implode under normal circumstances. Each of the models above represents different focuses. Quest II focuses on forward-looking rationality and international trade balance. Venables & Gasiorek focuses on micro-economic behavior of firms in space. REMI focuses on explicit structures based on maximizing behavior of actors in response to current conditions, and key statistical parameters based on large data sets. HERMIN focuses on special characteristics in different countries as revealed in recent year relationships between variables in aggregate time-series estimates. These models represent a spectrum of possible modeling approaches and each provide insights that are helpful in the evaluation and understanding of the role of E.U. interventions in the development of regional economics. The relative plausibility and reliability of each of these models to predict and compare the total economic effects of various types of structural interventions in cohesion regions is left to the reader to evaluate.

Detailed Comparisons of Four Models Used for E.U. Investment Evaluation[10]

Table II.1 Output

	Quest II	Venables & Gasiorek	REMI	HERMIN
Geographic scope:	All Nations or groups of Nations in the World or in E.U.	Regions, Territories	European Nations, Regions, Territories	EU, Nations, Regions, Territories
Number of Private Industries:	One?	16 in Spain	26-30 all sectors local, other regions, rest of EU, rest of world	3 private: 1 manufacturing "tradable" 2 agriculture 3 other "non tradable"
Number of Regions:	18+ nations	22 in Spain	1-67	Single region models only?
Endogenous Intermediate Agglomeration Productivity:	No	Only a Composite Price Effect?	Yes	No
Investment:	Optimal calculation using CES Function, adjustment cost, efficiency and labor augmenting technical progress. Ideal final equation not implemented so far.	Not shown in equation list.	Optimal capital versus actual capital stock adjustment process. Optimal based on relative labor and capital intensity of production.	Partial adjustment correction method without an explicit capital stock.
Consumption equation:	Life cycle income and financial wealth for 70%; real disposable personal income for 30%	After tax income, Cobb-Douglas shares by industry, shares by location, service and varieties using a CES hierarchical format and the Armington assumption	Consumption by categories by per capita income elasticities and Cobb-Douglas substitutability among categories based on delivered prices; for supply sources see industry shares below.	Personal disposable income, financial wealth (in some countries).
Government:	Exogenous spending pattern	Tax rate set to balance budget	In E.U. relative population and national demand in the baseline for government services.	Government decisions, budget equilibrium and debt repayment.

[10] Unknown Author. "Macro-Econometric Models as an Instrument for Better Programming Community Actions Through the Structural Funds."

	Quest II	Venables & Gasiorek	REMI	HERMIN
Exports and Imports:	Constrained by world total exports = total imports. Respond to relative prices—short run elasticities less than 1, long run elasticities = 1; also to demand changes.	Relative costs through ports and demand source	Export share of baseline, imports share of local demand: both change depending on relative prices.	Only tradable goods—international demand and competitiveness—in Spain; tradable sector output in Ireland
Exchange Rates:	Endogenous with exogenous risk premiums	Assumed fixed	Assumed fixed at rates in baselines	Imports at fixed exchange rates: as a residual (in some countries)
A hybrid equation including both supply and demand variables:	No	No	No	A single equation of output as a function of world demand, domestic absorption, labor costs, domestic relative to world prices, and a time trend.
Equilibrium Conditions:	All imports add up to all exports	All markets clear at market prices each year	Output by industry is all absorbed by demand at market prices each year	Keynesian demand determines output.

Table II.2 Labor and Capital Demand

	Quest II	Venables & Gasiorek	REMI	HERMIN
Types of Labor by Occupation:	1	No explicit employment	8-11	
Types of Labor by Industry:	1		26-30	4
Employment:	Positive function of output, negative function of real wage (Cobb-Douglas)	Not included	Output, labor productivity (trend from national baseline, agglomeration effect endogenous), relative costs of capital, labor and fuel with Cobb-Douglas substitutability as new equipment is purchased	Production with CES substitutability of capital and labor-agriculture exogenous
Endogenous Productivity:	Implied by relative labor/capital intensity.	Not included	Baseline with endogenous change in productivity based on access to labor (new economic geography formulation) and labor/capital substitution.	Not included
Capital Demand:	Cobb-Douglas substitutability	Not included	Based on relative cost of capital, labor, and relative capital using economic activity, relative to baseline optimal for the nation. Baseline optimal for the nation is calculated using actual capital stock in t-1 plus investment in the baseline divided by the adjustment speed.	CES production function with capital and labor

Table II.3 Population and Labor Supply

	Quest II	Venables & Gasiorek	REMI	HERMIN
Population:	Not explicit	Not explicit	Single year/age/gender (200 cohorts)	Not explicit
Participation Rates:	See labor force below	Not explicit	Unemployment and real wage coefficients by aged gender cohorts.	In Spain, different for men and women and a function of unemployment
Labor Force:	Responds to bargaining power, life cycle income, and financial wealth??	Not explicit	Participation rates by age and gender that are multiplied by the size of each respective cohort.	See participation rate above
Labor Mobility:	Not included	Completely mobile or completely immobile?	Over time through migration	Ireland migration from the UK
Equilibrium Condition:	World wide imports equal world wide exports	Local wage rate is calculated to employ all local labor or: wages the same in all locations	Real expected relative earnings times the consumer commodity access index = compensating differential in the very long run (depends on speed of adjustment)	Not explicit

Table II.4 Wages, Production Cost, Prices

	Quest II	Venables & Gasiorek	REMI	HERMIN
Nominal Wage Rates:	Productivity with bargaining power index and reservation wage determinants.	Wage rate to clear factor markets, calculated separately for each area in the model	Employment labor force ratio and current occupational demand, divided by expectation based on past demand	Negotiation depends on the level and rate of change of unemployment, fiscal leakages, prices, productivity (and in Ireland non-tradable wages respond to tradable wage inflation)
Price Index:	Based on local and import prices		Categories based on delivered price.	Non-tradable prices depend on labor costs and profit margins
Composite Prices:	Not computed	Use direct CES Function and Armington Assumption to incorporate variety availability in price	Delivered prices (production + transportation from production location) divided by an access index that captures availability of variety.	Cobb-Douglas function of prices for consumers
Cost of Capital:	A shadow price based on forward-looking real interest rates, profitability, tax rates, and markup rates.	Not explicit.	Relative cost depends on baseline cost and changes in construction costs.	Exogenous

Table II.5 Market Shares

	Quest II	Venables & Gasiorek	REMI	HERMIN
International trading partners:	All countries and trading blocks	Rest of world and rest of European Union	Rest of the nation, rest of the world and the rest of the European Union	Rest of the world
Trade flows to and from all regions and exterior markets (international):	Yes	For 'tradable' goods only?	Yes for all industries and all regions	Single area modeled and rest of the world
Types of Industries:	Monopolistic Competition	Perfectly competitive and monopolistic competition	Monopolistic competition for all industries (Imperfect competition increasing returns at firm level)	Not specified?
Determinant of trade:	Relative cost changes and changes in demand?	Different products defined by region in which produced. Armington assumption.	Variety and delivered price	Not specified?
Adjustment speed:	Not specified?	Short run—number of firms constant; in long run number of firms flexible	Adjustment based on adaptive expectations	Not specified?

Table II.6 Estimation and Methodology

	Quest II	Venables & Gasiorek	REMI	HERMIN
Trade Flow Estimates:	Measured	Based on estimated distance transport costs	Based on dynamically estimated gravity coefficient and travel times matrix (US or EU)	Measured for country exports and imports
Accessibility Estimates Based on Agglomeration:	No	Composite prices reflect variety access	Yes—based on CES from New Economic Geography (variety access)	No
Elasticity Estimates:	Short term estimates—long term set at 1	Not found	Dynamic change in shares following production cost changes (US or EU)	Single time series for shift in trade explained key cost changes

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Chapter III: Overview of the REMI Policy Insight® Model[11]

REMI Policy Insight® is a structural economic forecasting and policy analysis model. It integrates methods from several other model types to help its users understand the total macro-economic effects of policy decisions. It has the inter-industry detail available from input-output models. It allows for behavioral responses to housing and consumer prices, wages, and production costs as in computable general equilibrium models. Dynamic responses and other parameters are estimated using econometric methods. The agglomeration economies that are key to a region are represented using new economic geography theory. The model is dynamic, generating forecasts and simulations on an annual basis, and accounting for behavioral responses to wage, price, and other economic factors.

While the REMI model comprises thousands of simultaneous equations, its structure is relatively straightforward. The exact number of equations varies depending on the extent of detail in the model. The overall structure of the model can be summarized in five major blocks:

1. Output
2. Labor and Capital Demand
3. Demographic
4. Wages, Prices and Productions Costs
5. Market Shares

The blocks and their key interactions are shown in Figures III.1 and III.2.

[11] The material in this chapter is excerpted from *The REMI Economic Geography Forecasting and Policy Analysis Model* by Frederick Treyz, Ph. D. and George Treyz, Ph. D. Copyright® 2002 Regional Economic Models, Inc.

Figure III.1: REMI Model Linkages (excluding Economic Geography linkages)

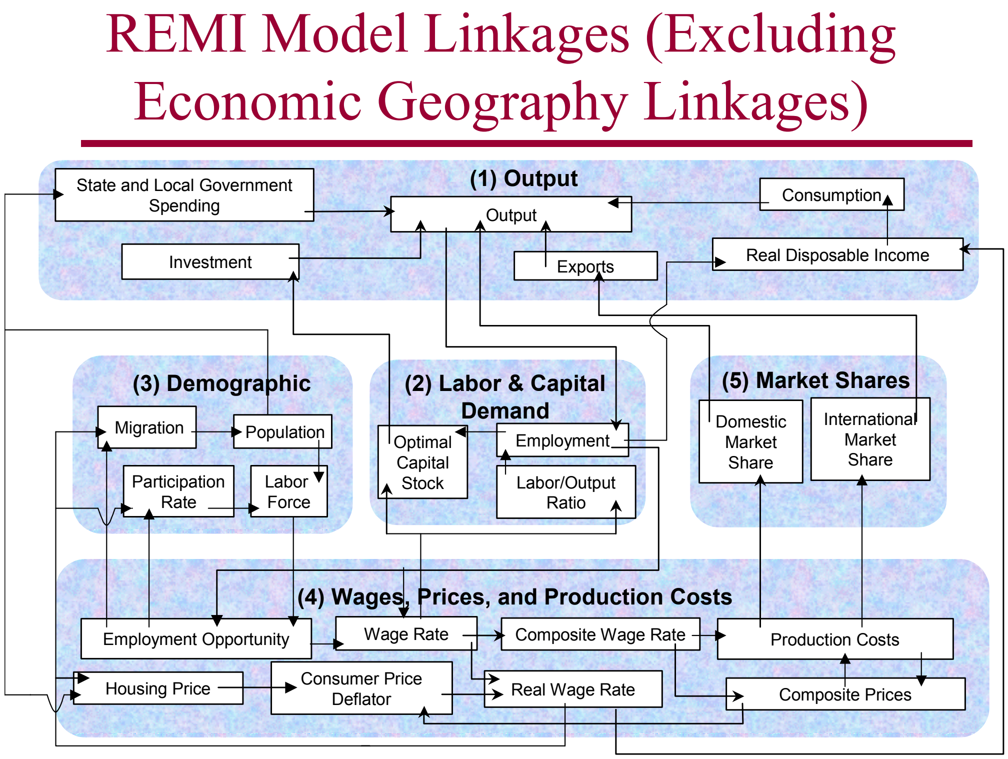
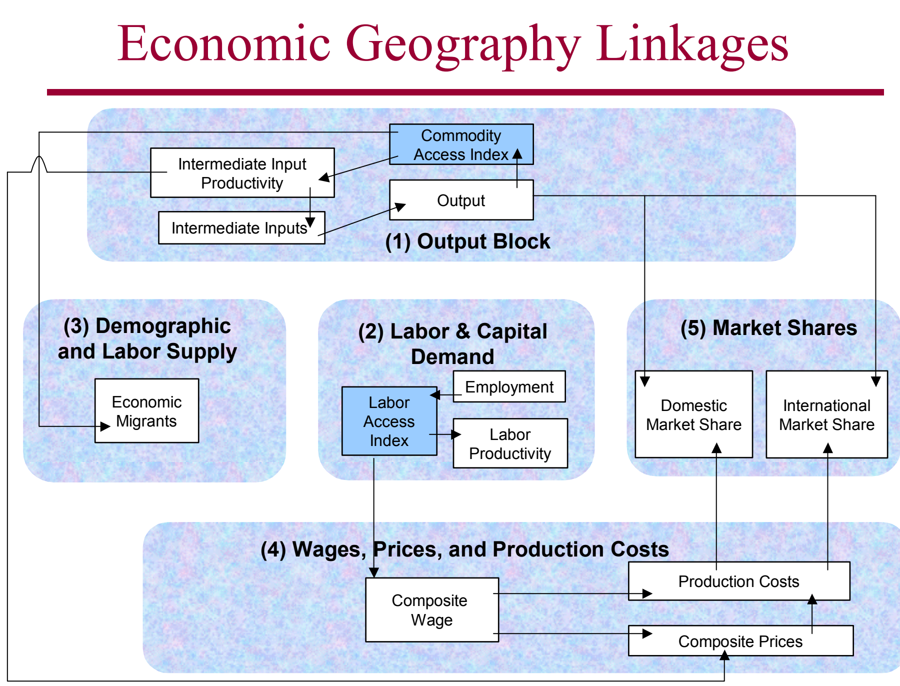


Figure III.2: Economic Geography Linkages



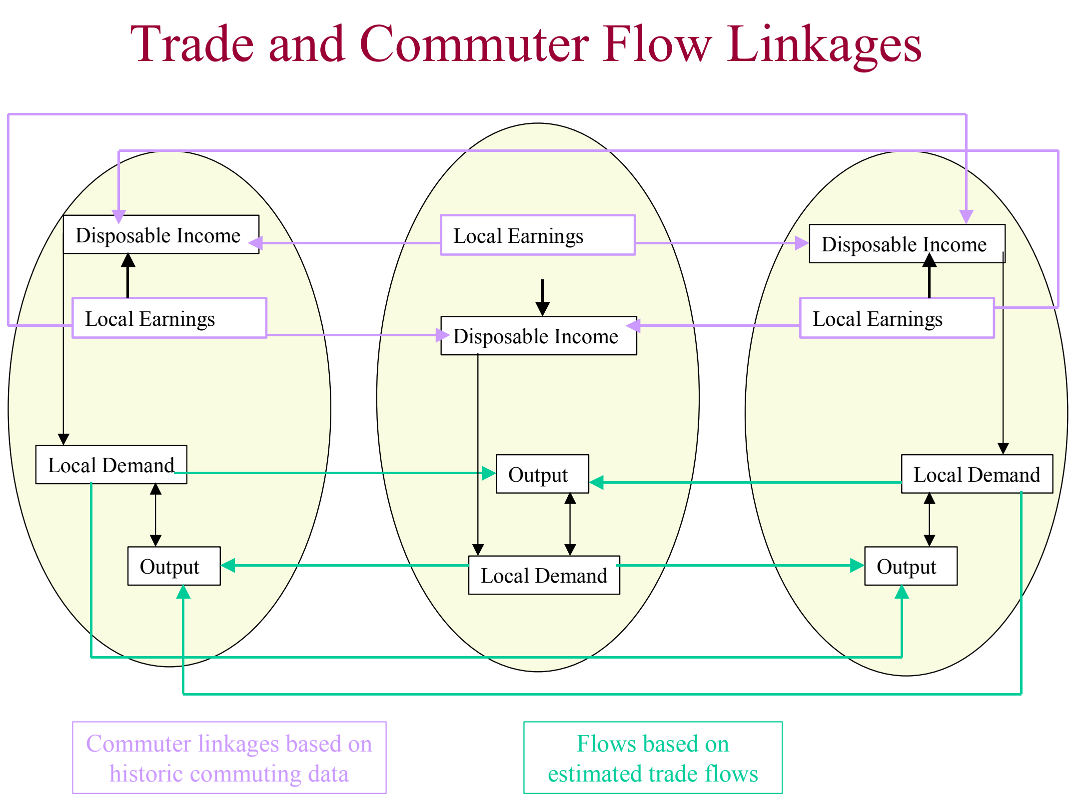
The output block consists of output, demand, consumption, investment, government spending, exports, and imports, as well as feedback from output change due to the change in the productivity of intermediate inputs. The labor and capital demand block includes labor intensity and productivity as well as demand for labor and capital. The demographic block includes labor force participation rate and migration equations. The wages, prices, and production costs block includes composite prices, determinants of production costs, the consumption price deflator, housing prices, and the wage equations. The market shares block includes the proportion of local, inter-regional, and export markets captured by each region.

Models can be built as single region, multi-region, or multi-region national models. A region is defined broadly as a sub-national area, and could consist of a state, province, county or city, or any combination of sub-national areas. Within a large, multinational currency zone such as the European Union, models of a national economy can be built using the same economic framework employed in regional models.

Single region models consist of an individual region, called the home region. The rest of the nation is also represented in the model. However, since the home region is only a small part of the total nation, the changes in the region do not have an endogenous effect on the variables in the rest of the nation.

Multi-regional models have interactions among regions, such as trade and commuting flows. These interactions include trade flows from each region to each of the other regions for each industry. These flows are illustrated for a three-region model in Figure 3.

Figure III.3: Trade and Commuter Flow Linkages



Block 1. Output and Demand

This block includes output, demand, consumption, investment, government spending, import, product access and export concepts. Output for each industry in the home region is determined by industry demand in all regions in the nation, the home region's share of each market, and international exports from the region.

For each industry, local demand is determined by the amount of consumption, investment, and government for that industry. Consumption depends on real disposable income per capita, relative prices, differential income elasticities, and population. Input productivity depends on access to inputs because with a larger choice set of inputs, it is more likely that the input with the specific characteristics required for the job will be formed. In the capital stock adjustment process, investment occurs to fill the difference between optimal and actual capital stock for residential, non-residential, and equipment investment. Government spending changes are determined by changes in the population.

Block 2. Labor and Capital Demand

The labor and capital demand block includes the determination of labor productivity, labor intensity, and the optimal capital stocks. Industry-specific labor productivity depends on the availability of workers with differentiated skills for the occupations used in each industry. The occupational labor supply and commuting costs determine firms' access to a specialized labor force.

Labor intensity is determined by the cost of labor relative to the other factor inputs, capital and fuel. Demand for capital is driven by the optimal capital stock equation for both non-residential capital and equipment. Optimal capital stock for each industry depends on the relative cost of labor and capital, and the employment weighted by capital use for each industry. Employment in private industries is determined by the value added and employment per unit of value added in each industry.

Block 3. Population and Labor Force

The population and labor force block includes detailed demographic information about the region. Population data is given for age, gender, and ethnic category, with birth and survival rates for each group. The size and labor force participation rate of each group determines the labor supply. These participation rates respond to changes in employment relative to the potential labor force and to changes in the real after tax wage rate. Migration includes retirement, military, international, and economic migration. Economic migration is determined by the relative real after tax wage rate, relative employment opportunity and consumer access to variety.

Block 4. Wages, Prices and Costs

This block includes delivered prices, consumer prices, and housing prices, production costs and equipment costs, the consumption deflator, and the wage equation. Economic geography concepts account for the productivity and price effects of access to specialized labor, goods and services.

These prices measure the price of the industry output, taking into account the access to production locations. This access is important due to the specialization of production that takes place within each industry, and because transportation and transaction costs of distance are significant. Composite prices for each industry are then calculated based on the production costs of supplying regions, the effective distance to these regions, and the index of access to the variety of output in the industry relative to the access by other users of the product.

The cost of production for each industry is determined by labor costs, capital costs, and fuel costs, and intermediate inputs. Labor costs reflect a productivity adjustment to account for access to specialized labor, as well as underlying wage rates. Capital costs include costs of non-residential structures and equipment, while fuel costs incorporate electricity, natural gas and residual fuels.

The consumption deflator converts industry prices to consumption commodity prices. For potential migrants, the consumer price is additionally calculated to include housing prices. Housing price changes depend on changes in income and population density.

Wage changes are due to changes in labor supply and demand conditions, and changes in the national wage rate. Changes in occupational demand and employment opportunities relative to the labor force determine wage rates by industry.

Block 5. Market Shares

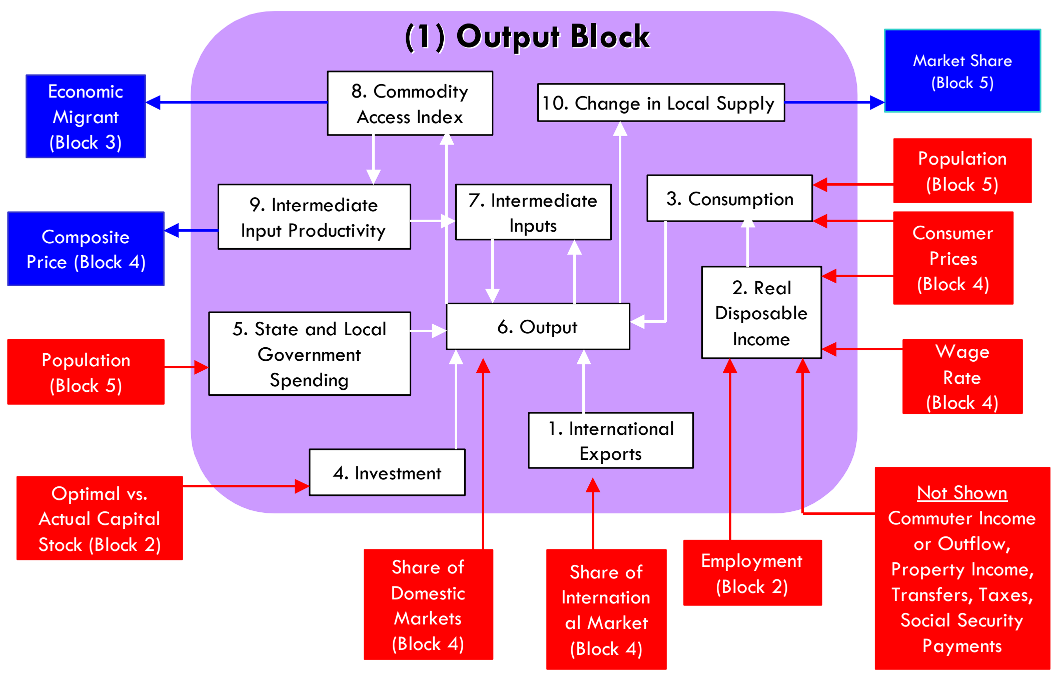
The market shares equations measure the proportion of local and export markets that are captured by each industry. These depend on relative production costs, the estimated price elasticity of demand, and effective distance between the home region and each of the other regions. The change in share of a specific area in any region depends on changes in its delivered price and the quantity it produces compared with the same factors for competitors in that market. The share of local and external markets then drives the exports from and imports to the home economy.

Detailed Diagrammatic and Verbal Description

The first task in this section is to examine the internal interactions within each of the blocks and to present the variables that are important for understanding how a regional (sub-national) economy works. The second objective is to examine the linkages between the blocks. Finally the last goal is to tie it all together by looking at the key inter-block and intra-block linkages.

Block 1. Output and Demand

Figure III.4-Output Block-Key Endogenous Linkages



This block incorporates the regional product accounts. It includes output, demand, consumption, government spending, imports, and exports. Economic geography concepts include the commodity access index, which determines the productivity of intermediate inputs. Inter-industry transactions from the input-output table are also accounted for in this block.

Output for each industry in the home region is determined by industry demand in all regions in the nation, the home region's share of each market, and international exports from the region. The shares of home and other regions' markets are determined by economic geography methods, explained in block 5.

Consumption, investment, government spending, and intermediate inputs are the sources of demand. Consumption depends on real disposable income per capita, relative prices, the income elasticity of demand, and population. Consumption for all goods and services increases proportionally with population. The consumption response to per capita income is divided into high and low elasticity consumption components. For example, the demand for consumer goods such as vehicles, computers, and furniture is highly responsive to income changes, while health services, and tobacco have low-income elasticities. Demand for individual consumption commodities are also affected by relative prices. Changes in demand by consumption components are converted into industry demand changes by taking the proportion of each commodity for each industry in a bridge matrix.

Real disposable income, which drives consumption, is determined by wages, employment, non-wage income, and consumer prices. Labor income depends on employment and the wage rate, described in blocks 2 and 4, respectively. Non-wage income includes commuter income, property income, transfers, taxes, and social security payments. Disposable income is stated in real terms by dividing by the consumer price index.

Investment occurs through the capital stock adjustment process. The stock adjustment process assumes that investment occurs in order to fill the gap between the optimal and actual level of capital. The investment in new housing, commercial and industrial buildings, and equipment is an important engine of economic development. New investment provides a strong feedback mechanism for further growth since investment represents immediate demand for buildings and equipment that are to be used over a long period of time. The need for new construction begets further economic expansion as inputs into construction, especially additional employment in this industry, create new demand in the economy.

Investment is separated into residential, nonresidential, and equipment investment categories. In each case, the level of existing capital is calculated by starting with a base year estimate of capital stock, to which investment is added and depreciation is subtracted for each year. The desired level of capital is calculated in the capital demand equations, in block 2. Investment occurs when the optimal level of capital is higher than the actual level of capital; the rate at which this investment occurs is determined by the speed of adjustment.

Government spending at the regional and local level is primarily for the purpose of providing people with services such as schooling and police protection. Thus, changes in government spending are driven by changes in population. The government spending equation takes into account regional differences in per capita government spending, as well as differential government spending levels across localities within a larger region.

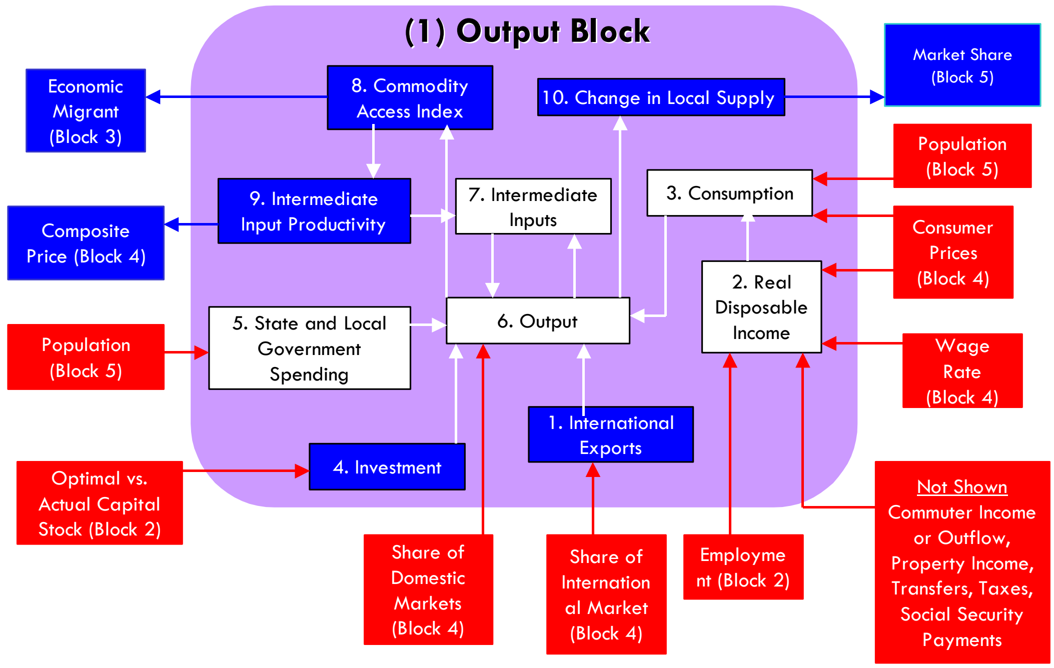
The demand for intermediate inputs depends on the requirements of industries that use inputs from other sectors. These inter-industry relationships are based on the input-output table for the economy. For example, a region with a large automobile assembly plant would have a correspondingly large demand for primary metals, since this industry is a major supplier to the motor vehicles industry.

Thousands of specialized parts are needed to assemble an automobile, and the close proximity of the parts suppliers to the assembly plant is particularly significant under just-in-time inventory management procedures. More generally, the location of intermediate suppliers is important to at least some extent for every industry. Thus, the economic geography of the producer and input suppliers is a key aspect of regional productivity.

The agglomeration economies provided by the proximity of producers and suppliers is measured in the commodity access index. Intermediate input productivity is determined by this index. The commodity access index for each industry is determined by the use of intermediate inputs, the effective distance to the input suppliers, and a measure of the productivity advantage of specialization in intermediate inputs. This productivity advantage is the elasticity of substitution between varieties in the production function. Although producers may be able to find a substitute for the precise component or service that they desire, access to the most favorable input provides a productivity advantage. When substitution between varieties is inelastic, then the productivity benefit of access to inputs is high. Thus, agglomeration economies are strong for the production of electrical equipment, computers, and machinery, and other industries that require specialized types of inputs for which substitution is difficult.

An increase in the output of an industry provides a larger pool of goods and/or services from which to choose. Since firms incur some fixed cost to produce a new variety, this increased pool of goods and services represents an increased availability of varieties. Therefore, an increase in industry output leads to a greater supply of differentiated goods and services which can in turn lead to higher productivity and increase output. This positive feedback between tightly related clusters of industries is one source of regional agglomeration. Since standard input-output analysis is often used to predict the effect of a firm either moving into or out of an area, it is important to explain why the results of the input-output analysis are incomplete. The following diagrams and explanation give an overview of the differences and similarities between REMI Policy Insight and Standard Input-Output.

Figure III.5- Block 1: Comparison of REMI vs. Input Output



White boxes indicate the linkages that constitute most I-O models

Some input-output models differentiate consumption by average household spending rates based on average earnings by industry. REMI differentiates between changes in income per capita and income changes due to changes in population, and includes different income elasticities for purchases of different consumer products (e.g. the consumption-type that includes cigarettes has a lower income elasticity than the type that includes motor vehicles). Also, most I-O models would not account for the inflow and outflow of commuters.

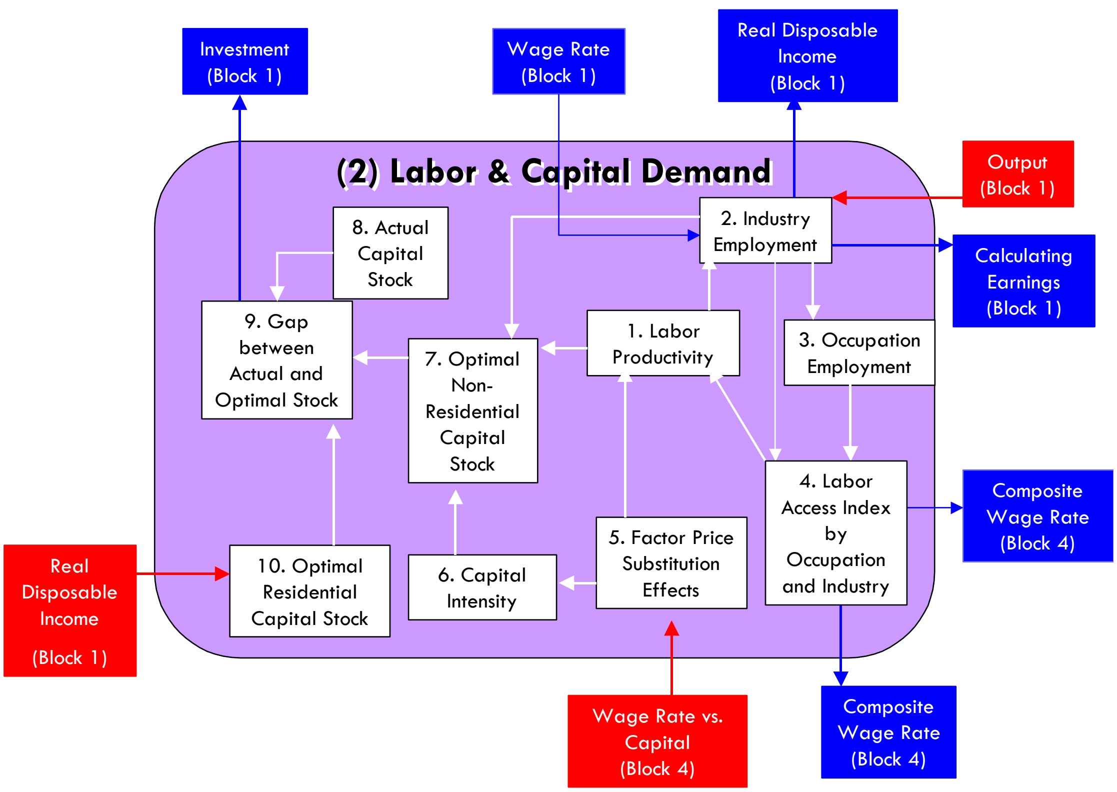
Thus, the I-O model captures the inter-industry flows that occur as output changes (each extra dollar of steel used 3 cents of coke) and has feedbacks to consumer spending that are generated by changes in workers income. Since population migration changes are not modeled, feedbacks to state and local governments in terms of new demands for per capita services are not included. Investment spending to construct new residential and commercial buildings cannot be modeled in static input-output models because it is a transitory process that occurs when higher incomes and population demand housing and new stores. This spending will return towards the baseline construction activity once the number of new houses and stores has risen enough to meet the one time permanent increase in demand.

The change in the share of all markets as costs, the access to intermediate inputs, the access to labor, and feedback from other areas in a multi-region model are not included in standard I-O models. These all have effects in the short run, but the effects are even greater in the long run. While an I-O analysis just gives a partial static picture, REMI catches all of the dynamic effects for each year in the future.

Another feature that is available in the REMI model is the ability to the user to input the sales of a firm that is locating in an area using a policy variable called Firm Sales. In this case the REMI model will accurately allow for the fact that if the new firm is like the current firms in the local area, the new firm will compete with them and displace some of their sales and employment. The difference between using this policy variable and another policy variable (called Industry Sales) that is similar to the input output way of inputting a new firm can be substantial. For example if a new grocery store moves into an area it is very likely to displace current grocery store sales and thus have a very small effect on net gain and employment. Only when the new firm is unique and serves an export market, not currently served by local firms is the result generated by Industry Sales appropriate. Thus in addition to missing all of the feedback from the other blocks the standard I/O analysis may miss the difference between net and gross new jobs.

Block 2. Labor and Capital Demand

Figure III.6-Labor and Capital Demand Block-Key Endogenous Linkages



The labor and capital demand block includes employment, capital demand, labor productivity, and the substitution between labor, capital, and fuel. Total employment is made up of farm, government, and private, non-farm employment. Employment in private, non-farm industries depends on employment demand and the number of workers needed to produce a unit of output. Employment demand is built up from the separate components of employment due to intermediate demand, consumer demand, local and regional government demand, local investment, and exports outside of the area. The employment per dollar of output depends on the national employment per dollar of output, the cost of other factors, and the access to specialized workers.

The availability of a large pool of workers within a region contributes to the labor force productivity. Each worker brings a set of unique characteristics and skills, even within the same occupational category. For example, a surgeon may be specialized in heart, brain, or knee surgery. Although a brain surgeon may be able to perform a heart operation, a heart surgeon is likely to be more effective. Hospitals in major medical centers such as London are in an excellent position to meet their staff requirements because the number of qualified job applicants in the region is so large.

More broadly, if a large number of potential employees can easily reach a location, that location will be better able match jobs with workers. The labor productivity due to labor access equation is calculated separately for each occupation. Occupational productivity in each location is based on the residential location of all potential workers and their actual or would-be commuting costs to that location.

The contribution of labor variety to productivity is measured by an occupation-specific elasticity of substitution based on a study that considered wages and commuting patterns across a large metropolitan area. While the match of workers to specialized roles that are consistent with their training has a large impact on productivity for medical occupations, it is significantly less important for workers in the food service sector. Industry productivity due to specialization is built up from occupational productivity, using the proportionate number of workers in each occupation that are employed by a given industry.

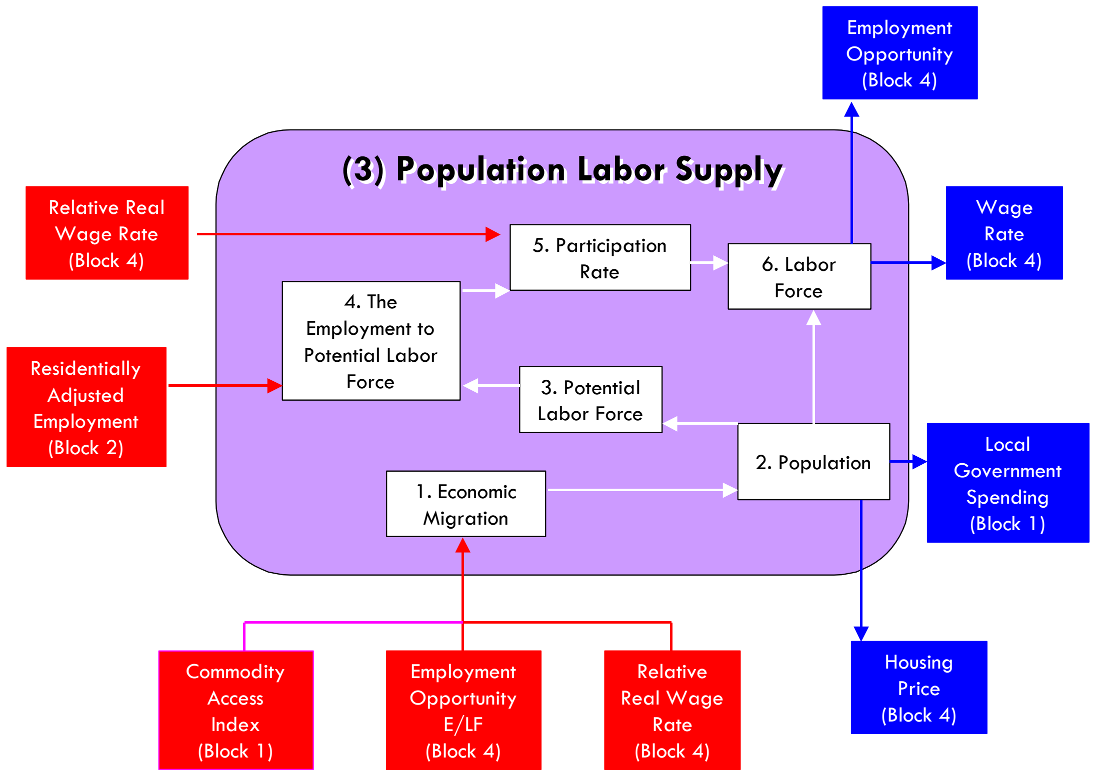
The number of employees needed per unit of output depends on the use of other factors of production as well as labor-access issues. Labor intensity, which measures the use of labor relative to other factors, is determined by the cost of labor relative to the cost of capital and fuel. The substitution between labor, capital, and fuel is based on a Cobb-Douglas production function, which implies constant factor shares. Labor intensity is calculated for each industry.

Demand for capital is driven by the optimal capital stock equation for industries and for housing. The optimal level of capital is determined for non-residential structures and equipment for each industry. The regional optimal capital stock is based on the industry size measured in capital-weighted employment terms, the cost of capital relative to labor, and a measure of the optimal capital stock on the national level. The variable for employment weighted by capital use is determined by the capital weight, employment, and labor productivity. The capital weight is the ratio of industry capital to employment in the region compared to the capital to employment ratio for the nation. The national optimal capital stock is based on the investment in the nation, the actual capital stock, the speed of adjustment, and the depreciation rate.

The optimal level of capital for residential housing is determined by the real disposable income in the region relative to the nation, the optimal residential capital stock for the nation, and the price of housing. To account for the cost of fuel, the fuel components of production (coal mining, petroleum refining, electric and natural gas utilities) are taken out of intermediate industry transactions and considered as a value-added factor of production. Then, firms substitute between labor, capital, and fuel (for electric, natural gas, and residual fuel) as the relative cost of factor inputs changes.

Block 3. Population and Labor Force

Figure III.7-Population Labor Supply Block-Key Endogenous Linkages



The population and labor force block includes detailed demographic information about the region. The population is central to the regional economy, both as a source of demand for consumer and government spending, and as the determinant of labor supply. As the composition of the population changes through births, deaths, and migration, so goes the region.

The demographic block is based on the cohort-survival method. Population in any given year is determined by adding the net natural change and the migration change to the previous year's population. The natural change is caused by births and deaths, while migration occurs for economic and non-economic reasons. Population data is given for age, gender, and ethnic category.

Birth rates are the ratio of births to the number of women in each age group. The survival rate is equal to one minus the death rate, which is the ratio of deaths to population in each cohort. Since birth rates vary widely across age and ethnic groups, and survival rates vary widely for gender as well as age and ethnic category, the detailed demographic breakdown is needed to accurately capture the aggregate birth and survival rates.

Migration, both economic and non-economic, also varies widely across population groups. Changes in retirement, international, and returning military migration are all assumed to occur for reasons that are not primarily due to changing regional economic conditions. Retirement migration depends on the retirement-age population in the rest of the country for regions that have gained retirement population in the past, and on the retirement age population within the regions for places that tend to have a net loss of retirees. The probability of losing or gaining a retiree is age and gender specific for each age group. International migration is also based on previous patterns. Changes in political restrictions on immigration and the economy of the immigrants' country are more significant in determining international migration than are changes in the economy of the home region. Returning military migration patterns are also better explained by existing patterns than by regional economic conditions, so returning military is also an exogenous variable.

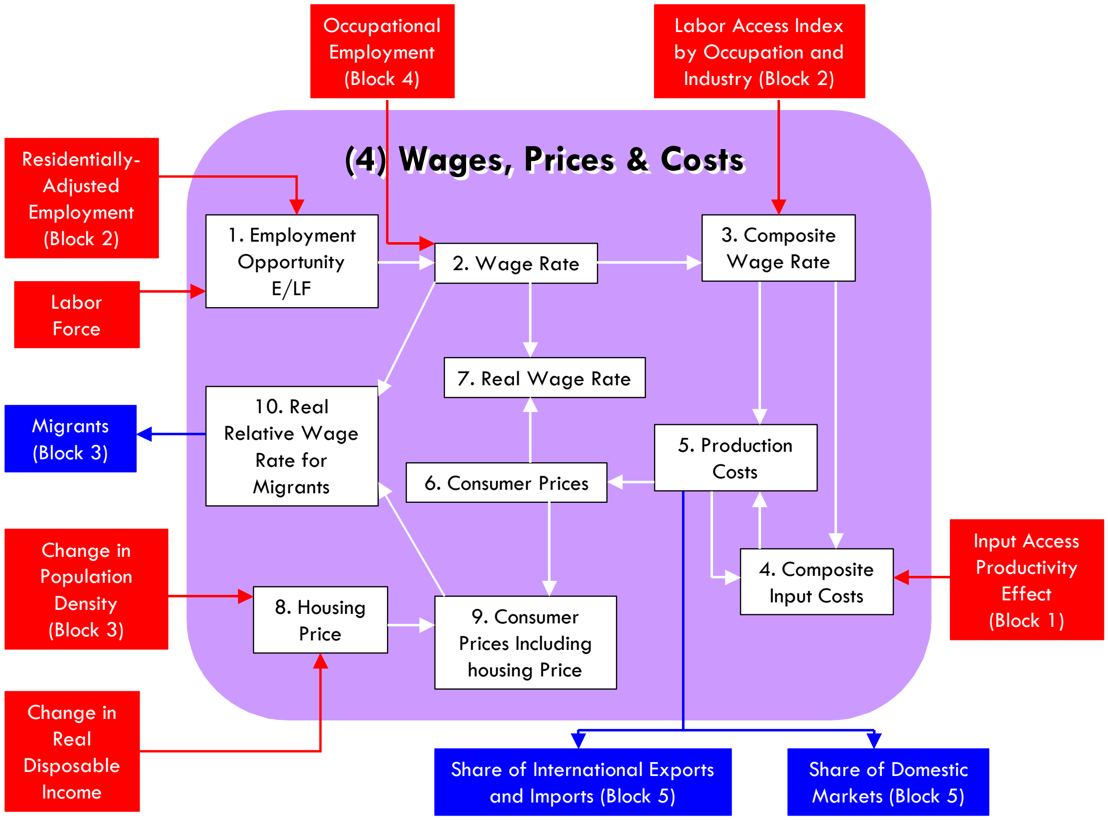
Economic migration is the movement of people to regions with better economic conditions. Economic migrants are attracted to places with relatively high wages and employment opportunities. Migrants are also attracted to places with high amenities. Potential migrants value access to consumer commodities, which depend on economic conditions. Thus, as the output of consumer goods and services increases, the amenity attraction of the region increases. Other amenities are due to non-economic factors. These amenities or compensating differentials are measured indirectly by looking at migration patterns over the last 20 years. In this way, the compensating differential is calculated as the expected wage rate that would result in no net in- or out-migration. For example, people may be willing to work in Florida even if paid only 85% of the average U.S. wage rate.

The labor force consists of unemployed individuals who are seeking work as well as employed workers. The labor force participation rate is thus the proportion of each population group that is working or looking for work. To predict the labor force, the model sums up the participation rate and cohort size for each demographic category. Participation rates vary widely across age, gender, and ethnic category; thus, the labor force depends in large part on the population structure of the region.

The willingness of individuals to participate in the labor force is also responsive to economic conditions. Higher wage rates and greater employment opportunities generally encourage higher labor force participation rates. The extent to which rates change in response to these economic factors, however, differs substantially for different population groups. For example, the willingness of men to enter the labor force is more influence by wages, while women are more sensitive to employment opportunities.

Block 4. Wages, Prices, and Costs

Figure III.8-Wages, Prices, and Costs Block-Key Endogenous Linkages



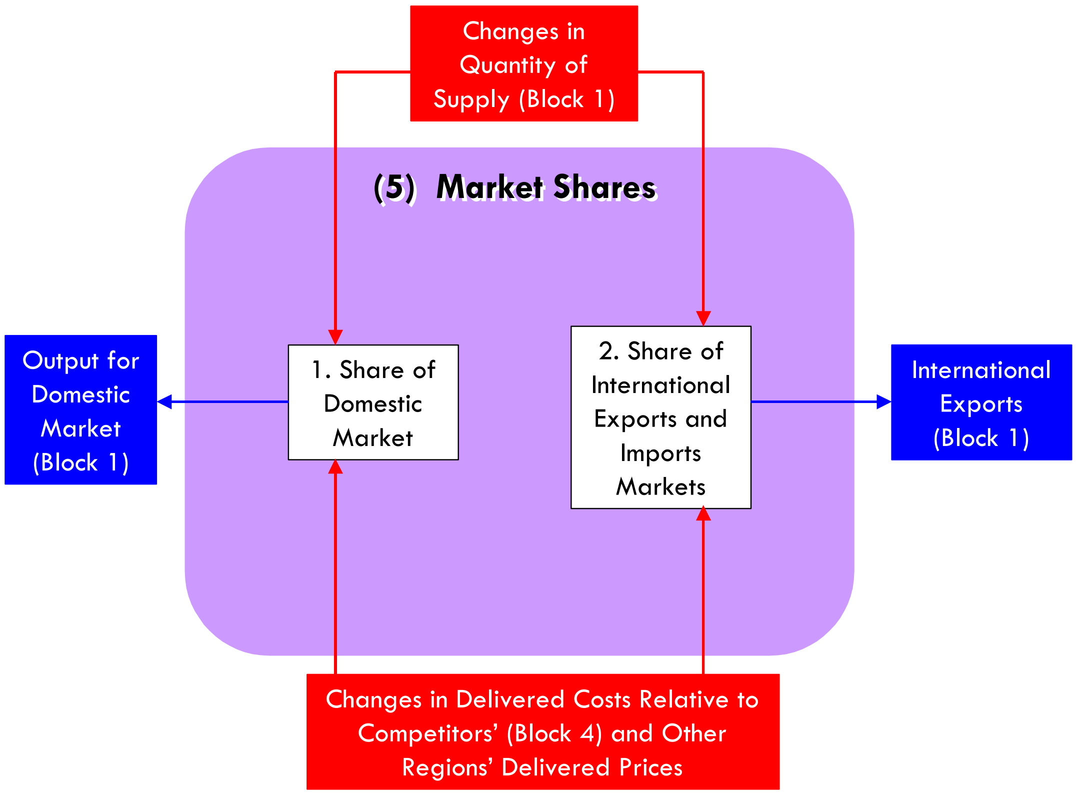
This block includes wages, consumer prices, production costs, housing prices, and composite wages and input costs. Wages, prices, and costs are determined by the labor and housing markets. The labor market is central to the regional economy, and wage differences are the primary source of price and cost differentials between regions. Demand for labor, from block 2, and labor force supply, from block 3, interact to determine wage rates. Housing prices depend on the change in population density and changes in real disposable income.

Economic geography concepts account for productivity and for corresponding price effects due to access to specialized labor and inputs into production. The labor access index from block 2, as well as the nominal wage rate, determines the composite wage rate. The composite cost of production depends on productivity-adjusted wage rate of the region, costs of structures, equipment, and fuel, and the delivered price of intermediate inputs.

The delivered price of a good or service is based on the cost of the commodity at the place of origin, and the distance cost of providing the commodity to the place of destination. This price measure is calculated relative to delivered prices in all other regions, and weights the delivered price from all locations that ship to the home region.

Block 5. Market Shares

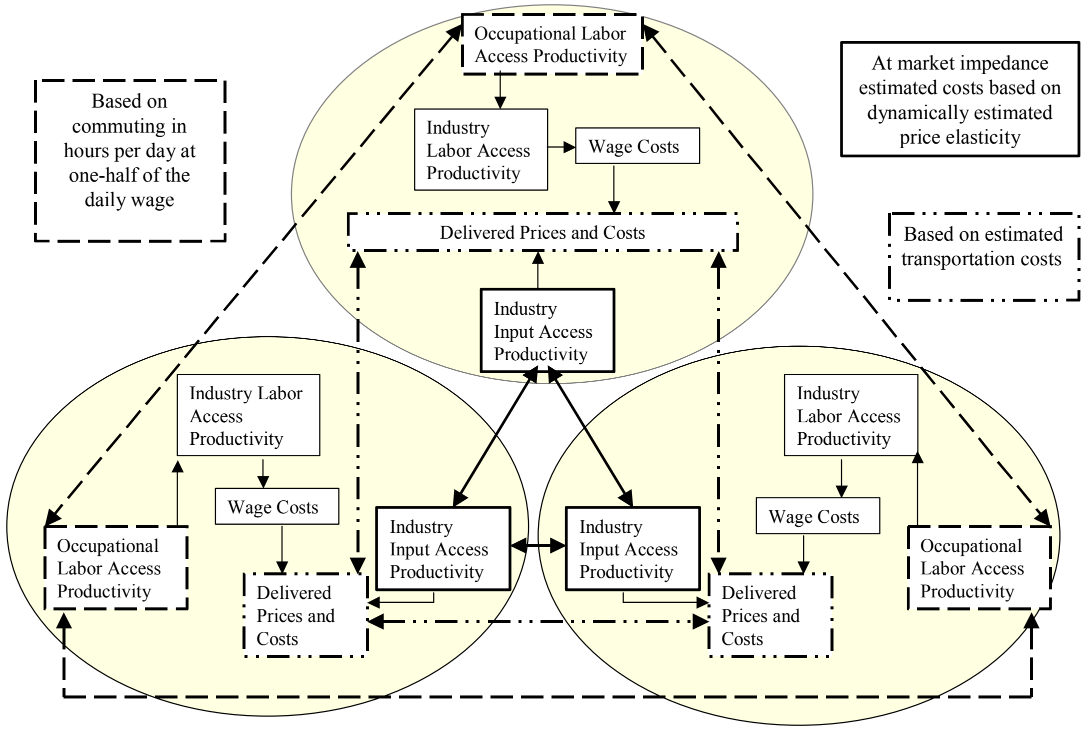
Figure III.9-Market Shares Block-Key Endogenous Linkages



The market shares block represents the ability of the region to sell its output within the local region, to other regions in the nation, and to other nations. Although the share of local markets is generally higher than any other market share, the equation for the market share of the home region is the same as for other regions within the nation. The share of international exports from the home region depend on national exports overall, and relative cost and output changes of the home region.

Changes in markets shares within the nation depend on changes in industry production costs and output. Production cost increases lower market shares, but higher output raises market shares. Market shares rise with output increases, since higher output is better able to meet local and other regions' demand for goods and services by providing more choices.

Multi-Regional Price and Wage Linkages



Chapter IV: Technical Documentation of the REMI Model

Most readers will find it useful to read Chapter III of this report before beginning a review of Chapter IV.

Block 1 - Output and Demand

Output and Demand Equations

The output in area k for industry i is determined by the following equation:

$$Q_i^k = \sum_{l=1}^{m} s_i^{k,l} DD_i^l + sx_i^{k,row} * X_i^u \tag{1-1}$$

where

Q_i^k = The output for industry i in area k.

DD_i^l = The domestic demand for industry i in area l.

X_i^u = Exports of industry i from the nation (u).

$s_i^{k,l}$ = Area k's share for industry i of the market in area l. $sx_i^{k,row}$ = Area k's share of the national exports of i to the rest of the world (row). m =The number of areas in the model (minimum 2). Also the letter that denotes the exogenous region (i.e. rest of the nation) for any model that does not incorporate a monetary feedback.

The DD_i^l is the quantity demanded in l. The s_i^{kl} term will incorporate the changes in k 's share of i in l that are due to the changes in k 's delivered price of i to l compared to the weighted average price charged by all of the areas that deliver to l, the variety of i offered in k compared with the variety offered by competitors in l, and the mix of fast growing relative to slow growing detailed industries that make up industry i in area k compared to the mix in the nation (see Block 5 below).

$$DD_i^l = \left(\sum_{j=1}^{n} a_{ij,t}^l Q_j^l + \sum_{j=n+1}^{n+c} a_{ij}^u C_j^l + \sum_{j=n+c+1}^{n+c+inv} a_{ij}^u I_j^l + \sum_{j=n+c+inv+1}^{n+c+inv+g} a_{ij}^u * G_j^l \right) * sd_{i,t}^l \tag{1-2}$$

where

DD_i^l = Domestic demand for industry i in area l.

a_{ij}^u = The average i purchased per dollar spent on j in the nation (u) in the current time period[12].

[12] Where input-output accounts use a commodity-by-industry input-output framework in which commodities and industries are classified separately, the make and use tables can be used to convert to an industry-by-industry framework.

$$a_{ij,t}^{l} = a_{ij}^{u} \Big/ MCPRODA_{i,t}^{l} \tag{1-3}$$

a_{ij}^{l} = The average i purchased per dollar spent on producing j in region l in period t.

$MCPRODA_{i,t}^{l}$ = The moving average of $MCPROD_{it}^{l}$

sd_{it}^{l} = The share of area l's demand for good i in time t that is supplied from within the nation.

n = The number of industries.

c = The number of final demand consumption categories.

inv = The number of investment sectors.

g = The number of government sectors.

Q_j^l = The output of industry j in l.

C_j^l = The demand for consumption category j in area l.

I_j^l = The demand for investment category j in area l.

G_j^l = The spending by government type j [13] in area l.

$$MCPROD_{i,t}^{l} = \left[\frac{\left\{ \sum_{l=1}^{m} \left(\dfrac{Q_{i,t}^{l}}{\sum_{j=1}^{m} Q_{i,t}^{j}} \right) \left[\left(ED_i^{lk} \right)^{\eta_i} \right]^{(1-\sigma_i)} \right\}^{\frac{1}{1-\sigma_i}}}{\left\{ \sum_{l=1}^{m} \left(\dfrac{Q_{i,T}^{l}}{\sum_{j=1}^{m} Q_{i,T}^{j}} \right) \left[\left(ED_i^{lk} \right)^{\eta_i} \right]^{(1-\sigma_i)} \right\}^{\frac{1}{1-\sigma_i}}} \right]^{-1} \tag{1-4}$$

$MCPROD_{it}^{l}$ = Intermediate Input Access Index. It predicts the change in the productivity of intermediate inputs due to changes in the access to these inputs in area l.

where

[13] All local government demands in a local area translate into local government spending in that area. However, demand for state government services in a county within a state result in government spending or services in the counties where state government services are supplied, which may only lead to a small amount of extra state government services or spending in the area where the demand arises. Likewise, national government demand may result in national spending or services in different areas of a country.

σ_i = The price elasticity of demand for industry *i*. (This parameter is estimated econometrically as the change in market share due to changes in *k*'s delivered price compared to other competitors in each market in which *i* is sold by area *k*.)

ED^{lk} = The "effective distance" between l and k. (This variable is obtained by aggregating from the small area trade flows in our database.)

Q_i^l = Output of *i* in *l*.

η_i = Distance deterrence elasticity. This is estimated using the exponent in the gravity equation (β_i) and the estimated price elasticity σ_i and then using the identity $\eta_i = \dfrac{\beta_i}{\sigma_i - 1}$.

$$MCPRODA_t = .2MCPROD_t + .8MCPRODA_{t-1}$$

$$CPROD_j^k = \prod_{j=1}^{c} \left(MCPRODA_i^k\right)^{PCE_{i,j}^u} \tag{1-5}$$

$CPROD_j^k$ = The consumption commodity *j* access index in area k.

$PCE_{i,j}^u$ = The proportion of each industries' input to consumption commodity *j*.

$$MIGPROD_t^k = \prod_{j=1}^{c} \left(CPROD_{j,t}^k \big/ CPROD_{j,t-1}^k \right)^{WC_{j,t-1}^u} \cdot MIGPROD_{t-1}^k \tag{1-6}$$

$MIGPROD_T = 1$

$MIGPROD^k$ = The consumer access index.

c = The number of consumption commodities.

$$wc_{j,t-1}^u = C_{j,t-1}^u \Big/ \sum_{j=1}^{c} C_{j,t-1}^u$$

Consumption Equations

Consumption of commodity *j* in area *k* in time *t* is predicted as:

$$C_{j,t}^{k} = \frac{e^{\alpha_j^k}}{e^{\alpha_j^u}} * \left(\frac{\dfrac{RYD_t^k}{N_t^k}}{\dfrac{RYD_t^u}{N_t^u}} \right)^{\beta_j} * \left(\frac{\dfrac{P_{j,t}^k}{P_t^k}}{\dfrac{P_{j,t}^u}{P_t^u}} \right)^{-1} * \frac{e^{\Psi_j * z_t^k}}{e^{\Psi_j * z_t^u}} * \frac{C_{j,t}^u}{N_t^u} * N_t^k \tag{1-7}$$

Industry Demand from Consumption: $C_{i,t}^{k} = \sum_{j=n+1}^{n+c} a_{i,j}^{u} C_{j}^{l}$

$C_{j,t}^{k}$ = Consumption, commodity *j*, time *t*, region *k*

N_t^k = Population, time *t*, region *k*.

N_t^u = Population, time *t*, national (*u*)

$C_{j,t}^{u}$ = Consumption commodity *j*, time *t*, national (*u*).

Z_t^k = Demographic variable reflecting age distribution, time *t*, and region *k*.

Z_t^u = Demographic variable reflecting age distribution, time *t*, national (*u*).

$P_{j,t}^{u}$ = Consumer price index, commodity *j*, time *t*, national (*u*).

Ψ_j := Econometrically estimated parameter, commodity *j* (medical age responsiveness).

$P_{j,t}^{k}$ = Average delivered price, commodity *j*, time *t*, region *k*.

P_t^k = Consumer price index, time *t*, region *k*.

P_t^u = Consumer price index, time *t*, national (*u*).

RYD_t^u = Real disposable income, time *t*, national (*u*).

RYD_t^k = Real disposable income, time *t*, region *k*.

α_j^k = Econometrically estimated parameter, commodity *j*, region *k*.

α_j^u = Econometrically estimated parameter, commodity *j*, national (*u*).

$a_{i,j}^{u}$ = Coefficient denoting the proportion of consumption commodity *j* satisfied by industry *i*.

β_j = Econometrically estimated parameter commodity *j* (income elasticity) subject to $\Sigma\beta j \cdot WT_j = 1$, where WT_j is the share of consumption type *j*.

C^k = The demand in area *k* for good *i* from local consumption.

$$RYD = (YP - TAX) \Big/ \overline{P}^{I} \tag{1-8}$$

$TAX =$ All tax and non-tax payments removed from personal income before households receive it.

$YP =$ Personal income.

$\overline{P}^{I} =$ The weighted average of consumer prices.

$$YP = YLP - TWPER + RA + YPROP + V \tag{1-9}$$

For a more detailed explanation of consumption see pp. 49-71 in REMI Economic Model Documentation, published as a chapter by Treyz and Petraglia in Regional Science Perspectives edited by M.L. Lahr and R.E. Miller, Elesiver Science, 2001 (attached).

Real Disposable Income Equations

Real disposable income in the region equals personal income (YP) adjusted for taxes (TAX) and the cost of living $\left(\overline{P}^{I}\right)$. Total personal income (YP) depends on wages and salaries, and other labor income and proprietors' income (YLP), property income $(YPROP)$, personal contributions to social insurance $(TWPER)$, transfer payments (V), and an adjustment to account for the difference between place-of-work and place-of-residence earnings (RA).

Wage and salary disbursement, *WSD*, are an aggregation of individual industry wages and salaries. Thus,

$$WSD = \sum_{i=1}^{n} E_i w_i \tag{1-10}$$

Where E_i is employment in industry i, and w_i is the wage rate of industry i.

Employees also receive other labor income, such as fringe benefits and the self-employed generate proprietors' income. The Bureau of Economic Analysis reports the total of these two income sources by major sector, so the local change in these totals on a per employee basis is predicted by their national change using the following equation:

$$YOL_I = \lambda_{YOL} E_I \left(YOL_I^u / E_I^u \right) \tag{1-11}$$

Where YOL_I is other labor income and proprietors' income for major sector I (to which industry i belongs), λ_{YOL} is a region-specific coefficient and is greater than 1 if the region has a higher ratio than the nation, and E_I is employment in sector I. Total labor and proprietors' income, YLP, for all industries in the region can be calculated as

$$YLP = WSD + \sum_{I} YOL_I \tag{1-12}$$

Property income, $YPROP$, depends on the population and its age distribution as well as historical regional differences in property income received.

$$YPROP = \lambda_{YPROP} NP \left(YPROP^u / NP^u \right) \tag{1-13}$$

and

$$NP = L65 + m65 * G65 \tag{1-14}$$

Where $m65$ is the national ratio of per capita property income received for persons 65 years and older ($G65$) relative to property received by persons younger than 65 ($L65$), and λ_{YPROP} adjusts for regional differences and is calculated in the last historical year by solving equations (1-9) and (1-10).

Personal contributions to social insurance, $TWPER$, are predicted as

$$TWPER = \lambda_{TWPER} WSD \left(TWPER^u / WSD^u \right) \tag{1-15}$$

Where λ_{TWPER} is a coefficient calculated in the last historical year to adjust for regional differences in the $TWPER$ per dollar of wage and salary disbursements.

The residence adjustment, RA, is used to convert place-of-work income (wage and salaries, other labor income, proprietor's income, and personal contributions for social insurance) to place-of-residence income.

$$RA^k = GI^k - GO^k \tag{1-16}$$

$$GI^k = \sum_{l=1}^{n} rs^{l,k} * \left(WSDNF^l + YOLNF^l - TWPER^l \right) \tag{1-17}$$

$GI^k =$ Gross inflow of commuter dollars for residents of region *k* who work in all other areas.

$WSDNF^l =$ Wage and salary disbursement (except for government) in area *l*.

$YOLNF^l =$ Other labor income (except for government) in area *l*.

$rs^{l,k} =$ The share of earnings in l that is earned by residents of k who work outside of *k* (currently fixed at the last year in history in lieu of future plans to endogenously incorporate new economic geography concepts to predict changes in rs^{lk} based on labor supply and wage costs by place of origin).

$$GO^k = \sum_{l \neq k}^{m} nrs^{k,l} \left(WSDNF^k + YOLNF^k - TWPER^k \right) \tag{1-18}$$

$GO^k =$ Gross outflow from region *k* to all other areas (*m*).

$nrs^{k,l} =$ Share of earnings in region *k* going to residents of region *l* (currently fixed at the last history year share).

Transfer payments, V, depend on the number of persons in each of three groups: Persons 65 years and older, persons younger than 65 who are not working, and all persons who are not working. Transfer payments also are adjusted for historical regional differences.

$$V = \lambda_V NV \left(V^u \Big/ NV^u \right) \tag{1-19}$$

and

$$NV = VG(G65) + VL\left[L65 - E\left(1 + RA \Big/ WSDT\right)\right] + \left[N - E\left(1 + RA \Big/ WSDT\right)\right] \tag{1-20}$$

Where VG are per capita transfer payments for persons 65 years and older relative to per capita transfer payments for all persons not working, VL are per capita transfer payments for persons younger than 65 who are not working, λ_V adjusts for regional differences and is calculated in the last historical year by solving equations (1-15) and (1-16), and E and N are, respectively, total employment and population in the region and *WSDT* is the total wage and salary disbursements.

The variable *TAX* depends on net income after subtracting transfer income. It is adjusted for regional differences by λ_{TAX} and changes as national tax rates change.

$$TAX = \lambda_{TAX} (YP - V)\left[TAX^u \Big/ (YP^u - V^u) \right] \tag{1-21}$$

Investment Equations

There are three types of fixed investment to be considered: residential, nonresidential, and equipment. Change in business inventories is the other component of investment and is based on the national change in inventories as a proportion of sales applied to the size of the local industry.

The way in which the optimal capital stock (K^*) is calculated for each investment category is explained in the factor and intermediate demand section below. Introducing time explicitly into the model, we can write equations that apply for all three types of fixed capital.

$$IL_{p,t} = \alpha\left[(K_t^*) - (1 - dr_t^u)K_{t-1}\right] \tag{1-22}$$

$$K_{t-1} = (1 - dr_{t-1}^u)K_{t-2} + IL_{t-1} \tag{1-23}$$

Using equation (1-19), the actual capital stock in equation (1-20) can be replaced with the sum of the surviving initial capital stock (K_0) and the surviving previous investment expenditures. The investment equation is

$$IL_{j,t}^k = \alpha_j * \left[K_{j,t}^{k*} - \underbrace{\left(K_{j0}^k * \prod_{i=1}^{t}(1 - dr_j) + \sum_{i=1}^{t-1} IL_{j,i}^k * \prod_{i+1}^{t}(1 - dr_{j,i}) \right)}_{K_{j,t}^k} \right] \tag{1-24}$$

$$I_{i,t}^k = \sum_j inv_{ij,t} IL_{j,t}^k \tag{1-25}$$

$I_{i,t}^k =$ Investment demand for output from industry *i*, time *t*, region *k*

$IL_{j,t}^{k}$ = Investment demand for investment type j, time t, region k

$inv_{ij,t}$ = Coefficient denoting the proportion of investment category j supplied by industry i, time t.

$K_{j,t}^{k*}$ = Optimal capital stock, type j, time t, region k.

K_{j0}^{k} = Capital stock, type j, time 0, region k.

dr_j = Depreciation rate, type j.

α_j = Speed of adjustment, type j.

For additional details see Rickman, Shao and Treyz, 1993.

The national change in business inventories is allocated according to the regional share of employment.

$$CBI_i^l = \left(E_i^l \big/ E_i^u \right) * CBI_i^u \tag{1-26}$$

CBI_i^l = The change in business inventories, industry i, region l.

CBI_i^u = The change in business inventories, industry i, national (u).

E_i^l = Employment, industry i, region l.

E_i^u = Employment, industry i, national (u).

Government Spending Equations

The state and local government demand equations are driven based on the average per capita demand for these services in the last history year (T).

$$G_{state,t}^l = \lambda_{state}^l * N_t^l * \left(\frac{G_{state,t}^u}{N_t^u} \div \frac{G_{state,T}^u}{N_T^u} \right) \tag{1-27}$$

$$G_{local,t}^l = \lambda_{local}^l * N_t^l * \left(\frac{G_{local,t}^u}{N_t^u} \div \frac{G_{local,T}^u}{N_T^u} \right) \tag{1-28}$$

where

$G_{state,t}^l$ = The demand for state services in region l, time t.

$G_{local,t}^l$ = The demand for local services in region l, time t.

λ_{local}^l = An estimate of the last history year local government spending per capita in region l.

λ^{l}_{state} = An estimate of the state last history year average spending per capita in the state in region *l*.

N^{l}_{t} = The total population, region *l*, time *t*.

Superscript *u* indicates similar values for the nation.

In the absence of adequate local demand estimates for state and local government separately, it is necessary to approximate these relative values based on assuming uniform productivity across all state and local government employees in the nation. It is important to note that local demand for local government services will be met in the local area, whereas the demand for state services in a local area may be met in part by state employees in the counties that provide state services, as set forth in the section on Market Shares below.

Block 2 – Labor and Capital Demand

Labor Demand Equations

The productivity of labor depends on access to a labor pool. In this instance, we have chosen to use employment by occupation as the measure of access to the specialized labor pool. Thus, the variety effect on the productivity of labor by occupation is expressed in the following equation:

$$FLO^{k}_{j,t} = 1 \div \left[\sum_{l=1}^{m} \frac{EO^{l}_{j,t}}{EO^{u}_{j,t}} * \left(1 + cc^{l,k}\right)^{1-\sigma_j} \right]^{\frac{1}{1-\sigma_j}} \tag{2-1a}$$

$$RCW^{k}_{i,t} = 1 \div \left[\sum_{l=1}^{m} \frac{E^{l}_{i,t}}{E^{u}_{i,t}} * \left(1 + cc^{l,k}\right)^{1-\sigma_i} \right]^{\frac{1}{1-\sigma_i}} \tag{2-1b}$$

$FLO^{k}_{j,t}$ = Labor productivity for occupation type *j* that depends on the relative access to labor in occupation *j* in region *k*, time *t*.

$RCW^{k}_{i,t}$ = Relative labor productivity due to industry concentration of labor.

$EO^{l}_{j,t}$ = Labor of occupation type *j* in region *l*, time *t*.

σ_j = Elasticity of substitution (i.e. cost elasticity).

$cc^{l,k}$ = Commuting time and expenses from *l* to *k* as a proportion of the wage rate.

$EO^{u}_{j,t}$ = Labor of occupation type *j*, national (*u*), time *t*.

$E^{l}_{i,t}$ = Employment in industry *i*, time *t*, in region *l*.

m = Number of regions in model including the rest of the nation region.

The value of σ_l is .12 and is based on elasticity estimates made by REMI under a grant from the National Cooperative Highway Research Program (Weisbrod, Vary and Treyz 2001) based on cross commuting among workers in the same occupation observed in 1300 Traffic Analysis Zones in Chicago. Key data inputs on travel times were provided by Cambridge Systematics, Inc.

In order to determine labor productivity changes by industry due to access to variety, a staffing pattern matrix is used as follows:

$$Fl_{i,t}^{k} = \left[\left[\left(\sum_{j=1}^{q} d_{j,i} * FLO_{j,t}^{k}\right) + RCW_{i,t}^{k}\right] \div 2\right] \div FL_{i,T}^{k} \qquad \text{(2-1c)}$$

$Fl_{i,t}^{k}$ = Labor productivity due to labor access to industry and relevant occupations by industry *i*, in region *k*, time *t*, normalized by $Fl_{i,T}^{k}$

$d_{j,i}$ = Occupation *j*'s proportion of industry *i*'s employment.

$FLO_{j,t}^{k}$ = The labor productivity for occupation *j*, region *k*, time *t*.

q = The number of occupations in industry *i*.

$FL_{i,T}^{k}$ = Labor productivity due to access by industry *i* in region *k* in the last year of history.

$RCW_{i,t}^{k}$ = Relative labor productivity due to industry concentration of labor.

Relative labor intensity is determined by the following equation based on Cobb-Douglas technology and the assumption that the optimal labor intensity is chosen when new equipment is installed.

$$L_{i,t}^{k} = L_{i,t-1}^{k} + \frac{I_{nrs,t}^{K}}{K_{nrs,t}^{K}} * \left[\underbrace{\left(RLC_{i,t}^{k}\right)^{b_{ji,t}-1}\left(RCC_{i,t}^{k}\right)^{b_{ji,t}}\left(RFC_{i,t}^{k}\right)^{b_{ji,t}}}_{h_{i,t}^{k}} - L_{i,t-1}^{k}\right] \qquad \text{(2-2)}$$

$L_{i,t}^{k}$ = Relative labor intensity, industry *i*, time *t*, region *k*.

$b_{ji,t}$ = Contribution to value added of factor *j*, (labor, capital and fuel respectively), industry i, time *t*, region *k*.

$I_{nrs,t}^{K}$ = Nonresidential investment, region *K*, time *t*.

$K_{nrs,t}^{K}$ = Nonresidential capital stock, region *K*, time *t*.

$RCC_{i,t}^{k}$ = Relative capital cost, industry i, time *t*, region *k*.

$RLC_{i,t}^{k}$ = Relative labor cost, industry i, time *t*, region *k* equals $\left(w_{i,t}^{k} / w_{i,t}^{u}\right)$, before accounting for labor productivity effects.

$RFC_{i,t}^{k}$ = Relative fuel cost industry i, time *t*, region *k*.

$h_{i,t}^{k} =$ Optimal labor intensity, industry i, time t, region k.

Simplified, the above equation can be written as,

$$L_{i,t}^{K} = L_{i,t-1}^{K} + \left(\frac{I_{nrs,t}^{K}}{K_{nrs,t}^{K}} \right) * \left(h_{i,t}^{K} - L_{i,t-1}^{K} \right) \tag{2-3}$$

where

$$EPV_{i,t} = \frac{L_{i,t}}{L_{i,T}} * \frac{E_{i,t}^{u}}{Q_{i,t}^{u}} * (Fl_{i,t}^{k})^{-\alpha_i} * epvindx_{i,t} \tag{2-4}$$

$EPV_{i,t} =$ Employees per dollar of output in industry i, time t.

$L_{i,t} =$ Labor intensity due to relative factor costs, industry i, time t.

$E_{i,t}^{u} / Q_{i,t}^{u} =$ Employees per dollar of output in the nation (u) in time t.

$\alpha_i =$ Labor share of industry i.

$Fl_{i,t}^{k} =$ Labor productivity due to labor access by industry i, time t, divided by $FL_{i,T}^{k}$

$L_{i,T} =$ Labor intensity due to relative factor costs in industry i in the last history year (T).

$epvindx_{i,t} =$ Change in region's 3-digit industry mix relative to the nation since the last year of history (=1 if 3-digit national forecast is not used).

In a multi-industry model, total employment in the area can be divided into three categories consisting of private non-farm industries, employment in farm and employment in government. Government is further divided into employment of state and local government sectors, and employment in federal civilian and military sectors. Output in private non-farm industries is determined by demand for inputs into the production process (intermediate demand) and demand from personal consumption, government, investment, and exports (final demand) and employees per unit of output (EPV_i). The equation for employment in private industry i for the single area model is

$$E_i = EPV_i * (QLI_i + QLC_i + QLG_i + QLINV_i + QXMA_i + QXROU_i + QXROW_i)$$
$$i = 1, \ldots, n \tag{2-5}$$

where $QLI_i \left(= \sum_j s_i^{k,k} * \alpha_{i,j}^{l} * Q_j\right)$ are sales of industry i 's product dependent on local intermediate demand, $QLC_i \left(= s_i^{k,k} * C_i\right)$ are sales dependent on local consumer demand, $QLG_i \left(= s_i^{k,k} * G_i\right)$ are sales dependent on local and on state government demand, $QLINV_i \left(= s_i^{k,k} * IL_{p,i}\right)$ are sales dependent on local investment, and *QXRMA* are sales to other areas in the in the multi-area model. $\sum_{l}^{n-1} s_i^{k,l} * D^l$ and *QXRMA* are sales to the rest of u, and $QXROW_i$ are sales to the rest of the world.

Federal government employment in the local area is a fixed proportion of government employment in the nation, based on the last observed proportion. The equations for federal civilian employment and federal military employment are

$$EG^k_{FC,t} = \frac{EG^k_{FC,T}}{EG^u_{FC,T}} * EG^u_{FC,t} \tag{2-6}$$

$$EG^k_{FM,t} = \frac{EG^k_{FM,T}}{EG^u_{FM,T}} * EG^u_{FM,t} \tag{2-7}$$

where

$EG^k_{FC,t}$ = Federal civilian employment in area k in time t (where T is the last history year)

$EG^k_{FM,t}$ = Federal military employment in area k in time t (where T is the last history year)

^{u} = As a superscript, denotes the federal union area.

State (EG_s) and local government (EG_L) employment are based on estimated output per state or local government employee. In the absence of such regional data the national average is used as the ratio of state and local output to state and local government employment. The changes in per capita state and local government in the U.S. and changes in the population that is served by state and/or local government drive state and local employment. Thus, non-farm employment, ENF, is

$$ENF = \sum_{i=1}^{n} E_i + EG_L + EG_S + EG_{F,C} + EG_{F,M} \tag{2-8}$$

Farm employment is estimated as a fixed share of national farm employment based on the last year of history. The equation for total employment (TE) is

$$TE = ENF + EF \tag{2-9}$$

Where EF is farm employment.

Capital Demand Equations

In the n-industry model, two types of capital stocks have been considered: Non-residential structures and equipment. The optimal capital stock equation for these two types of capital stock is:

$$K^{k^*}_{j,t} = \left(\frac{\sum_{i=1}^{n} kw_{i,t} * RLC^k_{i,t}}{\sum_{i=1}^{n} kw_{i,t} * RCC^k_{i,t}} \right) * \frac{AE^k_t}{AE^u_t} * K^{u*}_{j,t} * KP^k_j \tag{2-10}$$

$K_{j,t}^{k^*} =$ Optimal capital stock for type *j* capital (non-residential structures and equipment), time *t*, region *k*.

$kw_{i,t} =$ Industry *i*'s share of total capital stock, time *t*.

$RLC_{i,t}^{k} =$ Relative labor cost, industry *i*, time *t*, region *k*

$RCC_{i,t}^{k} =$ Relative capital cost, industry *i*, time *t*, region *k*.

$AE_{t}^{k} =$ Employment weighted by capital use, time *t*, region *k* (used instead of employment because the variation in capital use per employee across industries is very large).

$AE_{t}^{u} =$ Capital weighted employment, time *t*, national capital per employee in the industry and adjustment for labor productivity.

$K_{j,t}^{u^*} =$ National optimal capital stock for type *j* capital, time *t*.

$KP_{j}^{k} =$ Capital preference parameter, type *j*, region *k*, if calculated (otherwise =1).

The term of $\sum kw_i * RLC_i$ (or $\sum kw_i * RCC_i$), in equation 2-10 above, is the average relative wage rate (or average relative capital cost) weighted by capital in use. The equation used to determine the variable AE is

$$AE = \sum_{i=1}^{n} \frac{K_i^u \div TK^u}{E_i^u \div TE^u} * E_i * \left(FL_i\right)^{\alpha} = \sum_{i=1}^{n} kwe_i * E_i * \left(FL_i\right)^{\alpha} \tag{2-11}$$

$kwe_i =$ The average capital per employee in the *u* area

In equation 2-11, AE is the capital using economic activity in employment terms. $TK^u \left(= \sum K_i^u\right)$, and $TE^u \left(= \sum E_i^u\right)$ are total capital and total employment in the nation. It is necessary to use AE instead of E in equation 2-10, because the variation in capital use per employee across industries in very large. The term FL_i in equation 2-11 shows relative labor productivity based on labor force availability raised to labor share to reflect labor substitution for capital.

The optimal capital stock for residential housing (j=2) is based on the following equation:

$$K_{2,t}^{K*} = \left(RYD_t^K \middle/ RYD_t^u \right) K_{2,t}^{u*} * KP_j^k \tag{2-12}$$

Where RYD_t^K / RYD_t^u shares out the optimal national residential capital stock, based on the proportion of real disposable income in the region. The optimal capital stock of the nation for type $j(j=1,2,3)$ capital $\left(K_{j,t}^{u*}\right)$ is determined from equation 2-13

$$K_{j,t}^{u*} = \left(I_{j,t}^{u} / \alpha_j \right) + \left(1 - dr_{j,t}^{u}\right) K_{j,t-1}^{u} \tag{2-13}$$

Thus, if we know the speed (α_j) at which investment fills the gaps between the optimal $\left(K_{j,t}^{u*}\right)$ and actual capital stock $\left(K_{j,t}^{u}\right)$ and we know investment in the nation $\left(I_{j,t}^{u}\right)$ and the depreciation rate of capital $\left(dr_{j,t}^{u}\right)$, we can determine the optimal capital stock $\left(K_{j,t}^{u*}\right)$.

Demand for Fuel

Demand for fuel is not explicit in the model. As evident in equation (2-2), the cost of fuel does enter the demands for labor and capital and plays an important role in the model. The treatment of fuel is unique in that the detailed intermediate outputs for coal mining, crude petroleum refining, and electric and natural gas utilities are excluded from the intermediate industry transactions and treated as a value added factor for purposes of calculating relative costs and labor intensity. As value added factors, fuel, capital, and labor are the Cobb-Douglas substitutes in the production function.

Block 3 – Population and Labor Force

The population block includes a full cohort survival equation by single year of age, by gender and by racial/ethnic group. Births are determined by the number of females in each relevant age group, and are specific by area and ethnicity. The survival rates are area specific and are by age, racial/ethnic group and gender. Retired migrants are based in part by migration patterns for people at and above retirement age 65. In particular a "risk" probability model is used. For areas that experienced an inflow of retired migrants, the probability of a person over age 65 moving into the area is based on the proportion of that population captured in the past. This probability is applied each year in the future to the population age 65 and above in the nation. For areas experiencing net out migration of the retired population the past proportion of loss is applied to the number of people in the local area that are age 65 and older. When the data supports it, the above age 65 population can be divided into gender and age categories.

In particular, the equation for retired migrants is:

$$RTMG_i^l = rm_i^l \left(\left(1 - RTDUM_i\right) * N_i^l + RTDUM_i * N_i^u \right) \tag{3-1}$$

where

$RTMG_i^l =$ The net inflow or outflow of migrants of age *i* (*i*=65,66, …100+) to region *l*

rm_i^l = The net proportion of the relevant population that has historically migrated into or out of area *l*.

N_i^l = The 65 and above population in area *l*.

N_i^u = The 65 and above population in area *u*.

$$RTDUM_i = \begin{cases} 1 \text{ if } rm_i^l > 0 \\ 0 \text{ if } rm_i^l < 0 \end{cases}$$

The economic migration equation in the model is very important to forecasting the effects of alternative policies. It is based on the assumption that economic migrants will make their migration decisions based on the relative expected after tax real expected earned income in alternative locations and the relative amenity attractiveness of these locations.

The migration equation is

$$ECMG_t^l = \left[\ln\left(\lambda^l\right) + \beta\ln\left(REO_t^l\right) + \beta\ln\left(RWR_t^l\right) + \beta\ln\left(MIGPROD_t^l\right)\right] * LF_{t-1}^l \qquad (3\text{-}2)$$

where

$ECMG_t^l$ = Net economic migrants (all migrants less than 65 years of age) in area *l*.

LF_{t-1}^l = The labor force last period in area *l*.

$$REO_t^l = \frac{E_t^l / LF_t^l}{E_t^u / LF_t^u}$$

E_t^l = Employment in area *l* in period *t*.

$MIGPROD_t^l$ = The consumption access index in area *l* in period *t*.

$$RWR_t^l = \left(\frac{WR_t^l}{WR_t^u}\right) * \left(\frac{RYD_t^l / YP_t^l}{RYD_t^u / YP_t^u}\right) \qquad (3\text{-}3)$$

$WR_t^l = \sum_{i=1}^{n} \frac{E_{i,t}^l}{TE_{i,t}^l} * W_{i,t}^l$ = Local average wage

$WR_t^u = \sum_{i=1}^{n} \frac{E_{i,t}^l}{TE_{i,t}^l} * W_{i,t}^u$ = (*u*) average industry wage weighted by the employment industry shares in *l*.

λ^l = A fixed effect that captures the relative attractiveness of area *l*.

β = Estimated coefficient.

The estimated coefficient (β) in equation (3-2) is based on time-series cross-section data. (For further background see Greenwood, Hunt, Rickman, Treyz, 1991, and Treyz, Rickman, Hunt and Greenwood, 1993).

The total number of economic migrants is distributed by the historical average age and gender of economic migrants in *l*. The equation implies that for an increase in period 1 of 1% of *REO, RWR,* or *MIGPROD* that net migration equal to β% of last year's labor force will occur. In period 2 and each subsequent period, net migration above that in the baseline forecast will continue until the product of the three factors returns to the baseline value.

Labor Force Equations

$$LF^k = \sum_{i=l}^{n} PR_i^k * COH_i^k \tag{3-4}$$

$$PR_i^k = \beta_1^k * \left(REA^k\right)^{\beta_2} * \left(RWR^k\right)^{\beta_3} * PR_i^u \tag{3-5}$$

where

$PR_i^k =$ The participation rate (i.e. the proportion of the relevant population that is in the labor force).

$LF^k =$ The labor force in area *k*.

$COH_i^k =$ The number of people in cohort *i* in area *k*.

$\beta_1^k =$ The fixed effect for area *k*.

$\beta_2, \beta_3 =$ The parameters estimated on the bases of pooled or national time series.

$REA_t^k = EA_t^k / EA_t^u$

$EA_t^k = EA_{t-1}^k + \lambda_E\left(EO_t^k - EA_{t-1}^k\right)$

$EA_t^u = EA_{t-1}^u + \lambda_E\left(EO_t^u - EA_{t-1}^u\right)$

$EO_t^k =$ The employment in *k* divided by a synthetic labor force based on the local population at fixed national participation rates.

$RWR_i^k =$ The relative real wage rate.

$\lambda_E =$ An estimated parameter $0 < \lambda_E < 1$.

where

E_t^k is employment in area *k* in time period *t* divided by the labor force in the area.

The β and λ_E values by age cohorts, gender and racial/ethnic groups have been estimated for 160 (20x2x4) age cohorts in the U.S. The β_1^k parameter is a fixed effect for area *k* calibrated to the measured labor force (see Treyz, Christopher and Lou, 1996). For other countries these estimates will be modified using an iterative process to minimize the squared error of fit for labor force participation rates in the country for which a REMI model is being constructed.

Block 4 – Wages, Prices and Costs

Production Costs

$$\Omega_i^k = \left[\left(\frac{WADJ_i^k}{WR_i^u} \right)^{b_{1i}} * \prod_{j=2}^{6} \left(\frac{FC_j^k}{FC_j^u} \right)^{b_{j,i}} * \sum_{j=1}^{6} a^u_{j,i} + \sum_{j=7}^{n} a^l_{j,i} * CP^k_{i,T} \left(\frac{CIFP^k_{i,t}}{CIFP_{i,T}} \right) \right] * LAMOMG^k_{i,T} \quad (4\text{-}1)$$

where

$\Omega_i^k =$ The composite cost of production. (This is a composite cost because it incorporates productivity change due to access to material inputs).

$WADJ_i^k = W_i^k \Big/ \left[\left(FL^k_{i,t} \div FL^k_{i,T} \right) Flmult_i^k \right]$ = The productivity adjusted wage rate in area *k*.

$W_i^k =$ The wage rate in *k*.

$FL_i^k =$ The labor productivity in *k* in period *t* divided by $FL^k_{i,T}$.

$FC_j^k =$ *j*=2, the price of structures; *j*=3, the rental price of equipment; *j*=4,5,6, the price of electricity, natural gas and residual fuel, respectively.

$b_{j,i} =$ Contribution to value added of factor *j*, industry *i* as a proportion of all factor inputs.

$WADJ_i^u =$ The productivity adjusted wage rate in the nation (*u*).

$a^l_{j,i}$ = The proportion that input *j* is of all the intermediate inputs modified by changes in the industry access effect of material input productivity (see equation 1-3).

$Flmult_i^k =$ An adjustment to reconcile the aggregated date to the primary source data.

$LAMOMG^k_{i,T} =$ An adjustment for aggregation and normalization in the last history year (*T*).

$\sum a^u_{j,i}$ = The proportion of all factor inputs of the total inputs into production.

$$CP^k_{i,t} = CP^k_{i,T} * \frac{CIFP^k_{i,t}}{CIFP^k_{i,T}} * \frac{1}{MCPRODA_{i,t}} \quad (4\text{-}2)$$

$CP_{i,T}^{k}$ = The composite input cost based on composite prices calculated in the database at the smallest geographic size available.

$CIFP_{i,t}^{k}$ = The delivered average price. The local share of the price includes the composite price of production because it is based on the productivity of the inputs due to access to the those inputs.

Delivered Prices

$$CIFP_{i,t}^{k} = \left[\frac{\prod_{j=1}^{m} \left(\Omega_{i,t}^{j} * \left(ED_{i,t}^{j,k} \right)^{\gamma_i} \right)^{\frac{T_{i,t-1}^{j,k}}{D_{i,t-1}^{k}}}}{\prod_{j=1}^{m} \left(\Omega_{i,t-1}^{j} * \left(ED_{i,t-1}^{j,k} \right)^{\gamma_i} \right)^{\frac{T_{i,t-1}^{j,k}}{D_{i,t-1}^{k}}}} \right] * CIFP_{i,t-1}^{k} \qquad (4\text{-}3)$$

where

$CIFP_{i,t}^{k}$ = The weighted average of the delivered prices of good i sold in k in time period t.

Ω_{i}^{j} = The cost of producing output in industry i sold in k.

T_{i}^{jk} = The trade flow for good i from j to k.

ED_{i}^{jk} = The "effective distance" from j to k for good i.

γ_i = A parameter that is estimated based on observed actual transportation costs.

Cost of Equipment

$$PEQP^{l} = \sum_{i=1}^{n} a_{i,EQP}^{u} CP_{i}^{l} \qquad (4\text{-}4)$$

where

$PEQP^{l}$ = The cost of producers' durable equipment in l.

$a_{i,EQP}^{u}$ industry i input to the final demand for producers' durable equipment.

$$rec_{equi} = \left(\frac{CEQP_{x}^{k}}{CEQP^{u}} \right) PEQP^{k} \qquad (4\text{-}5)$$

$CEQP$ = Implicit rental cost of equipment for each dollar of equipment.

rec_{equi} = Relative implicit rental capital cost of equipment at local purchase prices for equipment.

Consumption Deflator

For consumption category j in time t we assume Cobb Douglas substitutability of the sectors that are inputs into this consumption commodity.

$$CIFP_{j,t}^{l} = CIFP_{j,t}^{u} * \prod_{i} CIFP_{i,t}^{PCE_{i,j}} \quad (4\text{-}6)$$

where

$PCE_{i,j} =$ The proportion of commodity *j* obtained from industry *i*.

$CIFP_{j,t}^{l} =$ The delivered (*CIF*) consumer price of consumption commodity *j* in time *t* in area *l*.

$CIFP_{j,t}^{u} =$ The average delivered (*CIF*) consumer price of consumption community *j* in time *t* in the nation or larger monetary areas.

$CIFP_{i,t}^{l} =$ The delivered (*CIF*) price of industry *i* in region *l* in time *t*.

Consumer Price Index Based on Delivered Costs

$$CIFP_{t}^{l} = \left(\prod_{j=1}^{r} \left(CIFP_{j,t}^{l} \Big/ CIFP_{j,t-1}^{l} \right)^{WC_{j,t-1}^{u}} \right) * CIFP_{t-1} \quad (4\text{-}7)$$

where

$CIFP_{t}^{l} =$ The consumer price index in region *l*.

$WC_{j,t}^{u} =$ The proportion of commodity *j* in time *t* in the total union of regions consumption.

$CIFP_{j,t}^{l} =$ The CIF consumer price of consumer commodity *j* in region *l*.

Consumer Price to be Used for Potential In or Out Migrants

$CIFPH_{t}^{l} =$ Equation (4-7) with the housing cost replaced by relative price of purchasing a house.

$CIFP_{jt}^{l} = PH_{t}^{l}$

where

$PH_{t}^{l} =$ Relative housing price at time *t* f in area *l*.

$CIFP_{t}^{l} =$ The cost of living in area *l* when the relative price of buying a new house is used in the consumer price index for housing costs.

Housing Price Equations

The relative level of housing prices is observed. This relative level is determined by many factors. However, for policy analysis and even for forecasting we only need to forecast the change in housing (or land) prices that will occur in response to economic change. An equation that shows a significant relationship to housing price change is as follows:

$$PH_t = \left\{ \left(\varepsilon_1 \left(\frac{RYD_t \div RYD_t^u}{RYD_{t-1} \div RYD_{t-1}^u} - 1 \right) + \varepsilon_2 * \left(\frac{N_t \div N_t^u}{N_{t-1} \div N_{t-1}^u} - 1 \right) \right) + 1 \right\} * PH_{t-1} \quad \text{(4-8)}$$

where

$PH^l =$ Relative housing price in area *l*.

$N^l =$ Population in area *l*.

$N^u =$ Population in the nation or larger monetary union.

$\varepsilon_1 =$ The estimated elasticity of response to change in real disposable income.

$\varepsilon_2 =$ The estimated elasticity of response to change in population.

$RYD =$ Real disposable income.

The Wage Equation

The final form of the wage rate (w) equation for area *l* is

$$W_{i,t}^k = \left[\left(1 + \Delta WD_{i,t}^k\right)\left(1 + k_t^u\right) \right] * W_{i,t-1}^k \quad \text{(4-9)}$$

where

$W_{i,t}^k =$ Wage rate in industry *i* in time *t*.

$\Delta WD_{i,t}^k =$ The predicted change in the wage rate in industry *i* due to changes in demand and supply conditions in the labor market in area *k*.

$k_t^u =$ The change in the national wage rate that cannot be explained by changes in the national (u)average wage rate for all industries that is due to change in demand and supply conditions in the nation and to industry mix changes in the nation.

$$\Delta WD_{i,t}^k = \alpha_1 \left[\left(\frac{E_t^k}{LF_t^k} \div \frac{EA_t^k}{LFA_t^k} \right) - 1 \right] + \alpha_2 \left[\left(\frac{EO_{i,t}^k}{EOA_{i,t}^k} \right) - 1 \right] \quad \text{(4-10)}$$

where

$LF_t^k =$ The labor force.

$LFA_t^k =$ A geometrically declining weighted average of the labor force.

$\alpha_1 =$ Estimated parameter using pooled time series data.

$\alpha_2 =$ Estimated parameter using pooled time series data.

$$EA_t^k = .2E_{t-1}^k + .8EA_{t-1}^k \qquad \frac{EO_{i,t}^k}{EOA_{i,t}^k} = \sum_{j=1}^{q} d_{i,j} \frac{EO_{j,t}^k}{EOA_{j,t}^k}$$

$$LFA_t^k = \lambda LF_t^k + (1-\lambda)LFA_t^k$$

$EO_{i,t}^k / EOA_{i,t}^k$ =The demand relative to past demand for the occupations used by industry *i* (as an option this ratio could be set equal to 1 for all non-skilled occupations in an area where an unlimited number of unskilled workers are competing for jobs at a legislated minimum

$\lambda =$ Estimated parameter 0< $\lambda \leq 1$

$d_{ji} =$ Occupation *j*'s proportion of industry *i*.

After the α_1 and α_2 values are estimated using equation (4-11) over all regions *k* then equation (4-11) can be used to predict $\Delta WD_{i,t}^u$.

$$\Delta WD_{i,t}^u = \alpha_1\left[\left(\frac{E_t^u}{LF_t^u} \div \frac{EA_t^u}{LFA_t^u}\right) - 1\right] + \alpha_2\left[\left(\frac{EO_{i,t}^u}{EOA_{i,t}^u}\right) - 1\right] \tag{4-11}$$

Then it is possible to predict the demand and supply effect on national (*u*) wages and thus determine the national wage change by industry.

Since

$$W_{i,t}^u = \left(1 + \Delta WD_{i,t}^u\right) * W_{i,t-1}^u \tag{4-12}$$

The average wage in year in the (*u*) area, taking into account the change in the mix of industries as well as demand and supply labor market conditions, can be calculated as follows:

$$WDM_t^u = \sum_{j=1}^{n} \frac{E_{i,t}^u}{E_t^u}\left(1 + \Delta WD_{i,t}^u\right) * W_{i,t-1}^u \tag{4-13}$$

where $WDM_t^u =$ the average wage in the year *t* based on year *t* wage mix changes, demand change for occupations and demand vs. supply in the labor market.

$E_{i,t}^u =$ Employment in industry *i* in period *t* in the nation (*u*) area.

$$E_{i,t}^u = \sum_{i=1}^{n} E_{i,t}^u$$

Then k_t^u is determined as:

$$k_t^u = \frac{\left(\left(WSD_t^u / E_t^u\right) - WDM_t^u\right)}{\left(\Sigma E_{i,t}^u * W_{i,t-1}^u\right) / E_t^u} \tag{4-14}$$

where

$WSD_t^u =$ Wage and salary disbursements in the nation (*u*) area in time period *t*.

and k_t^u will represent all national (*u*) wage changes not represented by change in industry mix and labor market demand and supply conditions relative to the hypothetical average wage in *t*-1 using the *u* wage rate for each industry in year t-1 and the current year's industry mix. This value is then used in equation (4-9) to align the weighted average of the wage changes over all of the component regions with that in the *u* area. Thus, the local areas will then reflect determinates of wage changes, such as changes in labor market legislation, increase union militancy, cost of living adjustments, etc., at the *u* level that are not due to labor force supply and demand changes or industry shifts.

Block 5 - Market Shares

$$s_{i,t}^{k,l} = \frac{DQ_{i,T}^{k}\left(\frac{\Omega A_{i,t}^{k}}{\Omega A_{i,T}^{k}}\right)^{1-\sigma_i}\left(IMIX_{i,t}^{k}\right)^{\lambda_i}\left(ED_{i}^{k,l}\right)^{-\beta_i}}{\sum_{j=1}^{m} DQ_{i,T}^{j}\left(\frac{\Omega A_{i,t}^{j}}{\Omega A_{i,T}^{j}}\right)^{1-\sigma_i}\left(IMIX_{i,t}^{j}\right)^{\lambda_i}\left(ED_{i}^{j,l}\right)^{-\beta_i}} \tag{5-1}$$

$s_{i,t}^{k,l}$ = The share of the domestic demand in area *l* supplied by area *k*, for industry *i* in time period *t.*

$DQ_{i,T}^{k} =$ Domestic output in the last history year.

$T =$ As a subscript indicates the last history year.

$\Omega A_{i,T}^{k} =$ The cost of production in *k* in the last history year.

$\Omega A_{i,t}^{k} =$ The moving average of the cost of production in *k*.

$ED =$ An effective distance equivalent to calibrate the model to detailed balanced trade flows at a low geographic level.

$\beta_i =$ The distance decay parameter in a gravity model.

$\sigma_i =$ The estimated price elasticity.

$\alpha_i =$ The elasticity of response to the mix between high and low growth representation in the local area compared to the nation.

$\lambda_i =$ A parameter between o< λ_i <1, as estimated econometrically, that shows the effect of detailed (3 digit SIC) mix on the change in *k*'s share of the market due to differential growth rates predicted in *u* for the detailed industry and the difference in *k*'s participation in these industries relative to *u* (see *IMIX* below).

for $l = 1,...m$ and n is the number of sub-national regions in the model. The value for σ_i is calculated by isolating movements along the demand curve from movements along the curve. The movement along the curve yields an elasticity of substitution (σ_i) estimate. These estimates are obtained from a pooled non-linear search over all regions. The β_i value is found using a dynamic search for the distance decay parameter in a gravity model for each industry.

$$IMIX^{k}_{I,t} = \left\{ \frac{\left(\prod_{i \in I} \left(Q^{u}_{i,t} \big/ Q^{u}_{i,t-1} \right)^{WI^{k}_{i,t-1}} \right)}{\left(\prod_{i \in I} \left(Q^{u}_{i,t} \big/ Q^{u}_{i,t-1} \right)^{WI^{u}_{i,t-1}} \right)} \right\} IMIX_{I,t-1} \tag{5-2}$$

$$wi^{k}_{i,t-1} = \left(\frac{Q^{k}_{i,t-1}}{\sum_{i \in I} Q^{k}_{i,t-1}} \right) \qquad wi^{u}_{i,t-1} = \left(\frac{Q^{u}_{i,t-1}}{\Sigma Q^{u}_{i,t-1}} \right)$$

$$IMIX_{I,T} = 1$$

$IMIX =$ A variable using local shares at a detailed level in the numerator applied to u growth rates and shares in the denominator applied to the same rates. Equals 1 if no detailed industry or forecasts are available.

$$sx^{k,row}_{i,t} = \frac{X^{k,row}_{i,T}}{X^{u,row}_{i,T}} * \left(\frac{\Omega A^{k}_{i,t}}{\Omega A^{k}_{i,T}} \right)^{1-\sigma_i} \tag{5-3}$$

where

$sx^{k,row}$ = Area k's share of national exports to the rest of the world (*row*).

$X^{k,row}_{i,T}$ = Area k's exports to the rest of the world in the last history year (T).

$X^{u,row}_{i,T}$ = The united areas' (u) exports to the rest of the world in the last history year (T).

$\Omega A^{k}_{i,t}$ = A moving average (with geometrically declining weights) of the relative cost of production in time period t (T if the last history year).

$Q_i =$ Output of industry i.

$$sd^{k}_{i,t} = 1 - \left(\frac{M^{k,row}_{i,T}}{M^{u,row}_{i,T}} * \left(\frac{\Omega A^{k}_{i,T}}{\Omega A^{k}_{i,t}} \right)^{1-\sigma_i} \right) \tag{5-4}$$

where

$sd^{l}_{i,t} =$ The share of area l's demand for good i that is supplied from within the nation (u).

$D^{u}_{i,t} =$ Demand for i in the nation (u).

$M^{k,row}_{i,T} =$ area k's imports from the rest of the world in the last history year (T).

$M^{u,row}_{i,T} =$ imports of i into the nation (u) in the last history year (T).

For further information about the incorporation of the new geography as shown in this section and section 4 above, please see Fan, Treyz, and Treyz, 2000.

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Chapter V: Data Sources and Calibration

Spain

Population

Population data was available for single-age cohorts for ages 0 to 100 for all of the model regions in the INEbase database on the website for Spain's National Institute of Statistics (Instituto Nacional de Estadistica; INE; www.ine.es). For our purposes, we needed the population for each of the model regions for the years 1996 and 1997. Unfortunately, the 1997 data was not available because Spain made major changes to their population registry, coordinating all of the towns together to avoid errors in counting, which resulted in a single year without any data. We used the Jan 1, 1998 population as the Dec 31, 1997 population, but we had no data for the end of 1996. We estimated the 1996 population by adding the deaths and migrants to the 1997 population for each age cohort to calculate approximately what the population should have been in 1996. The national population forecast in the model is driven by INE's national population forecast.

Births and Deaths

The number of deaths by age and number of births by age of mother were available for each of the regions in the TEMPUS databank on the INE website. These numbers were used with the population data to calculate survival rates and natality rates for each of the model regions. In the absence of any other data, we assumed the survival and natality rates to stay constant over time.

Migration

The 'Population' section of *Spain in Figures 1999* (available from INE) contained information about the net number of interregional and international migrations for each of the model regions in 1997. We used these numbers and assumed that each of the regions would continue to receive the same percentage of the nation's net international migrants throughout the forecast. No information was readily available for age distributions of migrants in each of the model regions; however, we did find some information in *Inmigración Extranjera en Andalucía 1991-2001,* a publication from the website of the Instituo de Estadistica de Andalucia (http://www.juntadeandalucia.es/institutodeestadistica/InmigExt/). This publication had numbers of net international and interregional migrants in 5-year age groups for Andalucia. We spread this data out to single year age groups and used this same distribution of migrants for all of the regions in Spain. The net number of international migrants per year used in the forecast came from one of INE's migration projections.

Labor Force

To estimate the labor force for the model regions, we calculated participation rates using labor-force and population numbers from EUROSTAT (http://europa.eu.int/comm/eurostat/). We then spread out these participation rates from 13 to 101 age cohorts, and applied them to the population from INE, which we used as our official population. This gave us a labor force for each region and each single year of age.

Similarly, we used EUROSTAT's population and labor-force forecast to generate our own national participation rate and labor-force forecast for the model.

Economic Data

A national input-output table was created using supply and use tables available from INE. Household income and spending data for each region came from INE, as well as employment and wage data by industry. Output and Productivity growth were calculated using a time series of output and employment data from the INE website. Capital Stock data came from a publication from Banco de Espana (www.bde.es). For the capital stock depreciation rate, we used Italy's values. Travel times from region to region were obtained from the 'European Peripherality Index' produced by IRPUD[14]. The Italian PCE matrix and Germany's industry by occupation matrix were used in the absence of better data. The relative housing prices were all set to 1, pending further information.

Southern Italy

Population

Historical population data for Southern Italy was provided to us by IRPET[15]. This data came in single-age groups for population ages 0 to 90, but not for ages 91-100. We had to spread the data to the remaining age groups using 100-age cohort population data from Instituto Nazionale di Statistica (ISTAT) (www.istat.it). IRPET also provided us with a national population forecast that also needed to be spread from 90 to 100 age groups.

Births and Natality Rates

Data on births by age of mother was extracted from our EUROSTAT database for the year 1996, and was used to calculate natality rates for Southern Italy. Natality rates were assumed to remain constant throughout the forecast. These natality rates were used to estimate the total number of births for the history year, 1998.

Deaths and Survival Rates

Detailed survival-rate data for the model was obtained from the ISTAT website. The rates were assumed to remain constant throughout the forecast. The total number of deaths for Southern Italy was not available, so that number was estimated by applying the survival rates to the population data.

Migration

We calculated the net migration number for the region as the residual of the difference between the beginning- and end-year populations, after taking into account the estimated numbers of births and deaths. IRPET provided us with international and interregional migration data in 5-year age groups for the year

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[15] The results and analysis of Southern Italy represent the joint work of REMI and IRPET. The staff members who are actively involved in the analysis of IRPET are Sara Mele, Roberto Pagni, and Renato Paniccia. The key staff members at REMI who contributed to this project include Sherri Lawrence, Nicholas Mata, Jerry Hayes, Jason Laprade, Kyra Comroe, Pallavi Konwar, Alicia Rodriguez, Jeff Waller, Sudro Brown II, and Johannah Shinner.

1997. We used these values to form single-year age distributions for international and interregional migrants and used these distributions for 1998. We also assumed that the percentage of the nation's net international migrants going to Southern Italy in 1997 remained constant for 1998 and all of the forecast years. In the absence of any other projections, we assumed that the total net number of international migrants into the nation remained constant over the forecast.

Labor Force

Southern Italy labor-force data was found on the ISTAT website with labor force broken down by sex and 5 large age groups which we spread to single-age groups. We used EUROSTAT's population and labor-force projections to form a participation-rate projection and applied it to the population projection provided to us by IRPET to form a labor-force projection.

Economic Data

IRPET provided us with a national input-output table, as well as input-output tables including detailed final demand and value added data and interregional trade flow data for each of the regions of Italy. IRPET also provided detailed industry employment and wage data, personal income, consumption by commodity, and capital-stock data for all of the Italian regions. They also provided depreciation rates for capital stock and an occupation by industry matrix. Output and productivity growth rates for individual industries were calculated using data from EUROSTAT and then calibrated to fit the overall projected growth rates provided by IRPET. Travel times from region to region were obtained from the 'European Peripherality Index' produced by IRPUD. The relative housing price was set to 1 pending further information. While REMI has reduced the number of coefficients that need to be estimated to a bare minimum, the model must still be calibrated to a designated last history year. This calibration involves using all of the information discussed in previous sections, but for one year only. It also involves generating a national forecast for the country or monetary union in which the region is located.

To develop the national forecast, we began with a forecast of domestic output using GDP growth rates by industry. We calculated initial growth rates by industry based on a time series of available data and then adjusted to hit a target national growth rate. In the case of Spain, the national growth rate is a historical average growth rate obtained from the OECD website. For Southern Italy, the national growth rate was obtained from IRPET. Employment is estimated using this projected output and rates of productivity growth by industry. We initially calculated the rates of productivity growth by industry from available data and then adjusted to hit a national target. For Spain, the national target comes from the OECD website. For Italy it comes from IRPET. Additionally, we developed a forecast of the national labor force by applying participation rates supplied by the client to cohorts. The combination of our projected productivity growth by industry and the size of our labor force sets a limit of output to maintain a fixed employment/labor-force ratio for the baseline national forecast.

In the Spain model, we have composed a database for the entire country for 30 industries and 18 NUTS II regions. We calculated the trade flows at this level, and then aggregated up to the four regions in the model.

In the Southern Italy model, we have composed a database for the entire country for 30 industries and 20 NUTS II regions. We calculated the trade flows at this level, and then aggregated up to the region in the model.

REMI Policy Insight® is calibrated using two region-specific factors: economic data and parameters of the behavioral equations. For regions with limited economic data, the necessary data is estimated based on the best available alternative. Known parameters for the closest region are used if parameters for a specific region are not available and cannot be calculated.

Parameter Estimation and Model Calibration

Regional Calibration

Regional calibration consists of adjusting various data for a specific region. If the value was 1, there was no adjustment from the national to the regional. Other values are determined using region-specific income and population data.

- **Unexplained fixed effect for commodities 1-12 (CONCOL)**
  No adjustment.
- **Adjustment for local differences in personal income taxes (XTAX)**
  Adjusted using region-specific data.
- **Adjustment for local differences in other labor/property income relative to employment for major sectors 1-10 (XYOL)**
  Adjusted using region-specific data.
- **Adjustment for local differences in personal contributions to social insurance (XTP)**
  Adjusted using region-specific data.
- **Adjustment for local differences in property income, taking age composition into account (XYPR)**
  Adjusted using region-specific data.
- **Adjusts for local differences in transfers, taking age composition and unemployment level into account (XV)**
  Adjusted using region-specific data.
- **Fixed share of federal military spending (XD10)**
  Not applicable.
- **Fixed share of federal civilian spending (XD11)**
  Not applicable.
- **Adjustment for local differences in per capita state and local government spending (XD12)**
  Not applicable.

National Calibration

- **Unexplained fixed effect for commodities 1-12 (CONCOLU)**
  Not applicable.

- **Speed of migration (REGCONST)**
  The economic migration speed of response is a key parameter to estimate using European data. In order to estimate this response, we need time series on the real wage rates, preferably using a deflator that includes housing prices, the relative employment to labor force ratio, and the number of net internal migrants each year from region to region. These series, with the possible exception of the price index using housing prices, are needed to test for an expected difference in speeds of adjustment for the U.S. and E.U. In the absence of time series data, we could establish whether the speed of adjustment response should be modified from that in the U.S. or other European countries by observing the migration flow data that is available. The Spain and Southern Italy models use a parameter based on a regression using Germany data.
- **Speed of adjustment for residential capital stock (ALPHARES)**
  U.S. based value.
- **Speed of adjustment for non-residential capital stock (ALPHANRS)**
  U.S. based value.
- **Value of Beta for low-income commodities (BETALowInc)**
  Germany based value.
- **Price elasticity of substitution in the consumption equation (CPICoef)**
  Germany based value.
- **Value of coefficient on medical portion of consumption (MDCoef)**
  Not applicable.
- **Alpha 1 for wage rate equation (ALPHA1WR)**
  Calculated based on Germany data for wage rates, labor force, and employment opportunity. The wage equation depends on the relative moving average of employment divided by the moving average of the labor force and the industry-weighted current occupational demand over its moving average. Calculating this equation requires the industry and employment data in addition to an industry / occupation staffing ratio matrix at the national level.
- **Alpha 2 for wage rate equation (ALPHA2WR)**
  Not applicable.
- **Housing price elasticity for disposable income (HPYDCoef)**
  The housing (or land price) equation is estimated using U.K. housing price data.
- **Housing price elasticity for population (HPPOCoef)**
  Not applicable.
- **Property income coefficient (YPRCoef)**
  Based on specific country national value.
- **Transfer payment coefficient (VCoef1)**
  Based on specific country national value.

- **Transfer payment coefficient (Vcoef2)**
  Based on specific country national value.
- **Default demand price elasticity for industries 1-30 (SIGMA)**
  The price elasticity for industries uses U.S. data (30 years for 3,000 counties by industry), as it is the only adequate data set available so far. In the U.S., we pool similar industries into categories so that the estimated elasticity is identical for all of the industries in the broader category. We also examine the elasticities for reasonableness. For some of the industries, we change the filter criterion to filter out territories that do not have a substantial representation of the industry in question or have erratic time series, possibly due to data reporting and classification errors. Using these methods, we obtain statistically significant estimates for all industries that meet our own test for professional reasonableness.

  $\sigma_i =$ The price elasticity for industry *i* is estimated using the same time series data for the β_i estimates described below. In this case, we use an algorithm to search over values of σ_i to find out what value of σ_i would improve the fit between output changes and demand changes based on the changes in shares that it would predict in the markets subsequent to the relative change in production costs (approximated by wage rate changes) in all of the areas. In other words, the elasticity of demand σ_i (the percentage change in the quantity demanded given the percentage change in relative delivered price) is determined econometrically.
- **Alternative demand price elasticity for industries 1-30 (ALTSIGMA)**
  See above (overall, a higher set of elasticities for sensitivity testing).
- **Transportation costs elasticity for industries 1-30 (GAMMA)**
  Transportation costs elasticities are derived from the U.S. satellite transportation accounts.
- **Cost elasticity for Occupations 1-14 (fSIGL)**
  Estimates of the cost elasticity for the different occupations are based on the amount and cost of cross commuting of people in 1300 Traffic Analysis Zones (TAZ's) around Chicago, Illinois. The data included the occupation and industry as well as the place of residence and the place of work of all those in the sample. We also had travel time and commuting cost estimates from every TAZ to every other TAZ. The estimates are quite robust and, since they represent industry hiring decisions, would be expected to be similar in any economy where there was a benefit in matching workers to their jobs for the benefit of both the firms and the workers[16].
- **Distance decay parameter for industries 1-30 (EDSTBETA)**
  The distance decay parameter is estimated using 30 years of U.S. time series data for each of the 3,000 counties in the U.S. Since no other data is available, these values are used in the Spain and Southern Italy models.

[16] See Weisbrod, et al, 2001

β_i = The distance (measured as travel time) decay parameter in a gravity model for industry *i*. The β_i coefficient determines how the home territory's share of the demand in the market of each other territory declines as the travel time to each of the other territories increases.

In order to estimate the β_i dynamically, we need to have time series estimates for each of the following:

- An approximation of the change in total output by industry for domestically produced goods and services in each territory for each year for each industry.
- An approximation of the change in total demand for domestically produced goods and services in each territory for every industry and year. This is broken down into:
  - Consumer demand
  - Investment demand (gross capital change)
  - Government demand
  - Intermediate demand

We can approximate the change in each of these concepts if we have changes in employment by industry, a national input-output table, and a travel-time matrix from each territory to each other territory. We have obtained such a matrix commissioned by the E.U. for all NUTS II and NUTS III regions in the E.U. areas from Professor Wegener[17]. This is accomplished as follows:

- An approximation of the change in output for domestic use in each territory for each year for each industry – use national outputs by industry from the national input-output table and national employment data (or use time series national output by industry and employment by industry if available), then apply the appropriate ratio to the local employment series.
- A change in total demand by industry for each territory for each year is determined by:

- Consumption demand change – based on changes in the wage bill (or disposable income if available). Converted to industry demand using consumption vector in the national input-output table.
- Investment demand change – based on wage bill in construction (or changes in the rate of change in the Gross Capital Stock) converted to industry using the change in gross capital stock in the input-output table.
- Government demand – changes in the total wages (or changes in population) convert demands from government from the private economy to industry demand using the appropriate national input-output table.
- Change in intermediate demand for outputs of each industry based on output estimates in (1) above and the national input-output table.

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After this data is assembled, then the β_i (travel time decay parameters) can be found using a search algorithm across the β_i values to find the β_i values. This minimizes the rate of error for predicting the change in output in each territory, based on the changes in demand in each of the other territories for that industry's goods or services. For example, output for grocery stores should be closely related (i.e. a high share) to the changes in demand in the home area and contiguous areas and not related very closely (i.e. a low share) to the change in demand in distant areas. However, the output in the home territory of automobiles should be much more related to demand changes in all territories than to change in the home area demand (i.e. very low decay) due to travel time. This will yield a relatively equal share in all markets.

Chapter VI: Modeling Work and Testing

Southern Italy

The initial REMI Policy Insight model of Southern Italy was shipped to the European Commission on April 10, 2003. This model was updated and reshipped on May 2, 2003, and then updated again and sent on August 1, 2003. REMI produced national and regional forecast models of Italy with extensive cooperation from the Instituto Regionale Per La Programmazione Economica Toscana (IRPET). The models have undergone extensive fine tuning based on feedback from their staff.

The overall national economy is predicted to grow at an annual average rate of 1.95%, while labor productivity is expected to growth 2.13%. In contrast, Southern Italy is projected to grow at a slightly slower overall annual average rate of 1.77%, with labor productivity expected to grow at a slightly faster rate of 2.3%. The industry breakdown is shown in Table VI.1:

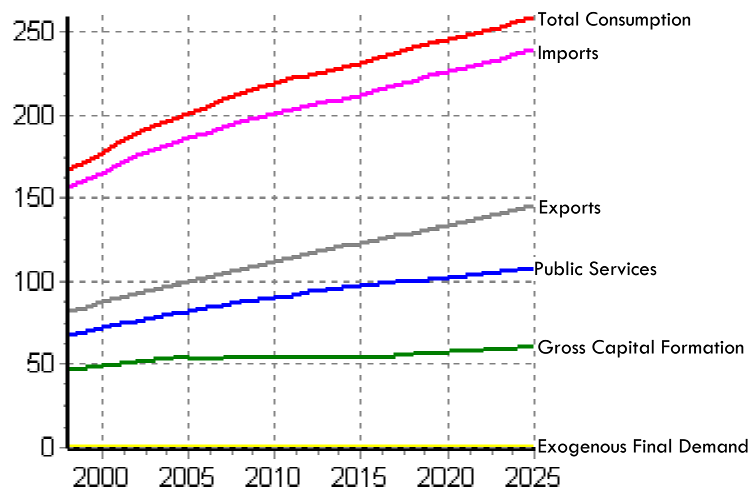
Table VI.1. Average Annual Growth Rates of Output and Labor Productivity for Italy and Southern Italy between 1998 and 2025.

	Output Growth Rates		Labor Productivity Growth Rates	
Industry	**Italy**	**Southern Italy**	**Italy**	**Southern Italy**
Agriculture, Hunting and Forestry	0.60%	0.58%	3.88%	3.81%
Fishing	-0.42%	0.20%	4.41%	4.34%
Mining Quarrying of Energy Prod Mat'ls	8.15%	9.67%	0.87%	0.92%
Mining Quarrying Excl. Energy Prod Mat'ls	5.43%	4.65%	1.21%	1.24%
Food products, Beverages & Tobacco	0.46%	0.38%	5.97%	5.88%
Textiles & Textile Products	1.48%	1.35%	1.34%	1.33%
Leather & Leather Products	0.46%	0.81%	0.57%	0.57%
Wood & Wood Products	5.84%	4.64%	2.97%	2.99%
Pulp, Paper, Publishing & Printing	2.62%	2.22%	1.09%	1.10%
Coke, Petroleum & Nuclear Fuel	4.76%	4.71%	0.43%	0.44%
Chemicals & Man-made fibres	3.18%	2.70%	4.33%	4.30%
Rubber & Plastic Products	1.76%	1.66%	1.90%	1.89%
Other Non-metallic Mineral Products	3.99%	2.46%	4.93%	4.88%
Basic Metals & Fabricated Metal Products	2.03%	1.92%	2.53%	2.51%
Machinery and Equipment n.e.c.	-0.02%	1.17%	1.51%	1.49%
Electrical and Optical equipment	0.94%	1.17%	1.84%	1.82%
Transport equipment	0.61%	1.03%	2.25%	2.22%
Manufacturing n.e.c.	4.94%	3.12%	5.44%	5.39%
Electricity, Gas & Water Supply	3.10%	2.52%	3.75%	3.72%
Construction	0.83%	0.86%	-0.23%	-0.22%
Wholesale & Retail; Repr of MV, Motorcycles	1.26%	1.38%	1.32%	1.31%
Hotels & Restaurants	2.34%	2.06%	3.52%	3.48%
Transport, Storage & Communication	2.03%	1.88%	1.11%	1.11%
Financial Intermediation	0.77%	0.97%	0.65%	0.65%
Business Activities, R&D & IT	2.14%	1.94%	1.94%	1.93%

	Output Growth Rates		Labor Productivity Growth Rates	
Industry	**Italy**	**Southern Italy**	**Italy**	**Southern Italy**
General government	1.87%	1.77%	4.30%	4.24%
Education	1.77%	1.74%	4.14%	4.09%
Health & Social Work	1.86%	1.77%	3.05%	3.02%
Community, Social & Personal Services	3.39%	2.60%	0.99%	1.01%
Real Estate & Renting	2.14%	2.06%	5.61%	5.60%

For Southern Italy, Gross Regional Product (GRP) is expected to grow from 208.470 in 1998 to 334.130 (1,000M 98Euro) by 2025. The breakdown of GRP by major final demand component is shown in Figure VI.1:

Figure VI.1. REMI Standard Regional Control - GRP by Final Demand Component (1,000M 98Euro)



The forecasts of Employment, Output, Demand, Imports, Exports to Rest of Italy, and Exports to Rest of World by major industry sector for Southern Italy are shown in Figures VI.2 through VI.7.

Figure VI.2. REMI Standard Regional Control – Employment (Thousands)

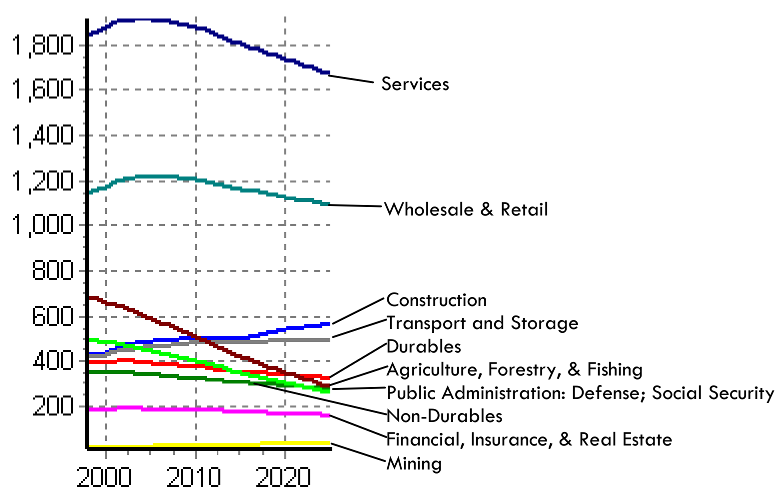


Figure VI.3. REMI Standard Regional Control – Output (1,000M 98Euro)

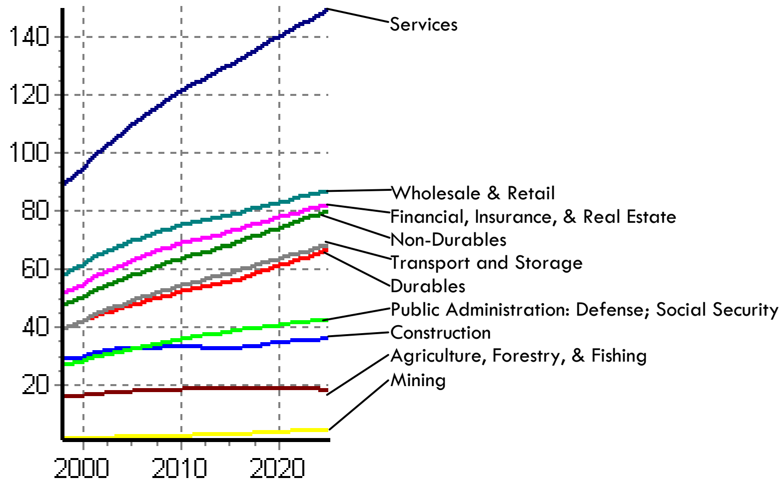


Figure VI.4. REMI Standard Regional Control – Demand (1,000M 98Euro)

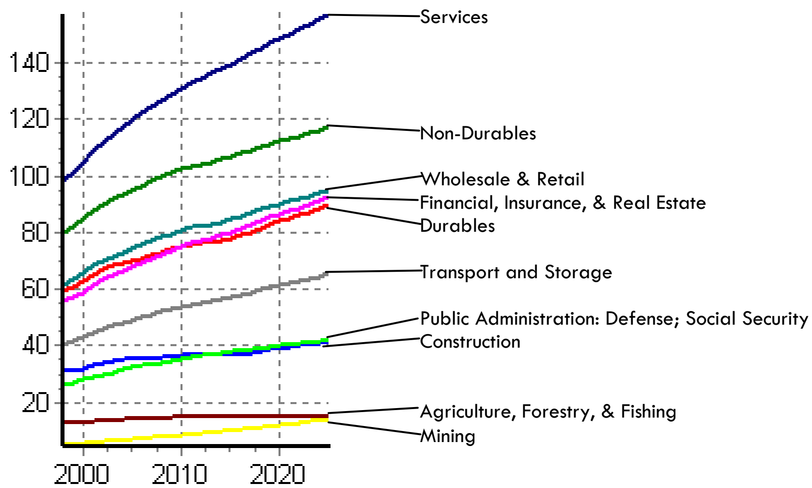


Figure VI.5. REMI Standard Regional Control – Imports (1,000M 98Euro)

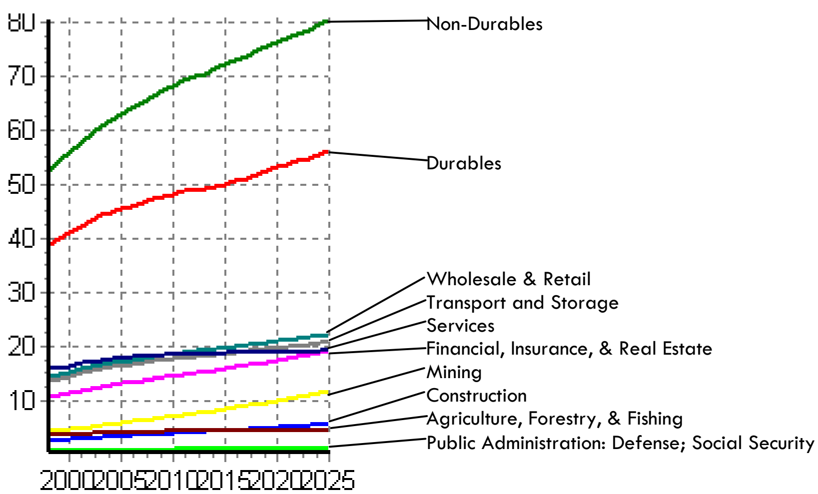


Figure VI.6. REMI Standard Regional Control – Exports to Rest of Italy (1,000M 98Euro)

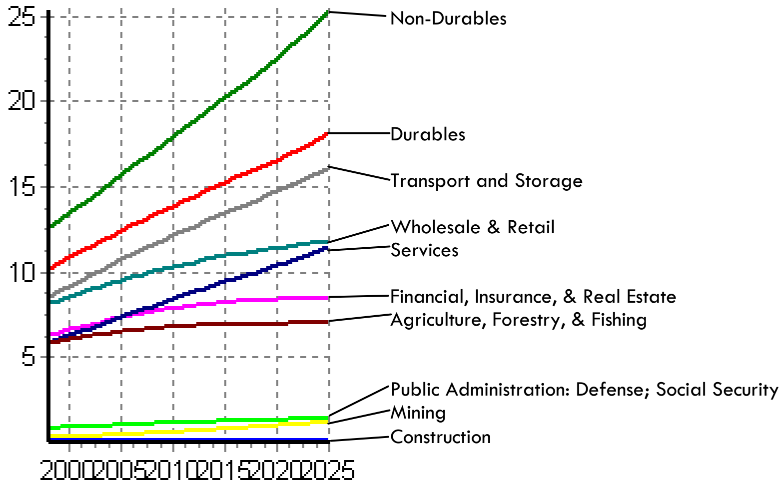
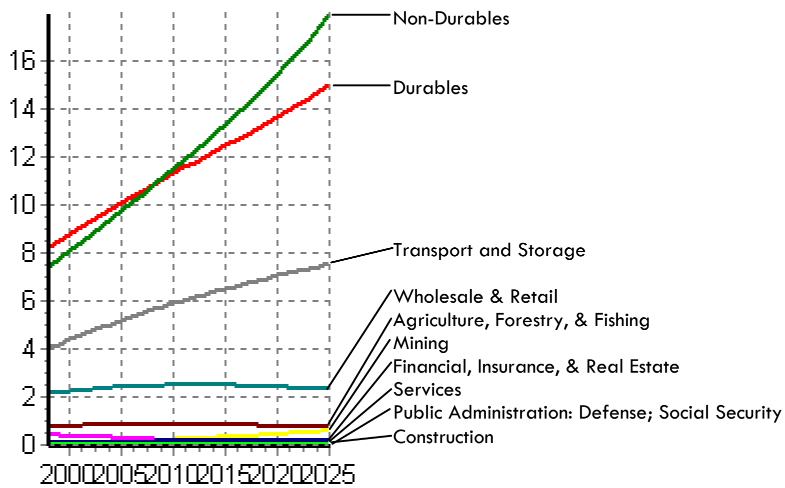


Figure VI.7. REMI Standard Regional Control – Exports to Rest of World (1,000M 98Euro)



The Relative Cost of Production, Relative Composite Labor Cost, Relative Labor Access, Relative Capital Cost, and Relative Composite Input Cost for major industries in Southern Italy are shown in Figures VI.8 through VI.12.

Figure VI.8. REMI Standard Regional Control – Relative Cost of Production

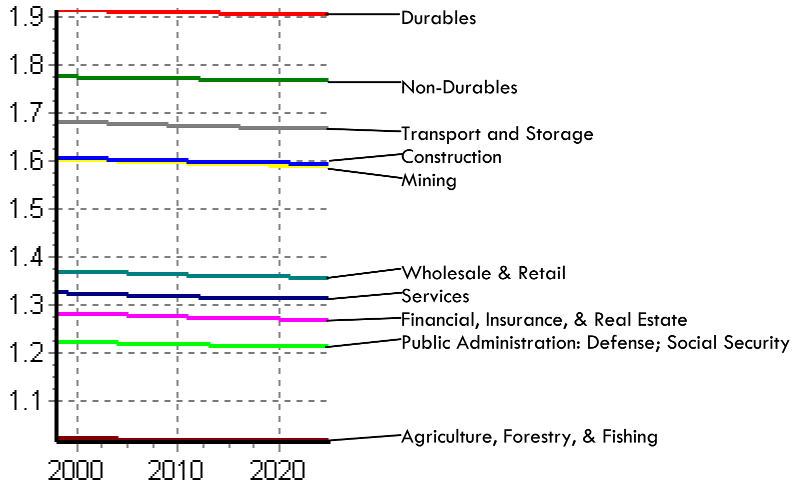


Figure VI.9. REMI Standard Regional Control – Relative Composite Labor Cost

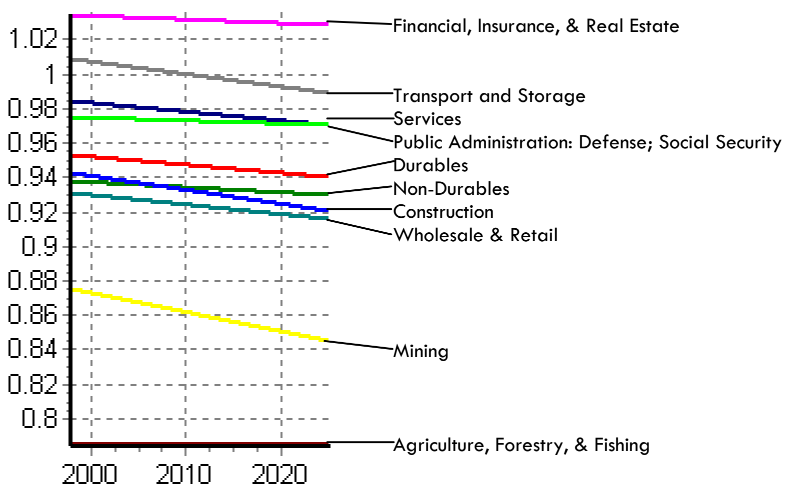


Figure VI.10. REMI Standard Regional Control – Relative Labor Access

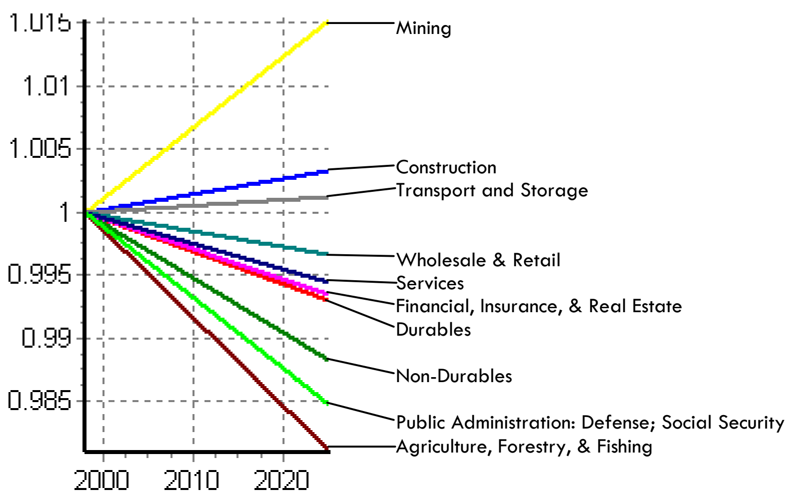


Figure VI.11. REMI Standard Regional Control – Relative Capital Costs

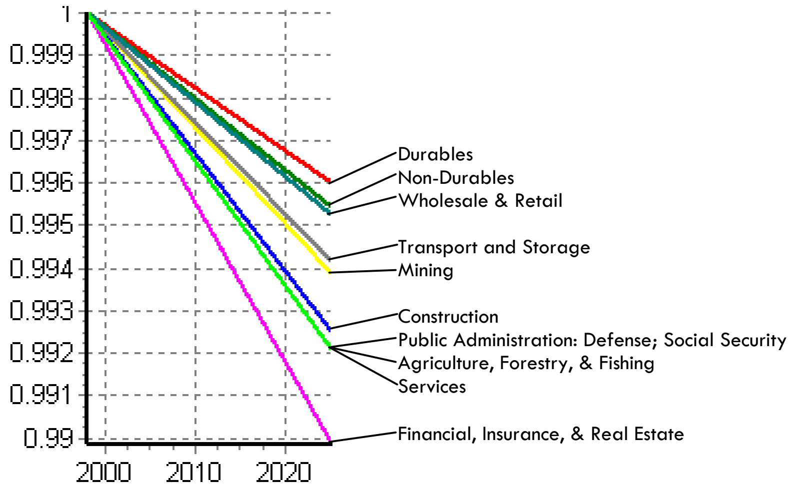
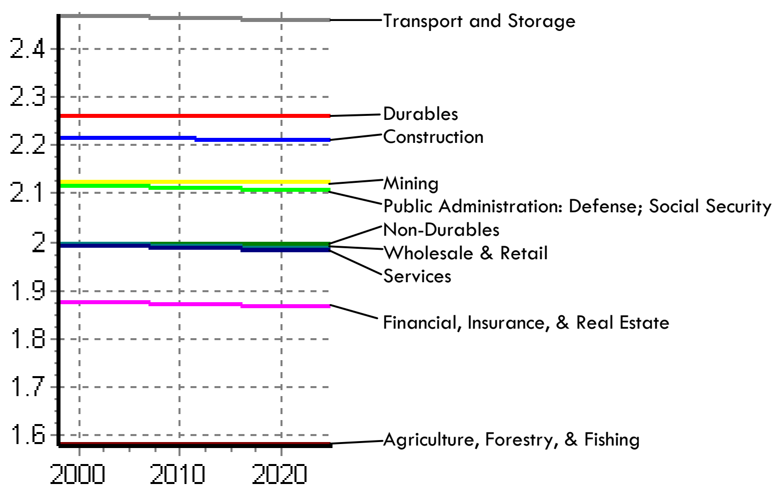
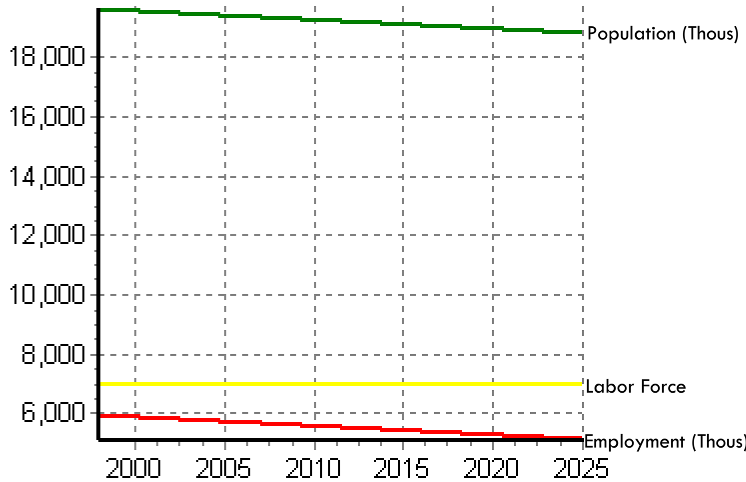


Figure VI.12. REMI Standard Regional Control – Relative Composite Input Costs



The overall Employment (number of jobs) in Southern Italy is expected to decline, as is the Population. The Labor Force is expected to slightly increase. Figure VI.13 shows the trends of these three key variables through 2025.

Figure VI.13. REMI Standard Regional Control – Employment, Population, Labor Force (Thousands)



The age/gender distribution of Southern Italy's population is shown in Figures VI.14 and VI.15.

Figure VI.14. REMI Standard Regional Control – Male Population by Major Age Category (Thousands)

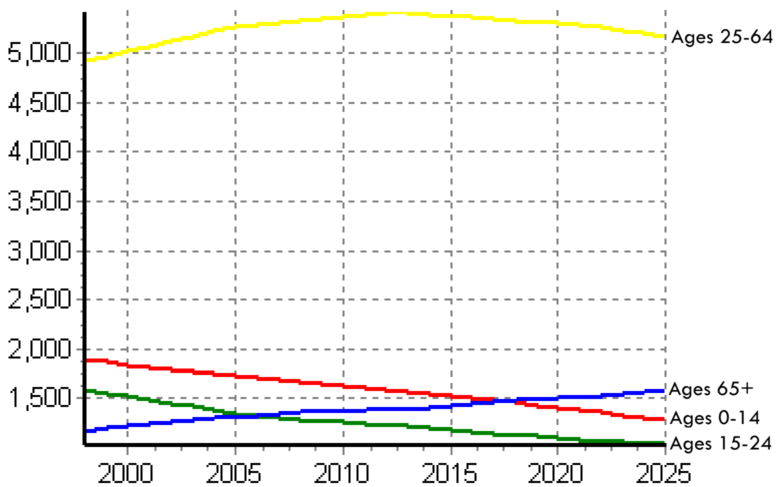
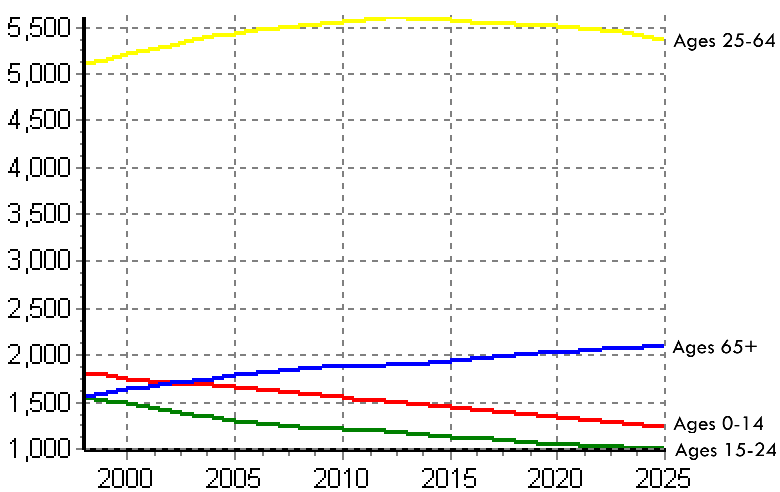
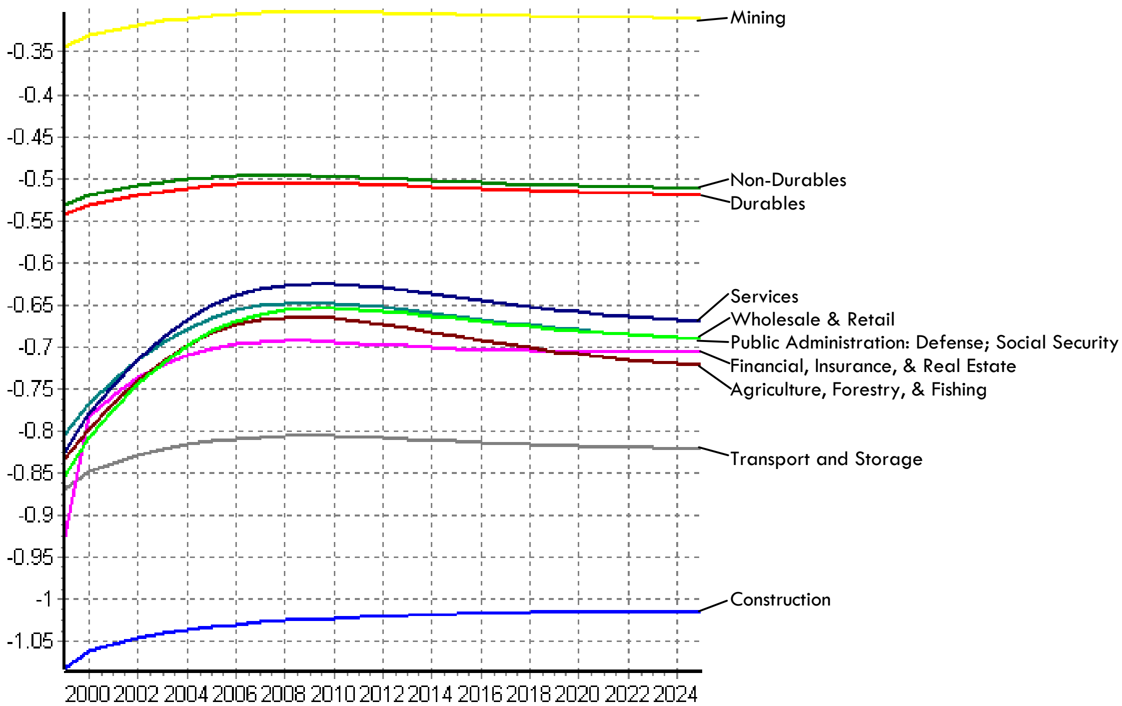


Figure VI.15. REMI Standard Regional Control – Female Population by Major Age Category (Thousands)



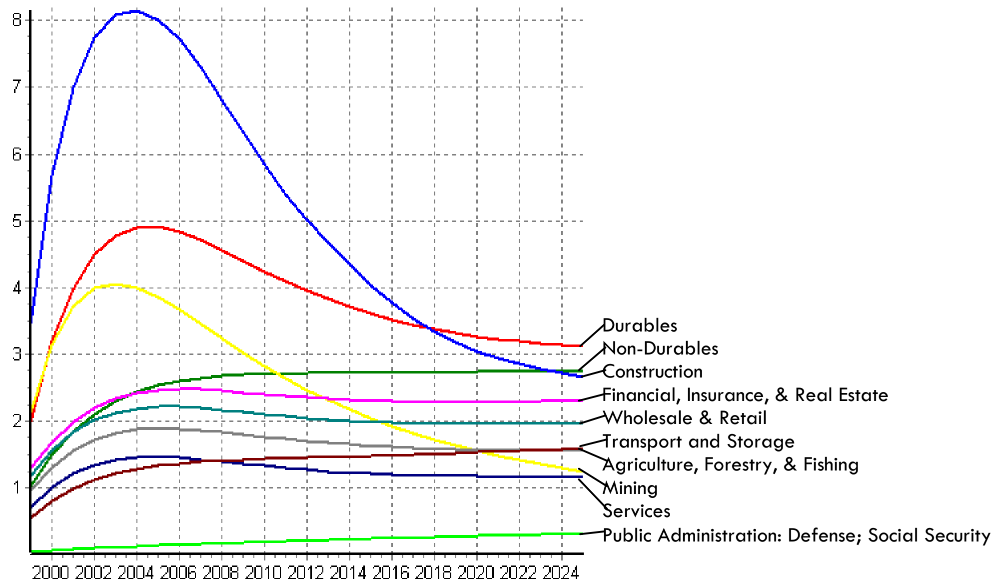
As a sample simulation, we ran a 0.5% decrease in the relative cost of production for all industries in Southern Italy through the model. The following sequence of graphs illustrates the results yielded by that simulation in terms of percentage differences from the baseline/REMI Standard Regional Control. The initial impact of the diminished production costs is a reduction in the delivered prices of goods and services relative to the baseline, as cost savings are passed on to consumers of intermediate and end-use commodities. These price changes vary by industry, as demonstrated in Figure VI.16.

Figure VI.16. 0.5% Decrease in Cost of Production – Relative Delivered Prices



Because of these price reductions goods produced in Southern Italy are more competitive relative to goods produced elsewhere, which stimulates increased output across the board. The construction and durables sectors show the greatest growth, as the general economic expansion spurs considerable spending on new buildings and equipment. Figure VI.17 shows how the sudden decrease in production costs causes an initial growth spurt compared to the baseline. While this growth gradually tapers off, the economy continues to produce at an overall higher level in the long run.

Figure VI.17. 0.5% Decrease in Cost of Production – Output (1,000M 98Euro)



The increased competitiveness of Southern Italy's output manifests itself on two fronts, as evident in Figure VI.18 and Figure VI.19. First, by cheapening locally produced goods relative to their imported counterparts, the production cost decline leads to increased regional purchase coefficients (which measure a region's self-sufficiency, or more specifically, the extent to which local demand is satisfied by local products). Second, local producers manage to increase their market share in other regions since their exports become relatively more attractive from a price standpoint.

Figure VI.18. 0.5% Decrease in Cost of Production – Regional Purchase Coefficients (Self-Supply Over Demand)

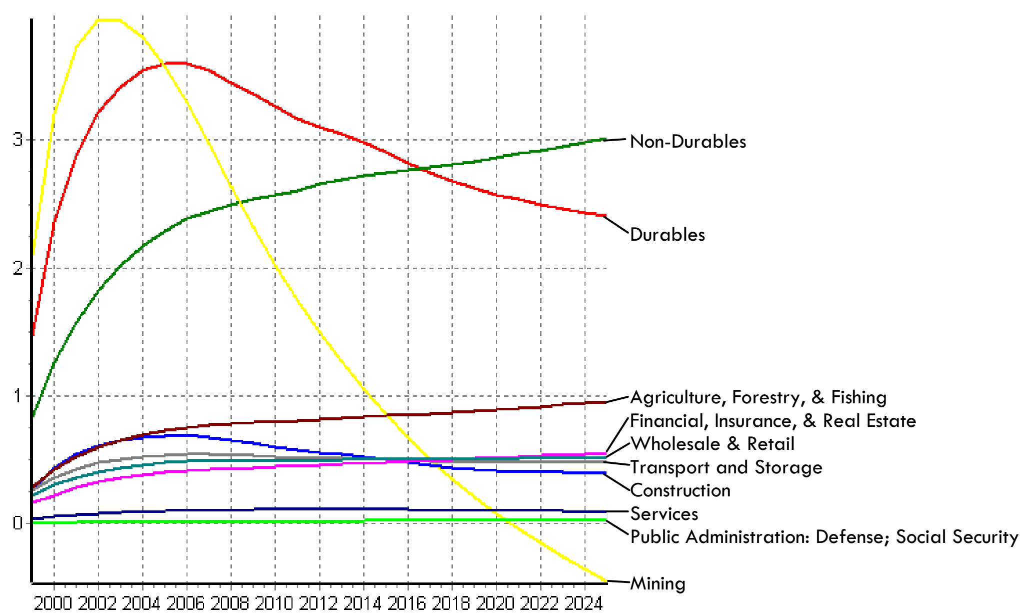
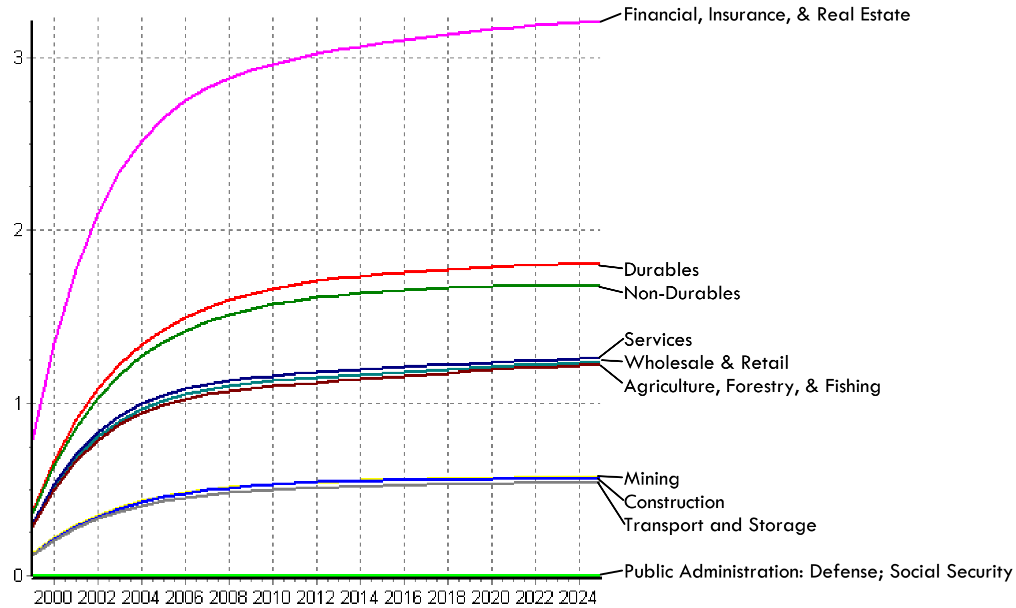
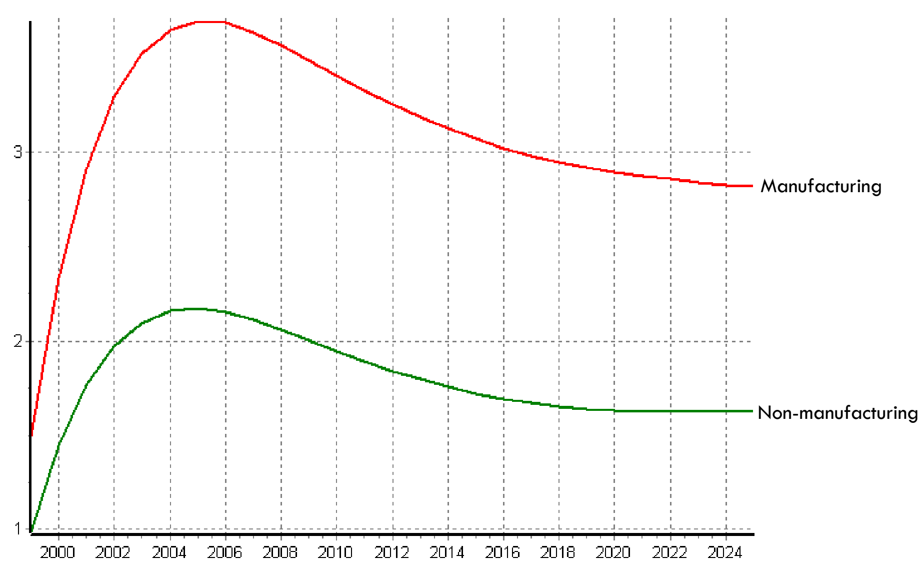


Figure VI.19. 0.5% Decrease in Cost of Production – Exports to Rest of World (1,000M 98Euro)



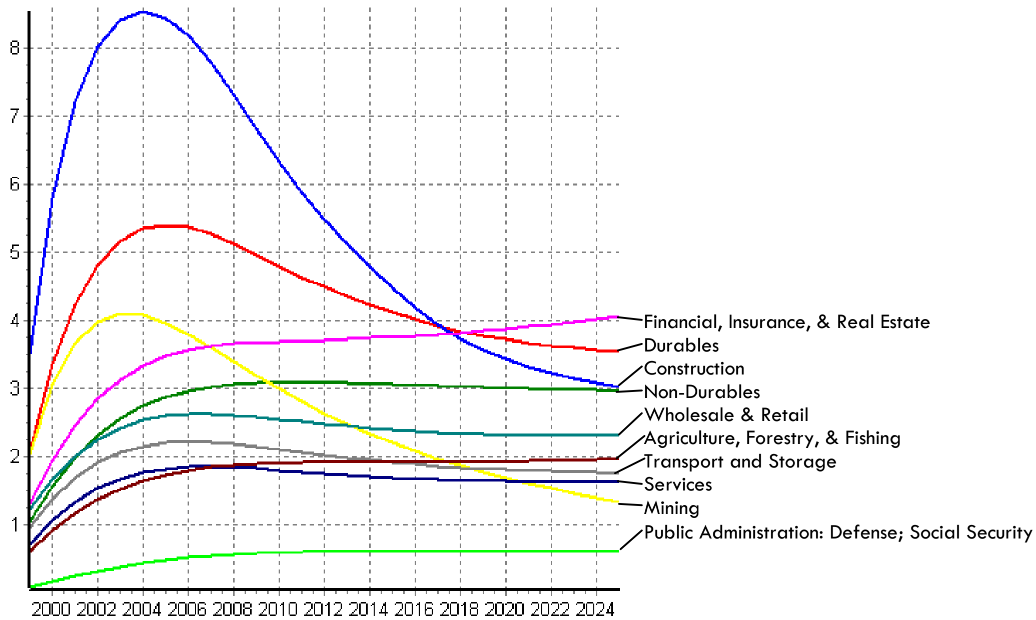
In addition to impacts on output and market share, the drop in production costs affects a number of domestic economic indicators. First, the resulting economic growth boosts employment in all sectors, as shown in Figure VI.20, particularly the manufacturing sectors where additional labor is needed to produce the durable capital goods and infrastructure needed by growing businesses.

Figure VI.20. 0.5% Decrease in Cost of Production – Employment (Thousands)



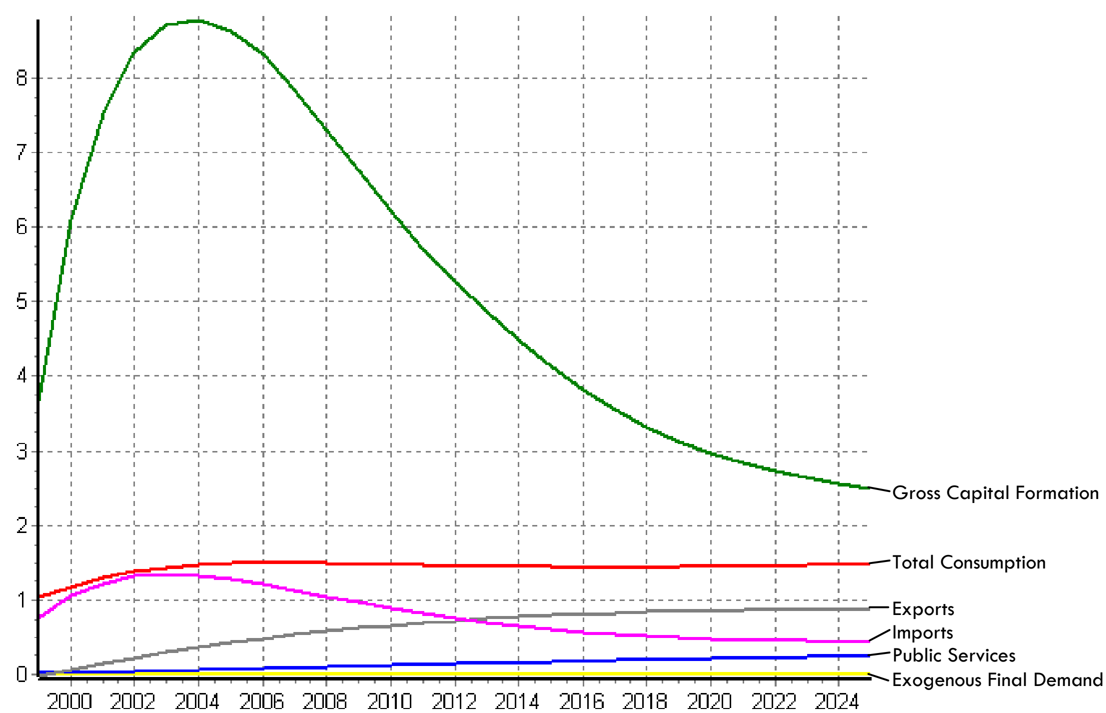
The rise in employment levels naturally increases total outlays for wages and salaries, especially in the construction and durables sectors that thrive during the near-term economic expansion. This effect is represented in Figure VI.21.

Figure VI.21. 0.5% Decrease in Cost of Production – Wage and Salary Disbursements (1,000M Nom Euro)



Finally, this increase in disbursements facilitates a rise in total consumption, which levels off at around 1.5% higher than in the baseline case over the long run. In the end, the growth driven by reduced production costs leads to higher overall gross regional product. Figure VI.22 shows how gross capital formation increases in the short run in parallel with the sudden demand for construction and machinery, although as the economic expansion wanes, the capital stock adjustment process built into Policy Insight helps to move capital formation back toward its baseline level.

Figure VI.22. 0.5% Decrease in Cost of Production – GRP by Final Demand (1,000M 98Euro)



Spain

The initial REMI Policy Insight four-area model of Spain was shipped to the European Commission on May 5, 2003, and then updated and delivered on August 1, 2003.

The overall national economy is predicted to grow at an annual average rate of 2.33%, while labor productivity is expected to grow at 1.71%. In contrast, Andalucia is projected to grow at a slightly slower overall annual average rate of 2.16%, Castilla-la Mancha at 2.05%, Extremadura at the slowest rate of 1.73%, and Rest of Spain at a slightly faster rate of 2.38%. Labor productivity is expected to grow at 1.76% for Andalucia, 1.84% for Castilla-la Mancha, 1.87% for Extremadura, and 1.68% for Rest of Spain. The industry breakdown is shown in Tables VI.2 and VI.3:

Table VI.2. Average Annual Growth Rates of Output for Spain and Four Regions between 1997 and 2025.

		Output Growth Rates			
Industry	**Spain**	**Andalucia**	**Castilla-la Mancha**	**Extremadura**	**Rest of Spain**
Agriculture	1.41%	1.38%	1.32%	1.26%	1.43%
Fishing	1.05%	0.87%	0.00%	0.00%	1.08%
Mining	2.84%	2.46%	2.78%	2.55%	2.89%
Food	1.24%	1.15%	1.10%	1.01%	1.27%
Textiles	1.99%	1.96%	1.91%	1.89%	2.00%
Leather	2.21%	2.03%	1.98%	1.85%	2.25%
Wood	2.96%	2.74%	2.92%	2.73%	2.99%
Pulp	2.90%	2.71%	2.70%	2.38%	2.92%
Petroleum	3.01%	2.84%	2.86%	2.49%	3.03%
Rubber	2.97%	2.76%	2.81%	2.47%	2.98%
Other	2.33%	2.13%	2.17%	1.78%	2.37%
Basic	2.41%	2.20%	2.26%	1.85%	2.44%
Machinery	1.35%	1.00%	1.06%	0.47%	1.38%
Electrical	1.92%	1.62%	1.61%	1.17%	1.94%
Transport	1.79%	1.66%	1.70%	1.59%	1.80%
Manufacturing	2.40%	2.14%	2.15%	1.61%	2.44%
Electricity	2.23%	2.06%	1.98%	1.72%	2.28%
Construction	1.65%	1.34%	1.16%	0.60%	1.77%
Sale	2.18%	2.03%	2.07%	1.92%	2.23%
Wholesale	2.18%	2.06%	1.87%	1.60%	2.23%
Hotels	2.41%	2.29%	2.35%	2.27%	2.44%
Transport	3.17%	3.01%	2.97%	2.77%	3.20%
Financial	2.13%	1.95%	1.90%	1.55%	2.18%
Real	3.00%	2.79%	2.67%	2.19%	3.05%
Computer	2.28%	2.08%	1.95%	1.47%	2.33%
Other	2.16%	1.98%	1.88%	1.39%	2.20%
Public	2.82%	2.77%	2.69%	2.41%	2.85%
Education	2.80%	2.73%	2.63%	2.32%	2.83%
Health	2.74%	2.64%	2.48%	2.13%	2.78%
Other	2.52%	2.36%	2.20%	1.87%	2.57%

Table VI.3. Average Annual Growth Rates of Labor Productivity for Spain and Four Regions between 1997 and 2025.

	Labor Productivity Growth Rates				
Industry	**Spain**	**Andalucia**	**Castilla-la Mancha**	**Extremadura**	**Rest of Spain**
Agriculture	3.34%	3.34%	3.34%	3.35%	3.33%
Fishing	3.38%	3.38%	0.00%	0.00%	3.38%
Mining	0.84%	0.82%	0.83%	0.81%	0.84%
Food	3.37%	3.37%	3.36%	3.34%	3.38%
Textiles	0.93%	0.92%	0.92%	0.90%	0.94%
Leather	0.84%	0.83%	0.82%	0.80%	0.84%
Wood	2.46%	2.45%	2.45%	2.43%	2.46%
Pulp	0.84%	0.83%	0.83%	0.81%	0.84%
Petroleum	0.84%	0.83%	0.83%	0.80%	0.84%
Rubber	1.47%	1.45%	1.45%	1.42%	1.47%
Other	3.37%	3.37%	3.36%	3.34%	3.38%
Basic	2.05%	2.04%	2.03%	2.01%	2.05%
Machinery	1.09%	1.08%	1.07%	1.05%	1.10%
Electrical	1.41%	1.39%	1.38%	1.36%	1.41%
Transport	1.79%	1.78%	1.77%	1.76%	1.79%
Manufacturing	3.37%	3.36%	3.35%	3.32%	3.37%
Electricity	3.20%	3.19%	3.18%	3.16%	3.20%
Construction	0.41%	0.41%	0.40%	0.38%	0.42%
Sale	0.92%	0.91%	0.90%	0.89%	0.92%
Wholesale	0.92%	0.91%	0.90%	0.89%	0.92%
Hotels	2.97%	2.97%	2.97%	2.97%	2.97%
Transport	0.84%	0.83%	0.82%	0.81%	0.84%
Financial	0.85%	0.85%	0.85%	0.85%	0.84%
Real	2.53%	2.55%	2.56%	2.58%	2.53%
Computer	1.50%	1.49%	1.49%	1.47%	1.50%
Other	1.50%	1.49%	1.49%	1.47%	1.50%
Public	3.37%	3.37%	3.36%	3.35%	3.37%
Education	3.37%	3.37%	3.36%	3.34%	3.37%
Health	2.54%	2.54%	2.53%	2.51%	2.54%
Other	0.84%	0.83%	0.83%	0.81%	0.84%

The Gross Regional Product (GRP) for Andalucia is expected to grow from 66.047 in 1997 to 121.691 (1,000M 98Euro) by 2025. Castilla-la Mancha is forecasted to grow from 17.073 to 30.554, Extremadura from 9.156 to 15.126, and Rest of Spain from 385.994 to 746.923. The breakdown of GRP by major final demand component for each region is shown in Figures VI.23 through VI.26.

Figure VI.23. REMI Standard Regional Control for Andalucia – GRP by Final Demand Component (1,000M 98Euro)

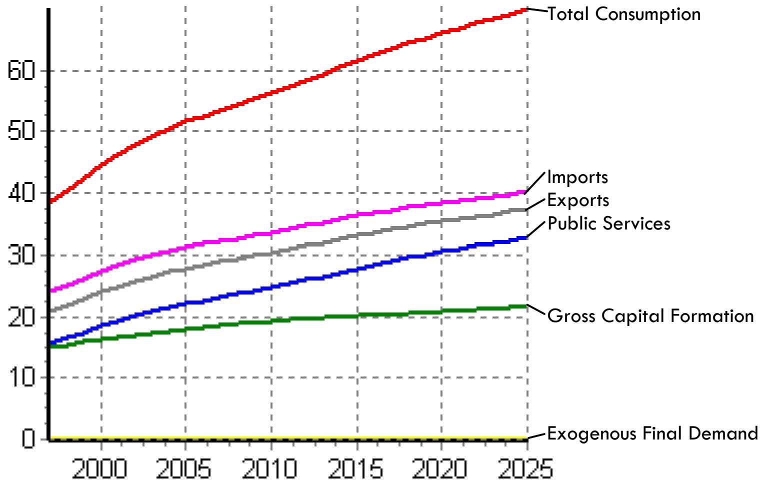


Figure VI.24. REMI Standard Regional Control for Castilla-la Mancha – GRP by Final Demand Component (1,000M 98Euro)

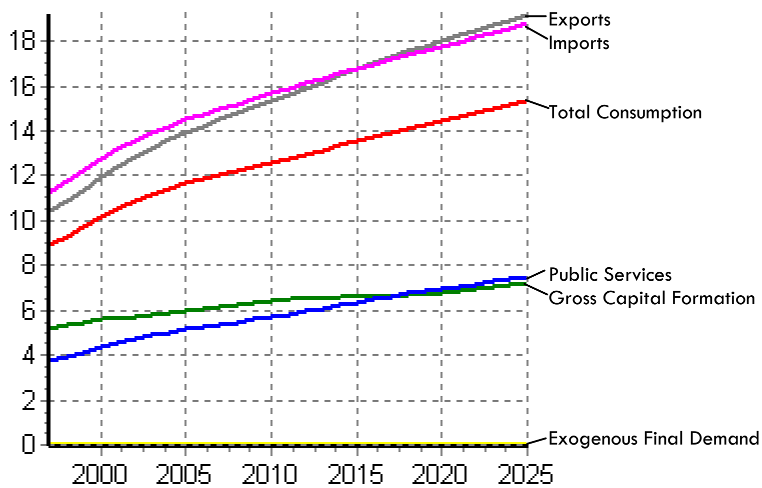


Figure VI.25. REMI Standard Regional Control for Extremadura – GRP by Final Demand Component (1,000M 98Euro)

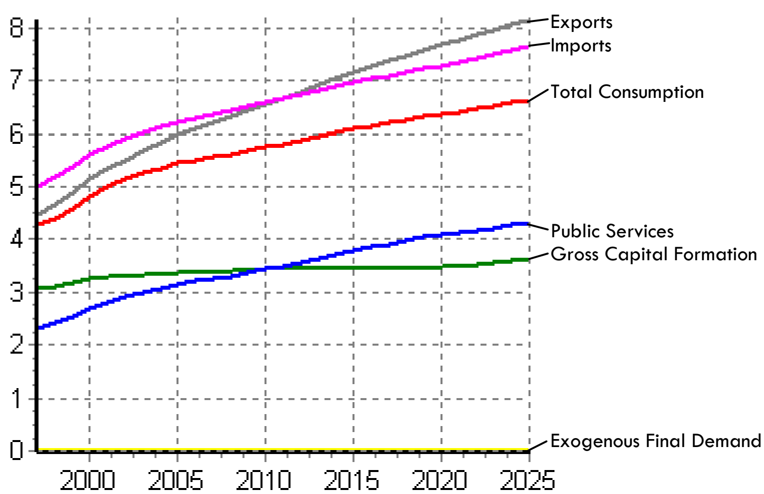
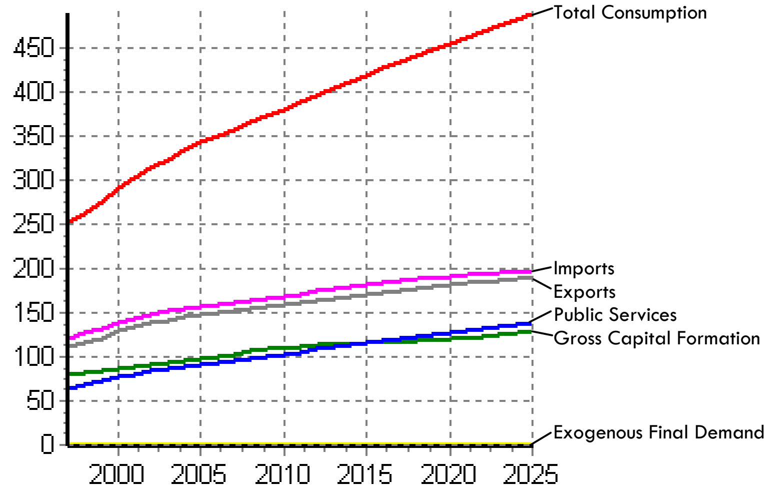


Figure VI.26. REMI Standard Regional Control for Rest of Spain – GRP by Final Demand Component (1,000M 98Euro)



The forecasts of Employment for each of the four regions by major industry sector are shown in Figures VI.27 through VI.30.

Figure VI.27. REMI Standard Regional Control for Andalucia – Employment (Thousands)

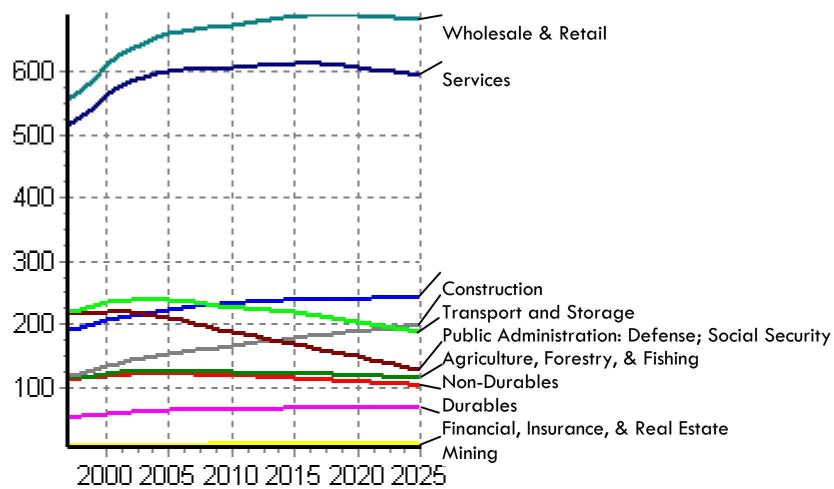


Figure VI.28. REMI Standard Regional Control for Castilla-la Mancha – Employment (Thousands)

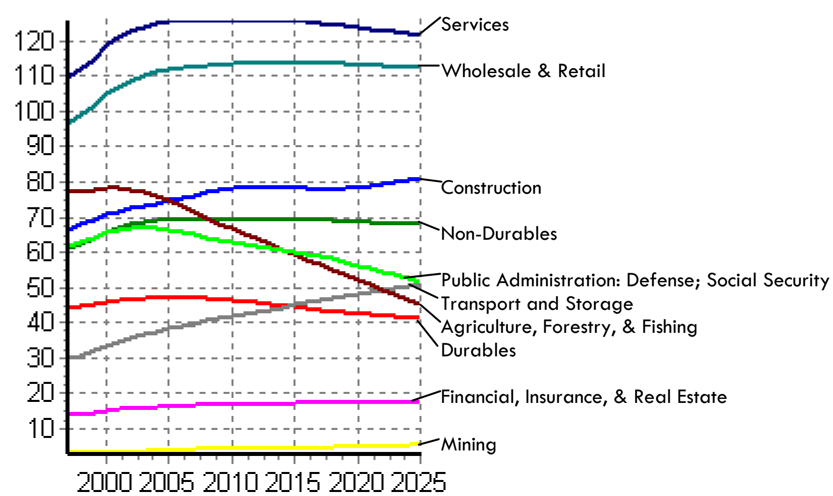


Figure VI.29. REMI Standard Regional Control for Extremadura – Employment (Thousands)

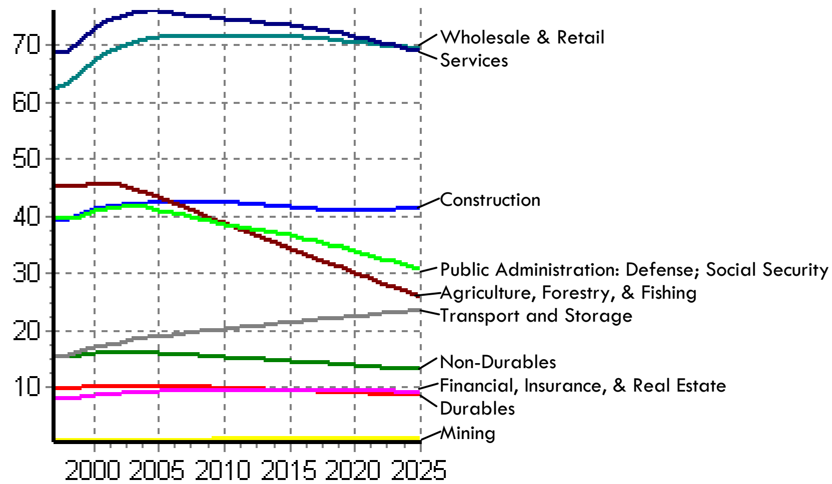
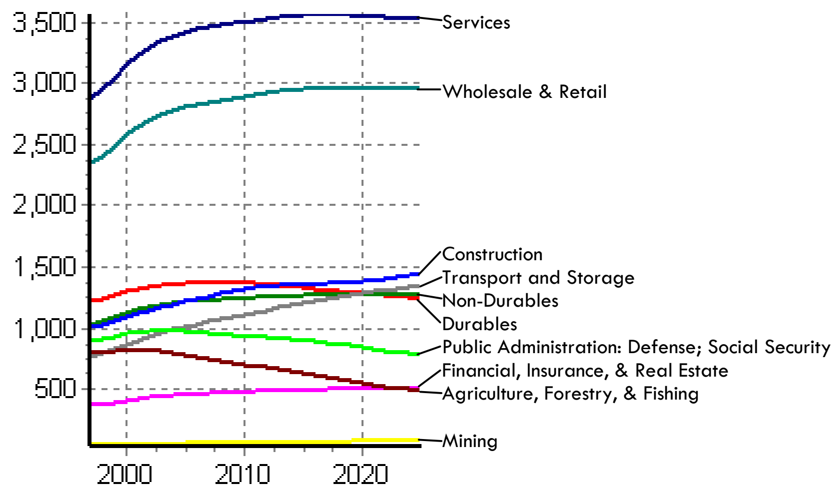


Figure VI.30. REMI Standard Regional Control for Rest of Spain – Employment (Thousands)



The overall Employment (number of jobs) in each of the four regions except Extremadura is expected to slightly increase (grow and then level off), as are the Population and the Labor Force. Extremadura shows a slight decrease in all three variables. Figures VI.31 through VI.34 show the trends of these three key variables for each of the four regions through 2025.

Figure VI.31. REMI Standard Regional Control for Andalucia – Employment, Population, Labor Force (Thousands)

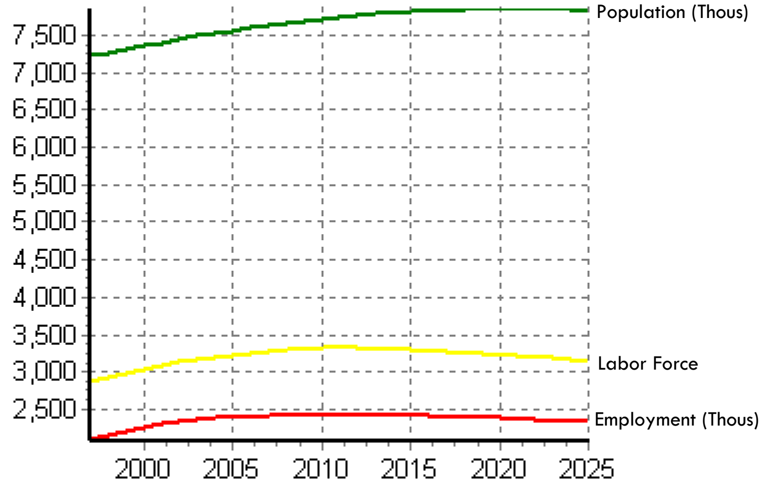


Figure VI.32. REMI Standard Regional Control for Castilla-la Mancha – Employment, Population, Labor Force (Thousands)

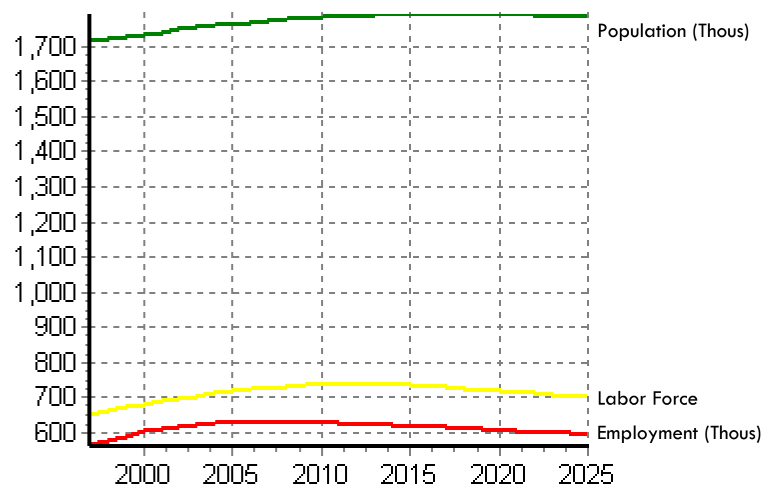


Figure VI.33. REMI Standard Regional Control for Extremadura – Employment, Population, Labor Force (Thousands)

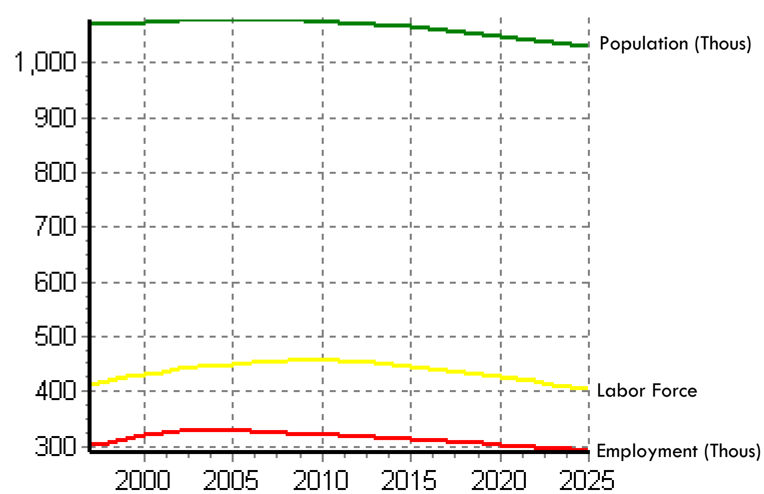
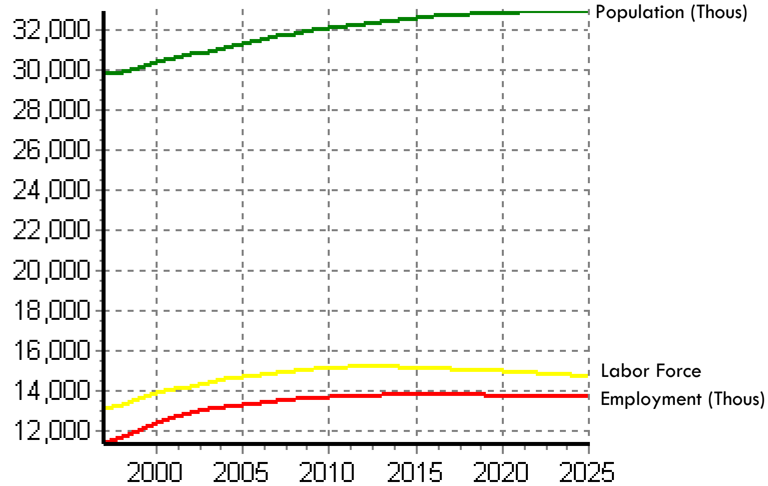
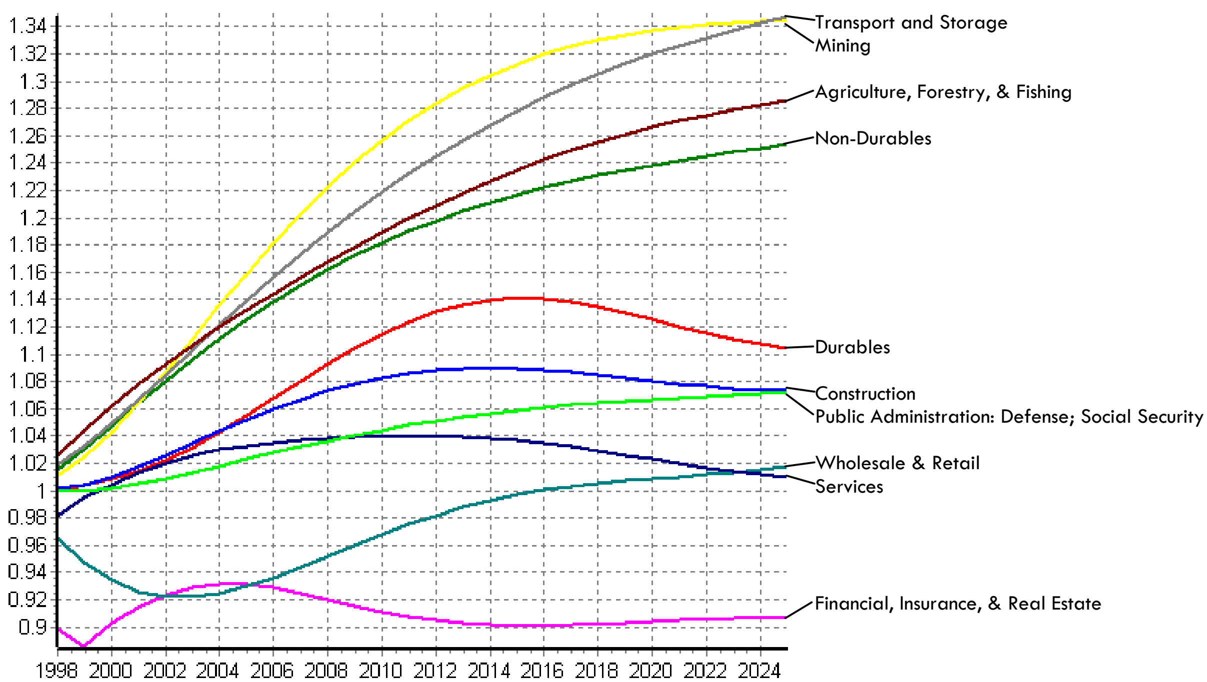


Figure VI.34. REMI Standard Regional Control for Rest of Spain – Employment, Population, Labor Force (Thousands)



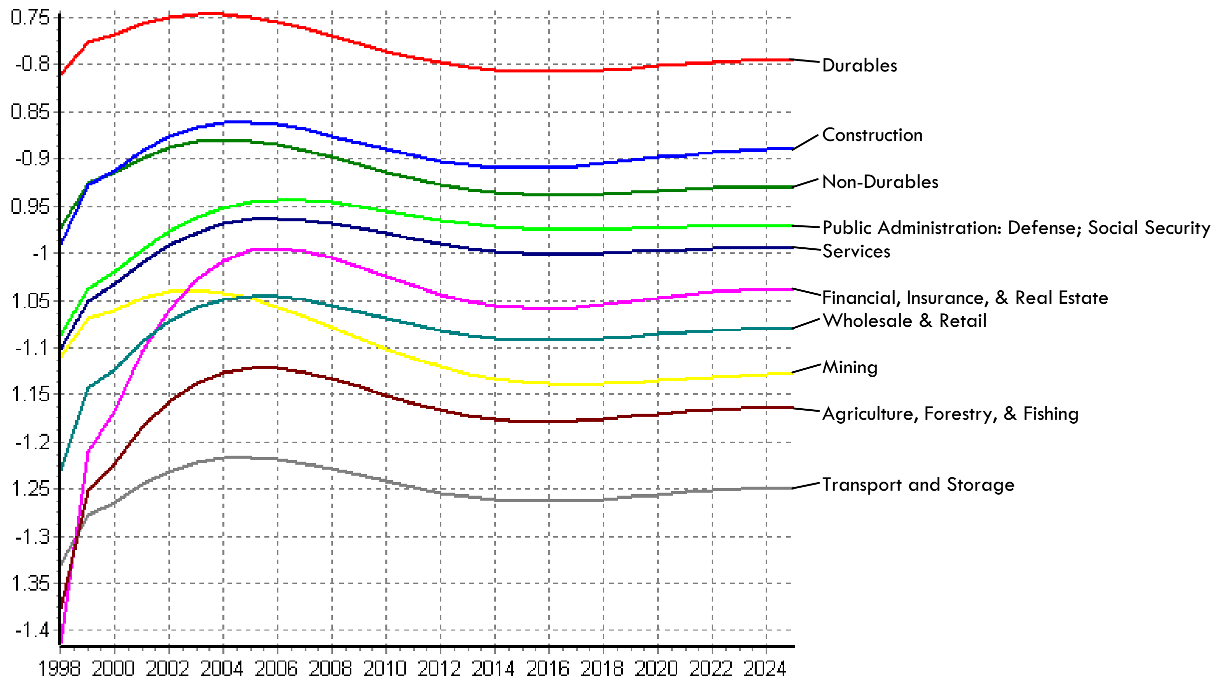
As a sample simulation, total factor productivity for all industries in the Andalucia region was increased by 1%. Running this simulation through the model yielded the following results (in terms of percentage differences from the baseline/REMI Standard Regional Control). Figure VI.35 shows how the rise in productivity affects labor productivity differently across sectors. The biggest sustained percent deviation from the baseline occurs in sectors dealing directly with natural resources, such as mining, agriculture, and utilities.

Figure VI.35. 1% Increase in Relative Factor Productivity for Andalucia – Labor Productivity in Andalucia (Output/Thousand Employees)



Enhanced productivity translates directly into the production cost savings illustrated in Figure VI.36. Since the increase occurs in *total* factor productivity, the initial savings are achieved not through factor substitution, but through increased output by the existing factor base. However, as with the Italy simulation described above, the declining production costs increase Andalucia's competitiveness and soon trigger an economic expansion that boosts employment and stimulates capital formation. At the outset of the forecast period, the other regions of Spain also see a surge in economic activity as they supply Andalucia's increased demand for intermediate inputs. This growth leads to rises in GRP and output across the country relative to baseline projections, although the increases are considerably larger in Andalucia itself.

Figure VI.36. 1% Increase in Relative Factor Productivity for Andalucia – Relative Cost of Production in Andalucia



Over the long run, Andalucian industry starts to displace production from the rest of Spain, causing the rest of Spain to revert towards baseline levels even while Andalucia's GRP remains 2% above the baseline forecast. This difference is evident in Figure VI.37 and Figure VI.38, which depict exports from Andalucia (which steadily increase relative to the baseline, improving its market share) and exports from the rest of Spain (which decline modestly as they are partially supplanted by cheaper Andalucian exports). By the end of the forecast, the rest of Spain has rebounded somewhat due to the cyclical nature of the capital stock formation process (which tends to accelerate macroeconomic trends), while Andalucia's improved productivity continues to provide it with economic advantages in external markets.

Figure VI.37. 1% Increase in Relative Factor Productivity for Andalucia – Exports to Rest of World from Andalucia (1,000M 98Euro)

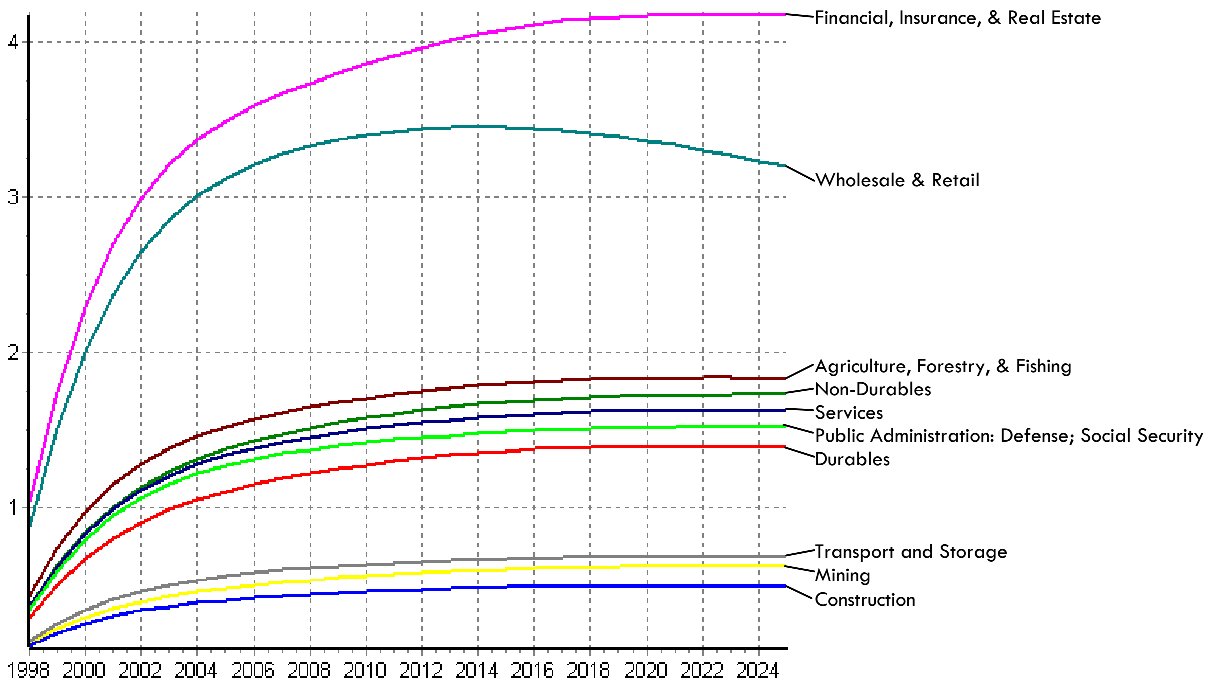
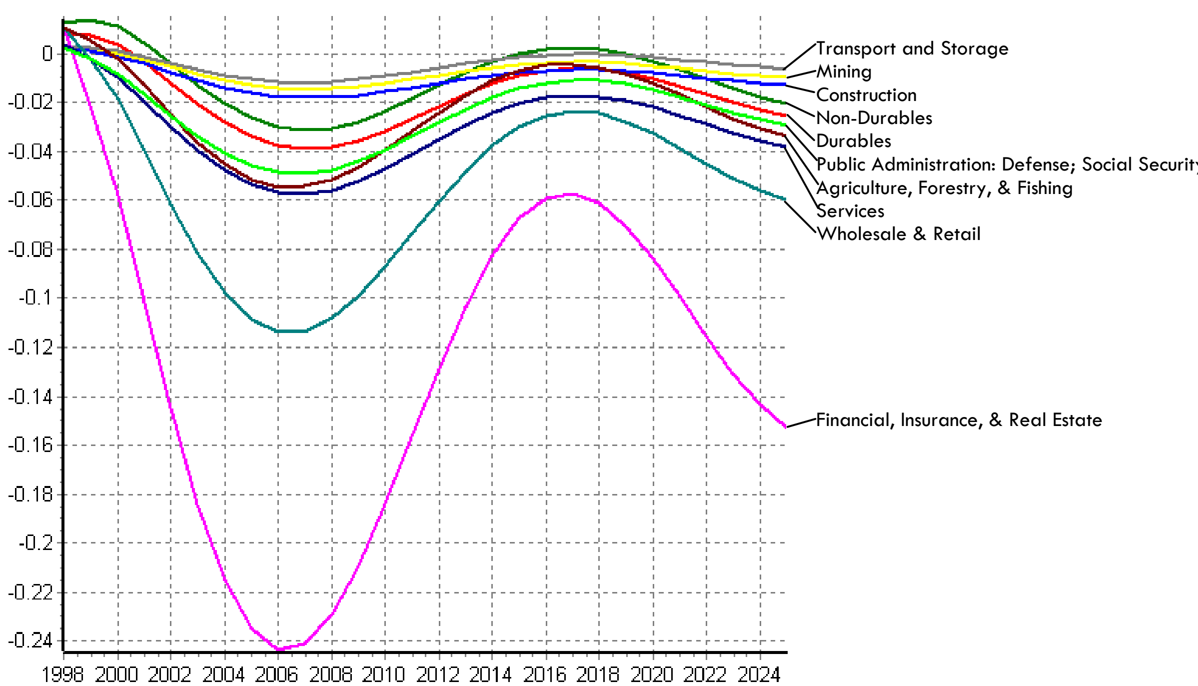


Figure VI.38. 1% Increase in Relative Factor Productivity for Andalucia – Exports to Rest of World from Rest of Spain (1,000M 98 Euro)



Chapter VII: Concluding Comments

The importance of the structural funds spending in the E.U. (and in the forthcoming expansion of the E.U.) argues for expanding the scope of both ex ante and ex post estimates of the total socio-economic effects of proposed projects. Such an analysis is necessary not only for improving the efficiency of the allocation of these funds, but also for developing insights that will enable policy planners to examine how their regional economies work. This improved understanding may direct policy makers toward projects that will induce structural changes that meet the objectives of the people who live in the areas receiving aid. In essence, the use of the REMI Policy Insight model is a reality check on ideas that may be formulated based on misconceptions about the ways in which regional economies function. This reality check may be disappointing, but it may lead to a deeper appreciation of which steps are involved to reach different goals, and also to policies that are geared to the ends that are most important to the people in the regions where the policies are implemented.

In the analysis described in Chapter I, we develop conservative estimates based on the existing infrastructures and capital stock, depreciated over its lifetime. We do not assume changes in outlook and behavior, such as purchase of new equipment that may occur due to the demonstration effects of working with new equipment, or revised attitudes toward training programs based on working with others who have had training. If the microanalysis of these effects could be undertaken we may find that some policies have long-term effects that were not captured in our simulations. It is only recently that we have been able to quantify the value of increased access to a large labor pool and the agglomeration productivity effects that arise from access to a wide variety of intermediate inputs. Thus, further work on the key direct effects of different E.U. investments on individual behavior and decision making could eventually be added to the analysis.

In short, we have come a long way from focusing on the short-run demand effects of policy to looking at the long-term effects that influence productivity, the quality of life, and other factors that are key to the economic development and future lives of the people living in areas effected by the policies. Unfortunately, the microanalysis currently available to us did not estimate the benefits to health and the quality of the environment that could be input as policy variables in the model. At the same time, much more can be done to develop the direct effects of inputs into REMI Policy Insight in order more accurately to capture the real implications of alternative policies. These analyses would equip policymakers with the necessary information to use public funds in the most effective way possible.

Appendix

Part I: Investments in the Objective 1 Portion of Southern Italy

Structural Funds Programs And Their Economic Impact On Local Regions In Europe: Agriculture Southern Italy

COMBINED (OFFICIAL) SIMULATION: Subsidies to investments in Agri-business in Regione Campania, data from P.O.R. (Operative regional Program) Ob. 3 2000-2006 (Roberto Pagni)

Note: This is a 50/50 combination of 'Agriculture: Capacity increase alternative' and 'Agriculture: Productivity change alternative' simulations given below.

This is a correct version of simulation (named << .66times eq Demand+new ag sales+fd sales+tax >> in REMI.RWB)

Priority IV "Local Development Systems"

Measures: 4.8, 4.9, 4.13, 4.15, 4.17, 4.20 (EAGGF: European Agriculture Guidance Guarantee Fund)

Total amount of public resources: 42.1 Meuro per year.

Policy variables: assumptions and sources

All values below are in amount unless otherwise stated. Also, all values are fixed to 1998 Fixed National Euro (M) unless otherwise stated.

OFFICIAL AGRICULTURE

		2000	2001	2002	2003	2004
1. Exogenous Final Demand (amt)	Machinery and Equip n.e.c.	56.166	56.166	56.166	56.166	56.166
2. Industry Sales (amount)	Agri, Hunting and Forestry	7.92935	15.06577	21.48854	27.26903	32.47148
3. Firm Sales (amount)	Agri, Hunting and Forestry	1.9825	3.76675	5.372575	6.817818	8.118536
3. Firm Sales (amount)	Food prod, Bevs & Tobacco	11.825	22.4675	32.04575	40.66618	48.42456
4. Personal Taxes (amount)	Applicable Personal Income	7.575	7.575	7.575	7.575	7.575
5. Nullify Invest Ind. by Industry Sales	Agri, Hunting and Forestry	7.92935	15.06577	21.48854	27.26903	32.47148
6. Non-Residential Capital (amt)	Non-residential Cap Stock	13.8075	13.8075	13.8075	13.8075	13.8075
7. Factor Productivity (share)	Agri, Hunting and Forestry	0.06355	0.117843	0.16535	0.20665	0.242938
7. Factor Productivity (share)	Food prod, Bevs & Tobacco	0.057311	0.106249	0.149307	0.186928	0.220232

		2005	2006	2007	2012	2018	2024
1. Exogenous Final Demand	Machinery and Equip n.e.c.	56.166	56.166	0	0	0	0
2. Industry Sales	Agri, Hunting and Forestry	37.15368	41.36766	37.2309	21.98447	11.68345	6.209065
3. Firm Sales	Agri, Hunting and Forestry	9.289182	10.34276	9.308488	5.496569	2.921102	1.552393
3. Firm Sales	Food prod, Bevs & Tobacco	55.4071	61.69139	55.52225	32.78533	17.42347	9.259547
4. Personal Taxes	Applicable Personal Income	7.575	7.575	0	0	0	0
5. Nullify Invest	Agri, Hunting and Forestry	37.15368	41.36766	37.2309	21.98447	11.68345	6.209065
6. Non-Residential Capital	Non-residential Cap Stock	13.8075	13.8075	0	0	0	0
7. Factor Productivity (share)	Agri, Hunting and Forestry	0.274924	0.303145	0.270641	0.156498	0.08299	0.044624
7. Factor Productivity (share)	Food prod, Bevs & Tobacco	0.249795	0.276049	0.246733	0.143966	0.077232	0.042118

Official Agriculture

Effects of a 50% public subsidy of 295M euros for agricultural and food industry equipment

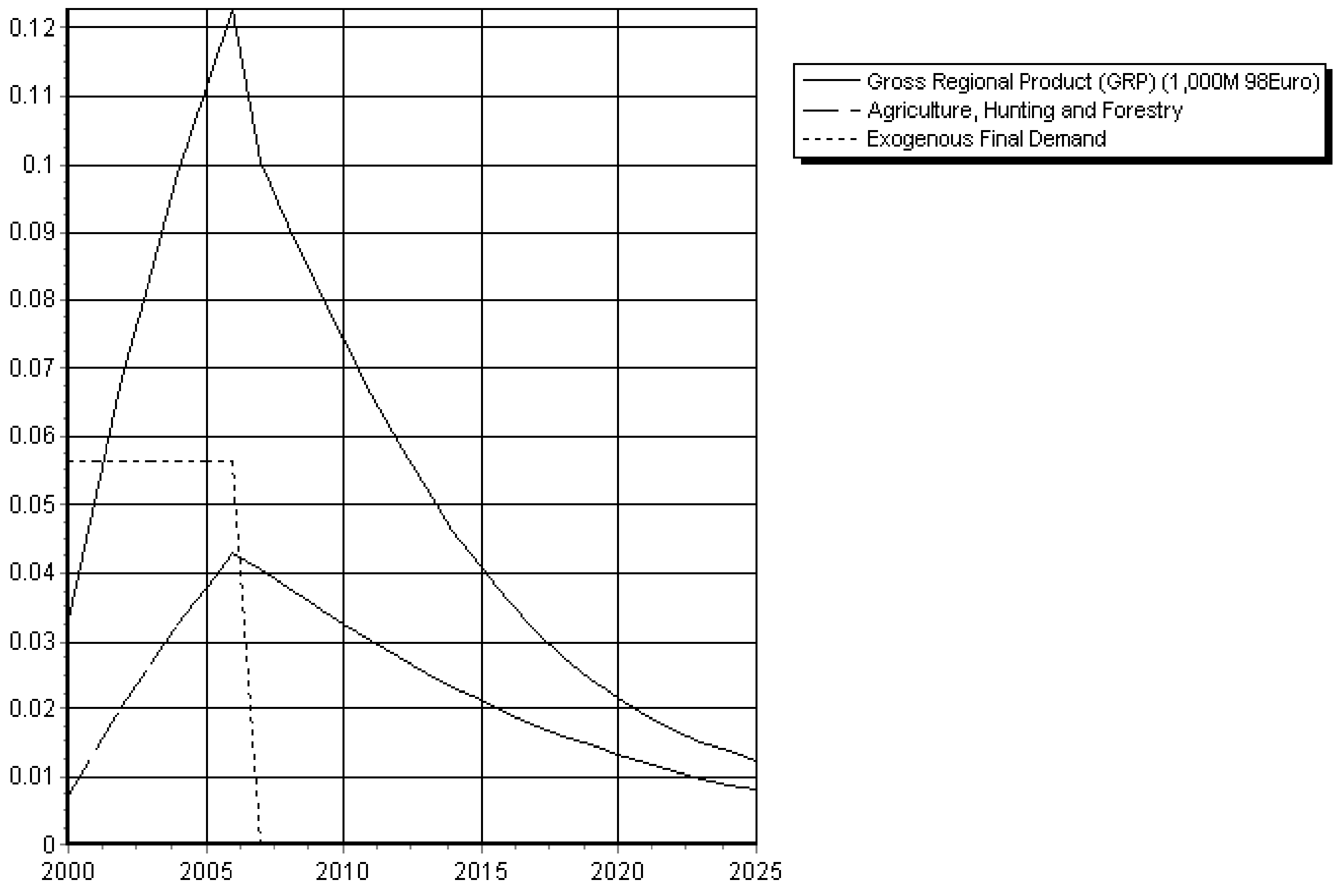
Variable	2006	2012	2018	2024
Employment (Thous)	2.254	0.8691	0.2583	0.05371
Gross Regional Product (GRP) (1,000M 98Euro)	0.1229	0.05911	0.02759	0.01367
Personal Income (1,000M Nom Euro)	0.08228	0.04584	0.02148	0.009216
PCE-Price Index (98 Euro)(IT Baseline)	-0.01273	-0.00711	-0.00475	-0.00345
Real Disp Personal Income (1,000M 98Euro)	0.04201	0.02637	0.01437	0.008728
Population (Thous)	0.1602	0.2832	0.3359	0.3418
Econ Migrants	0.03305	0.01269	0.002953	-0.00059
Total Migrants	0.03306	0.0127	0.002954	-0.0006
Labor Force	0.6792	0.5552	0.3315	0.2031
Demand (1,000M 98Euro)	0.2808	0.0849	0.02667	0.007568
Output (1,000M 98Euro)	0.2766	0.124	0.05634	0.02704
Delivered Price	-5.97E-05	-2.56E-05	-1.57E-05	-1.10E-05
Relative Cost of Production	-0.0001	-4.51E-05	-2.66E-05	-1.80E-05
Labor Intensity	-2.38E-07	-4.77E-07	-7.15E-07	-7.15E-07
Labor Access Index	5.72E-06	5.13E-06	2.68E-06	1.01E-06
Indust Mix Index	0	0	0	0
Reg Pur Coeff (SS over Dem)	5.43E-05	4.73E-05	2.50E-05	1.35E-05
Imports (1,000M 98Euro)	0.06122	-0.00183	-0.00801	-0.00714
Self Supp (1,000M 98Euro)	0.2196	0.08673	0.03467	0.0148
Exp to MR (1,000M 98Euro)	0	0	0	0
Exp to RN (1,000M 98Euro)	0.00811	0.01031	0.007248	0.004646
Exp to RW (1,000M 98Euro)	0.04887	0.02691	0.01437	0.007633
Wage Rate (Thous NomEuro)	-0.00013	-7.63E-06	-0.0002	-0.00056

Effects of a 50% public subsidy for agricultural and food industry equipment from 2000 to 2006 *

	2006	2012	2018	2024
Jobs per Million euros	7.65	2.95	0.88	0.18
Labor force per Million euros	2.30	1.88	1.12	0.69
Population per Million euros	0.54	0.96	1.14	1.16
GDP per euro invested	0.42	0.20	0.09	0.05
Real Disposable income per euro	0.14	0.09	0.05	0.03

* EU contributed half of the public investment subsidy. Therefore multiply by 2 to get the return to the EU investment.

Combined Agricultural
Effects



AGRICULTURE: Capacity increase alternative

Subsidies to investments in Agri-business in Regione Campania, data from P.O.R. (Operative regional Program) Ob. 3 2000-2006 (Roberto Pagni)

This is a correct version of simulation (named << .66times eq Demand+new ag sales+fd sales+tax >> in REMI.RWB)

Priority IV "Local Development Systems"

Measures: 4.8, 4.9, 4.13, 4.15, 4.17, 4.20 (EAGGF: European Agriculture Guidance Guarantee Fund)

Total amount of public resources: 42.1 Meuro per year.

Policy variables: assumptions and sources

All values below are in amount unless otherwise stated. Also, all values are fixed to 1998 Fixed National Euro (M) unless otherwise stated.

1. Exogenous Final Demand (amount), detail: Machinery and Equipment n.e.c.

AGRICULTURE

		2000	2001	2002	2003	2004
1. Exog Final Demand (amt)	Machinery and Equip n.e.c.	56.166	56.166	56.166	56.166	56.166

		2005	2006	2007	2012	2018	2024
1. Exog Final Demand (amt)	Machinery and Equip n.e.c.	56.166	56.166	0	0	0	0

The amount of public resources for the measures mentioned above is about 42,1 million euro (M-euro) per year. We have calculated a gross demand for farm equipment of 84,2 M-euro per year (that is the total cost of investments; the premium for young farmer start-up has been consider able to cause an amount of investment equal to the double of the subsidy). It is hard to know the investments induced by public intervention (the so called net effect), because many investments would have been realized also without European funds (the so called deadweight). So we have estimated an increase of net demand for machinery and equipment due to subsidies equal to 2/3 (56,2 M-euro).

2. Industry Sales: detail: Agriculture, Hunting and Forestry
   Firm Sales, detail: Agriculture, Hunting and Forestry
   Firm Sales, detail: Food products, Beverages & Tobacco

		2000	2001	2002	2003	2004	2005
2. Industry Sales	Agri, Hunting and Forestry	15.8587	30.13153	42.97708	56.166	64.94296	74.30737
2. Firm Sales	Agri, Hunting and Forestry	3.965	7.5335	10.74515	13.63564	16.23707	18.57836
2. Firm Sales	Food prods, Bev & Tobacco	23.65	44.935	64.0915	81.33235	96.84912	110.8142

		2006	2007	2012	2018	2024
2. Industry Sales	Agri, Hunting and Forestry	82.73533	74.4618	43.96895	23.3669	12.41813
2. Firm Sales	Agri, Hunting and Forestry	20.68553	18.61698	10.99314	5.842204	3.104787
2. Firm Sales	Food prods, Bevs & Tobacco	123.3828	111.0445	65.57067	34.84694	18.51909

We have estimated that 60% of investments have been done in agricultural sector, and 40% in food industry.

The increase of sales due to investments has been calculated as follows. NB: For all sector investments we have considered 10 years life of equipment and a deadweight of 1/3)

a) 60% of 84,2 Meuro for agriculture is equal to 50,5 Meuro per year: we divide for 1.7 capital output ratio (that is capital over production) and the result is 29,7 Meuro. We assume that 80% of 29,7 equal to 23,8 Meuro was industry sales (without displacement); (15,9 Meuro net effect)
b) So 20% of 29,7 Meuro, equal to 5,9 M-euro is considered firms sales (net effect considering 2/3: 4 Meuro)
c) 40% of 84,2 Meuro for food products is equal to 33,7 Meuro: we divide by 0.95 capital output ratio and the result is 35,5 Meuro per year of Firm sales in food industry; (23,6 Meuro net effect)

Depreciation for Industry Sales/Firm Sales

The rate of depreciation is calculated in the following manner. The measure that is depreciating does so as a geometric series and therefore we will have:

$$X + X(1-r) + X(1-r)^2 + X(1-r)^3 \ldots\ldots + X(1-r)^\infty = Y$$

$$\Rightarrow \quad X[1 + (1-r) + (1-r)^2 + (1-r)^3 + \ldots(1-r)^\infty] = Y$$

$$\Rightarrow \quad 1/1-(1-r) = Y/X$$

$$\Rightarrow \quad 1/r = Y/X \ldots\ldots (1)$$

since, $1 + (1-r) + (1-r)^2 + (1-r)^3 + \ldots(1-r)^\infty = 1/1-(1-r) = 1/1-z$ where $z = 1-r$ by the summation of the geometric series.

Here X = output in one year

Y = output in the total number of years wanted.

Using equation (1), we calculated “r” at 0.1 so that the industry sales for agriculture was depreciating at the rate of 10% and has an average lifetime of 10 years.

3. Personal taxes:

		2000	2001	2002	2003	2004
3. Personal Taxes	Applicable Pers Income	7.575	7.575	7.575	7.575	7.575

		2005	2006	2007	2012	2018	2024
3. Personal Taxes	Applicable Pers Income	7.575	7.575	0	0	0	0

84.25M euro is the total investment per year. This is multiplied with 0.5 to give 42.13 M euro subsidy. Now 42.13 multiplied with 0.15 (regional contribution) gives us 5.0556 M euro regional taxes. 42.13 is also multiplied with .23 (national contribution), which is then again multiplied with 0.26 (southern Italy share) to give us 2.52M euro of national taxes. Therefore, total taxes= 2.52+5.0556 = 7.575M euros.

4. Nullify Investments Induced by Industry Sales

		2000	2001	2002	2003	2004
4. Nullify Invest. Induced by Industry Sales / Int'l Exports	Agri, Hunting and Forestry	15.8587	30.13153	42.97708	54.53807	64.94296

		2005	2006	2007	2012	2018	2024
4. Nullify Invest. Induced by Industry Sales / Int'l Exports	Agri, Hunting and Forestry	74.30737	82.73533	74.4618	43.96895	23.3669	12.41813

Removes the investment that would have been generated by the model in response to the industry sales because this investment has already been entered as exogenous demand.

5. Non-residential Capital

		2000	2001	2002	2003	2004
5. Non-Residential Capital	Non-residential Capital Stock	27.615	27.615	27.615	27.615	27.615

		2005	2006	2007	2012	2018	2024
5. Non-Residential Capital	Non-residential Capital Stock	27.615	27.615	0	0	0	0

Increases the capital stock so that the gap between optimal and actual will not change so as to avoid the generation of more investment when it has already been entered as aggregate demand.

Effects of a 50% public subsidy of 295 M euros for agricultural and food industry equipment

Variable	2006	2012	2018	2024
Employment (Thous)	5.857	1.366	0.1831	0.01855
Gross Regional Product (GRP) (1,000M 98Euro)	0.1703	0.04474	0.009399	0.005524
Personal Income (1,000M Nom Euro)	0.1777	0.06439	0.01263	0.00354
PCE-Price Index (98 Euro)(IT Baseline)	0.00737	0.005081	0.001556	0.00E+00
Real Disp Personal Income (1,000M 98Euro)	0.04356	0.01361	0.002838	0.002777
Population (Thous)	0.375	0.5723	0.5957	0.5664
Econ Migrants	0.07003	0.011	-0.00229	-0.003613
Total Migrants	0.07002	0.01101	-0.00229	-0.00362
Labor Force	1.678	1.067	0.4766	0.2759
Demand (1,000M 98Euro)	0.3573	0.03052	-0.02789	-0.01636
Output (1,000M 98Euro)	0.3744	0.08826	0.01471	0.00824
Delivered Price	6.60E-05	4.32E-05	1.47E-05	2.50E-06
Relative Cost of Production	9.18E-05	5.98E-05	2.05E-05	3.46E-06
Labor Intensity	-8.35E-07	-1.67E-06	-2.15E-06	-2.15E-06
Labor Access Index	1.55E-05	1.14E-05	4.35E-06	1.25E-06
Indust Mix Index	0	0	0	0
Reg Pur Coeff (SS over Dem)	6.14E-05	2.10E-05	5.25E-06	3.82E-06
Imports (1,000M 98Euro)	0.08223	-0.00308	-0.01256	-0.008072
Self Supp (1,000M 98Euro)	0.2751	0.0336	-1.53E-02	-0.00827
Exp to MR (1,000M 98Euro)	0	0	0	0
Exp to RN (1,000M 98Euro)	0.007591	0.007233	0.005295	0.00338
Exp to RW (1,000M 98Euro)	0.09171	0.04734	0.02473	0.0131
Wage Rate (Thous NomEuro)	-6.30E-03	-1.64E-03	-0.00177	-0.002014

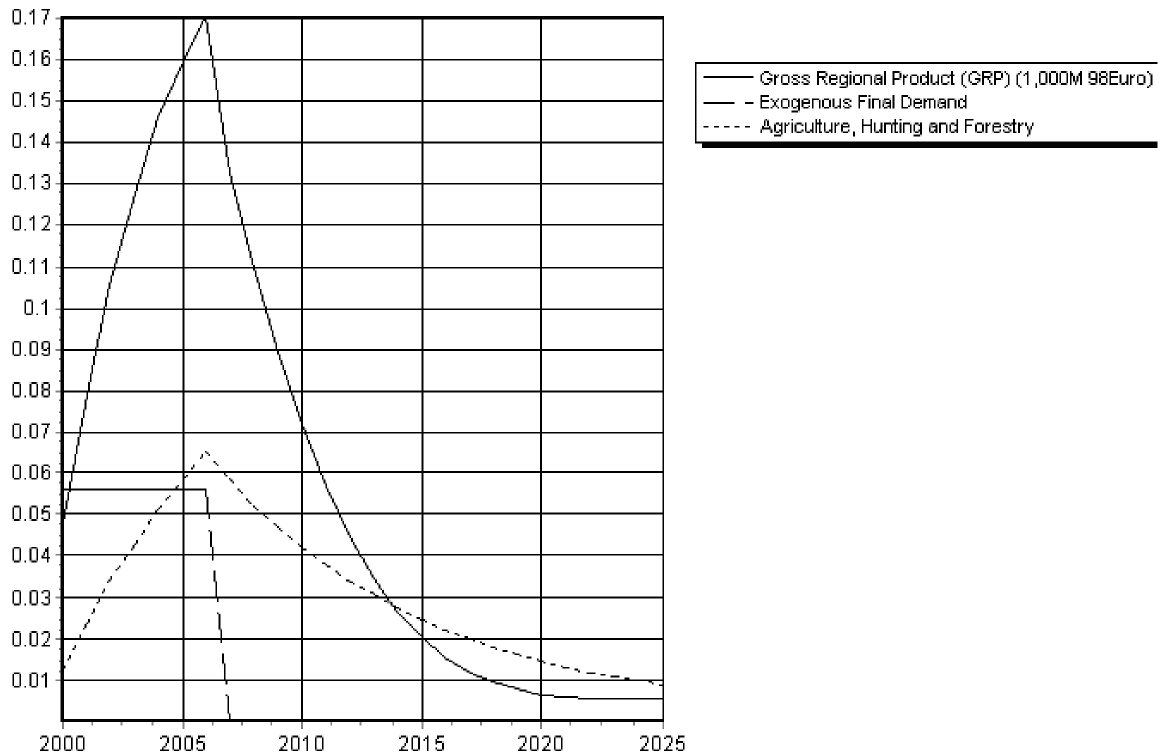
Effects of a 50% public subsidy for agricultural and food industry equipment from 2000 to 2006 *

	2006	2012	2018	2024
Jobs per Million euros	19.87	4.64	0.62	0.06
Labor force per Million euros	5.69	3.62	1.62	0.94

Population per Million euros	1.27	1.94	2.02	1.92
GDP per euro invested	0.58	0.15	0.03	0.02
Real Disposable income per euro	0.15	0.05	0.01	0.01

* EU contributed half of the public investment subsidy. Therefore multiply by 2 to get the return to the EU investment.

Effects of a 295M euro investment in agricultural equipment with 50% public subsidy



AGRICULTURE: Productivity change alternative

PRODUCTIVITY SIMULATION: Subsidies to investments in Agri-business in Regione Campania, data from P.O.R. (Operative regional Program) Ob. 3 2000-2006 (Roberto Pagni)

This is a correct version of simulation (named << .66times eq Demand+new ag sales+fd sales+tax >> in REMI.RWB)

Priority IV "Local Development Systems"

Measures: 4.8, 4.9, 4.13, 4.15, 4.17, 4.20 (EAGGF: European Agriculture Guidance Guarantee Fund)

Total amount of public resources: 42.1 Meuro per year.

Policy variables: assumptions and sources

All values below are in amount unless otherwise stated. Also, all values are fixed to 1998 Fixed National Euro (M) unless otherwise stated. Values like "Agriculture: Capacity increase alternative".

1. Exogenous Final Demand (amount), detail: Machinery and Equipment n.e.c.

		2000	2001	2002	2003	2004
1. Exog Final Demand	Machinery and Equip n.e.c.	56.166	56.166	56.166	56.166	56.166

		2005	2006	2007	2012	2018	2024
1. Exog Final Demand	Machinery and Equip n.e.c.	56.166	56.166	0	0	0	0

The amount of public resources for the measures mentioned above is about 42,1 million euro (M-euro) per year. We have calculated a gross demand for farm equipment of 84,2 M-euro per year (that is the total cost of investments; the premium for young farmer start-up has been consider able to cause an amount of investment equal to the double of the subsidy). It is hard to know the investments induced by public intervention (the so called net effect), because many investments would have been realized also without European funds (the so called deadweight). So we have estimated an increase of net demand for machinery and equipment due to subsidies equal to 2/3 (56,2 M-euro).

2. Personal taxes:

		2000	2001	2002	2003	2004
2. Personal Taxes	Applicable Pers Income	7.575	7.575	7.575	7.575	7.575

		2005	2006	2007	2012	2018	2024
2. Personal Taxes	Applicable Pers Income	7.575	7.575	0	0	0	0

-84.25M euro is the total investment per year. This is multiplied with 0.5 to give 42.13 M euro subsidy. Now 42.13 multiplied with 0.15 (regional contribution) gives us 5.0556M euro regional taxes. 42.13 is also multiplied with .23 (national contribution), which is then again multiplied with 0.26 (southern Italy share) to give us 2.52M euro of national taxes.

Therefore, total taxes= 2.52+5.0556 = 7.575M euros.

3. Factor Productivity

AGRICULTURE (Productivity effects)

	2000	2001	2002	2003	2004
3. Factor Productivity (share) Agriculture, Hunting and Forestry	0.127099	0.235686	0.3307	0.413299	0.485875
3. Factor Productivity (share) Food products, Beverages & Tobacco	0.114622	0.212499	0.298614	0.373856	0.440464

	2005	2006	2007	2012	2018	2024
3. Factor Productivity (share) Agriculture, Hunting and Forestry	0.549847	0.606289	0.541282	0.312996	0.16598	0.089248
3. Factor Productivity (share) Food products, Beverages & Tobacco	0.499591	0.552098	0.493465	0.287932	0.154463	0.084235

Productivity values are in Percent

Assumes that the net increase in the capital in agriculture and food products will change factor productivity in the industry in the same proportion to the increase in capital due to the subsidies program.

AGRICULTURE (Productivity effects)

Productivity effects of a 50% public subsidy of 295M euros for agricultural and food industry equipment

Variable	2006	2012	2018	2024
Employment (Thous)	-1.335	0.3711	0.3335	0.08789
Gross Regional Product (GRP) (1,000M 98Euro)	0.07541	0.07333	0.04572	0.02173
Personal Income (1,000M Nom Euro)	-0.01276	0.02728	0.0304	0.01459
PCE-Price Index (98 Euro)(IT Baseline)	-0.03267	-0.01921	-0.01114	-0.0069
Real Disp Personal Income (1,000M 98Euro)	0.04033	0.039	0.02609	0.01456
Population (Thous)	-0.05078	0.003906	0.08008	0.1133
Econ Migrants	-0.00376	0.01425	0.00824	0.002541
Total Migrants	-0.00376	0.01426	0.008251	0.002541
Labor Force	-0.3169	0.04346	0.187	0.1284
Demand (1,000M 98Euro)	0.204	0.1389	0.08112	0.03125
Output (1,000M 98Euro)	0.1784	0.1592	0.09778	0.04559
Delivered Price	-0.00018	-9.41E-05	-4.55E-05	-2.43E-05
Relative Cost of Production	-0.00029	-0.00015	-7.31E-05	-3.91E-05
Labor Intensity	2.38E-07	7.15E-07	7.15E-07	5.96E-07
Labor Access Index	-3.99E-06	-1.01E-06	1.01E-06	8.35E-07
Indust Mix Index	0	0	0	0
Reg Pur Coeff (SS over Dem)	4.70E-05	7.36E-05	4.45E-05	2.30E-05
Imports (1,000M 98Euro)	0.04021	-0.00058	-0.00345	-0.0063
Self Supp (1,000M 98Euro)	0.1639	0.1394	0.08456	0.03757
Exp to MR (1,000M 98Euro)	0	0	0	0
Exp to RN (1,000M 98Euro)	0.008575	0.01334	0.009186	0.005913
Exp to RW (1,000M 98Euro)	0.006001	0.006458	0.004002	0.00214
Wage Rate (Thous NomEuro)	0.006012	0.001621	0.001373	0.000893

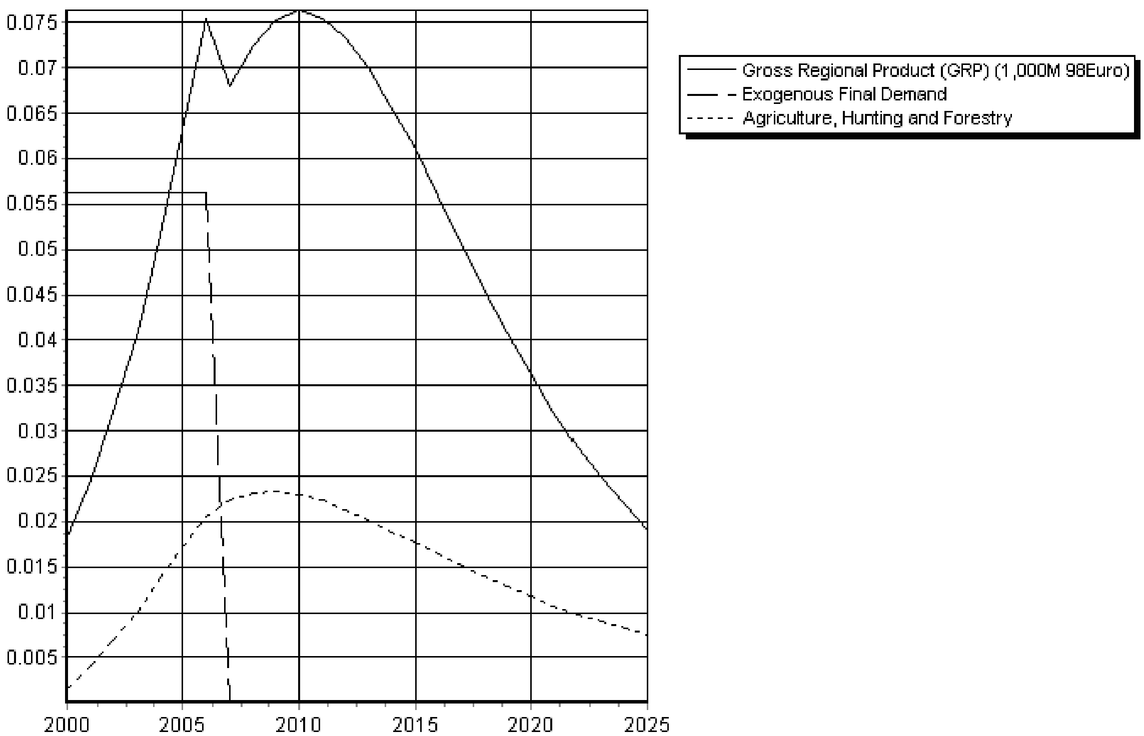
Effects of a 50% public subsidy for agricultural and food industry equipment from 2000 to 2006 *

	2006	2012	2018	2024
Jobs per Million euros	-4.53	1.26	1.13	0.30
Labor force per Million euros	-1.08	0.15	0.63	0.44

Population per Million euros	-0.17	0.01	0.27	0.38
GDP per euro invested	0.26	0.25	0.16	0.07
Real Disposable income per euro	0.14	0.13	0.09	0.05

* EU contributed half of the public investment subsidy. Therefore multiply by 2 to get

Productivity effects of 295M euro public investment in agricultural equipment with 50% public subsidy



COMBINED (OFFICIAL) SIMULATION: Subsidies to investments in Fashion product Industry (Textile, Leather etc.) in Regione Campania, data from P.O.R. (Operative regional Program) Ob. 3 2000-2006 (Roberto Pagni)

Note: This is a 50/50 combination of the 'Fashion: Capacity increase alternative' and the 'Fashion: Productivity change alternative' simulations.

All values below are in amount unless otherwise stated. Also, all values are fixed to 1998 Fixed National Euro (M) unless otherwise stated.

OFFICIAL FASHION						
		2000	2001	2002	2003	2004
Exogenous Final Demand (amount)	Machinery and Equip n.e.c.	16.83817	16.83817	16.83817	16.83817	16.83817
Personal Taxes (amount)	Applicable Personal Income	3.056	3.056	3.056	3.056	3.056
Industry Sales (amount)	Textiles & Textile Products	1.122545	2.120375	3.007347	3.795775	4.49661

Industry Sales (amount)	Leather & Leather Products	0.610079	1.152377	1.634427		2.06292	2.443808
Firm Sales (amount)	Textiles & Textile Products	1.122545	2.24509	3.367635		4.490179	5.612724
Firm Sales (amount)	Leather & Leather Products	0.610079	1.220158	1.830236		2.440315	3.050394
Nullify Invest Ind by Industry Sales	Textiles & Textile Products	1.122545	2.120375	3.007347		3.795775	4.49661
Nullify Invest Ind by Industry Sales	Leather & Leather Products	0.610079	1.152377	1.634427		2.06292	2.443808
Non-Residential Capital (amount)	Non-residential Capital Stock	4.21	4.21	4.21		4.21	4.21
Factor Productivity (share)	Textiles & Textile Products	0.035333	0.066375	0.094697		0.120418	0.144234
Factor Productivity (share)	Leather & Leather Products	0.046253	0.087515	0.125531		0.160429	0.19305

		2005	2006	2007	2012	2018	2024
1. Exogenous Final Demand	Machinery and Equip n.e.c.	16.83817	16.83817	0	0	0	0
2. Personal Taxes (amount)	Applicable Personal Income	3.056	3.056	0	0	0	0
3. Industry Sales (amount)	Textiles & Textile Products	5.119581	5.673341	5.043033	2.7987	1.380619	0.681069
3. Industry Sales (amount)	Leather & Leather Products	2.78238	3.083336	2.740777	1.521032	0.750336	0.370146
3. Firm Sales (amount)	Textiles & Textile Products	6.735269	7.857814	7.219233	4.725393	2.841673	1.708875
3. Firm Sales (amount)	Leather & Leather Products	3.660472	4.270551	3.923917	2.5698	1.546375	0.93053
4. Nullify Invest	Textiles & Textile Products	5.119581	5.673341	5.043033	2.7987	1.380619	0.681069
4. Nullify Investment	Leather & Leather Products	2.78238	3.083336	2.740777	1.521032	0.750336	0.370146
5. Non-Residential Capital	Non-residential Capital Stock	4.21	4.21	0	0	0	0
6. Factor Productivity (share)	Textiles & Textile Products	0.166384	0.186972	0.166743	0.096649	0.051491	0.027962
6. Factor Productivity (share)	Leather & Leather Products	0.223632	0.252451	0.226382	0.134744	0.074303	0.041782

1. Factor Productivity

The values assume that the net increase in the capital in these two industries change factor productivity in proportion to the increase in capital due to the subsidies program.

Official Fashion

Effects of a 50% public subsidy of 88.9M euros for equipment subsidies for the fashion industry equipment

Variable	2006	2012	2018	2024
Employment (Thous)	0.3242	0.09082	0.04053	0.01904
Gross Regional Product (GRP) (1,000M 98Euro)	0.01831	0.006927	0.003632	0.002136
Personal Income (1,000M Nom Euro)	0.01373	0.005554	0.003601	0.002441
PCE-Price Index (98 Euro)(IT Baseline)	-0.00111	-0.00061	-0.00047	-0.00029
Real Disp Personal Income (1,000M 98Euro)	0.003662	0.002777	0.001862	0.001221
Population (Thous)	0.01563	0.02539	0.0332	0.03711
Econ Migrants	0.003693	0.001175	0.000496	6.87E-05
Total Migrants	0.003689	0.001181	0.000509	6.68E-05
Labor Force	0.09229	0.05957	0.03857	0.02686
Demand (1,000M 98Euro)	0.05548	0.01178	0.005615	0.00293
Output (1,000M 98Euro)	0.05072	0.01941	0.01044	0.00592
Delivered Price	-3.46E-06	-1.19E-06	-8.35E-07	-7.15E-07
Relative Cost of Production	-9.89E-06	-4.41E-06	-2.38E-06	-1.67E-06
Labor Intensity	0.00E+00	-1.19E-07	-1.19E-07	-2.38E-07
Labor Access Index	8.94E-07	6.56E-07	3.58E-07	2.38E-07
Indust Mix Index	0	0	0	0
Reg Pur Coeff (SS over Dem)	-4.17E-07	4.23E-06	2.33E-06	1.55E-06
Imports (1,000M 98Euro)	0.01859	0.001282	0.000153	-0.00015
Self Supp (1,000M 98Euro)	0.03696	0.01056	0.005402	0.003113

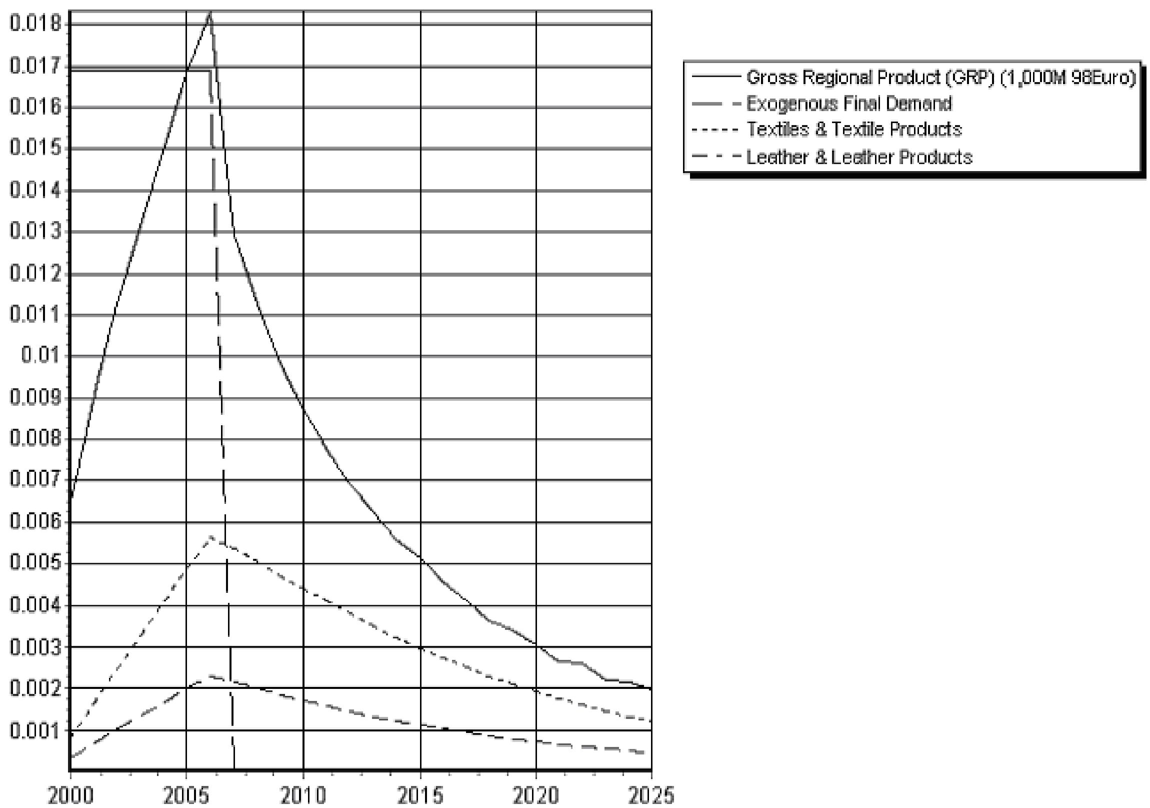
Exp to MR (1,000M 98Euro)	0	0	0	0
Exp to RN (1,000M 98Euro)	0.000801	0.001503	0.001045	0.000687
Exp to RW (1,000M 98Euro)	0.01294	0.007336	0.004017	0.002174
Wage Rate (Thous NomEuro)	0.000309	0.000134	6.10E-05	7.63E-06

Effects of a 50% subsidy for fashion industry equipment

	2006	2012	2018	2024
Jobs per Million euros of public funds	3.65	1.02	0.46	0.21
Labor force per Million euros of public funds	1.04	0.67	0.43	0.30
Population per Million euros of public funds	0.18	0.29	0.37	0.42
GDP per euro invested of public funds	0.21	0.08	0.04	0.02
Real disposable income per euro of public funds	0.04	0.03	0.02	0.01

*: The EU subsidy of 25% was matched by other public sources, increasing the total public subsidy to 50%. Therefore, to get the return on the investment by EU, multiply the numbers in the above table by 2.

Combined Fashion
Effects



FASHION: Capacity increase alternative

SIMULATION: Subsidies to investments in Fashion product Industry (Textile, Leather etc.) in Regione Campania, data from P.O.R. (Operative regional Program) Ob. 3 2000-2006 (Roberto Pagni)

Priority IV “Local Development Systems”

Measures: 4.2 Support to productive development of regional enterprises (ERDF: European Regional Development Fund)

Total amount of public resources of measure 4.2: about 84.2 Meuro per year. This amount can be used by all enterprises in manufacturing sectors.

We have estimated that Fashion sector will receive 15% of total resource: about 12.7 Millions euro per year.

This is the sum of the share of value added produced by: a) Textile and textile products (10%), b) Leather and leather products (5%).

Policy variables: assumptions and sources

All values below are in amount unless otherwise stated. Also, all values are fixed to 1998 Fixed National Euro (M) unless otherwise stated.

1.Exogenous Final Demand (amount), detail: Machinery and Equipment n.e.c.

		2000	2001	2002	2003	2004
1. Exog. Final Demand	Machinery and Equip n.e.c.	16.83817	16.83817	16.83817	16.83817	16.83817

		2005	2006	2007	2012	2018	2024
1. Exog. Final Demand	Machinery and Equip n.e.c.	16.83817	16.83817	0	0	0	0

The amount of public resources for the measures mentioned above is about 12.7 millions euro (M-euro) per year. We have calculated a gross demand for equipment in fashion products industry of about 25.3 M-euro per year (that is the total cost of investments: public plus private resources). It is hard to know the investments induced by public intervention (the so called net effect), because many investments would have been realized also without European funds (the so called deadweight). So we have estimated an increase of net demand for machinery and equipment due to subsidies equal to 2/3 (16.8 Meuro per year).

2.Personal taxes:

		2000	2001	2002	2003	2004
2. Personal Taxes	Applicable Pers. Income	3.056	3.056	3.056	3.056	3.056

		2005	2006	2007	2012	2018	2024
2. Personal Taxes	Applicable Pers. Income	3.056	3.056	0	0	0	0

Multiply 0.15 by 12.7M euros to get 1.905M euros for the regional taxes. Multiply 0.35 by 12.7 to get 4.445M euros for the national taxes. 4.445 is then multiplied by .26 to get the share of national taxes for the Southern Italy region, which is 1.1557. The 1.905+1.1557 gives the total taxes of 3.056M euros.

3.Sales

		2000	2001	2002	2003	2004
3. Industry Sales	Textiles & Textile Products	2.24509	4.240751	6.014693	7.591551	8.993219
3. Industry Sales	Leather & Leather Products	1.220157	2.304755	3.268853	4.125841	4.887617
3. Firm Sales	Textiles & Textile Products	2.24509	4.490179	6.735269	8.980358	11.22545
3. Firm Sales	Leather & Leather Products	1.220157	2.440315	3.660472	4.880629	6.100787

		2005	2006	2007	2012	2018	2024
3. Industry Sales	Textiles & Textile Products	10.23916	11.34668	10.08607	5.5974	2.761237	1.362138
3. Industry Sales	Leather & Leather Products	5.56476	6.166672	5.481555	3.042063	1.500672	0.740292
3. Firm Sales	Textiles & Textile Products	13.47054	15.71563	14.43847	9.450785	5.683346	3.41775
3. Firm Sales	Leather & Leather Products	7.320944	8.541101	7.847833	5.1396	3.09275	1.861059

a) Industry Sales, detail: Textile and textile products

b) Firm Sales, detail: Textile and textile products

a) Industry Sales, detail: Leather and leather products

b) Firm Sales, detail: Leather and leather products

The increase of sales due to investments has been estimated on the base of following hypothesis:

1) For all sectors investments we have considered 10 years life of equipment
2) For all sectors investments we have considered a deadweight of 1/3
3) Both for Textile and for Leather sector we have estimated the 50% of industry sales and the other part firm sales. We think that about the half of subsidized enterprises would be in competition with other firms in the area, especially with irregular firms (not involved of course in the European programme) witch are particularly relevant in Campania fashion products sector.
4) The amount of increase of sales has been computed with a capital output ratio equal to 2.5 for textile sector and equal to 2.3 for leather sector

Depreciation for Industry Sales (Both Textiles and Leather Products):

The depreciation rate is calculated as discussed for agriculture above.

Thus, 1/r = 900/100 where let 100 be the amount of output for one year and thus 900 is the quantity of output for 9 years.

- ⇨ 1/r = 9
- ⇨ 1 = 9r
- ⇨ 9r = 1
- ⇨ r = 1/9 = .1111

Thus, the industry sales for fashion were calculated to be depreciating at the rate of .1111 or 11.11%. In other words, only .8889 or 88.89% of output was produced in the next year (say, 2001) by the same machineries and equipments than in the previous year (say, 2000).

4. Nullify Investments Induced by Industry Sales/ Int'l Sales

		2000	2001	2002	2003	2004
4. Nullify Invest. Ind. by Industry Sales	Textiles & Textile Prod	2.24509	4.240751	6.014693	7.591551	8.993219
4. Nullify Invest. Ind. by Industry Sales	Leather & Leather Prod	1.220157	2.304755	3.268853	4.125841	4.887617

		2005	2006	2007	2012	2018	2024
4. Nullify Invest. Ind. by Industry Sales	Textiles & Textile Prod	10.23916	11.34668	10.08607	5.5974	2.761237	1.362138
4. Nullify Invest. Ind. by Industry Sales	Leather & Leather Prod	5.56476	6.166672	5.481555	3.042063	1.500672	0.740292

Removes the investment that would have been generated by the model in response to the industry sales because this investment has already been entered as exogenous demand.

5. Non-residential Capital

		2000	2001	2002	2003	2004
5. Non-Residential Capital	Non-residential Capital Stock	8.42	8.42	8.42	8.42	8.42

		2005	2006	2007	2012	2018	2024
5. Non-Residential Capital	Non-residential Capital Stock	8.42	8.42	0	0	0	0

Increases the capital stock so that the gap between the optimal and the actual will not change so as to avoid the generation of more investment when it has already been entered as aggregate demand.

Effects of a 50% public subsidy of 88.9M euros for equipment subsidies for the fashion industry equipment.

Variable	2006	2012	2018	2024
Employment (Thous)	1.055	0.272	0.06494	0.0249
Gross Regional Product (GRP) (1,000M 98Euro)	0.03217	0.007477	0.001099	0.000458
Personal Income (1,000M Nom Euro)	0.03876	0.01587	0.005798	0.003113
PCE-Price Index (98 Euro)(IT Baseline)	0.001373	0.001144	0.000427	0.000153
Real Disp Personal Income (1,000M 98Euro)	0.008652	0.003448	0.001251	0.000885
Population (Thous)	0.05469	0.08789	0.09766	0.0918
Econ Migrants	0.01165	0.002071	-4.96E-05	-0.0004
Total Migrants	0.01165	0.002081	-4.01E-05	-0.0004
Labor Force	0.2813	0.187	0.08984	0.05469
Demand (1,000M 98Euro)	0.08917	0.01166	-0.00256	-0.00232
Output (1,000M 98Euro)	0.08514	0.02191	0.005432	0.002563

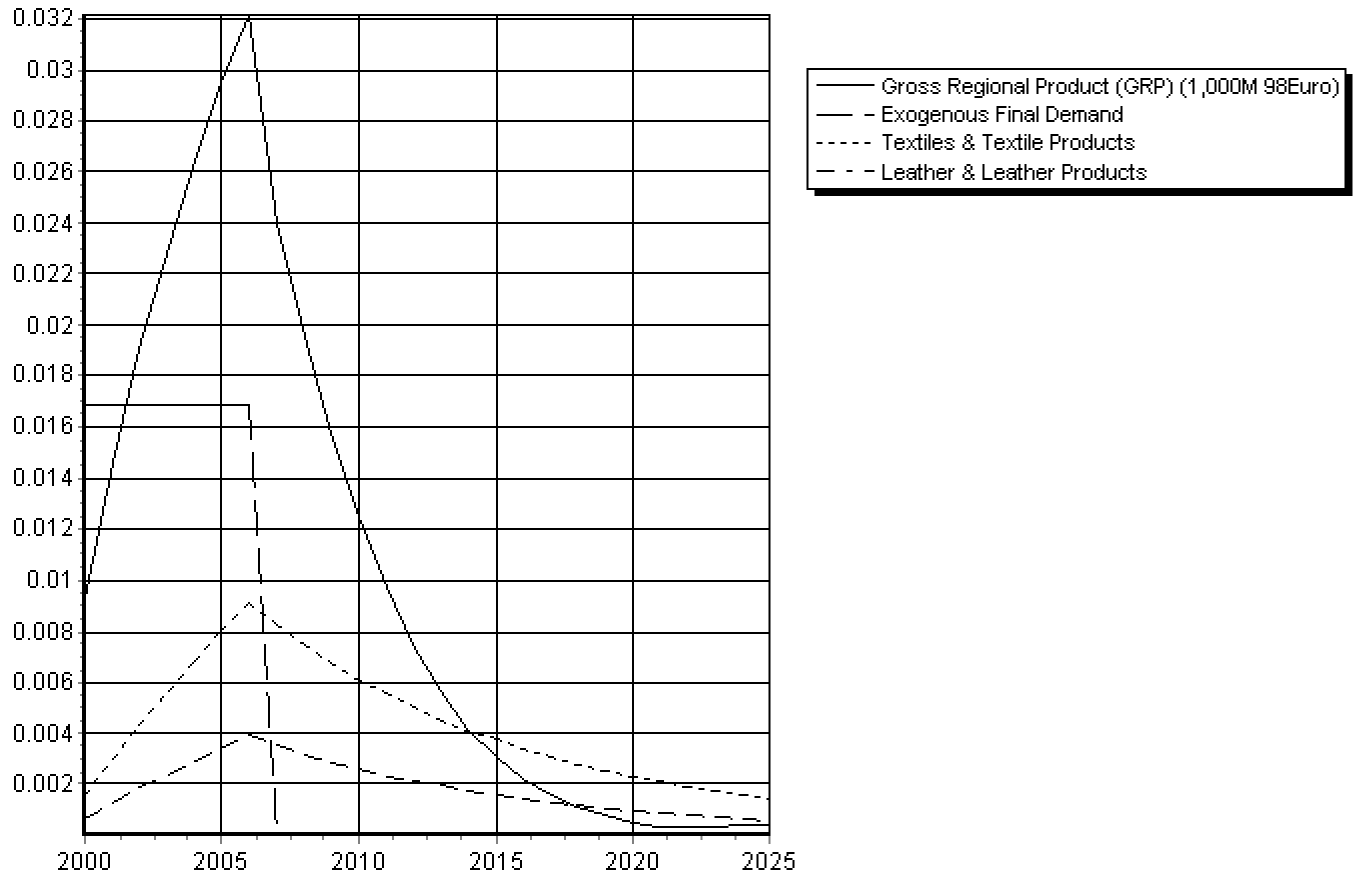
Delivered Price	1.17E-05	8.70E-06	3.46E-06	1.07E-06
Relative Cost of Production	1.65E-05	1.19E-05	5.13E-06	1.67E-06
Labor Intensity	-1.19E-07	-2.38E-07	-3.58E-07	-4.77E-07
Labor Access Index	2.68E-06	2.09E-06	9.54E-07	3.58E-07
Indust Mix Index	0	0	0	0
Reg Pur Coeff (SS over Dem)	1.97E-06	1.13E-06	-2.38E-07	1.19E-07
Imports (1,000M 98Euro)	0.02832	0.003174	-0.00064	-0.00081
Self Supp (1,000M 98Euro)	0.061	0.008514	-0.00195	-0.00147
Exp to MR (1,000M 98Euro)	0	0	0	0
Exp to RN (1,000M 98Euro)	0.000412	0.001244	0.00106	0.000763
Exp to RW (1,000M 98Euro)	0.02375	0.01217	0.006302	0.003319
Wage Rate (Thous NomEuro)	3.82E-06	0.000256	-2.29E-05	-2.14E-04

Effects of a 50% subsidy for fashion industry equipment

	2006	2012	2018	2024
Jobs per Million euros of public funds	11.87	3.06	0.73	0.28
Labor force per Million euros of public funds	3.16	2.10	1.01	0.62
Population per Million euros of public funds	0.62	0.99	1.10	1.03
GDP per euro invested of public funds	0.36	0.08	0.01	0.01
Real disposable income per euro of public funds	0.10	0.04	0.01	0.01

*: The EU subsidy of 25% was matched by other public sources, increasing the total public subsidy to 50%. Therefore, to get the return on the EU investment, multiply the above numbers by 2.

Effects of an 88.9M euro public investment in fashion industry with 50% public subsidy



FASHION: Productivity change alternative

PRODUCTIVITY SIMULATION: Subsidies to investments in Fashion product Industry (Textile, Leather etc.) in Regione Campania, data from P.O.R. (Operative regional Program) Ob. 3 2000-2006 (Roberto Pagni)

Priority IV "Local Development Systems"

Measures: 4.2 Support to productive development of regional enterprises (ERDF: European Regional Development Fund)

Total amount of public resources of measure 4.2: about 84.2 Meuro per year. This amount can be used by all enterprises in manufacturing sectors.

We have estimated that Fashion sector will receive 15% of total resource: about 12.7 Millions euro per year.

This is the sum of the share of value added produced by: a) Textile and textile products (10%), b) Leather and leather products (5%).

Policy variables: assumptions and sources

All values below are in amount unless otherwise stated. Also, all values are fixed to 1998 Fixed National Euro (M) unless otherwise stated.

1. Exogenous Final Demand (amount), detail: Machinery and Equipment n.e.c.

		2000	2001	2002	2003	2004
1. Exog. Final Demand	Machinery and Equip n.e.c.	16.83817	16.83817	16.83817	16.83817	16.83817

		2005	2006	2007	2012	2018	2024
1. Exog. Final Demand	Machinery and Equip n.e.c.	16.83817	16.83817	0	0	0	0

The amount of public resources for the measures mentioned above is about 12.7 millions euro (M-euro) per year. We have calculated a gross demand for equipment in fashion products industry of about 25.3 M-euro per year (that is the total cost of investments: public plus private resources). It is hard to know the investments induced by public intervention (the so called net effect), because many investments would have been realized also without European funds (the so called deadweight). So we have estimated an increase of net demand for machinery and equipment due to subsidies equal to 2/3 (16.8 Meuro per year).

2. Personal taxes:

		2000	2001	2002	2003	2004
2. Personal Taxes	Applicable Pers. Income	3.056	3.056	3.056	3.056	3.056

		2005	2006	2007	2012	2018	2024
2. Personal Taxes	Applicable Pers. Income	3.056	3.056	0	0	0	0

Multiply 0.15 by 12.7M euros to get 1.905M euros for the regional taxes. Multiply 0.35 by 12.7 to get 4.445M euros for the national taxes. The 4.445 is then multiplied by .26 to get the share of national taxes for the Southern Italy region, which is 1.1557. The 1.905+1.1557 gives the total taxes of 3.056M euros.

3. Factor Productivity

			2000	2001	2002	2003	2004
3. Factor Productivity (share)	Textiles/Tex Prod	Percent	0.070667	0.132749	0.189393	0.240836	0.288467
3. Factor Productivity (share)	Leather/ Lea Prod	Percent	0.092506	0.17503	0.251063	0.320857	0.3861

			2005	2006	2007	2012	2018	2024
3. Factor Productivity (share)	Textiles/Tex Prod	Percent	0.332768	0.373944	0.333486	0.193297	0.102983	0.055925
3. Factor Productivity (share)	Leather/ Lea Prod	Percent	0.447265	0.504901	0.452765	0.269488	0.148606	0.083564

The values assume that the net increase in the capital in these two industries change factor productivity in proportion to the increase in capital due to the subsidies program.

Productivity effects of a 50% public subsidy of 88.9M euros for equipment subsidies for the fashion industry equipment

Variable	2006	2012	2018	2024
Employment (Thous)	-0.4023	-0.09033	0.0166	0.0127
Gross Regional Product (GRP) (1,000M 98Euro)	0.004547	0.006317	0.006134	0.003662
Personal Income (1,000M Nom Euro)	-0.01111	-0.0047	0.001282	0.001526
PCE-Price Index (98 Euro)(IT Baseline)	-0.00368	-0.0023	-0.00131	-0.00075
Real Disp Personal Income (1,000M 98Euro)	-0.00113	0.002075	0.002319	0.001465
Population (Thous)	-0.01758	-0.0293	-0.02344	-0.01758
Econ Migrants	-0.00414	0.00042	0.00108	0.000664
Total Migrants	-0.00414	0.000427	0.001083	0.00066
Labor Force	-0.09473	-0.06787	-0.01172	-0.00147
Demand (1,000M 98Euro)	0.02209	0.0119	0.01361	0.007996
Output (1,000M 98Euro)	0.01663	0.01685	0.01544	0.009155
Delivered Price	-1.86E-05	-1.07E-05	-5.13E-06	-2.62E-06
Relative Cost of Production	-3.61E-05	-2.07E-05	-9.89E-06	-5.01E-06
Labor Intensity	0.00E+00	1.19E-07	1.19E-07	1.19E-07
Labor Access Index	-9.54E-07	-8.35E-07	-1.79E-07	5.96E-08
Indust Mix Index	0	0	0	0
Reg Pur Coeff (SS over Dem)	-2.74E-06	7.33E-06	5.19E-06	2.86E-06
Imports (1,000M 98Euro)	0.008926	-0.00064	0.000885	0.000519
Self Supp (1,000M 98Euro)	0.01331	0.01257	0.01263	0.007538
Exp to MR (1,000M 98Euro)	0	0	0	0
Exp to RN (1,000M 98Euro)	0.001175	0.001785	0.00103	0.000626
Exp to RW (1,000M 98Euro)	0.002129	0.002495	0.001717	0.001026
Wage Rate (Thous NomEuro)	0.000599	1.14E-05	9.92E-05	0.000168

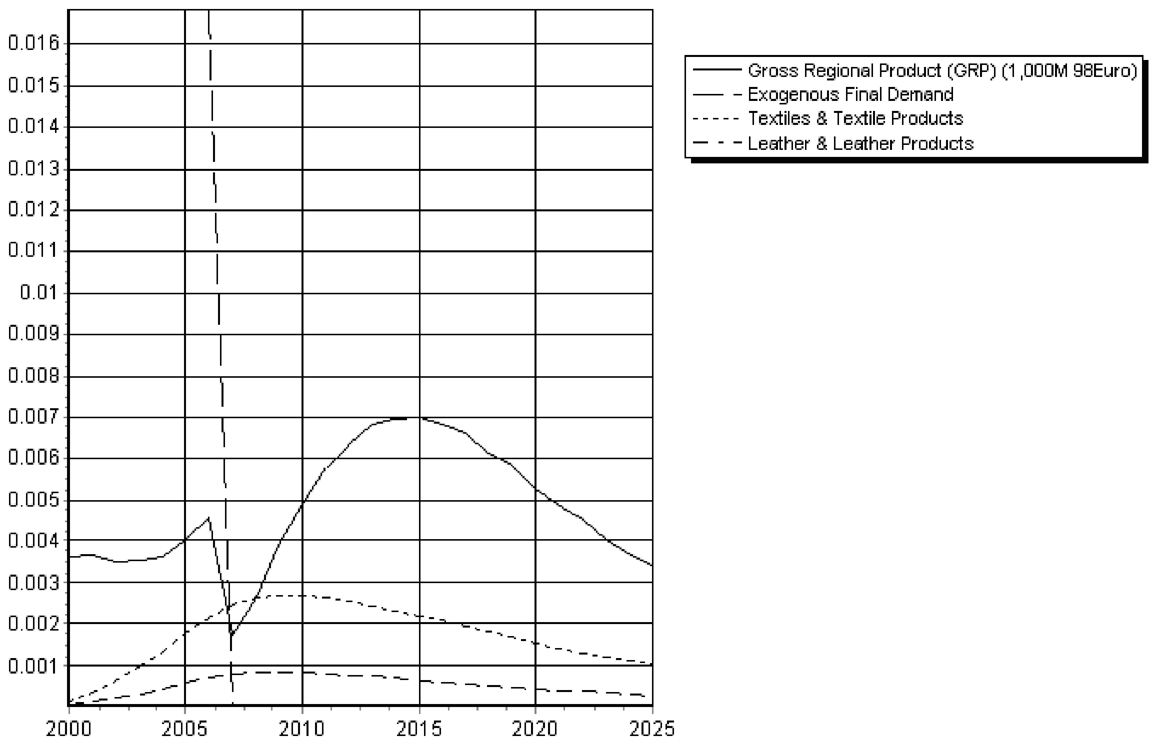
Effects of a 50% subsidy for fashion industry equipment

	2006	2012	2018	2024
Jobs per Million euros of public funds	-4.53	-1.02	0.19	0.14

Labor force per Million euros of public funds	-1.07	-0.76	-0.13	-0.02
Population per Million euros of public funds	-0.20	-0.33	-0.26	-0.20
GDP per euro invested of public funds	0.05	0.07	0.07	0.04
Real disposable income per euro of public funds	-0.01	0.02	0.03	0.02

*: The EU subsidy of 25% was matched by other public sources, increasing the total public subsidy to 50%. Therefore, to get the return on the EU investment, multiply the above numbers by 2.

Productivity effects of 88.9M euro public investment in fashion industry with 50% public subsidy



SIMULATION: Occupational training in Regione Campania, data from P.O.R. (Operative Regional Program) Ob. 3 2000-2006 (Sara Mele)

Priority III “Human resources”:

Measures: 3.2, 3.3, 3.4, 3.5, 3.7, 3.8 and 3.14 (ESF: European Social Fund).

Total amount of public resources: 60.7 Meuro.

Policy variables: assumptions and sources

All values below are in shares unless otherwise stated. Also, all values are fixed to Percent unless otherwise stated.

1. Occupational training, detail: Blue collars/Other personnel

HUMAN CAPITAL

			2000	2001	2002	2003	2004
1. Occupational Training (no.)	Blue collars/Other pers.	Thousands	2.023	3.94485	5.770608	7.505077	9.152823

			2005	2006	2007	2012	2018	2024
1. Occ. Train (no.)	Blue collars/Other pers.	Thousands	10.71818	12.20527	11.59501	8.971997	6.595242	4.848109

We have estimated the number of trainees (Blue collars/Other personnel) considering an average cost per person of about 6.000 euros. We knew the total amount of resources for the seven measures 60,7 Meuros. The deadweight loss is estimated at 80% and the depreciation at 5%.

Depreciation in Occupational Training (number):

A deadweight of 80% is assumed such that only 20% of the trainees are benefited due to the training and get jobs displacing other applicants. The retention rate {i.e. (1-r)} is calculated as discussed for agriculture above. The number of years for which the training will be of value is assumed to be 20 years for the purpose of calculation. The retention rate “1-r” was found to be 0.95. Thus, the value of occupational training was calculated to be depreciating at the rate of .05 or 5%. In other words, only 0.95 or 95% of output was produced in the next year (say, 2001), due to the training received, than in the previous year (say, 2000

).

2. Exogenous Final Demand, detail: Education

			2000	2001	2002	2003	2004	2005
2. Exog. Final Demand (amt.)	Education	1998 Fixed National Eur (M)	60.7	60.7	60.7	60.7	60.7	60.7

			2006	2007	2012	2018	2024
2. Exog. Final Demand (amt.)	Education	1998 Fixed National Eur (M)	60.7	0	0	0	0

We assumed that training programs are offered by private agencies in the education sector. So we introduced an exogenous demand for these firms equal to total cost of training courses (completely financed by public resources)

3. -Personal Taxes, detail: Applicable Personal Income

	2000	2001	2002	2003	2004	2005
3. Personal Taxes (amt) Applicable Pers Inc 1998 Fixed Nat Eur (M)	6.7	6.7	6.7	6.7	6.7	6.7
3. Personal Taxes (amt) Applicable Pers Inc. 1998 Fixed Nat Eur (M)	4.1	4.1	4.1	4.1	4.1	4.1

	2006	2007	2012	2018	2024
3. Personal Taxes (amt) Applicable Pers Inc 1998 Fixed Nat Eur (M)	6.7	0	0	0	0
3. Personal Taxes (amt) Applicable Pers Inc 1998 Fixed Nat Eur (M)	4.1	0	0	0	0

Priority III for "Human resources" is financed by European Social Fund (63%), national (26%) and regional (11%) governments. So we have estimated the increase of personal taxes for citizens of Regione Campania necessary to finance the Regional Operational Programme.

Regional co-financing is completely collected with regional taxes. For the national co-financing we have calculated the share of national taxes paid by Southern Italy's citizens.

Multiply the total amount of public resources of 60.7M euros by .11 to get the share of regional taxes equal to 6.7M euros.

Multiply 60.7M euros by 0.26 to get the national share of taxes. This number is then multiplied by 0.26 (this is the share of taxes for Southern Italy) to get the national taxes for Southern Italy, which comes to 4.1M euros.

4. Labor Productivity

All Productivity measures are in shares.

		2000	2001	2002	2003	2004
4. Labor Productivity	Food products, Beverages & Tobacco	0	0.0135	0.027	0.0405	0.054
4. Labor Productivity	Textiles & Textile Products	0	0.0135	0.027	0.0405	0.054
4. Labor Productivity	Leather & Leather Products	0	0.0135	0.027	0.0405	0.054
4. Labor Productivity	Wood & Wood Products	0	0.0135	0.027	0.0405	0.054
4. Labor Productivity	Pulp, Paper, Publishing & Printing	0	0.0135	0.027	0.0405	0.054
4. Labor Productivity	Coke, Petroleum & Nuclear Fuel	0	0.0135	0.027	0.0405	0.054
4. Labor Productivity	Chemicals & Man-made fibres	0	0.0135	0.027	0.0405	0.054
4. Labor Productivity	Rubber & Plastic Products	0	0.0135	0.027	0.0405	0.054
4. Labor Productivity	Other Nonmetallic Mineral Products	0	0.0135	0.027	0.0405	0.054
4. Labor Productivity	Basic Metals & Fab Metal Products	0	0.0135	0.027	0.0405	0.054
4. Labor Productivity	Machinery and Equipment n.e.c.	0	0.0135	0.027	0.0405	0.054
4. Labor Productivity	Electrical and Optical equipment	0	0.0135	0.027	0.0405	0.054
4. Labor Productivity	Transport equipment	0	0.0135	0.027	0.0405	0.054
4. Labor Productivity	Manufacturing n.e.c.	0	0.0135	0.027	0.0405	0.054

		2005	2006	2007	2012	2018	2024
4. Labor Productivity	Food products, Beverages & Tobacco	0.0675	0.081	0.0945	0.0945	0.0945	0.0945
4. Labor Productivity	Textiles & Textile Products	0.0675	0.081	0.0945	0.0945	0.0945	0.0945

4. Labor Productivity	Leather & Leather Products	0.0675	0.081	0.0945	0.0945	0.0945	0.0945
4. Labor Productivity	Wood & Wood Products	0.0675	0.081	0.0945	0.0945	0.0945	0.0945
4. Labor Productivity	Pulp, Paper, Publishing & Printing	0.0675	0.081	0.0945	0.0945	0.0945	0.0945
4. Labor Productivity	Coke, Petroleum & Nuclear Fuel	0.0675	0.081	0.0945	0.0945	0.0945	0.0945
4. Labor Productivity	Chemicals & Man-made fibres	0.0675	0.081	0.0945	0.0945	0.0945	0.0945
4. Labor Productivity	Rubber & Plastic Products	0.0675	0.081	0.0945	0.0945	0.0945	0.0945
4. Labor Productivity	Other Nonmetallic Mineral Products	0.0675	0.081	0.0945	0.0945	0.0945	0.0945
4. Labor Productivity	Basic Metals & Fab Metal Products	0.0675	0.081	0.0945	0.0945	0.0945	0.0945
4. Labor Productivity	Machinery and Equipment n.e.c.	0.0675	0.081	0.0945	0.0945	0.0945	0.0945
4. Labor Productivity	Electrical and Optical equipment	0.0675	0.081	0.0945	0.0945	0.0945	0.0945
4. Labor Productivity	Transport equipment	0.0675	0.081	0.0945	0.0945	0.0945	0.0945
4. Labor Productivity	Manufacturing n.e.c.	0.0675	0.081	0.0945	0.0945	0.0945	0.0945

It is assumed that employers capture a 5% return on the 6,000 euros investment per person over any additional wages they pay for trained employees that they hire. The policy is influenced by deadweight and replacement effect of about 80%, so only 20% of the trained employees can be considered as a direct output of the training policy. The total value of this is 0.05 * 60.7 * 0.2 = 0.607M euros. Their value divided by the total base line wage bill of the industries above yields 0.0135%. This is not depreciated due to the lifetime advantage that has been demonstrated for education.

Effects of a 100% public subsidy of 425M euros for Human Capital: Blue Collar Training

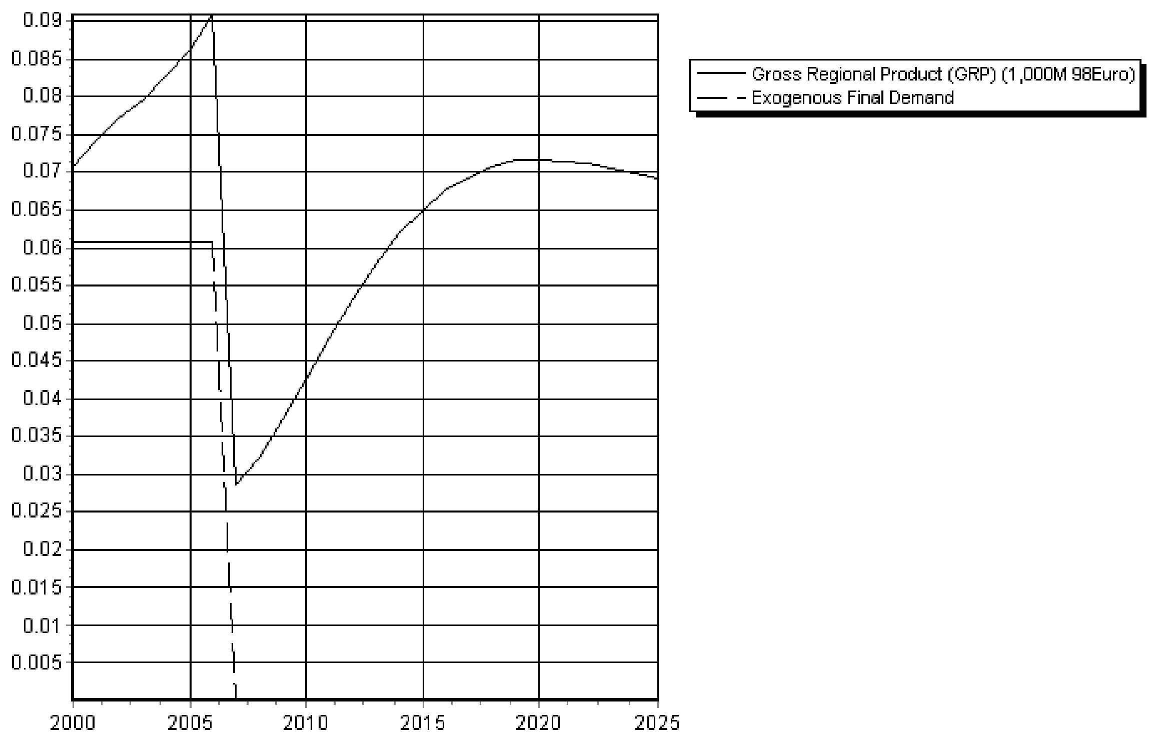
Variable	2006	2012	2018	2024
Employment (Thous)	1.354	0.3042	0.6104	0.5171
Gross Regional Product (GRP) (1,000M 98Euro)	0.09091	0.05322	0.07071	0.06995
Personal Income (1,000M Nom Euro)	0.03363	-0.04486	-0.02435	-0.01672
PCE-Price Index (98 Euro)(IT Baseline)	-0.01544	-0.02586	-0.02657	-0.02568
Real Disp Personal Income (1,000M 98Euro)	0.02527	0.02539	0.03342	0.03427
Population (Thous)	0.1211	0.07813	0.08789	0.0957
Econ Migrants	0.009659	-0.00247	0.002445	0.002132
Total Migrants	0.009652	-0.00247	0.002451	0.002125
Labor Force	0.4722	0.1143	0.2183	0.2441
Demand (1,000M 98Euro)	0.1404	0.09088	0.1276	0.1238
Output (1,000M 98Euro)	0.1384	0.1205	0.1594	0.1581
Delivered Price	-0.00013	-0.00019	-0.00017	-0.00015
Relative Cost of Production	-0.00019	-0.00028	-0.00025	-0.00022
Labor Intensity	-1.19E-07	7.15E-07	1.19E-06	1.55E-06
Labor Access Index	5.08E-05	6.27E-05	5.56E-05	4.47E-05
Indust Mix Index	0	0	0	0
Reg Pur Coeff (SS over Dem)	6.62E-05	5.90E-05	6.78E-05	6.25E-05
Imports (1,000M 98Euro)	0.008347	-0.00716	-0.00389	-0.00473
Self Supp (1,000M 98Euro)	0.1322	0.09805	0.1315	0.1286
Exp to MR (1,000M 98Euro)	0	0	0	0
Exp to RN (1,000M 98Euro)	0.002106	0.01225	0.01495	0.0158
Exp to RW (1,000M 98Euro)	0.003975	0.01014	0.01284	0.01379
Wage Rate (Thous NomEuro)	-0.00275	-0.01057	-0.01205	-0.01231

Effects of a 100% subsidy for Human Capital: Blue Collar Training from 2000 to 2006 *

	2006	2012	2018	2024
Jobs per Million euros	3.2	0.7	1.4	1.2
Labor force per Million euros	1.1	0.3	0.5	0.6
Population per Million euros	0.3	0.2	0.2	0.2
GDP per euro invested	0.2	0.1	0.2	0.2
Real Disposable income per euro	0.1	0.1	0.1	0.1

*: EU contributed 63% of the public investment subsidy, national govt. contributed 26% and regional govt. contributed 11%. Therefore, to get the return on investment by EU, multiply the above numbers by 1.58.

Effects of a 425M euro public investment in human capital with 100% public subsidy



SIMULATION: Subsidies to inter-modal commodities transportation (Operative regional Program) Ob. 3 2000-2006

Priority VI “Network services”

Measures: 6.1 (ERDF: European Regional Development Fund)

Total amount of public resources: 814 Meuro.

Policy variables: assumptions and sources

All values below are in amounts unless otherwise stated. Also, all values are fixed to 1998 Fixed National Euro (M) unless otherwise stated.

1. Exogenous demand in Construction

		2000	2001	2002	2003	2004
1. Exog Final Demand	Construction	148.48	148.48	148.48	148.48	148.48

		2005	2006	2007	2012	2018	2024
1. Exog Final Demand	Construction	148.48	148.48	0	0	0	0

The increasing demand in investment in Construction has been estimated through the total amount of investment and the usage of the specific intermediate column cost of railroad building provided by the Ministry of the Economy

This is based on the total spending over 7 years of 1,039Million euros.

2. Intermediate Demand

		2000	2001	2002	2003	2004
2. Intermediate Demand	Other Nonmetallic Mineral Prod	-6.656	-6.656	-6.656	-6.656	-6.656
2. Intermediate Demand	Basic Metals & Fab. Metal Prod	20.096	20.096	20.096	20.096	20.096
2. Intermediate Demand	Machinery and Equip n.e.c.	15.232	15.232	15.232	15.232	15.232
2. Intermediate Demand	Electrical and Optical Equip	-3.456	-3.456	-3.456	-3.456	-3.456
2. Intermediate Demand	Transport equipment	12.8	12.8	12.8	12.8	12.8
2. Intermediate Demand	Manufacturing n.e.c.	1.536	1.536	1.536	1.536	1.536
2. Intermediate Demand	Electricity, Gas & Water Supply	0	0	0	0	0
2. Intermediate Demand	Construction	-11.264	-11.264	-11.264	-11.264	-11.264
2. Value Added, no Effect on Sales or Emp	Construction	4.48	4.48	4.48	4.48	4.48
2. Intermediate Demand	Wholesale & Retail; Repr of MV	-2.56	-2.56	-2.56	-2.56	-2.56
Intermediate Demand	Hotels & Restaurants	0	0	0	0	0
2. Intermediate Demand	Transport, Storage & Communication	-3.84	-3.84	-3.84	-3.84	-3.84
2. Intermediate Demand	Financial Intermediation	-5.12	-5.12	-5.12	-5.12	-5.12
2. Intermediate Demand	Business Activities, R&D & IT	-11.52	-11.52	-11.52	-11.52	-11.52
2. Intermediate Demand	Public Admn: Defence; Social Security	0	0	0	0	0
2. Intermediate Demand	Education	0	0	0	0	0
2. Intermediate Demand	Health & Social Work	-0.128	-0.128	-0.128	-0.128	-0.128
2. Intermediate Demand	Community, Social & Pers Services	-0.64	-0.64	-0.64	-0.64	-0.64
2. Intermediate Demand	Real Estate & Renting	-5.12	-5.12	-5.12	-5.12	-5.12

		2005	2006	2007	2012	2018	2024
2. Intermediate Demand	Other Nonmetallic Mineral Prod	-6.656	-6.656	0	0	0	0
2. Intermediate Demand	Basic Metals & Fab. Metal Prod	20.096	20.096	0	0	0	0
2. Intermediate Demand	Machinery and Equip n.e.c.	15.232	15.232	0	0	0	0
2. Intermediate Demand	Electrical and Optical Equip	-3.456	-3.456	0	0	0	0
2. Intermediate Demand	Transport equipment	12.8	12.8	0	0	0	0
2. Intermediate Demand	Manufacturing n.e.c.	1.536	1.536	0	0	0	0
2. Intermediate Demand	Electricity, Gas & Water Supply	0	0	0	0	0	0
2. Intermediate Demand	Construction	-11.264	-11.264	0	0	0	0
2. Value Added, no Effect on Sales or Emp	Construction	4.48	4.48	0	0	0	0
2. Intermediate Demand	Wholesale & Retail; Repr of MV	-2.56	-2.56	0	0	0	0
Intermediate Demand	Hotels & Restaurants	0	0	0	0	0	0
2. Intermediate Demand	Transport, Storage & Comm.	-3.84	-3.84	0	0	0	0
2. Intermediate Demand	Financial Intermediation	-5.12	-5.12	0	0	0	0
2. Intermediate Demand	Business Activities, R&D & IT	-11.52	-11.52	0	0	0	0
2. Intermediate Demand	Public Admn: Defence; Soc Sec	0	0	0	0	0	0
2. Intermediate Demand	Education	0	0	0	0	0	0
2. Intermediate Demand	Health & Social Work	-0.128	-0.128	0	0	0	0
2. Intermediate Demand	Community, Social & Pers Servs	-0.64	-0.64	0	0	0	0
2. Intermediate Demand	Real Estate & Renting	-5.12	-5.12	0	0	0	0

This is based on a breakout of the difference for railroad construction compared to construction in general from a breakout compiled by the Ministry of the Economy.

3. Personal Taxes:

		2000	2001	2002	2003	2004
3. Personal Taxes	Applicable Pers. Income	21.8	21.8	21.8	21.8	21.8

		2005	2006	2007	2012	2018	2024
3. Personal Taxes	Applicable Pers. Income	21.8	21.8	0	0	0	0

Multiply the investment of 116M euros by 27.3% to get the national taxes. This number is then multiplied by 0.26 (or 26%) to get the share of taxes for Southern Italy, which gives us 8.23M euros. Multiply 116 by 11.7% to get the share of regional taxes, which comes to 13.57M euros. Therefore, total taxes = 13.57 + 8.23 = 21.8M euros.

4. -Transportation Cost Matrix

One of the main indicators of such a measure is to increase the amount of tons of commodities by railroad per 100 inhabitants. The present value is 1.99 and the target value should be 2.75. This will determine a decrease in transportation cost by moving commodities from road to railroad (parameter has been estimated using data drawn from the Transportation National Account 1994 and Italian State Railways Yearbook). The projection of decreasing transportation cost at regional level has been estimated by using the transport margins in the Italian Objective 1 I-O matrix at market price

This is the effective distance policy variable matrix for Transportation Costs.

	Southern Italy	Rest of Nation
Southern Italy	0.9991	0.9999
Rest of Nation	0.9999	1

5. Accessibility Cost Matrix

to be filled up

This is the effective distance policy variable matrix for Accessibility Costs

	Southern Italy	Rest of Nation
Southern Italy	0.99972	0.99998
Rest of Nation	0.99998	1

This has been estimated at 0.25 of the change in transportation costs based on the contribution to access from reduced transportation costs.

Effects of 814M euros as 78% of transportation infrastructure project.

Total net investment is 1043.6M euros. (Private share 22%).

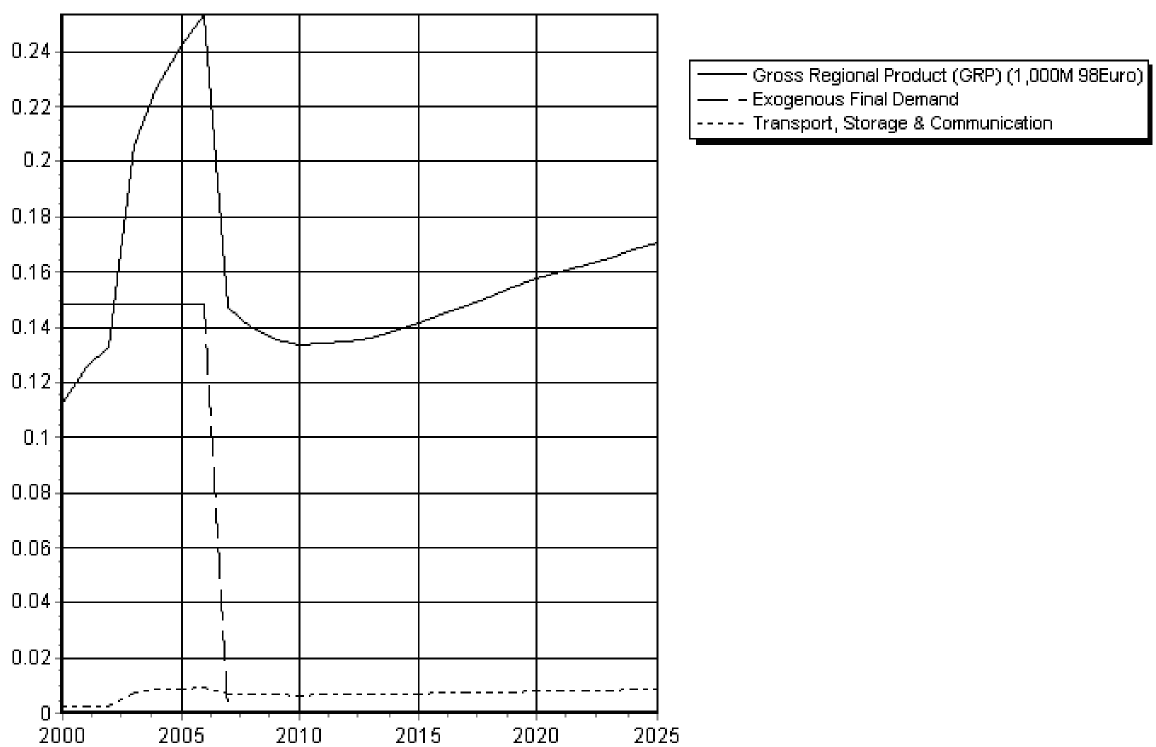
Variable	2006	2012	2018	2024
Employment (Thous)	6.588	2.267	2.253	2.251
Gross Regional Product (GRP) (1,000M 98Euro)	0.2535	0.135	0.1513	0.1681
Personal Income (1,000M Nom Euro)	0.2798	0.1562	0.2025	0.2727
PCE-Price Index (98 Euro)(IT Baseline)	-0.006943	-0.01694	-0.02159	-0.02525
Real Disp Personal Income (1,000M 98Euro)	0.0905	0.07858	0.09363	0.1105
Population (Thous)	0.4492	0.7012	0.9512	1.182
Econ Migrants	0.08223	0.03696	0.03731	0.0347
Total Migrants	0.08222	0.03697	0.03731	0.0347
Labor Force	1.99	1.317	1.332	1.465
Demand (1,000M 98Euro)	0.6535	0.2119	0.2218	0.2435
Output (1,000M 98Euro)	0.533	0.228	0.2547	0.2835
Delivered Price	-7.09E-05	-1.36E-04	-1.51E-04	-1.54E-04
Relative Cost of Production	-8.08E-05	-1.74E-04	-1.96E-04	-2.01E-04
Labor Intensity	-1.79E-06	-3.70E-06	-5.25E-06	-6.68E-06
Labor Access Index	1.85E-05	1.23E-05	1.06E-05	1.04E-05
Indust Mix Index	0	0	0	0
Reg Pur Coeff (SS over Dem)	1.90E-04	1.20E-04	1.30E-04	0.000134
Imports (1,000M 98Euro)	0.1061	-0.00571	-0.01471	-0.01723
Self Supp (1,000M 98Euro)	0.5475	0.2177	0.2365	0.2608
Exp to MR (1,000M 98Euro)	0	0	0	0
Exp to RN (1,000M 98Euro)	-0.01574	0.005562	0.01072	0.01338
Exp to RW (1,000M 98Euro)	0.001236	0.004742	7.45E-03	9.32E-03
Wage Rate (Thous NomEuro)	0.006149	0.006409	0.007179	0.009483

Effects of a 78% public subsidy to Integrated Transport System *

	2006	2012	2018	2024
Jobs per Million euros of public funds	8.1	2.8	2.8	2.8
Labor force per Million euros of public funds	2.4	1.6	1.6	1.8
Population per Million euros of public funds	0.6	0.9	1.2	1.5
GDP per euro invested of public funds	0.3	0.2	0.2	0.2
Real Disposable income per euro of public funds	0.1	0.1	0.1	0.1

* EU provides 50% of the subsidy. Therefore, multiply the above numbers by 2 to get the EU return.

Effects of 814M euro public investment in transportation equipment with 78% public subsidy



SIMULATION: Subsidies to increasing tourism sector competitiveness and tourism expenditure

Total amount of public resources: 213M euros

Policy variables: assumptions and sources

All values below are in amounts unless otherwise stated. Also, all values are fixed to 1999 Fixed National Euro (M) unless otherwise stated.

1. Industry productivity improvements, modeled as exogenous final demand

	2000	2001	2002	2003	2004	2005	2006
Textiles & Textile Products	0.067	0.067	0.067	0.067	0.067	0.067	0.067
Other Nonmetallic Mineral Products	0.067	0.067	0.067	0.067	0.067	0.067	0.067
Basic Metals & Fabricated Metal Products	1.206	1.206	1.206	1.206	1.206	1.206	1.206
Machinery and Equipment n.e.c.	1.809	1.809	1.809	1.809	1.809	1.809	1.809
Electrical and Optical equipment	9.648	9.648	9.648	9.648	9.648	9.648	9.648
Transport equipment	0	0	0	0	0	0	0
Manufacturing n.e.c.	0.469	0.469	0.469	0.469	0.469	0.469	0.469
Construction	24.455	24.455	24.455	24.455	24.455	24.455	24.455
Wholesale & Retail; Repr of MV, Motorcycles	1.608	1.608	1.608	1.608	1.608	1.608	1.608
Business Activities, R&D & IT	1.474	1.474	1.474	1.474	1.474	1.474	1.474

An investment of 286M euros is the net new investment resulting from a 50% subsidy (213M out of 426M) and a one-third deadweight loss of 140M. The investment in hotels is 171M euros and the investment in equipment is 114M euros. Spreading this evenly over seven years yields annual investment of 24.4M euros for hotels and 16.3M euros for equipment and other items, as shown in the table above.

2. Hotels and restaurants industry sales

			2000	2001	2002	2003	2004	2005
2. Industry Sales	Hotels & Rests	1999 Fixed Nat Eur (M)	2.966	8.598	16.446	26.296	37.795	50.742

			2006	2007	2012	2018	2024
2. Industry Sales	Hotels & Rests	1999 Fixed Nat Eur (M)	64.962	76.739	105.303	108.046	100.028

Sales were estimated as the sum of two components: sales to customers within the rest of Italy and sales to the rest of the world. The percent changes in sales were derived from simulations on another industry with a similar demand elasticity to hotels and restaurants. The percentage sales to the rest of Italy and internationally are 40% and 30% respectively.

3. Production Cost in Hotels & Restaurants

			2000	2001	2002	2003	2004	2005
3. Production Cost (share)	Hotels & Rests	Percent	-0.0134	-0.0243	-0.0341	-0.0428	-0.0508	-0.0582

			2006	2007	2012	2018	2024
3. Production Cost (share)	Hotels & Rests	Percent	-0.0649	-0.0603	-0.0439	-0.0318	-0.0242

This is estimated as follows: Take 20% of the capital stock of machinery and equipment and divide it by the baseline value of the output for hotels and restaurants. This gives the % increase in productivity for machinery and equipment. Again, take 10% of the capital stock for hotels and restaurants and divide it by the baseline value of the output for hotels and restaurants. This gives the % increase in productivity for hotels and restaurants industry. Add the two values and this will give the total increase in productivity, or in other words, the % decrease in production cost. This is multiplied by a 30% local share to give the production cost changes inserted into the model for the local market. The other 70% was used in step 2 as described above.

4. Nullify Investments Induced by Industry Sales/Int'l Exports

		2000	2001	2002	2003	2004	2005
4. Nullify Invest Ind. by Industry Sales / Int'l Exp.	Hotels & Rests	2.966	8.598	16.446	26.296	37.795	50.742

		2006	2007	2012	2018	2024
4. Nullify Invest Ind. by Industry Sales / Int'l Exp.	Hotels & Rests	64.962	76.739	105.303	108.046	100.028

This cancels the investment that would normally be generated by industry sales. This is done because the investments have been already put in explicitly.

5. Non-Residential Capital Stock

	2000	2001	2002	2003	2004	2005	2006
Non-Residential Capital Amount	12.257	12.257	12.257	12.257	12.257	12.257	12.257

The change to non-residential capital stock (due to investment) is calculated using the total net new investment of 286M Euros, multiplied by a 30% parameter for local sales and spread evenly over the 7-year period. The amount is zero for the remainder of the forecast period. The effect of this is to nullify the extra investment that would be generated by the increase in purchase by local residents because of item 3 above, since this investment is already capured in step 1.

6. Personal Taxes

			2000	2001	2002	2003	2004
5. Personal Taxes	Applicable Pers Inc	1999 Fixed Nat Eur (M)	9.44	9.44	9.44	9.44	9.44

			2005	2006	2007	2012	2018	2024
5. Personal Taxes	Applicable Pers Inc	1999 Fixed Nat Eur (M)	9.44	9.44	0	0	0	0

Multiply total annual investments of 69.7M euros by 19.8% for national taxes to get 13.8M euros of national taxes. This is then multiplied by 0.26 to get Southern Italy's share of national taxes, which comes to 3.558M euros. The regional share of taxes of 8.4% is multiplied with 69.7M to get 5.8548 euros of taxes. Therefore, total taxes equals 5.8548 + 3.588 =9.44M euros.

Effects of 213M euro public investment in tourism

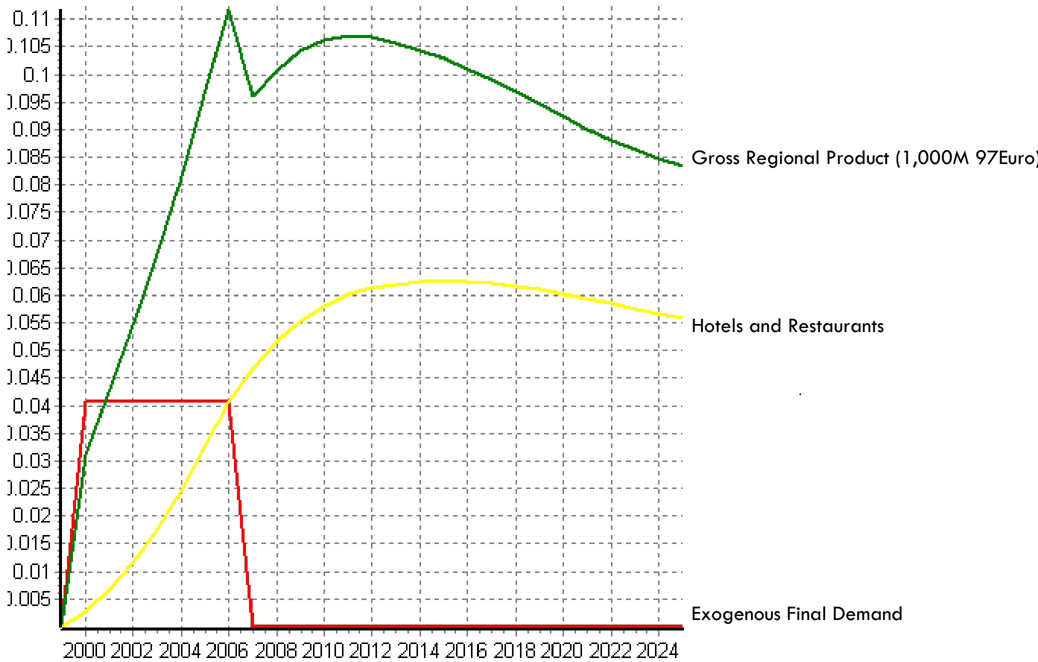
Variable	2006	2012	2018	2024
Employment (Thous)	3.028	2.355	1.754	1.247
Gross Regional Product (GRP) (1,000M 97Euro)	0.1117	0.1067	0.09683	0.08475
Personal Income (1,000M Nom Euro)	0.1237	0.14	0.1478	0.1469
PCE-Price Index (97 Euro)(Reg vs National Baseline)	-0.00589	-0.00168	-0.00014	0
Real Disp Personal Income (1,000M 97Euro)	0.04449	0.04813	0.04355	0.03882
Population (Thous)	0.1758	0.377	0.5391	0.6348
Econ Migrants	0.03909	0.02913	0.01903	0.01118
Total Migrants	0.03908	0.02914	0.01904	0.01118
Labor Force	0.8276	1.017	0.9688	0.8408
Demand (1,000M 97Euro)	0.2361	0.1603	0.1294	0.1049
Output (1,000M 97Euro)	0.2299	0.2075	0.1857	0.161
Delivered Price	-1.7E-06	2.03E-05	2.3E-05	0.000018
Relative Cost of Production	4.41E-06	3.27E-05	3.54E-05	2.77E-05
Labor Intensity	-3.6E-07	-8.3E-07	-1.3E-06	-1.7E-06
Labor Access Index	7.27E-06	9.42E-06	8.76E-06	6.91E-06
Indust Mix Index	0	0	0	0
Reg Pur Coeff (SS over Dem)	3.19E-05	1.2E-05	5.36E-06	2.8E-06
Imports (1,000M 97Euro)	0.05934	0.045	0.03864	0.03204
Self Supply (1,000M 97Euro)	0.1768	0.1153	0.09082	0.07291
Exports to Multiregions (1,000M 97Euro)	0	0	0	0
Exports to Rest of Nation (1,000M 97Euro)	-0.01164	-0.01231	-0.01203	-0.01067
Export to Rest of World (1,000M 97Euro)	0.06469	0.1045	0.1068	0.09881
Wage Rate (Thous NomEuro)	0.00206	0.003593	0.004417	0.004524

Effects of 213M euro public investment in tourism *

	2006	2012	2018	2024
Jobs per Million euros of public funds	14.2	11.1	8.2	5.9
Labor force per Million euros of public funds	3.9	4.8	4.5	3.9
Population per Million euros of public funds	0.8	1.8	2.5	3.0
GDP per euro invested of public funds	0.5	0.5	0.5	0.4
Real Disposable income per euro of public funds	0.2	0.2	0.2	0.2

* EU contributed 70% of the public investment subsidy. Therefore, multiply the above numbers by 1.43 to get the return on EU investment.

Effects of 150M euro public investment in tourism



Part II: Investments in Andalucia

SIMULATION: Occupational training in Andalucia

Priority III “Human resources”:

Measures: 3.2, 3.3, 3.4, 3.5, 3.7, 3.8 and 3.14 (ESF: European Social Fund).

Total amount of public resources (per year): 108.14M euros

Policy variables: assumptions and sources

All values below are in shares unless otherwise stated. Also, all values are fixed to Percent unless otherwise stated.

1. Exogenous Final Demand-detail
   a. Education
   b. Machinery & Equipment n.e.c
   c. Electrical & Optical Equipment
   d. Construction

			2000	2001	2002	2003	2004	2005
1. Exog. Final Demand (amt.)	Education	1999 Fixed Nat Eur (M)	67.28	67.28	67.28	67.28	67.28	67.28
1. Exog. Final Demand (amt)	Machinery & Equip nec	1999 Fixed Nat Eur (M)	12.71	12.71	12.71	12.71	12.71	12.71
1. Exog. Final Demand (amt)	Elec. & Optical Equip	1999 Fixed Nat Eur (M)	10	10	10	10	10	10
1. Exog Final Demand (amt)	Construction	1999 Fixed Nat Eur (M)	18.14	18.14	18.14	18.14	18.14	18.14

			2006	2007	2012	2018	2024
1. Exog. Final Demand (amt.)	Education	1999 Fixed Nat Eur (M)	67.28	0	0	0	0
1. Exog. Final Demand (amt)	Machinery & Equip nec	1999 Fixed Nat Eur (M)	12.71	0	0	0	0
1. Exog. Final Demand (amt)	Elec. & Optical Equip	1999 Fixed Nat Eur (M)	10	0	0	0	0
1. Exog Final Demand (amt)	Construction	1999 Fixed Nat Eur (M)	18.14	0	0	0	0

We assumed that training programs are offered by private agencies in the education sector. So we introduced an exogenous demand for these firms equal to total cost of training courses (completely financed by public resources)

2. Personal Taxes

			2000	2001	2002	2003	2004	2005
2. Personal Taxes (amt)	Applicable Pers Inc	1998 Fixed Nat Eur (M)	35.123	35.123	35.123	35.123	35.123	35.123

			2006	2007	2012	2018	2024
2. Personal Taxes (amt)	Applicable Pers Inc	1998 Fixed Nat Eur (M)	35.123	0	0	0	0

The total amount of regional spending is 245.861M euros over 7 years. Thus, personal taxes for each of the seven years is equal to 245.861/7 = 35.123M euros.

3. Occupational training

TRAINING

			2000	2001	2002	2003	2004
3. Occupational Training (no.)	Technicians	Thousands	1.436	2.8002	4.09619	5.327381	6.497011
3. Occupational Training (no)	Admin support occups	Thousands	1.436	2.8002	4.09619	5.327381	6.497011
3. Occupational Training (no)	Service occupations	Thousands	1.436	2.8002	4.09619	5.327381	6.497011
3. Occupational Training (no)	Production occupations	Thousands	1.436	2.8002	4.09619	5.327381	6.497011
3. Occupational Training (no)	Marketing & sales occ	Thousands	1.436	2.8002	4.09619	5.327381	6.497011

			2005	2006	2007	2012	2018	2024
3. Occ. Training (no)	Technicians	Thousands	7.608161	8.663753	8.230565	6.368654	4.681546	3.441367
3. Occ. Training (no)	Admin support occ	Thousands	7.608161	8.663753	8.230565	6.368654	4.681546	3.441367
3. Occ. Training (no)	Service occ	Thousands	7.608161	8.663753	8.230565	6.368654	4.681546	3.441367
3. Occ Training (no)	Production occ	Thousands	7.608161	8.663753	8.230565	6.368654	4.681546	3.441367
3. Occ. Training (no)	Marketing occ	Thousands	7.608161	8.663753	8.230565	6.368654	4.681546	3.441367

The total number of trainees is given as 81,600. The average cost per person is about 825 euros. The total amount of resources for each of the seven years is 108.14M euros. The deadweight loss is given as 91.2% and the depreciation is taken as 5%.

Depreciation in Occupational Training (number):

A deadweight of 91.2% is given such that only 8.8% of the trainees are benefited due to the training and get jobs displacing other applicants. The retention rate {i.e. (1-r)} is calculated as discussed for agriculture above. The number of years for which the training will be of value is assumed to be 20 years for the purpose of calculation. The retention rate “1-r” was found to be 0.95. Thus, the value of occupational training was calculated to be depreciating at the rate of .05 or 5%. In other words, only 0.95 or 95% of output was produced in the next year (say, 2001), due to the training received, than in the previous year (say, 2000).

4. Labor Productivity

All Productivity measures are in shares.

			2000	2001	2002	2003	2004	2005
4. Labor Productivity	Agriculture & Forestry	Percent	0	0.0019	0.003768	0.005637	0.007505	0.009373
4. Labor Productivity	Fishing	Percent	0	0.0019	0.003768	0.005637	0.007505	0.009373
4. Labor Productivity	Mining & Quarrying	Percent	0	0.0019	0.003768	0.005637	0.007505	0.009373
4. Labor Productivity	Food, Bevs & Tobacco	Percent	0	0.0019	0.003768	0.005637	0.007505	0.009373
4. Labor Productivity	Textiles & Textile Prods	Percent	0	0.0019	0.003768	0.005637	0.007505	0.009373
4. Labor Productivity	Leather & Lea. goods	Percent	0	0.0019	0.003768	0.005637	0.007505	0.009373
4. Labor Productivity	Wood & Wood prods	Percent	0	0.0019	0.003768	0.005637	0.007505	0.009373
4. Labor Productivity	Pulp, Paper, Publ. & Printing	Percent	0	0.0019	0.003768	0.005637	0.007505	0.009373
4. Labor Productivity	Petroleum & Chems	Percent	0	0.0019	0.003768	0.005637	0.007505	0.009373
4. Labor Productivity	Rubber & Plastic Products	Percent	0	0.0019	0.003768	0.005637	0.007505	0.009373
4. Labor Productivity	Other Non-Metallic Mineral Prods	Percent	0	0.0019	0.003768	0.005637	0.007505	0.009373
4. Labor Productivity	Basic Metals & Fab. Metals	Percent	0	0.0019	0.003768	0.005637	0.007505	0.009373
4. Labor Productivity	Machinery & Equip n.e.c.	Percent	0	0.0019	0.003768	0.005637	0.007505	0.009373
4. Labor Productivity	Electrical & Optical Equip	Percent	0	0.0019	0.003768	0.005637	0.007505	0.009373

4. Labor Productivity	Transport Equipment	Percent	0	0.0019	0.003768	0.005637	0.007505	0.009373
4. Labor Productivity	Manufacturing n.e.c.	Percent	0	0.0019	0.003768	0.005637	0.007505	0.009373
4. Labor Productivity	Electricity, Gas & Water	Percent	0	0.0019	0.003768	0.005637	0.007505	0.009373
4. Labor Productivity	Construction	Percent	0	0.0019	0.003768	0.005637	0.007505	0.009373
4. Labor Productivity	Sale & Repr of MV & Motorcycles.	Percent	0	0.0019	0.003768	0.005637	0.007505	0.009373
4. Labor Productivity	Wholesale & Retail	Percent	0	0.0019	0.003768	0.005637	0.007505	0.009373
4. Labor Productivity	Hotels & Restaurants	Percent	0	0.0019	0.003768	0.005637	0.007505	0.009373
4. Labor Productivity	Transport, Storage, Comm.	Percent	0	0.0019	0.003768	0.005637	0.007505	0.009373
4. Labor Productivity	Financial Intermediation	Percent	0	0.0019	0.003768	0.005637	0.007505	0.009373
4. Labor Productivity	Real Estate & Renting	Percent	0	0.0019	0.003768	0.005637	0.007505	0.009373
4. Labor Productivity	Computer, R & D	Percent	0	0.0019	0.003768	0.005637	0.007505	0.009373
4. Labor Productivity	Other bus. activities	Percent	0	0.0019	0.003768	0.005637	0.007505	0.009373
4. Labor Productivity	Public Admin; Defence; SS	Percent	0	0.0019	0.003768	0.005637	0.007505	0.009373
4. Labor Productivity	Education	Percent	0	0.0019	0.003768	0.005637	0.007505	0.009373
4. Labor Productivity	Health & social work	Percent	0	0.0019	0.003768	0.005637	0.007505	0.009373
4. Labor Productivity	Other Community, Soc & Per Servs, HH	Percent	0	0.0019	0.003768	0.005637	0.007505	0.009373

			2006	2007	2012	2018	2024
4. Labor Productivity	Agriculture & Forestry	Percent	0.011242	0.01311	0.01311	0.01311	0.01311
4. Labor Productivity	Fishing	Percent	0.011242	0.01311	0.01311	0.01311	0.01311
4. Labor Productivity	Mining & Quarrying	Percent	0.011242	0.01311	0.01311	0.01311	0.01311
4. Labor Productivity	Food, Bevs & Tobacco	Percent	0.011242	0.01311	0.01311	0.01311	0.01311
4. Labor Productivity	Textiles & Textile Prods	Percent	0.011242	0.01311	0.01311	0.01311	0.01311
4. Labor Productivity	Leather & Lea. goods	Percent	0.011242	0.01311	0.01311	0.01311	0.01311
4. Labor Productivity	Wood & Wood prods	Percent	0.011242	0.01311	0.01311	0.01311	0.01311
4. Labor Productivity	Pulp, Paper, Publ. & Printing	Percent	0.011242	0.01311	0.01311	0.01311	0.01311
4. Labor Productivity	Petroleum & Chems	Percent	0.011242	0.01311	0.01311	0.01311	0.01311
4. Labor Productivity	Rubber & Plastic Products	Percent	0.011242	0.01311	0.01311	0.01311	0.01311
4. Labor Productivity	Other Non-Metallic Mineral Prods	Percent	0.011242	0.01311	0.01311	0.01311	0.01311
4. Labor Productivity	Basic Metals & Fab. Metals	Percent	0.011242	0.01311	0.01311	0.01311	0.01311
4. Labor Productivity	Machinery & Equip n.e.c.	Percent	0.011242	0.01311	0.01311	0.01311	0.01311
4. Labor Productivity	Electrical & Optical Equip	Percent	0.011242	0.01311	0.01311	0.01311	0.01311
4. Labor Productivity	Transport Equipment	Percent	0.011242	0.01311	0.01311	0.01311	0.01311
4. Labor Productivity	Manufacturing n.e.c.	Percent	0.011242	0.01311	0.01311	0.01311	0.01311
4. Labor Productivity	Electricity, Gas & Water	Percent	0.011242	0.01311	0.01311	0.01311	0.01311
4. Labor Productivity	Construction	Percent	0.011242	0.01311	0.01311	0.01311	0.01311
4. Labor Productivity	Sale & Repr of MV & Motorcycles.	Percent	0.011242	0.01311	0.01311	0.01311	0.01311
4. Labor Productivity	Wholesale & Retail	Percent	0.011242	0.01311	0.01311	0.01311	0.01311
4. Labor Productivity	Hotels & Restaurants	Percent	0.011242	0.01311	0.01311	0.01311	0.01311
4. Labor Productivity	Transport, Storage, Comm.	Percent	0.011242	0.01311	0.01311	0.01311	0.01311
4. Labor Productivity	Financial Intermediation	Percent	0.011242	0.01311	0.01311	0.01311	0.01311
4. Labor Productivity	Real Estate & Renting	Percent	0.011242	0.01311	0.01311	0.01311	0.01311
4. Labor Productivity	Computer, R & D	Percent	0.011242	0.01311	0.01311	0.01311	0.01311
4. Labor Productivity	Other bus. activities	Percent	0.011242	0.01311	0.01311	0.01311	0.01311
4. Labor Productivity	Public Admin; Defence; SS	Percent	0.011242	0.01311	0.01311	0.01311	0.01311
4. Labor Productivity	Education	Percent	0.011242	0.01311	0.01311	0.01311	0.01311
4. Labor Productivity	Health & social work	Percent	0.011242	0.01311	0.01311	0.01311	0.01311
4. Labor Productivity	Other Community, Soc & Per Servs, HH	Percent	0.011242	0.01311	0.01311	0.01311	0.01311

It is assumed that employers capture a 5% return on the 825 euros investment per person over any additional wages they pay for trained employees that they hire. 38% of the employees trained found a job on completion of their training but only 58% were working after a year. Thus, only 22.04% (38 * 0.58) of the trained employees can be considered as a direct output of the training policy. The total value of this is 0.05 * 825 * 0.2204 * 81600 = 741866.4 euros or 0.742M euros. Their value divided by the total base line wage bill (taken for the year 2003) of the industries above yields 0.0019%. This is not depreciated due to the lifetime advantage that has been demonstrated for education.

Effects of a 757M euro public investment in Training

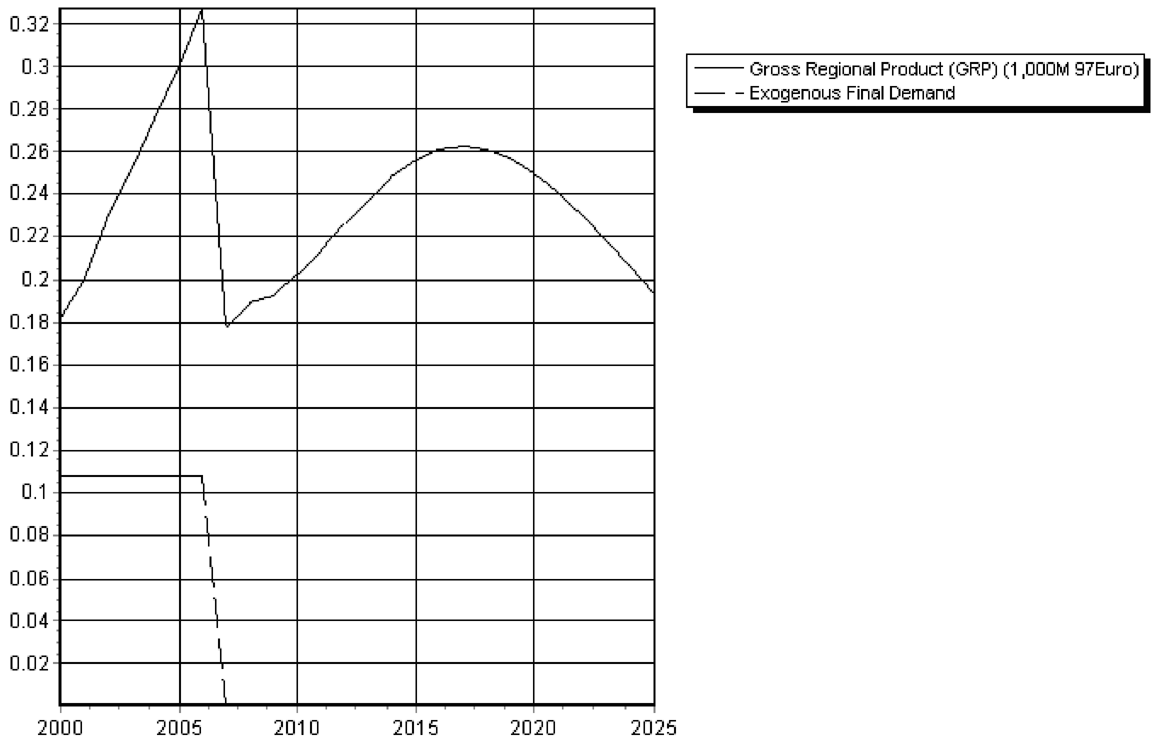
Variable	2006	2012	2018	2024
Employment (Thous)	6.631	2.825	3.238	2.038
Gross Regional Product (GRP) (1,000M 97Euro)	0.3257	0.2267	0.2612	0.2054
Personal Income (1,000M Nom Euro)	0.2764	0.1335	0.2059	0.1743
PCE-Price Index (97 Euro)(Reg vs National Baseline)	-0.04536	-0.1025	-0.1013	-0.1002
Real Disp Personal Income (1,000M 97Euro)	0.2459	0.1838	0.204	0.1591
Population (Thous)	0.4282	0.7876	1.196	1.476
Econ Migrants	0.07321	0.06446	0.04945	0.02923
Total Migrants	0.07322	0.06446	0.04945	0.02923
Labor Force	2.17	1.49	1.738	1.571
Demand (1,000M 97Euro)	0.6463	0.4133	0.4604	0.3382
Output (1,000M 97Euro)	0.5905	0.4457	0.5134	0.4036
Delivered Price	-0.0004	-0.00068	-0.00057	-0.00046
Relative Cost of Production	-0.00044	-0.00073	-0.00061	-0.0005
Labor Intensity	-8.94E-06	-5.71E-05	-8.60E-05	-9.67E-05
Labor Access Index	0.0012	0.001504	0.001295	0.001017
Indust Mix Index	0	0	0	0
Reg Pur Coeff (SS over Dem)	0.000313	0.000384	0.000423	0.00035
Imports (1,000M 97Euro)	0.08194	0.01502	0.01087	-0.00573
Self Supply (1,000M 97Euro)	0.5643	0.3983	0.4495	0.344
Exports to Multiregions (1,000M 97Euro)	0.01727	0.01982	0.0292	0.02654
Exports to Rest of Nation (1,000M 97Euro)	0	0	0	0
Export to Rest of World (1,000M 97Euro)	0.008945	0.02767	0.03469	0.03312
Wage Rate (Thous NomEuro)	0.01294	0.000845	0.001011	0.000366

Effects of a 757M euro public investment in Training *

	2006	2012	2018	2024
Jobs per Million euros of public funds	8.8	3.7	4.3	2.7
Labor force per Million euros of public funds	2.9	2.0	2.3	2.1
Population per Million euros of public funds	0.6	1.0	1.6	1.9
GDP per euro invested of public funds	0.4	0.3	0.3	0.3
Real Disposable income per euro of public funds	0.3	0.2	0.3	0.2

* EU contributed 68% of the public investment subsidy. Multiply by 1.48 for E.U. returns

Effects of a 757M euro public investment in training



SIMULATION: Subsidies to railroad infrastructure in Andalucia

Total amount of public resources: 2120M euros.

Policy variables: assumptions and sources

All values below are in amounts unless otherwise stated. Also, all values are fixed to 1999 Fixed National Euro (M) unless otherwise stated.

1. Exogenous Final Demand, detail: Construction

			2001	2002	2003	2004	2005
1. Exog Final Demand	Construction	1999 Fixed Nat Eur (M)	196.8486	424.9875	428.2488	501.4251	259.6857

			2006	2007	2012	2018	2024
1. Exog Final Demand	Construction	1999 Fixed Nat Eur (M)	110.1251	0	0	0	0

These values have been taken from the Spanish report, based on the total spending over 7 years of 1921.321 Million euros.

2. Intermediate Demand

			2001	2002	2003	2004	2005
2. Intermediate Demand	Other Non-Metallic Mineral Prods	1999 Fixed Nat Eur (M)	-8.82425	-19.0512	-19.1974	-22.4777	-11.6411
2. Intermediate Demand	Basic Metals & Fab Metals	1999 Fixed Nat Eur (M)	26.64244	57.51985	57.96126	67.86529	35.14712
2. Intermediate Demand	Machinery & Equip n.e.c.	1999 Fixed Nat Eur (M)	20.19395	43.59785	43.93242	51.4393	26.64017
2. Intermediate Demand	Electrical & Optical Equip	1999 Fixed Nat Eur (M)	-4.58182	-9.89195	-9.96786	-11.6711	-6.04441
2. Intermediate Demand	Transport Equip	1999 Fixed Nat Eur (M)	16.96971	36.63685	36.918	43.2263	22.3867
2. Intermediate Demand	Manufacturing n.e.c.	1999 Fixed Nat Eur (M)	2.036365	4.396422	4.43016	5.187156	2.686404
2. Intermediate Demand	Electricity, Gas & Water	1999 Fixed Nat Eur (M)	0	0	0	0	0
2. Intermediate Demand	Construction	1999 Fixed Nat Eur (M)	-14.9333	-32.2404	-32.4878	-38.0391	-19.7003
2. Value Added with no Effect on Sales or Empl.	Construction	1999 Fixed Nat Eur (M)	5.939399	12.8229	12.9213	15.12921	7.835345
2. Intermediate Demand	Wholesale & Retail	1999 Fixed Nat Eur (M)	-3.39394	-7.32737	-7.3836	-8.64526	-4.47734
2. Intermediate Demand	Hotels & Rests	1999 Fixed Nat Eur (M)	0	0	0	0	0
2. Intermediate Demand	Transport, Storage, Comm	1999 Fixed Nat Eur (M)	-5.09091	-10.9911	-11.0754	-12.9679	-6.71601
2. Intermediate Demand	Financial Intermediation	1999 Fixed Nat Eur (M)	-6.78788	-14.6547	-14.7672	-17.2905	-8.95468
2. Intermediate Demand	Other business activities	1999 Fixed Nat Eur (M)	-15.2727	-32.9732	-33.2262	-38.9037	-20.148
2. Intermediate Demand	Public Admin & Defence; SS	1999 Fixed Nat Eur (M)	0	0	0	0	0
2. Intermediate Demand	Education	1999 Fixed Nat Eur (M)	0	0	0	0	0
2. Intermediate Demand	Health & social work	1999 Fixed Nat Eur (M)	-0.1697	-0.36637	-0.36918	-0.43226	-0.22387
2. Intermediate Demand	Other Community, Soc & Pers Servs, HH	1999 Fixed Nat Eur (M)	-0.84849	-1.83184	-1.8459	-2.16132	-1.11934
2. Intermediate Demand	Real Estate & Renting	1999 Fixed Nat Eur (M)	-6.78788	-14.6547	-14.7672	-17.2905	-8.95468

			2006	2007	2012	2018	2024
2. Intermediate Demand	Other Non-Metallic Mineral Prods	1999 Fixed Nat Eur (M)	-4.93664	0	0	0	0
2. Intermediate Demand	Basic Metals & Fab Metals	1999 Fixed Nat Eur (M)	14.90487	0	0	0	0
2. Intermediate Demand	Machinery & Equip n.e.c.	1999 Fixed Nat Eur (M)	11.29732	0	0	0	0
2. Intermediate Demand	Electrical & Optical Equip	1999 Fixed Nat Eur (M)	-2.56326	0	0	0	0
2. Intermediate Demand	Transport Equip	1999 Fixed Nat Eur (M)	9.493547	0	0	0	0

2. Intermediate Demand	Manufacturing n.e.c.	1999 Fixed Nat Eur (M)	1.139226	0	0	0	0
2. Intermediate Demand	Electricity, Gas & Water	1999 Fixed Nat Eur (M)	0	0	0	0	0
2. Intermediate Demand	Construction	1999 Fixed Nat Eur (M)	-8.35432	0	0	0	0
2. Value Added with no Effect on Sales or Empl.	Construction	1999 Fixed Nat Eur (M)	3.322741	0	0	0	0
2. Intermediate Demand	Wholesale & Retail	1999 Fixed Nat Eur (M)	-1.89871	0	0	0	0
2. Intermediate Demand	Hotels & Rests	1999 Fixed Nat Eur (M)	0	0	0	0	0
2. Intermediate Demand	Transport, Storage, Comm	1999 Fixed Nat Eur (M)	-2.84806	0	0	0	0
2. Intermediate Demand	Financial Intermediation	1999 Fixed Nat Eur (M)	-3.79742	0	0	0	0
2. Intermediate Demand	Other business activities	1999 Fixed Nat Eur (M)	-8.54419	0	0	0	0
2. Intermediate Demand	Public Admin & Defence; SS	1999 Fixed Nat Eur (M)	0	0	0	0	0
2. Intermediate Demand	Education	1999 Fixed Nat Eur (M)	0	0	0	0	0
2. Intermediate Demand	Health & social work	1999 Fixed Nat Eur (M)	-0.09494	0	0	0	0
2. Intermediate Demand	Other Community, Soc & Pers Servs, HH	1999 Fixed Nat Eur (M)	-0.47468	0	0	0	0
2. Intermediate Demand	Real Estate & Renting	1999 Fixed Nat Eur (M)	-3.79742	0	0	0	0

The intermediate demand has been estimated through the total amount of investment and the usage of the specific intermediate column cost of railroad building compared to general intermediate demands taken from another study.

3. Personal Taxes

			2001	2002	2003	2004	2005
3. Personal Taxes	Applicable Personal Income	1999 Fixed National Eur (M)	9.33	20.06	20.21	23.66	12.25

			2006	2007	2012	2018	2024
3. Personal Taxes	Applicable Personal Income	1999 Fixed National Eur (M)	5.2	0	0	0	0

Personal taxes has been estimated by taking the ratio of wage bill for Andalucia upon the wage bill for all the regions and then multiplying this ratio by 45% of the exogenous final demand for the particular year. We take 45% because that is the percentage of the national contribution.

4. Transportation Cost Matrix

We assume a transportation cost savings of 30% within Andalucia, 12% between Andalucia and Castilla, 20% between Andalucia and rest of Spain while 2% between Castilla and rest of Spain. Take the ratio of money saved due to time savings upon transportation costs. Now multiply this value of the benefits by 0.3 or 30% to get total transportation benefits. 1 minus this value gives us the total transportation costs.

Year 2006 Filled in for all Subsequent Years Effective Distance Policy Variable Matrix for Transportation Costs

	Andalucia	Castilla-la Mancha	Extremadura	Rest of Spain
Andalucia	0.996712	0.998685	1	0.997808
Castilla-la Mancha	0.998685	1	1	0.999781
Extremadura	1	1	1	1
Rest of Spain	0.997808	0.999781	1	1

Year 2024 — Filled in for all Subsequent Years — Effective Distance Policy Variable Matrix for Transportation Costs

	Andalucia	Castilla-la Mancha	Extremadura	Rest of Spain
Andalucia	0.993868	0.997547	1	0.995912
Castilla-la Mancha	0.997547	1	1	0.999591
Extremadura	1	1	1	1
Rest of Spain	0.995912	0.999591	1	1

5. Accessibility Cost Matrix

This has been estimated at 0.5 of the change in transportation costs based on the contribution to access from reduced transportation costs.

Year 2006 — Filled in for all Subsequent Years — Effective Distance Policy Variable Matrix for Accessibility Costs

	Andalucia	Castilla-la Mancha	Extremadura	Rest of Spain
Andalucia	0.998356	0.999342	1	0.998904
Castilla-la Mancha	0.999342	1	1	0.99989
Extremadura	1	1	1	1
Rest of Spain	0.998904	0.99989	1	1

Year 2024 — Filled in for all Subsequent Years — Effective Distance Policy Variable Matrix for Accessibility Costs

	Andalucia	Castilla-la Mancha	Extremadura	Rest of Spain
Andalucia	0.996934	0.998774	1	0.997956
Castilla-la Mancha	0.998774	1	1	0.999796
Extremadura	1	1	1	1
Rest of Spain	0.997956	0.999796	1	1

6. Commuting Cost Matrix

Year 2006 Filled in for all Subsequent Years Effective Distance Policy Variable Matrix for Commuting Costs

	Andalucia	Castilla-la Mancha	Extremadura	Rest of Spain
Andalucia	0.9995	1	1	0.9995
Castilla-la Mancha	1	1	1	1
Extremadura	1	1	1	1
Rest of Spain	0.9995	1	1	1

Effects of a 2120M euro public investment in railroad infrastructure*

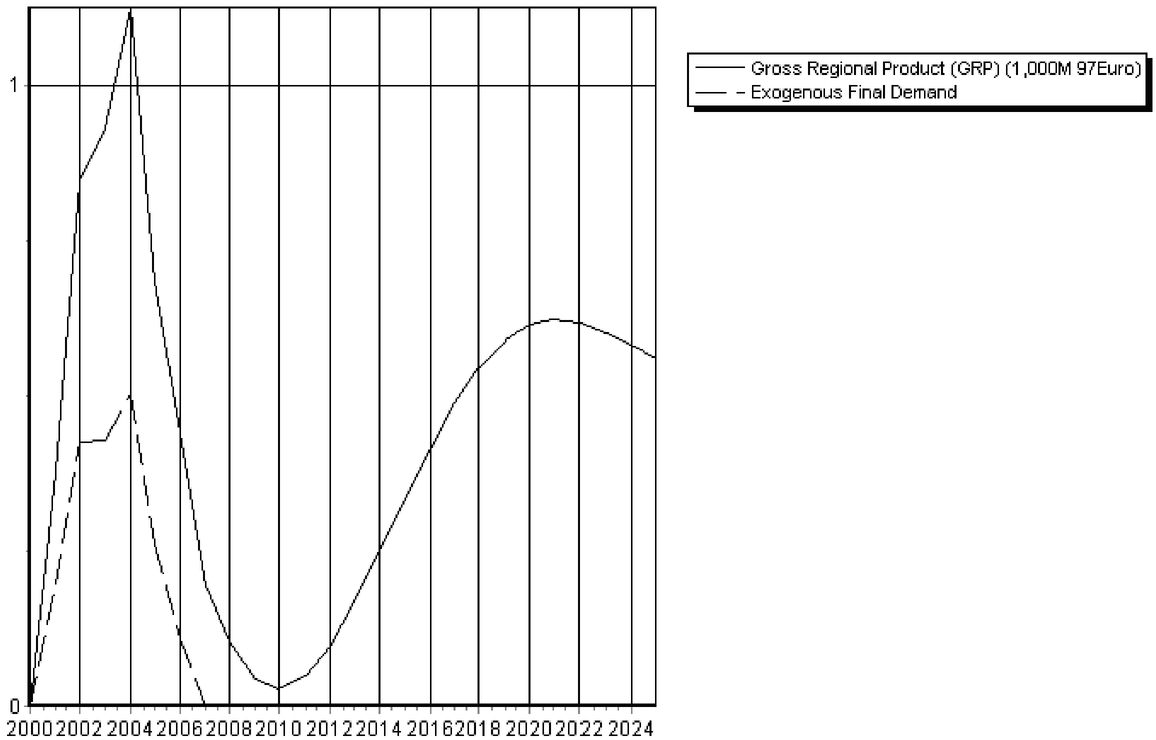
Variable	2006	2012	2018	2024
Employment (Thous)	10.24	-0.5142	5.446	5.228
Gross Regional Product (GRP) (1,000M 97Euro)	0.4273	0.1572	0.4992	0.5699
Personal Income (1,000M Nom Euro)	0.4112	-0.04568	0.3154	0.4203
PCE-Price Index (97 Euro)(Reg vs National Baseline)	0.03821	-0.1472	-0.1603	-0.2137
Real Disp Personal Income (1,000M 97Euro)	0.3133	0.09299	0.3167	0.3636
Population (Thous)	1.442	1.728	1.97	2.357
Econ Migrants	0.09287	0.02366	0.03363	0.0702
Total Migrants	0.09287	0.02367	0.03363	0.0702
Labor Force	5.666	1.246	2.289	2.97
Demand (1,000M 97Euro)	0.9143	-0.1728	0.3578	0.3997
Output (1,000M 97Euro)	0.8043	0.01013	0.5795	0.6405
Delivered Price	0.000161	-0.00094	-0.00088	-0.00098
Relative Cost of Production	0.000209	-0.00092	-0.00087	-0.00096
Labor Intensity	4.57E-05	-5.54E-05	-0.00012	-0.00015
Labor Access Index	0.000452	0.000503	0.000486	0.000543
Indust Mix Index	0	0	0	0
Reg Pur Coeff (SS over Dem)	0.000365	0.000239	0.000545	0.000612
Imports (1,000M 97Euro)	0.1285	-0.08035	-0.03615	-0.05126
Self Supply (1,000M 97Euro)	0.7858	-0.09241	0.394	0.451
Exports to Multiregions (1,000M 97Euro)	0.02681	0.07763	0.1392	0.1323
Exports to Rest of Nation (1,000M 97Euro)	0	0	0	0
Export to Rest of World (1,000M 97Euro)	-0.00833	0.02492	0.04636	0.05718
Wage Rate (Thous NomEuro)	0.01517	-0.00467	-0.00546	-0.00364

Effects of a 2120M euro public investment in railroad infrastructure*

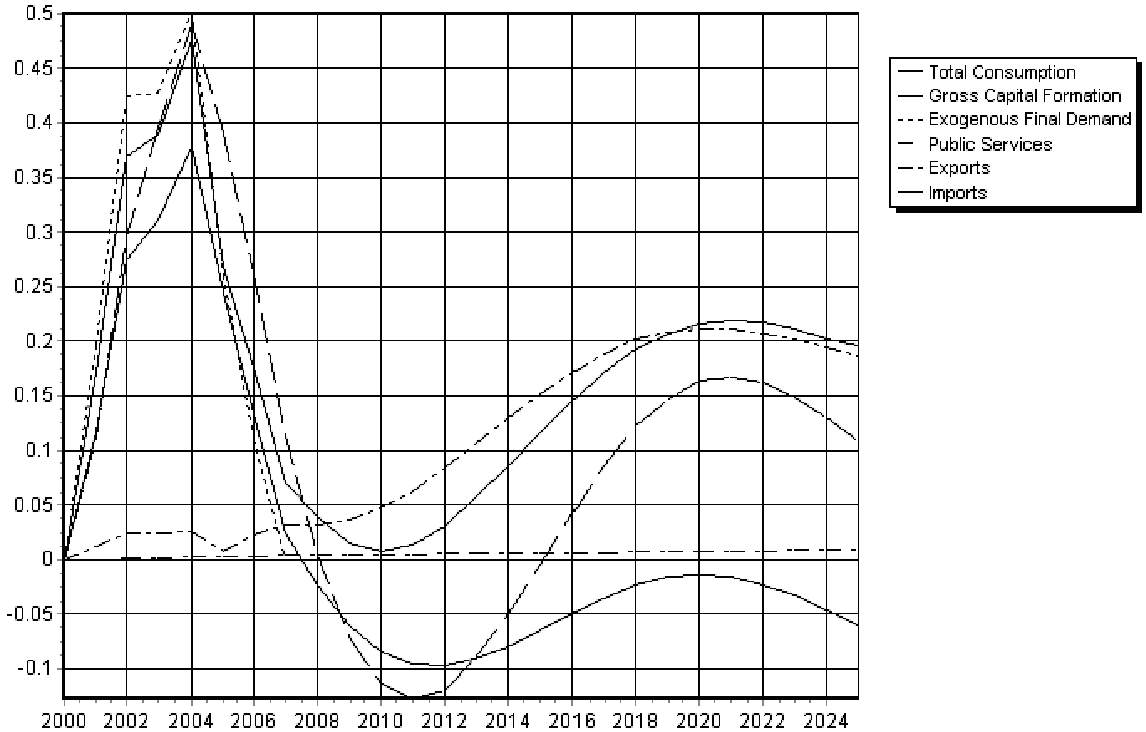
	2006	2012	2018	2024
Jobs per Million of euros of public funds	4.8	-0.2	2.6	2.5
Labor force per Million of euros of public funds	2.7	0.6	1.1	1.4
Population per Million euros of public funds	0.7	0.8	0.9	1.1
GDP per euro invested of public funds	0.2	0.1	0.2	0.3
Real Disposable income per euro of public funds	0.1	0.0	0.1	0.2

* EU contributed 57% of the public investment subsidy. Therefore, multiply the above numbers by 1.75 to get the return on EU investments.

Effects of 1550M euro public investment in railroad infrastructure



Effects of 1550M euro investment in railroad infrastructure



Domestic Trade Flows: Wholesale and Retail (% change)

2018	Andalucia	Castilla-la Mancha	Extremadura	Rest of Spain	Rest of World	Output
Andalucia	0.32%	0.98%	0.44%	1.31%	0.23%	0.49%
Castilla-la Mancha	-0.54%	0.35%	0.26%	0.45%	0.11%	0.33%
Extremadura	-1.03%	0.29%	0.21%	0.32%	0.05%	0.21%
Rest of Spain	-0.28%	0.38%	0.21%	0.33%	0.07%	0.31%
Rest of World	-0.28%	-0.11%	-0.05%	-0.06%	X	X
Demand	0.30%	0.40%	0.20%	0.36%	X	X

Domestic Trade Flows: Computer, Research and Development (% change)

2018	Andalucia	Castilla-la Mancha	Extremadura	Rest of Spain	Rest of World	Output
Andalucia	0.58%	1.45%	0.66%	1.52%	0.13%	0.45%
Castilla-la Mancha	-0.05%	0.99%	0.58%	0.87%	0.04%	0.70%
Extremadura	-0.44%	0.97%	0.56%	0.79%	0.02%	0.38%
Rest of Spain	0.17%	1.04%	0.56%	0.79%	-0.04%	0.55%
Rest of World	-0.13%	-0.04%	-0.02%	-0.02%	X	X
Demand	0.34%	0.72%	0.39%	0.58%	X	X

SIMULATION: Subsidies to highway infrastructure in Andalucia

Total amount of public resources: 2042M euros

Policy variables: assumptions and sources

All values below are in amounts unless otherwise stated. Also, all values are fixed to 1999 Fixed National Euro (M) unless otherwise stated.

1. Exogenous Demand, detail: Construction

			2000	2001	2002	2003	2004
1. Exog Final Demand	Construction	1999 Fixed Nat Eur (M)	291.7	291.7	291.7	291.7	291.7

			2005	2006	2007	2012	2018	2024
1. Exog Final Demand	Construction	1999 Fixed Nat Eur (M)	291.7	291.7	0	0	0	0

Divide the total public investments of 2042M euros by 7 to get the exogenous final demand of 291.7M euros for each of the seven years.

2. Personal taxes

			2000	2001	2002	2003	2004
2. Personal Taxes	Applicable Pers Inc	1999 Fixed Nat Eur (M)	44.26	44.26	44.26	44.26	44.26

			2005	2006	2007	2012	2018	2024
2. Personal Taxes	Applicable Pers Inc	1999 Fixed Nat Eur (M)	44.26	44.26	0	0	0	0

Divide the regional funds of 264.33M euros by 7 to get 37.761M euros. Divide Andalucia’s wage bill by the wage bill for all regions to get the ratio of Andalucia’s share of the national taxes. Multiply this by the national funds of 348.284M euros to get 45.495M euros. Divide 45.495M euros by the seven year period to get 6.499M euros of national taxes per year. Therefore, total taxes for each year = 37.761 + 6.499M = 44.26M euros.

3. Transportation Cost Matrix

Assume a return of 5% on the cost for the highway infrastructure. Thus, 0.05 * 2042M euros = 102M euros of benefit per year. However, as highways are getting built, people will be able to use them before the project completion year of 2007. Therefore, we assume 1/3 of the total benefits of 102M euros will be received in 2005; 2/3 benefits will be received in 2006 and thereafter, the total benefits of 102M euros will be received.

92M euros of the benefits will go to the Andalucia area. 1M each to Castilla and Extremadura and 3M to the rest of Spain from and to Andalucia.

Now, 92 divided by the transportation cost in Andalucia (8377M euros) gives us 0.011. 1/3 of this value (0.00366) is the value of benefits accrued in 2005. (1- 0.00366) is the transportation cost, which is 0.99634.

Also, for Castilla and Extremadura we assume only ½ of the benefits are accrued due to traveling on new roads. So, only 1M euros are accrued as benefits compared to the 92M euros in the Andalucia region or

1/92. Thus, total benefits is 0.00366 divided by 2, and then divided by 92 (0.00366*1/2*1/92). Thus, cost is 1- 0.00366*1/2*1/92 which gives us 0.99998.

Similarly for the rest of Spain, we assume only 1/6 of the benefits are accrued due to traveling on the Andalucian highways. Therefore, total cost is given by 1- { 3/92*1/6*0.00366}= 0.99998.

Similary, the transportation costs are found for year 2006 where the benefits value is 0.00366*2 = 0.00732 and for 2007 and beyond, benefits accrued is 0.00366*3 or 0.011.

Year 2005 Filled in for all Subsequent Years Effective Distance Policy Variable Matrix for Transportation Costs

	Andalucia	Castilla-la Mancha	Extremadura	Rest of Spain
Andalucia	0.99634	0.99998	0. 99998	0.99998
Castilla-la Mancha	0.99998	1	1	1
Extremadura	0.99998	1	1	1
Rest of Spain	0.99998	1	1	1

Year 2006 Filled in for all Subsequent Years Effective Distance Policy Variable Matrix for Transportation Costs

	Andalucia	Castilla-la Mancha	Extremadura	Rest of Spain
Andalucia	0.99268	0.99996	0. 99996	0.99996
Castilla-la Mancha	0.99996	1	1	1
Extremadura	0.99996	1	1	1
Rest of Spain	0.99996	1	1	1

Year 2007 Filled in for all Subsequent Years Effective Distance Policy Variable Matrix for Transportation Costs

	Andalucia	Castilla-la Mancha	Extremadura	Rest of Spain
Andalucia	0.989	0.99994	0. 99994	0.99994
Castilla-la Mancha	0.99994	1	1	1
Extremadura	0.99994	1	1	1
Rest of Spain	0.99994	1	1	1

4. Accessibility Cost Matrix

This has been estimated at 1/2 of the transportation benefits. Thus, for year 2005 benefits is ½ of 0.00366. For 2006, it is 0.00366 and for 2007 and beyond 0.0055. The other calculations are performed in exactly the same way as transportation costs.

Year 2005 Filled in for all Subsequent Years Effective Distance Policy Variable Matrix for Accessibility Costs

	Andalucia	Castilla-la Mancha	Extremadura	Rest of Spain
Andalucia	0.99817	0.99999	0.99999	0.99999
Castilla-la Mancha	0.99999	1	1	1
Extremadura	0.99999	1	1	1
Rest of Spain	0.99999	1	1	1

Year 2006 Filled in for all Subsequent Years Effective Distance Policy Variable Matrix for Accessibility Costs

	Andalucia	Castilla-la Mancha	Extremadura	Rest of Spain
Andalucia	0.99634	0.99998	0.99998	0.99998
Castilla-la Mancha	0.99998	1	1	1
Extremadura	0.99998	1	1	1
Rest of Spain	0.99998	1	1	1

Year 2007 Filled in for all Subsequent Years Effective Distance Policy Variable Matrix for Accessibility Costs

	Andalucia	Castilla-la Mancha	Extremadura	Rest of Spain
Andalucia	0.9945	0.99997	0.99997	0.99997
Castilla-la Mancha	0.99997	1	1	1
Extremadura	0.99997	1	1	1
Rest of Spain	0.99997	1	1	1

5. Commuting Cost Matrix

We assume 1% of the total investments for commuting costs. This gives us 20.42M euros. However, only half of this value is considered since commuting costs is often taken as half of the wage value. This gives 10.21M euros.

This value divided by the wage bill for Andalucia (43035) gives us 0.000237. Now, 1-0.000237 = 0.99976 for the year 2007. For 2006, 2/3 of 0.00024 is 0.00016 and therefore, commuting cost is 1-0.00016 = .99984. For 2005, 1- 0.00008 = 0.9992.

Year 2005 Filled in for all Subsequent Years Effective Distance Policy Variable Matrix for Commuting Costs

	Andalucia	Castilla-la Mancha	Extremadura	Rest of Spain
Andalucia	0.9992	0.99999	0.99999	1
Castilla-la Mancha	0.99999	1	1	1
Extremadura	0.99999	1	1	1
Rest of Spain	1	1	1	1

Year 2006 Filled in for all Subsequent Years Effective Distance Policy Variable Matrix for Commuting Costs

	Andalucia	Castilla-la Mancha	Extremadura	Rest of Spain
Andalucia	0.99984	0.99999	0.99999	1
Castilla-la Mancha	0.99999	1	1	1
Extremadura	0.99999	1	1	1
Rest of Spain	1	1	1	1

Year 2007 Filled in for all Subsequent Years Effective Distance Policy Variable Matrix for Commuting Costs

	Andalucia	Castilla-la Mancha	Extremadura	Rest of Spain
Andalucia	0.99975	0.99998	0.99998	1
Castilla-la Mancha	0.99998	1	1	1
Extremadura	0.99998	1	1	1
Rest of Spain	1	1	1	1

Effects of a 2042M euro public investment in highway infrastructure

Variable	2006	2012	2018	2024
Employment (Thous)	20.97	-0.3623	5.86	6.135
Gross Regional Product (GRP) (1,000M 97Euro)	0.8349	0.09389	0.4099	0.4669
Personal Income (1,000M Nom Euro)	0.8255	0.006973	0.3963	0.5745
PCE-Price Index (97 Euro)(Reg vs National Baseline)	0.04926	-0.0988	-0.082	-0.07709
Real Disp Personal Income (1,000M 97Euro)	0.6253	0.08977	0.3036	0.3435
Population (Thous)	1.629	2.268	2.769	3.205
Econ Migrants	0.2621	0.08016	0.05049	0.07144
Total Migrants	0.2621	0.08016	0.05049	0.07144
Labor Force	6.823	1.8	2.627	3.542
Demand (1,000M 97Euro)	1.778	-0.09238	0.4616	0.5644
Output (1,000M 97Euro)	1.612	0.03656	0.6125	0.7028
Delivered Price	0.000219	-0.00064	-0.00047	-0.00039
Relative Cost of Production	0.000305	-0.00056	-0.00039	-0.00031
Labor Intensity	3.87E-05	-3.36E-05	-7.28E-05	-7.42E-05
Labor Access Index	0.00057	0.000477	0.000396	0.000382
Indust Mix Index	0	0	0	0
Reg Pur Coeff (SS over Dem)	0.001289	0.000702	0.000946	0.000964
Imports (1,000M 97Euro)	0.1534	-0.1494	-0.09677	-0.09479
Self Supply (1,000M 97Euro)	1.624	0.05698	0.5583	0.6592
Exports to Multiregions (1,000M 97Euro)	-0.00352	-0.03196	0.0316	0.02227
Exports to Rest of Nation (1,000M 97Euro)	0	0	0	0
Export to Rest of World (1,000M 97Euro)	-0.00881	0.01155	0.02261	0.02126
Wage Rate (Thous NomEuro)	0.02419	0.005474	0.006012	0.01325

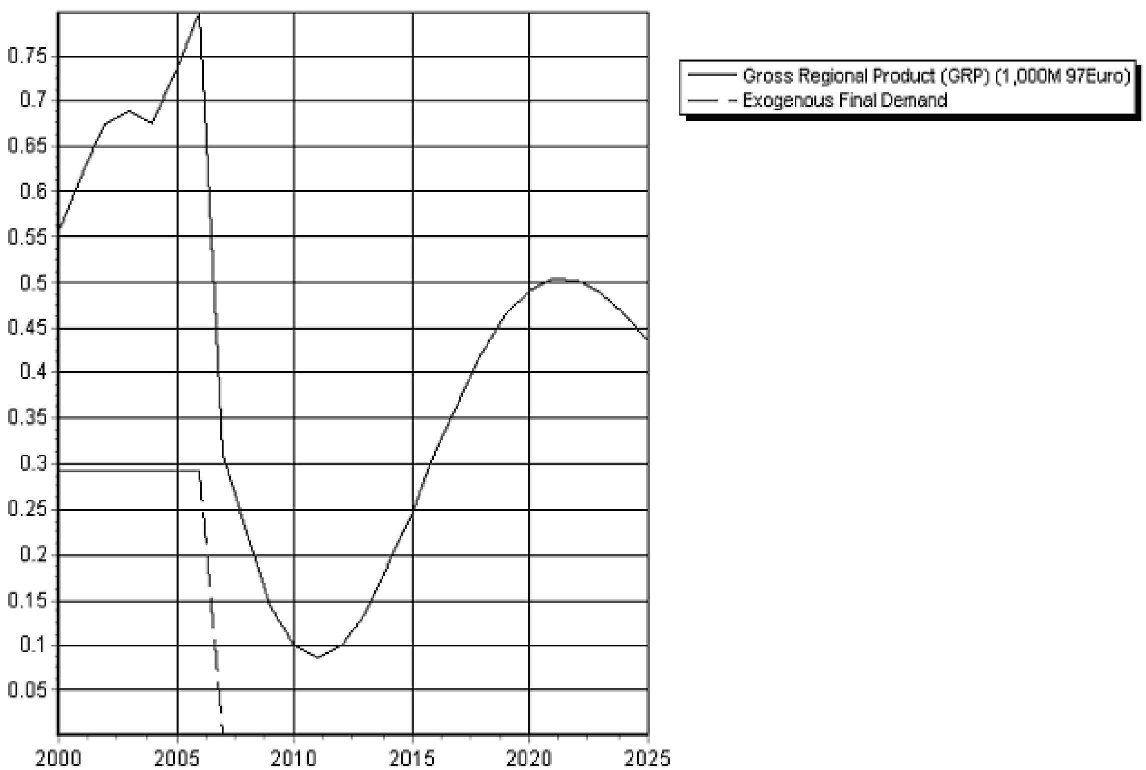
Effects of a 2042M euro public investment in highway infrastructure *

	2006	2012	2018	2024
Jobs per Million of euros of public funds	10.27	-0.18	2.87	3.00

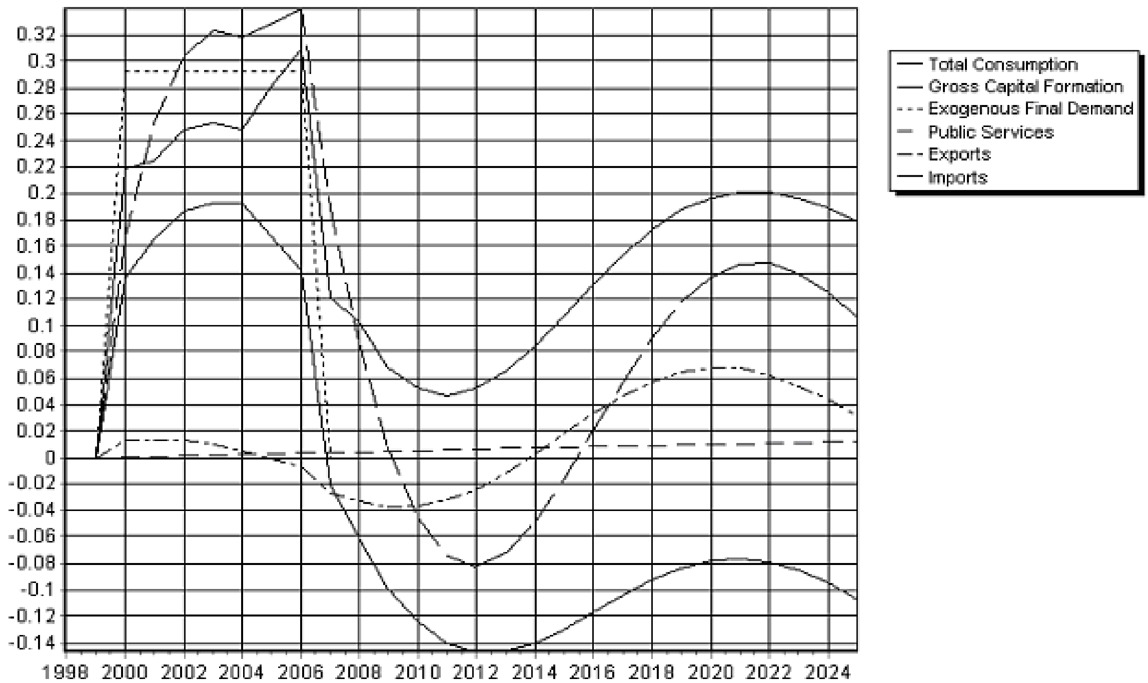
Labor force per Million of euros of public funds	3.34	0.88	1.29	1.73
Population per Million euros of public funds	0.80	1.11	1.36	1.57
GDP per euro invested of public funds	0.41	0.05	0.20	0.23
Real Disposable income per euro of public funds	0.31	0.04	0.15	0.17

* EU contributed 70% of the public investment subsidy. Therefore, multiply the above numbers by 1.43 to get the return on EU investments.

Effects of 2042M euro public investment in highway infrastructure



Effects of 2042M euro public investment in highway infrastructure



2018 | Wholesale & Retail | Type: Percent Change

	Andalucia	Castilla-la	Extremadu	Rest of Sp	Rest of W	Output
Andalucia	0.29%	0.22%	0.16%	0.24%	0.09983%	0.26392%
Castilla-la Mancha	-1.98%	0.12%	0.06%	0.13%	0.04414%	0.11630%
Extremadura	-1.97%	0.13%	0.07%	0.14%	0.05173%	0.07231%
Rest of Spain	-1.99%	0.11%	0.05%	0.13%	0.05242%	0.12103%
Rest of World	-0.13%	-0.04%	-0.05%	-0.04%	X	X
Demand	0.27%	0.13%	0.06%	0.13%	X	X

2018 | Computer, Research & Development | Type: Percent Change

	Andalucia	Castilla-la	Extremadu	Rest of Sp	Rest of W	Output
Andalucia	0.78%	0.45%	0.28%	0.40%	0.07149%	0.57110%
Castilla-la Mancha	-1.06%	0.38%	0.22%	0.33%	0.01564%	0.26638%
Extremadura	-1.06%	0.39%	0.22%	0.33%	0.01853%	0.15519%
Rest of Spain	-1.06%	0.38%	0.22%	0.33%	-0.02449%	0.20334%
Rest of World	-0.07%	-0.02%	-0.02%	-0.02%	X	X
Demand	0.31%	0.27%	0.15%	0.24%	X	X

SIMULATION: Subsidies to increasing tourism sector competitiveness and tourism expenditure

Total amount of public resources: 150M euros

Policy variables: assumptions and sources

All values below are in amounts unless otherwise stated. Also, all values are fixed to 1999 Fixed National Euro (M) unless otherwise stated.

7. Exogenous Final Demand, detail –Hotels & Restaurants, Machinery & Equipment

			2000	2001	2002	2003	2004
1. Exogenous Final Demand	Hotels & Rests	1999 Fixed Nat Eur (M)	25	25	25	25	25
1. Exogenous Final Demand	Machinery & Equip n.e.c.	1999 Fixed Nat Eur (M)	3.57	3.57	3.57	3.57	3.57

			2005	2006	2007	2012	2018	2024
1. Exogenous Final Demand	Hotels & Rests	1999 Fixed Nat Eur (M)	25	25	0	0	0	0
1. Exogenous Final Demand	Machinery & Equip n.e.c.	1999 Fixed Nat Eur (M)	3.57	3.57	0	0	0	0

An investment of 175M euros is estimated for Hotels and Restaurants and of 25M euros is estimated for Machinery and Equipment over 7 years. Thus, 175/7 = 25M euros and 25/7 = 3.57M euros for each of the seven years.

8. Hotels and restaurants industry sales

			2000	2001	2002	2003	2004	2005
2. Industry Sales	Hotels & Rests	1999 Fixed Nat Eur (M)	15.462	16.32	17.196	17.958	18.654	19.284

			2006	2007	2012	2018	2024
2. Industry Sales	Hotels & Rests	1999 Fixed Nat Eur (M)	19.872	4.9782	3.5334	3.6462	3.573

Take the difference between the rest-of-the-world values and the local andalucian values in the trade flows matrix to get the percentage difference of 0.13% for the year 2010. We take year 2010 to discount for the increase in economic activity right after 2006 which could lead to misleading values. The level of output in 2007 for hotels and restaurants was found to be 13.517. Assuming half of the output is exports, we get the value 6.7585. This is then multipled by 0.0013 (or 0.13%) to get the increase in exports of 0.008786Billions or 8.786Million euros.

Similarly, a difference of 0.0667% was found in the trade flows matrix for 2025. The level of output for 2025 was found to be 18.490. Exports are therefore, half of it, which is 9.245Billions. This is multiplied by 0.000667 to get 0.006166billions or 6.166M euros.

Given the values for 2007 and 2025, we can linearly find the values for the other years.

9. Production Cost in Hotels & Restaurants

			2000	2001	2002	2003	2004	2005
3. Production Cost (share)	Hotels & Rests	Percent	-0.02895	-0.05485	-0.07829	-0.09975	-0.11951	-0.13807

			2006	2007	2012	2018	2024
3. Production Cost (share)	Hotels & Rests	Percent	-0.15574	-0.14839	-0.11721	-0.0914	-0.07409

This is estimated as follows: Take 20% of the capital stock of machinery and equipment and divide it by the baseline value of the output for hotels and restaurants. This gives the % increase in productivity for machinery and equipment. Again, take 10% of the capital stock for hotels and restaurants and divide it by the baseline value of the output for hotels and restaurants. This gives the % increase in productivity for hotels and restaurants industry. Add the two values and this will give the total increase in productivity, or in other words, the % decrease in production cost.

10. Nullify Investments Induced by Industry Sales/Int'l Exports

		2000	2001	2002	2003	2004	2005
4. Nullify Invest Ind. by Industry Sales / Int'l Exp.	Hotels & Rests	15.462	16.32	17.196	17.958	18.654	19.284

		2006	2007	2012	2018	2024
4. Nullify Invest Ind. by Industry Sales / Int'l Exp.	Hotels & Rests	19.872	4.9782	3.5334	3.6462	3.573

This cancels the investment that would normally be generated by industry sales. This is done because the investments have been already put in explicitly.

11. Personal Taxes

			2000	2001	2002	2003	2004
5. Personal Taxes	Applicable Pers Inc	1999 Fixed Nat Eur (M)	6.43	6.43	6.43	6.43	6.43

			2005	2006	2007	2012	2018	2024
5. Personal Taxes	Applicable Pers Inc	1999 Fixed Nat Eur (M)	6.43	6.43	0	0	0	0

Divide the total regional investments of 45M euros by 7 to get the value of personal taxes equal to 6.43M euros.

Variable	2006	2012	2018	2024
Employment (Thous)	2.753	0.3726	0.6995	0.6953
Gross Regional Product (GRP) (1,000M 97Euro)	0.1078	0.02046	0.03724	0.03928
Personal Income (1,000M Nom Euro)	0.1033	0.01601	0.04095	0.05721
PCE-Price Index (97 Euro)(Reg vs National Baseline)	-0.01469	-0.0228	-0.01941	-0.01527
Real Disp Personal Income (1,000M 97Euro)	0.0965	0.03103	0.04	0.03963
Population (Thous)	0.2002	0.3232	0.4111	0.4551
Econ Migrants	0.03489	0.0152	0.007627	0.005169
Total Migrants	0.03489	0.01521	0.007627	0.005169
Labor Force	0.9038	0.4094	0.3975	0.4507

Demand (1,000M 97Euro)	0.2327	0.02771	0.05769	0.06488
Output (1,000M 97Euro)	0.2096	0.03523	0.06784	0.07233
Delivered Price	8.29E-06	-4.38E-05	-2.50E-05	-4.95E-06
Relative Cost of Production	-1.16E-05	-5.96E-05	-3.74E-05	-1.55E-05
Labor Intensity	8.46E-06	9.78E-06	1.00E-05	1.25E-05
Labor Access Index	4.61E-05	3.57E-05	2.46E-05	1.49E-05
Indust Mix Index	0	0	0	0
Reg Pur Coeff (SS over Dem)	0.000103	2.21E-05	3.27E-05	2.96E-05
Imports (1,000M 97Euro)	0.03113	0.00172	0.00555	0.007351
Self Supply (1,000M 97Euro)	0.2016	0.02597	0.05214	0.05756
Exports to Multiregions (1,000M 97Euro)	0.006324	0.002227	0.007343	0.007919
Exports to Rest of Nation (1,000M 97Euro)	0	0	0	0
Export to Rest of World (1,000M 97Euro)	0.001698	0.007042	0.008358	0.006824
Wage Rate (Thous NomEuro)	0.002092	-0.00014	-0.00065	-0.00036

Effects of a 150M euro public Investment in Tourism*

	2006	2012	2018	2024
Jobs per Million of euros of public funds	18.4	2.5	4.7	4.6
Labor force per Million of euros of public funds	6.0	2.7	2.7	3.0
Population per Million euros of public funds	1.3	2.2	2.7	3.0
GDP per euro invested of public funds	0.7	0.1	0.2	0.3
Real Disposable income per euro of public funds	0.6	0.2	0.3	0.3

* EU contributed 70% of the public investment subsidy. Therefore, multiply the above numbers by 1.43 to get the return on EU investments.

Effects of 150M euro public investment in tourism