

WORKING PAPER SERIES

CEEApIA WP No. 23/2011

A CGE Approach to Measuring the Impacts of EU Structural Funds in a Small Open Economy

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November 2011

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Working Paper n.º 23/2011
Novembro de 2011

RESUMO/ABSTRACT

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The present work studies the European Union (EU) funds in a regional context, while assessing the impact of EU funds on the gross domestic product (GDP) and employment of the Autonomous Region of the Azores. The theoretical model is based on a modeling platform for the Azorean economy, supported by a dynamic multi-sectoral Computable General Equilibrium model (CGE) - AzorMod, which incorporates the economic behavior of six agents: firms, households, the regional government, the central government, the European Commission and an external sector.

Using simulations, we study the impact of eliminating EU funds from the Azorean economy. The study reveals that the absence of EU funds causes a reduction in public consumption and in consumer well-being and an increase in investment. GDP and employment decrease in the first year of the simulations. The GDP level is only recovered at the end of ten years when there are no EU transfers and employment at the end of one year. After this period, the estimated values, without EU funds, exceed the projected values for the scenario that include community funds.

Keywords: EU Funds, Computable General Equilibrium Model (CGE), Azores

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Abstract

The present work studies the European Union (EU) funds in a regional context, while assessing the impact of EU funds on the gross domestic product (GDP) and employment of the Autonomous Region of the Azores. The theoretical model is based on a modeling platform for the Azorean economy, supported by a dynamic multi-sectoral Computable General Equilibrium model (CGE) - AzorMod, which incorporates the economic behavior of six agents: firms, households, the regional government, the central government, the European Commission and an external sector.

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1 Introduction

Since the addition of Portugal to the European Union (EU) in 1986 and within the negotiated frameworks, the Autonomous Region of the Azores is the beneficiary of financial transfers from the European Regional Development Fund (ERDF) of the European Social Fund (ESF), the European Agricultural Guidance and Guarantee Fund – Guidance Section (EAGGF), current European Agricultural Fund for Rural Development (EAFRD), the Financial Instrument of Fisheries Guidance (FIFG), current European Fisheries Fund (EFF), the Cohesion Fund and the European Agricultural Guidance and Guarantee Fund – Guarantee Section (EAGGF) as well as the current European Agricultural Guarantee Fund (EAGF).

The community financial flows transferred to regional public and private entities seek: 1) structural development and adjustment of the economy; 2) improvement of work and employment by promoting social inclusion and reducing employment disparities; 3) financing market mechanisms; 4) promoting sustainable rural development; 5) supporting the Common Fisheries Policy and; 6) promoting sustainable development through measures within the field of Trans-European Transport and Environment Networks.

Evaluation of the effects of EU transfers on growth, investment and employment levels of the beneficiary countries is based on models specifically developed to do so. Bradley et al. (1995) is used to evaluate reimbursed community programs under Objective 1; Ferreira et al. (2003) appreciates the execution of three Community Support Frameworks (CSF); Lima e Cardenete (2005) studies the incidence of European funds in the region of Andalusia; Rodríguez-Pose and Fratesi (2003) analyzes the impact of structural funds attributed to the regions in Objective 1.

The present study seeks to examine community funds in the Azores, investigating the impact of said funds in the economy and employment that constitute contribution to the public money management bodies in the application of EU funds. To this end, we use AzorMod, a platform for modeling the economy of the Azores represented by a multi-sectoral, dynamic computable general equilibrium (CGE) model developed by Fortuna et al. (2009) that incorporates the behavior of six economic agents: enterprises, families, regional governments, central governments, the European Commission and the rest of the world. The model's simulation focuses on elimination of EU transfers in the 2002-2013 period, with 2001 as the base year.

The present study is structured in five sections. Section 2 includes the framework of community funds within EU policies and identifies the objectives of each fund in light of the respective rules. The literature review is developed in Section 3, which also presents the primary models used in the study of the impact of community funds in the economies of the beneficiary countries. The fourth section details the characterizations of AzorMod while Section 5 addresses the results obtained in the simulation. The key lessons and limitations of the study, as well as clues for future studies are developed in the Conclusion.

2 Community Funds and the Azorean Economy

Community funds (ERDF, ESF, EAGGF, FIFG and the Cohesion Fund) are substantial instruments of financial support set by the European Union in the practice of certain policies, namely with regard to the Common Agricultural Policy, the Common Fisheries Policy, Social Policy and Cohesion Policy. Community support attributed to the EU countries is determined by regional development.

In the 1994-1999 and 2000-2006 periods, continental Portugal and its outermost regions (the Azores and Madeira) are considered eligible within Objective 1, which promotes the development and structural adjustment of regions with an average GNP lower than 75% of the EU average. In the 2007-2013 period, the Azores is integrated in the Convergence Objective (formerly Objective 1) and the Territorial Cooperation Objective, making the region eligible for the Operating Program of Transnational Cooperation Madeira – Azores – Canary Islands.

The Azores territory is considered an outermost region by the definition of Article 299 of the EU Treaty and the business framework of Portugal since 1986 (Prior to Regulation – 1986 to 1988; CSF I – 1989 to 1993; CSF II – 1994 to 1999; CSF III – 2000 to 2006; QREN and PEN – 2007 to 2013), making it a beneficiary of transfers from the ERDF, ESF, EAGGF/EAFRD, FIFG/EFF, EAGGF/EAGF and the Cohesion Fund. In the initial phase of Portugal's inclusion to the EU, the Azores also benefited from transfers to a pre-association fund.

During the first years of integration, EU transfers result in the presentation of individualized projects, such as the SATA and PNIC Azores, among others. Afterward, community funds are systematized by national and regional Operating Systems (OS) and Community Development (CD). Regional OS with particular relevance include: *PEDRAA I and II*, *PRODESA*, *PROCONVERGÊNCIA*, *PRO-Emprego* and the

PRORURAL. The interventions in question add to specific agricultural measures in favor of the outermost regions, financed by the EAGF, through the POSEI, which integrates the *Regime Específico de Abastecimento* (Specific Supply Arrangements) and the *Medidas a Favor das Produções Agrícolas Locais Regionais* (Measures in Favor of Regional Agricultural Production), which are an important source of agricultural funding since 1992.

The community funds that result from execution of investment projects by the *Administração Directa Regional* (Direct Regional Administration) are accounted for by the *Conta da Região Autónoma dos Açores – CRAA* (Account of the Azores) in capital transfers. The community budget destined to the *Administração Indirecta* (Indirect Administration), the *Administração Local* (Local Administration) and private entities (including societies integrated by the Azores) are divided into two groups: one integrating the CRAA in extra-budgetary operations, and the other with exclusive record in the final beneficiary.

3 Literature Review

Study of the effects of EU transfers in the growth, investment and employment of beneficiary countries is largely conducted with macroeconomic models specifically designed to this end. The models are used to study the country's evolution, rather than the different regions within the countries, resulting in a limitation for their usage, since the regions within Objective 1 are also beneficiaries of community transfers.

There are several applications of input-output matrixes in the study of development programs, including estimation of the impacts and net effects of the principal programs financed by the structural funds.

Beutel (2002) quantifies the development that can be attributed to the structural funds, public intervention (structural funds and national public intervention) and full

intervention (structural funds, national public intervention and private participation) expenditure reporting on a national level: Spain, Portugal, Greece and Ireland, with Eastern Germany and Mezzogiorno on a macro-regional level.

MODEM is a multi-sectoral base input-output model developed by the *Departamento de Prospectiva e Planeamento* (Department of Forecasting and Planning) as an instrument to study the macroeconomic impact of major ventures (CSF, EXPO'98, PIDDAC, investments in social equipment and the AutoEuropa), substantiating an annual model of simultaneous determination with 59 homogeneous branches of activity corresponding to the existing disaggregation of the symmetrical model of input-output matrixes constructed for Portugal for the year of 2005 (Dias and Lopes, 2008).

Efforts to study the effects of EU regional policies, particularly the impact of structural funds, lead to creation of a number of new models oriented to problems relating to the regional outskirts (Bradley et al. 1995). At the center of the HERMIN model structure is construction of small- and medium-scale macro models, with about 100 to 150 equations that relate to Ireland, Portugal and Spain, based on lessons obtained from the HERMES and QUEST models, as well as recent, national econometric models (Bradley et al., 1995).

HERPOR is a macroeconometric model constructed for the Portuguese economy by a team of technicians from the *Departamento de Prospectiva e Planeamento* (Department of Forecasting and Planning) and researchers from the Technical University of Lisbon. This model, an evolution of the HERMIN model, contemplates the views of supply and demand and its short-, mid- and long-term impacts simultaneously (Ferreira et al., 2003).

This reference model is used to simulate the macroeconomic impacts of the CSF III, as well as the combined effects of the CSF III and the previous CSF, being econometrically estimated from statistics and other data about the Portuguese economy in a way that dynamic simulation of the model recreates the historical evolution from 1977 to 1999 in a satisfactory manner (Ferreira et al., 2003).

Treyz et al. (2003) use the macroeconometric model REMI to study the major programs financed by structural funds in face of certain scenarios. Their study aims to show how the socioeconomic effects of community programs can be evaluated through a model developed to study the economies of nations, as well as the regions of various countries. Analysis reveals the full effect of structural measures and public investments on the economy, showing how to develop a comparative study of the future effectiveness of funding expenditures as well as structural and cohesion funds (Treyz et al., 2003).

De la Fuente (2009) develops a simple model to estimate the relative effectiveness of cohesion expenses in similar, non-subsidiary projects. The adopted methodology uses regional Spanish data to estimate the relative effectiveness of projects financed by structural and cohesion funds. A key concept of their model is that it maintains the accumulated stock of EU capital and uses a regional production function that allows this component to be more or less productive than the one from projects not co-financed.

Ederveen et al. (2002) empirically study the effectiveness of structural funds for promoting economic growth and lowering regional asymmetries in the EU by analyzing a data panel of thirteen EU countries, estimating a cross-sectional equation within a linear regression context.

Rodriguez-Pose and Fratesi (2003) study to what degree structural funds contribute to reduction in disparities between levels of development among regions, with the axes

of underlying policy funds as its base. Their model is used for the NUTS II and the Objective I subset.

Rodriguez-Pose and Fratesi (2003) use a regression model to establish a simple relation between commitment of structural funds from the Objective I regions and Europe's regional growth. Regional growth over the 1989-1999 period, shows a regression from the initial GNP, per capita, and the total expenses of Objective I (structural funds), measured by GNP percentage, in the same time period. National growth rates are added to the model in order to lower the risk of spatial autocorrelation.

The CGE models comprise an aggregated representation of the economy, based on the equilibrium flow of factor and production markets, in real and nominal terms. By contrast with input-output models, the amounts and relative prices are endogenous, while consumption changes from an exogenous variable to an income-related one. The general equilibrium approach aims to model all existing relationships in the economy that represent both monetary and goods transactions, in contrast to the partial equilibrium approach, which analyzes the different sectors in an isolated manner under *ceteris paribus* conditions (Menezes et al., 2006).

CGE models are applied to the study of international commerce, public finances, agriculture, transportation, health, the environment and income distribution (Menezes et al., 2006). With regard to community funds, Lima and Cardenete (2005) design three CGE models to apply to the region of Andalucía (AGEM_A) in order to evaluate the impact of structural funds, namely the ERDF. Their model encompasses four agent behaviors, namely families, enterprises, the public sector and the rest of the world, and functions with three databases that correspond to the Social Accounting Matrixes of 1990, 1995 and 1999, used in the study of funds related to negotiated frameworks between the European Commission and the country. The negotiated community funds

for the multiannual implementation periods, labeled CSF, corresponding to the 1989-93, 1994-99 and 2000-06 periods, are also used in the study (Lima and Cardenete, 2005).

4 Characterization of the AzorMod model

The present study of the impact of community transfers in the Azores economy uses the dynamic general equilibrium model for the Azores –AzorMod, developed by Fortuna et al. (2009). AzorMod offers a modeling platform of the Azores economy, represented by a dynamic, multi-sectoral CGE model that incorporates the behavior of six economic agents: enterprises, families, the regional government, the central government, the European Commission and the rest of the world. The model's agents are defined as follows:

Enterprises: The CGE models do not account for the behavior of individual enterprises, but those of similar aggregated groups in their activity. The production sectors within the AzorMod are disaggregated in 45 sectors of activity.

This model assumes that: i) the producers operate in a perfect competitive market and maximize profits (or minimize costs for each level of production) in order to determine optimum input and output levels; and ii) the production costs equal the average and the marginal costs, an implicit condition where profit is maximized for constant returns of scaling technology.

The production level for each activity is determined from a nested production structure. During the first stage, the producers choose between intermediary inputs and added value according to a Leontief production function. In the second stage, the optimal capital-work combination is given by another optimization process, where the possibilities of substitution between work and capital are represented by the function of

Constant Elasticity Substitution (CES). The tax-related costs of enterprises, as well as the contributions to social security are also accounted for in the optimization process;

Families: Grouped in six income groups, the first being the lowest income. The family representing each income group receives part of the capital income (net operating surplus), part of the work income, unemployment compensation from the central government and other net transfers from regional and central governments, paying taxes on their income and saving part of their net income.

Regional Governments: receive taxes on income, expenses, patrimony and others, along with transfers from the central government, EU funds and the rest of the world.

Central Governments: receive all contributions for social security, estimates unemployment installments and makes transfers to families and the regional government.

European Commission: transfers community funds to the regional government, such as direct subsidies to production sectors and other subsidies.

External Market: The external market specification is based on the presupposition of a small country, meaning the country is a price taker in the import and export markets. In the price model, four commercial partners are defined: Continental Portugal, the EU, the United States of America (USA) and the rest of the world.

A common presupposition for CGE models, also adopted by AzorMod, is that the economy is initially in equilibrium, with quantities normalized in such a manner that the prices of goods equal the unit. Due to the homogeneity of zero-degree prices, the model only determines relative prices; therefore, a determined price is selected to provide the cash against which all other relative prices of the model are measured. This model chooses the GNP deflator as cash. Different prices are defined for all activity sectors, both exports and imports. The commercial and transportation margins are paid by all

search categories in the AzorMod, except in the case of government consumption (intermediate, private and investment goods).

Equilibrium between production, capital and employment requires demand to equal supply in prevalent prices (considering unemployment in the job market). The stock of social capital constitutes a specific sector, in a way that equality between capital supply and demand determines the return of capital per field of activity. The equations of market equilibrium are separated by goods.

The AzorMod has a recursive dynamic structure that comprises a sequence of several temporary equilibriums. The first equilibrium in the sequence is given by the reference year. In each time period, the model is solved for an equilibrium given the exogenous conditions from that particular period. The equilibriums are connected to each other through capital accumulation. Therefore, endogenous determination of the investment behavior is essential to the dynamic of the model. The model is solved by annual steps, with a simulated horizon of 13 years.

The closing rules respect the way that supply and demand of goods, macroeconomic identities and markets factors are balanced ex-post. In mathematical terms, the model must be constituted by an equal number of independent equations and endogenous variables. The most often used closing rule of macro-CGE models is based on investment and savings. The model assumes that investment adapts to internal and external savings; therefore, it reflects an economy where savings constitute the restricting condition.

Additional presuppositions related to regional government behaviors are as follows. Regional government savings are fixed in real terms while consumption adjusts to the objective regarding government savings, with distribution between consumption of different goods and services provided by a Cobb-Douglas function; the transfers

received by the central government, the EU, the USA and the rest of the world are fixed in real terms, as well as transfers from the regional government to families. Finally, exchange rates are kept unchanged in the simulations whereas checking account balances are adjusted. A possible closing alternative resides in keeping the balances of corresponding checking accounts in the USA and the rest of the world, while their exchange rates are adjusted.

For a detailed description of the model please refer to Fortuna et al. (2009) available at <http://www.ceeapla.uac.pt>.

5 Simulation

This simulation investigates the impact of community funds in the economy and employment of the Azores. The starting point of the exercise focuses on eliminating EU transfers from the 2002-2013 period, with 2001 as the base year. The following is considered for the studied year: 1) a scenario with EU transfers in the 2002-2013 period; 2) a scenario without EU transfers in the 2002-2013 period; and 3) the impacts measured as accumulated growth rates, given the difference between the scenarios with and without EU transfers.

The data used in the simulation reports the social accounting matrix for Azores 2001 (SAM), where EU transfers in the base year take the value of €118,907,898.00, representing 6% of GNP (€2,106,517,278.00) and 13% of the regional government revenue (€907,982,068.00). In the year 2008, community transfers to the Azores ascended to €206,191,312.88, constituting 6% of GNP (€3,395,000,000.00) and 20% of the country's revenue (€1,055,509,625.95).

It is necessary to account for the following when reading the results: 1) in the scenario with EU transfers, the model assumes that the variables throughout the simulated period register an annual growth of 2.7%; 2) the model is embodied in a

sequential dynamic model and the impact of positive or negative shocks is carried over to the following year via capital stock, optimized in each specific year (excluding dynamic optimization); 3) capital stock is homogeneous and not differentiated by proprietary. Differentiating capital implies sending capital income and profits to the country or region where the capital owners are located, which impacts quality of life for the country's consumers. If the profits are sent to their origin, then the capital stock and investment would not be as high as predicted in the model. Additionally, the loss of quality of life would be overestimated, since the model assumes profits are reinvested, leading to a higher growth rate.

The impacts are measured by the following indicators: Gross National Product (GNP), employment and equivalent variation.

5.1 Gross National Product

In the scenario with EU transfers, GNP registers a growing trend, initiating the simulation period with €2.163 million and ending with €2.900 million. In the scenario without EU transfers, GNP also indicates a growing trend, with an annual growth rate of 2.9%, from €2.124 million in 2002 to €2.919 million in 2013. Figures 1 and 2 present the evolution of GNP in real terms and the accumulated impact in percentage.

In 2002, the elimination of community funds results in a GNP decrease of around 1.83%. However, this negative impact lessens throughout the studied period, registering an increase of 0.16% in 2011. At the end of the simulated period, in 2013, GNP reaches a value of 0.64% over the expected GNP from the scenario with EU transfers.

In short, ten years would be required for the Azores to reach a GNP similar to the one assessed in the scenario with EU transfers. At the end of this period, GNP would surpass the value obtained in the scenario with EU transfers. This behavior is the result of the annual growth rate of the GNP, in which the scenario without EU transfers

(2.9%) is superior to the scenario with EU transfers (2.7%), which contributes to the progressive bridging of the negative impact from the suppression of community funds.

Please insert Figures 1 and 2 about here

Prior to the study of variables per se, it is important to proceed to the comparative study of the components that comprise the country's GNP.

In the Azores, investment and public consumption constitute dynamic variables of the impact registered in GNP, as seen in Figure 3.

Please insert Figure 3 about here

Private consumption shows an increasing trend in the scenarios with and without EU transfers, with the latter showing an annual growth rate of 2.9%.

Elimination of community funds has a negative impact on private consumption, around 2.1% in 2002. This impact lowers throughout the simulated period. However, 11 years would be necessary to recover the consumption level obtained in the scenario with EU transfers. The level of private consumption at the end of this period would be 0.2% superior to the base scenario.

Suppression of EU transfers creates an initial negative impact of 8.6% on public consumption. This reduction increases throughout the simulated period, reaching 9.7% in 2013. In short, in the scenario without community transfers, public consumption is systematically inferior to the scenario with EU transfers. The behavior of this variable is directly related to the regional government's revenue and expenses.

Elimination of EU transfers has a negative impact of around 11.4% on transfers received by the Azores, contributing to a reduction of the region's revenue throughout the simulation period.

AzorMod assumes the regional fund is in formal balance, in other words, that revenue equals expenses, where a decrease in revenue implicates an equal decrease in expenses.

In both scenarios, investment shows an increasing trend, with a growth rate of 3.4% in the scenario without community transfers.

Elimination of EU transfers has a positive impact of 11.2% on investment. This impact becomes systematically superior throughout the simulation period, reaching 19.8% in 2013. In short, the scenario without community funding indicates an investment that is superior to the scenario with community funding. Evolution of investment price indexes (PI) constitutes the explanation variable of the investment behavior. The PI registers a decreasing tendency in the 2002-2013 period of the scenario without EU transfers, where a decrease in investment costs leads to an increase of investments.

Exports show a growing trend in the scenarios with or without EU transfers, registering a growth rate of 3% in the latter. Elimination of community funding has a negative impact of 0.1% on exports in 2002. Export levels recover in 2003, surpassing projected values for the scenario with EU transfers in subsequent years.

Imports have a growing behavior, throughout the simulation period in both scenarios. Elimination of EU transfers has a positive impact on imports, making this variable assume higher values than the scenario with transfers.

In the scenario without EU transfers, CPI registers a progressive decrease from 0.2% in 2002 to 0.3% in 2013.

PI presents an initial increase of 1.7%. During the simulated period, the price indexes suffer a progressive reduction to investments, albeit still superior to the scenario with EU transfers.

5.2 Employment

Figure 4 displays the behavior of employment and unemployment, in the scenarios with and without EU transfers, as well as the impact of eliminating community transfers from these variables.

Please insert Figure 4 about here

In the scenario without transfers, employment grows at a rate of 2.8%.

Elimination of EU funds has a negative impact of 0.1% on employment, requiring two years to reach the level of employment in the scenario with EU transfers. This changes from 2003 to 2013, with employment showing a superior value to the scenario without community funds.

The impact of eliminating EU transfers on unemployment has high percentages, but these variations are of little relevance when analyzed in quantitative terms.

5.3 Equivalent Variation

The Equivalent Variation (EV) measures gains or losses in the quality of life of families. In this model, families are grouped into six income groups, the first being the lowest income. Figure 5 displays the effect of eliminating EU transfers from quality of life.

Without community funds, the income groups q1, q2 and q3 lose quality of life and do not recover it during the simulation period. Groups q4, q5 and q6 also lose quality of life, but manage to reach the level they would have had in the scenario with EU transfers. The first two groups recover in 2013 (at the end of the thirteenth year) and the

last in 2011 (at the end of the eleventh year). In short, lower income means greater difficulty recovering quality of life.

Please insert Figure 5 about here

7 Conclusions

The present study investigates the impact of community funds on the economy and employment of the Azores. To this end, an Azores economy modeling platform is designed, represented by the dynamic, multi-sectoral AzorMod computable general equilibrium (CGE) model. The starting point of this exercise focuses on eliminating EU transfers in the 2002-2013 period, with 2001 as the base year. The indicators analyzed in the study are GNP, CPI, private consumption, public consumption, revenue and expenses of the regional government, investment, imports, exports, employment and equivalent variation.

The results obtained indicate that eliminating EU transfers generates a short-term 1.83% reduction from GNP; 8.6% from public consumption; 2.11% from private consumption; 0.1% from exports; 0.1% from employment; and an increase of 11.2% and 2.3% on investment and imports, respectively. The break in CPI (-0.2%) and salary costs (-3.6%) constitutes a determining factor on the registered behavior of the reference variables.

Over the long term, the level of public consumption in the scenario with community transfers is not recovered. Exports and employment manage to recover after one year, while GNP and private consumption only reach their values from the scenario with EU funds at the end of ten and 11 years, respectively.

Loss of quality of life is also assessed for all income groups. The groups with the lowest income (q1, q2 and q3) do not recover their quality of life from the scenario with community transfers. The remaining groups (q4, q5 and q6) only reach their quality of

life from the scenario with EU funds after 12 years (q4 e q5) and ten years (q6), respectively.

This study presents a global summary of the Azores' Community Funds, including annual quantification. In theoretical terms, the study reveals that lack of community funds causes a decrease in public consumption and quality of life for consumers, contrary to an increase of investments.

Nevertheless, this is a theoretical exercise lessons of which must be taken in light of the premises and limitations of the model; the results obtained can provide clues to the application of EU transfers, namely in respect to their contribution to the incomes and investments of families.

Key limitations in this study are that AzorMod considers EU transfers in an aggregate manner, making it impossible to determine impacts per community fund and per sector. Additionally, the model provides a "picture" of the Azores economy as a whole in the year 2001.

For future studies, it would be pertinent to investigate the sectoral impact of EU transfers, particularly in the agricultural sector, since it benefits from the community flows of two funds (EAFRD and EAGF). Further study of subsidies from the regional government throughout the years and the contribution to the financing of many Azores sectors may also be of interest to future academicians. An update to the AzorMod database, the reformulation of certain equations and consideration for spatial disaggregation are factors that require revision.

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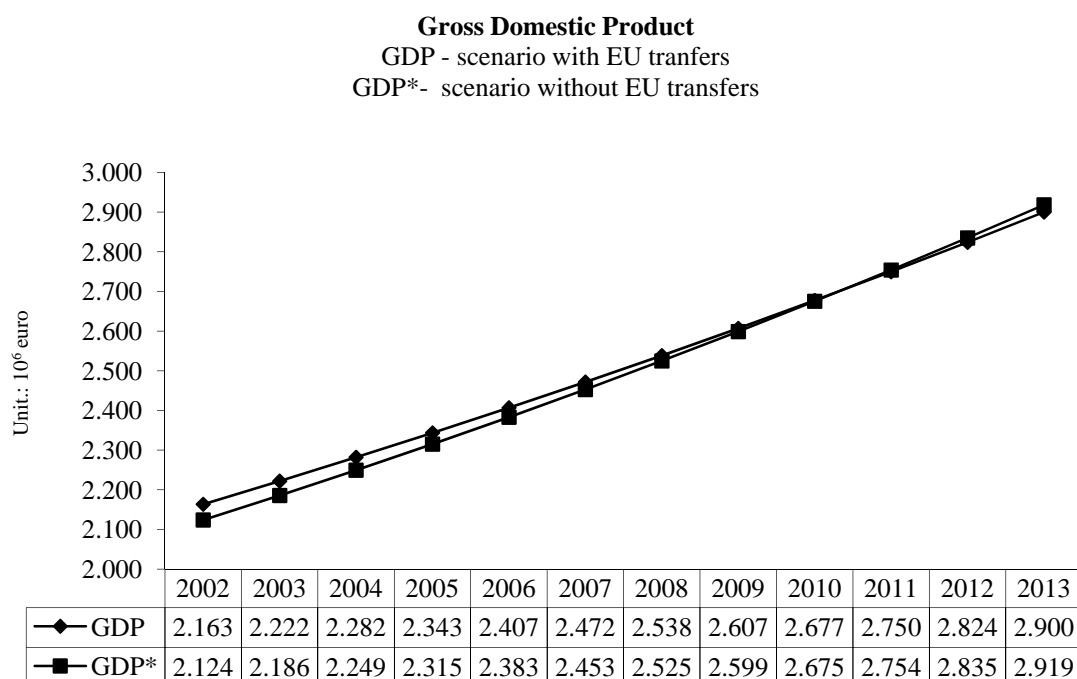
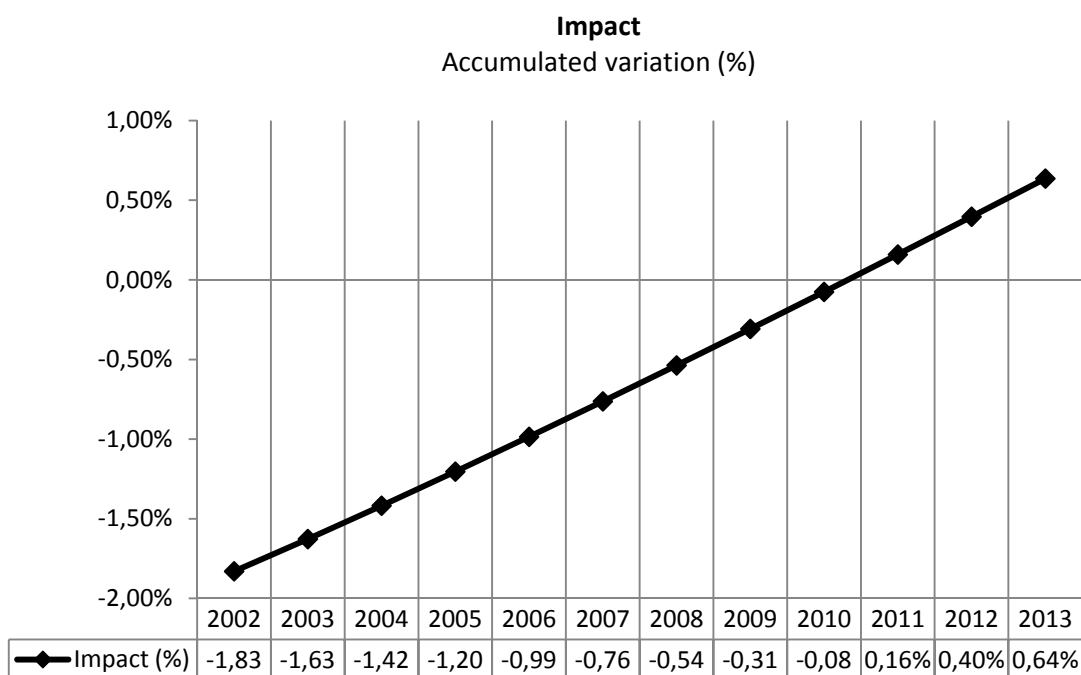
Figure 1 – Evolution in real terms and accumulated impact in percentage**Figure 2** - GNP Impact – Accumulated variation

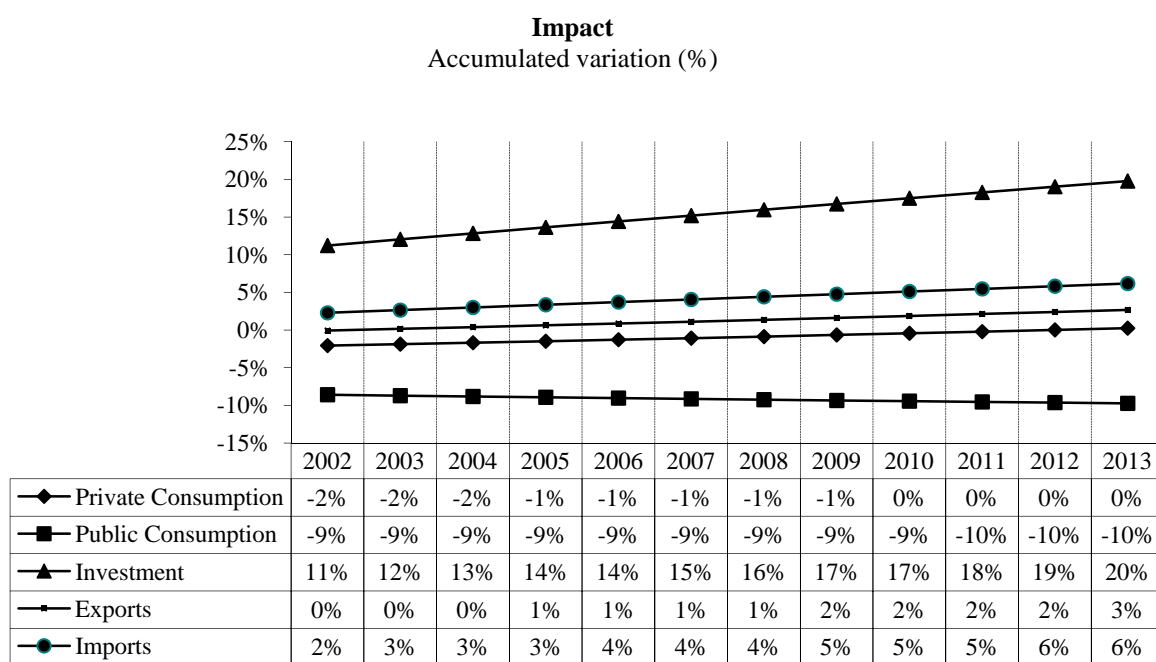
Figure 3 - GNP components Impact – Accumulated variation

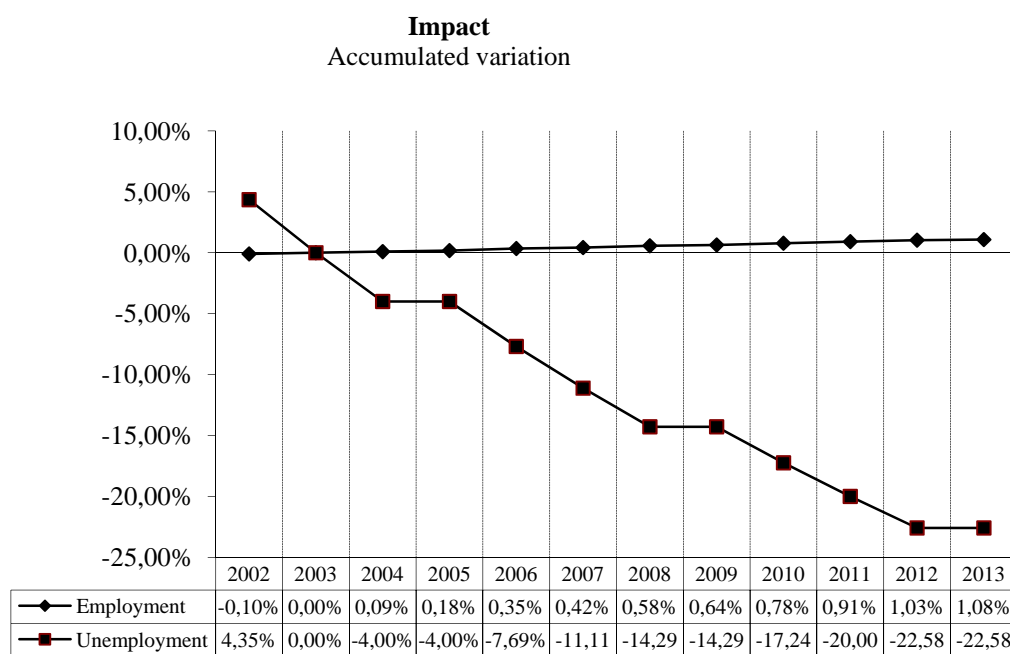
Figure 4- Employment and unemployment – Accumulated variation

Figure 5- Equivalent variation – Accumulated variation

