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THE DISTRIBUTIONAL CONSEQUENCES OF THE STABILIZATION AND ADJUSTMENT POLICIES IN GREECE DURING THE CRISIS, WITH THE USE OF A MULTISECTORAL COMPUTABLE GENERAL EQUILIBRIUM MODEL

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Abstract

The paper investigates quantitatively the economic implications of the various stabilization and adjustment policies, adopted by the Greek government in the period 2008-2013, to deal with the unsustainable public finances. To this end a static computable general equilibrium model is presented, that is capable of simulating the main macroeconomic and especially distributional aspects of the Greek crisis that has afflicted the country since 2008. The model is designed to explore in a comparative static manner the outcomes of different policies, and has considerable sectoral and distributional detail. The model is fitted to a 2004 social accounting matrix that includes much detail about the relevant economic actors. Policy simulations are made under a closure rule that seems to fit the Greek economy during the crisis. Simulations of the large shocks that have affected Greece between 2008-2013 indicate that the model reproduces the main outcomes of the economy during the implementation of the policy package adopted during the crisis, and indicates that the package adopted has been very regressive. The policy simulations suggest that the mixture of policies adopted during the stabilization programme by the Greek government has resulted in a large GDP decrease, a large employment decline, and as a painful consequence, a substantial decrease in the public sector deficit, but at the cost of very large decreases in private real incomes and an even larger increase in income inequality. It remains to be seen whether there can be other policy packages that can achieve similar public sector deficit reductions without the adverse income and distributional implications.

JEL-Classification: C68, E61, E65

Keywords: Greek economy, macrosectoral models, stabilization policies, distributional implications of macro policies, computable general equilibrium models

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1. Introduction

The objective of this paper is to investigate quantitatively the economic implications of the adoption of the stabilization and adjustment policies, adopted by the Greek government in the period 2008-2013, to deal with the unsustainable public finances. To this end an empirical model is presented, that is capable of simulating the main macroeconomic and especially distributional aspects of the Greek crisis that has afflicted the country since 2008. It is well known that the crisis has been sizeable. It has involved a decline in GDP between 2008 and 2013 of more than 25 percent, with falls in almost all sectors of economic activity, an increase in unemployment from around 8 percent to more than 25 percent, a huge decline in real household incomes, and a 64 percent decline in gross capital formation. Despite this collapse, which was unprecedented for postwar developed economies, prices have not declined; the consumer price index increased by 10 per cent between 2008 and 2013. The adjustment programme applied since 2010 has failed to stem the decline in GDP, despite substantial reductions in public spending and pensions, and significant reductions in public and private sector wages, as well as the adoption of a number of structural reforms. Public and private investments have declined substantially, and a significant proportion of the country's young educated workforce has emigrated, with negative consequences for future potential growth. Giannitsis and Zografakis (2015) as well as Matsaganis and Leventi (2014) have documented that, during the period 2009-13, poverty and inequality in Greece have increased considerably.

In this context, it is appropriate to simulate various policies which could place Greece back on a growth path. However, such a quest is constrained by the lack of appropriate structural models with enough sectoral and distributional detail. It is the intention of this paper to present such a model.

There is no lack of empirical macroeconomic models for Greece. The appendix in Christodoulakis and Kalyvitis (2001) gives a good survey of available models up to 2000. However, there are few computable general equilibrium models that include sectoral and distributional details. Sarris and Zografakis (2004) built such a model in the early 2000s to examine the reform of the tax system in Greece. That model (which is related to the model presented here) was based on a very detailed social accounting matrix (SAM) of the Greek economy, but its main limitation was that it was a

comparative static model without dynamics. Consistent dynamics are very difficult to build into a multisectoral setting with distributional detail.

The latest exercise in macro dynamic modeling is the work of Papageorgiou (2014), who developed a dynamic stochastic general equilibrium (DSGE) for Greece. The model is a small open economy DSGE model and aims at capturing the main features of the Greek economy. It is a New Keynesian models in the sense that it includes nominal rigidities and imperfect competition in the product and labour markets. At its core is a neoclassical growth model with optimizing agents and technology-driven long-run growth. The model shares the main standard characteristics of the models used by most central banks and international institutions, but also includes some features that are important to adapt it to the case of Greece. As such it is a very useful tool for macro dynamic policy analysis. Its limitation is that it does not have significant sectoral or distributional detail.

The model described here is a standard static computable general equilibrium (CGE) model (for analysis and description of this type of model, see the various chapters in the Handbook of computable general equilibrium modeling (Dixon and Jorgenson, 2013), especially chapters 4, 21, and 26) and is very similar to the model developed for the analysis of Greek tax policy by Sarris and Zografakis (2004). The model is calibrated to a detailed SAM for Greece for the year 2004[1]. Nevertheless, as the model is not intended to serve as a forecasting tool but rather as a platform for testing a variety of ideas concerning the functioning of the Greek economy and policies during the crisis, the exact specification of the base year is not important.

In this class of model there is no dynamics, and the question asked is of a comparative static nature such as: "What would the economy look like in the same year as the SAM if the exogenous variables that are specified had taken some other values". Dynamics can be built in this class of models by running the one-year static model in subsequent periods after updating recursively relevant exogenous variables. However, this procedure, common as it may be in the literature, does not add much to the comparative static results, and has not been adopted here. A fully dynamic CGE

[1] While a SAM for 2008, the last year before the onset of the current crisis, has also been developed, based on newer statistics for the Greek economy, it was deemed that the SAM of 2008 necessitated changes in the organization of the data by the national statistical service, compared to 2004, that would have required significant departures from the earlier model structure, something that would necessitate a costly and time consuming revision of the earlier model, for which there were no available resources.

with optimizing agents, infinite horizons, and rational or other expectations can exhibit dynamic behaviour, but is also quite difficult to build, rests on many assumptions, such as all macro models, and also has the limitation, crucial for our investigation, that it cannot describe the optimizing behaviour of different classes of households and the distributional consequences of policies within the economy. Hence there is a trade-off between fully optimizing dynamic stochastic one or two sector CGE models and static multisectoral ones with distributional and sectoral detail.

The rest of the paper is organized as follows. We first outline the structure of the basic model. In section 3, we present the analytical description of the model. In section 4, we discuss the possible closure rules of the model and outline the rules that are adopted for the Greek case. In section 5, we discuss the Social Accounting Matrix (SAM) that is used for the base year and the base year calibration. In section 6, we discuss the calibration of the model to the 2004 SAM. Section 7 presents the results of policy simulations similar to those that have occurred during the crisis period. Section 8 contrasts the results of the model with the results from a model with full neoclassical closure. Section 9 concludes.

2. The basic structure of the computable general equilibrium model for Greece

The model used in this study belongs to the family of computable general equilibrium (CGE)[2] models, which were first introduced by Johansen (1960), before they were applied to the analysis of developing and advanced economies alike.[3] CGE models, as policy-making tools, have several well-known advantages over the traditional macroeconomic models: they allow for consistent comparative analysis of

[2] The CGE model is a numerical representation of the key relationships within a Walrasian general equilibrium system, as developed by the Arrow-Debreu general equilibrium theorem. The ancestry of modern empirical research on CGE modelling goes back to Johansen's model. The theoretical framework of the CGE requires that markets clear through the price mechanism. However, empirical applications of the CGE model do not always assume clearing through prices. Instead, researchers often use non-neoclassical assumptions of market rigidities and imperfections, in an attempt to capture the macroeconomic forces at work in the real world. In these cases, some of the markets in the model may clear by adjustment in prices, while others may incorporate endogenous price-setting (as in traditional macroeconometric models that assume excess supply), which ensures a quantity-adjusted equilibrium, or may even incorporate rigidities for specific prices.

[3] For a more extensive discussion, see Dervis, de Mello & Robinson (1982, Robinson (1989), Shoven & Whalley (1984 and 1992) and Gunning & Keyzer (1995).

policy measures, by ensuring comparability across the scenarios considered, given that in all scenarios the economy is in a state of equilibrium. In addition, CGE models describe the behaviour of economic agents at the microeconomic level, while at the same time they can capture structural features of the economy without having to resort to descriptive or statistical correlations. For this reason, such models are seen as appropriate for analyses of structural problems and changes and are widely used to explore the redistributive effects of economic policy measures.

The models of the CGE type consist of a set of equations that describe the various conditions and relations of production, consumption, income distribution, saving, investment, external trade, etc., all serving to form a picture of the "initial equilibrium" of an economy (here, the Greek economy as at the end of 2004). The model described by the equations is calibrated to the economy's dataset for a given year, taken as the base year; solving the model for the base year will reproduce exactly the actual outturns for that year.

The analysis of policy measures by the model is normally a two-step process: the first step involves constructing a reference scenario. In the second step, the various policy scenarios are added to the reference scenario, and the simulation is conducted on the new assumptions. The implications of the scenarios under consideration are estimated by comparing the simulation results against the outturns for the base year. We assess the impact of the crisis scenarios in terms of macroeconomic indicators, such as GDP, consumption, investment, redistributive effects, employment, fiscal aggregates and the trade balance. The redistributive effects can be estimated by the model in terms of income redistribution both among the primary factors of production and among social or economic groups within each factor (e.g. within individual household types).

The model encompasses three types of markets, namely the markets for goods, inputs and foreign trade. In fact there is a fourth market, i.e. the money market, but this is excluded, in line with common practice, thereby ensuring that the model only estimates real-sector variables and prices. This is not a disadvantage of the specific model, given that Greece's EMU participation and loss of monetary sovereignty means inability to use monetary policy tools such as money supply or interest rates; these are now determined by the European Central Bank (ECB) and are therefore considered as exogenous variables.

Our model is based on the SAM of 2004 (see Zografakis and Mitrakos, 2008 and Zografakis, Kontis and Mitrakos 2008, 2009). The SAM identifies 15 economic sectors and six types of labour inputs. Capital is taken as a given and constant for each sector in the short term. In addition, there are 15 types of households, distinguished according to the household head's nationality (immigrant or Greek), education (high-skilled or low-skilled), sector of activity (agricultural or non-agricultural), as well as according to expenditure/income level (poor, middle-income or rich households).

At this point we should note that the performance of the CGE-type models depends not so much on their detail as regards sectors and institutions but rather on their closure rules. These rules, the determination of which is instrumental in such models, refer to the basic assumptions about the behaviour of the economy and are of three types, based on whether they refer to: (a) the manner in which the labour market adjusts; (b) how investment is determined; and (c) how the external sector adjusts. We discuss the closure rule assumed for this study later.

The model initially classifies households into two groups: The first group comprises households whose head is an immigrant, while the second group comprises households whose head is a Greek national (Greek households). Greek households are further distinguished into agricultural households, non-agricultural households and non-working households. Non-agricultural Greek households (i.e. semi-urban and urban households) are further distinguished into low-skill and high-skill households. Skills refer to the household head's educational attainment, with low skills corresponding to a level of up to secondary education and high skills being defined as those who have completed some tertiary education, including post-graduate studies.

Finally, each of these groups of households is divided into poor, middle-income and rich households, depending on the level of total income. The distinction between poor, medium and rich households is based on the average per capita expenditure equivalent, where poor households are defined as those spending less than 60% of the median total expenditure, rich households are those over 120% and the medium households are those falling in between.

The labour production factor is divided into six groups of workers, based on the sector of economic activity. The first and second groups comprise immigrant workers, distinguished by their level of education into low- and high skilled respectively. The

third and fourth groups comprise Greek workers (dependent employees), again based on their skills, while the fifth and sixth groups comprise Greek self-employed workers, low- and high-skilled respectively.

The SAM assumes only one type of firm, standing for all the different types of firms in Greece, and one product for each branch. This product can be used for domestic consumption or be exported (not all products are exportable). The allocation of output between domestic consumption and exports is determined through a constant elasticity of transformation (CET) function which is commonly used in models of this type. Subsequently, an Armington CES function (see Dervis de Melo & Robinson, 1982 and Robinson, 1989) links the domestic product to the differentiated imported product to generate a composite product available on the domestic market and purchased by all institutional sectors both as an intermediate and final good and as an asset. Finally, there are some products that are not tradable, hence not exposed to imports. In this case the composite product is simply the domestically-produced good.

To determine the level of output in the model, we use multi-level CES production functions. What matters here is the total labour input function for different types of work. At the first level there are three main types of work: immigrant employees, Greek employees, Greek self-employed. At the second level, each main type of work is an aggregate CES function of the two categories of labour based on skills, i.e. low-skilled-and high-skilled labour respectively. This type of multi-level CES structure allows for ample flexibility in factor complementarity and substitution relationships.

In the model we assume that capital is constant within each sector in the short term and that supply is driven by profit maximisation. This assumption implies a positively sloped supply curve and enables equilibrium to be achieved through price adjustments. All types of labour inputs are characterised by high mobility across sectors in the short term. Their aggregate supply in the economy is determined, in the short term, by labour supply functions, which is in turn determined by the real wage for each type of work relative to the real wage in the initial state. Demand for capital expresses the desired demand for capital stock. Since the capital stock is assumed to be constant during the current period, demand for capital adjusts to the available

capital stock through the rate of return of capital services, and this determines business investment. This also fulfils the zero profit condition.

The model includes prices for the domestic products and the six types of work that are labour inputs. The exchange rate of the foreign currency is taken as a constant and is equal to one (numeraire). The adoption of the nominal exchange rate as a numeraire is not a problem in this case, since the euro's exchange rate vis-à-vis the other currencies does not depend on developments in the Greek economy but rather on economic developments and policies of all EMU countries with respect to non-EMU countries. Greece is considered a small importer, therefore the prices of all its imports are determined exogenously. Regarding exports, the model assumes that the country produces differentiated products. The global demand for each exportable Greek product is product-specific and must be balanced against the supply of the respective exportable product. Thus, the international prices of these exported products are determined endogenously through the supply-demand equilibrium in the respective markets.

Households earn income from labour, dividends paid by private businesses, the public sector (i.e. government transfers such as pensions and other benefits), transfers from other households (adding up to zero at the aggregate level) and transfers from the external sector (e.g. remittances). Their total disposable income is equal to the sum total of labour incomes earned by their members, plus income from other institutional sectors (public sector, enterprises, the rest of the world, other households) minus the income they transfer to the public sector (direct taxes, social security contributions) and to other households. Enterprises transfer income to households in the form of dividends and rents, while government transfers to households consist of pensions, unemployment benefits, interest on public debt and other transfers. Finally, the rest of the world transfers income to households in the form of pensions, transfer payments and income support.

The disposable income of households is calculated as their net earnings from all branches of activity, institutional sectors and factors of production, minus their net payments to institutional sectors and factors. Enterprises receive income from the production process (return on the value added of capital) as well as transfers from the public sector and, on the other hand, pay direct taxes and dividends. What remains in the end is their endogenously determined saving.

Households determine their total consumption expenditure on the basis of a consumption function, which depends on their current real disposable income and their past real income and disposable income. The consumer price deflator used in the model is a weighted average of consumer prices of all the products consumed and is determined endogenously. The consumer behaviour of households exhibits a multi-level structure.

The model identifies four types of investment: i) residential investment by households; ii) business investment; iii) investment by the public sector; and iv) investment in inventories. The value of residential investment is determined simply by a fixed percentage of disposable household income. Dividing this by the cost of purchasing a new house, we obtain the real residential investment. Business investment for each individual sector is determined by the respective investment functions, which are positively related to the current return on capital and negatively related to the cost of acquiring new capital, the interest rate (exogenously determined) and the exchange rate (exogenously determined). Total real public investment is a policy variable and its allocation among the various sectors of economic activity is determined by fixed coefficients. Investment in inventories and the relevant changes are derived from the difference between the desired level of inventories (which in turn is equal to a fixed percentage of current production) and past inventories. Total real public expenditure is a policy variable. The allocation of public expenditure among sectors of economic activity is based on fixed allocation coefficients. Population growth is exogenous and the household composition remains unchanged over time.

Taxable income equals disposable income plus direct taxes. Average taxable personal income for each of the 15 household groups is determined by taxable income and the number of taxpayers in each group. Given the tax brackets and rates that were actually applied to the 2004 income and based on the average taxable income per taxpayer, we can determine personal income tax. Average tax for each household group depends on tax brackets and rates, taxable income − which is equal to disposable income − and finally on the number of taxpayers. In the model, taxes are calculated using the average household for each of the 15 groups considered. Revenues from the direct taxation of households depend on the number of taxpayers and the average income tax per household group, as defined above.

Income is endogenous. In each group of households, the average personal taxable income increases or decreases depending on the exogenous changes that we choose to adopt in the model (e.g. an increase in pension expenditure will result in increased income for the groups of households that earn income of this type). Such higher income will be taxed according to its level and the applicable tax scale. Thus, an increase in one category of income may entail a higher tax bracket in a dynamic manner in the model. In a similar way we can derive the tax that each household will have to pay in the event of a change in the tax brackets and/or rates.

3. The analytical form of the model

The sequel gives the basic equations of the model. The actual programmed (in GAMS) model is more detailed since it has to take into account many specificities of the social accounting matrix.

3.1 Production, Supply of Products and Factor Demands

The economy will be assumed to be composed of n sectors indexed by i. Denote by XS_i the quantity of the product of sector i that is supplied (produced) in a given period t (the index t will be in suppressed unless explicitly needed) in the home country of concern h (here h is Greece and the subscript h will be suppressed except if needed). The production function will be assumed to be given by a nested CES structure. In the first level, the quantity of a composite labour-intermediate good input (denoted by LN_i) is combined with an index of capital-energy input (denoted by KE_i) to produce the product.

$$(1) \qquad XS_i = CES(LN_i, KE_i, \sigma_{i1}) = (\delta_{11i}^{1/\sigma_{1i}} (LN_i)^{\frac{\sigma_{1i}-1}{\sigma_{1i}}} + \delta_{12i}^{1/\sigma_{1i}} (KE_i)^{\frac{\sigma_{1i}-1}{\sigma_{1i}}})^{\frac{\sigma_{1i}}{\sigma_{1i}-1}}$$

The parameters δ_{1ji} (for j=1,2) are constants, which however, are specified to change from year to year by technological improvements in the following manner

$$(2) \qquad \delta_{1ji} = \delta_{1ji}^{*} e^{-(1-\sigma_{1i})\alpha_{1ji} t}$$

where the constants α_{1ji} are technological parameters.

The composite factors LN and KE are given by CES functions of labour and intermediate goods, and capital with energy

$$(3) \qquad LN_i = (\delta_{LN1i}^{1/\sigma_{LNi}} (L_i)^{\frac{\sigma_{LNi}-1}{\sigma_{LNi}}} + \delta_{LN2i}^{1/\sigma_{LNi}} (N_i)^{\frac{\sigma_{LNi}-1}{\sigma_{LNi}}})^{\frac{\sigma_{LNi}}{\sigma_{LNi}-1}}$$

(4) $$KE_i = (\delta_{KE1i}^{1/\sigma_{KEi}} (K_i)^{\frac{\sigma_{KEi}-1}{\sigma_{KEi}}} + \delta_{KE2i}^{1/\sigma_{KEi}} (E_i)^{\frac{\sigma_{KEi}-1}{\sigma_{KEi}}})^{\frac{\sigma_{LKEi}}{\sigma_{KEi}-1}}$$

The unit variable cost function associated with the above production function is the following.

(5) $$PS_i = (\delta_{11i} PLN_i^{1-\sigma_{1i}} + \delta_{12i} PKE^{(1-\sigma_{1i})})^{1/(1-\sigma_{1i})}$$

where PS_i denotes the unit cost function of XS_i, and PLN_i and PKE_i denote the prices of the two composite goods that make up production respectively. These last two prices are given by CES expressions similar to (5).

The derived demand for the two composite factors is given by the following equations:

(6) $$LN_i = XS_i \delta_{11i} \left(\frac{PLN_i}{PS_i} \right)^{-\sigma_{1i}}$$

(7) $$KE_i = XS_i \delta_{12i} \left(\frac{PKE_i}{PS_i} \right)^{-\sigma_{1i}}$$

Similar equations hold for the demands of L and N, or K and E as functions of LN and KE respectively. For instance the demand for total labour L and capital are given as follows:

(8a) $$L_i = LN_i \delta_{2LNi} \left(\frac{PL_i}{PLN_i} \right)^{-\sigma_{LNi}} = LD_i$$

(8b) $$K_i = KE_i \delta_{1KEi} \left(\frac{r_{Ki}}{PKE_i} \right)^{-\sigma_{KEi}}$$

where $PL_i = w_i$ denotes the price of composite labour utilized in sector i, and r_{Ki} denotes the price or reward of capital. The last equation in (8a) just defines the demand for labour LD as equal to L. The above specification is an extension of the standard fixed coefficient specification.

In the second level of the production structure, the index of intermediates is given by a CES function of intermediate inputs denoted by NI_{ji} (intermediate input of j'th composite product into the production of sector i).

(9) $$N_i = CES(NI_{ji}, \sigma_{2i}) = \left(\sum_j \delta_{2ji}^{1/\sigma_{3i}} NI_{ji}^{\frac{\sigma_{2i}-1}{\sigma_{2i}}} \right)^{\frac{\sigma_{2i}}{\sigma_{2i}-1}}$$

Given (9) the demand for intermediate j in sector i production is given by cost minimization of the total expenditure on intermediates subject to (9), and results in the following demand functions:

(10) $$NI_{ji} = N_i \delta_{2ji} \left(\frac{PC_j}{PN_i} \right)^{-\sigma_{2i}}$$

where PC_j is the market price of the composite good of sector j that is sold in the domestic market (composed of domestic and imported goods, see below). The price of the composite intermediate PN_i can be easily found if (10) is substituted in (9), and is the following:

$$(11) \qquad PN_i = \left(\sum_j \delta_{2ji} PC_j^{(1-\sigma_{2i})} \right)^{\frac{1}{(1-\sigma_{2i})}}$$

In the model there will be 6 types of labour utilized in each sector: four types of salaried labour (unskilled and skilled Greek labour, and unskilled and skilled immigrant labour), and two types of self-employed labour (unskilled and skilled). The labour aggregator function will be modelled as a three level CES function of the different types of labour. For each sector the first stage of the aggregation will be among self-employed and salaried (wage) workers with a CES function. In the second level each of the two types of labour aggregates (salaried and self-employed) will be modeled as CES aggregators of skilled and unskilled workers. Finally within the salaried group, and for each skill type the aggregation will be among Greek and immigrant salaried labour.

$$(12a) \quad LD_i = CES(LD_{si}, LD_{wi}, \sigma_i^l) = AL_i(\lambda_{si}^{l\,1/\sigma_i^l} LD_{si}^{\frac{\sigma_i^l - 1}{\sigma_i^l}} + \lambda_{wi}^{l\,1/\sigma_i^l} LD_{wi}^{\frac{\sigma_i^l - 1}{\sigma_i^l}})^{\frac{\sigma_i^l}{\sigma_i^l - 1}}$$

where LD_{si} and LD_{wi} denote the aggregate labour demands for self-employed and salaries (wage) labour in sector i, and AL is a constant.

$$(12b) \quad LD_{ki} = CES(LD_{kji}, \sigma_{ki}^l) = AL_{ki}(\sum_j \lambda_{kji}^{l\,1/\sigma_{ki}^l} LD_{kji}^{\frac{\sigma_{ki}^l - 1}{\sigma_{ki}^l}})^{\frac{\sigma_{ki}^l}{\sigma_{ki}^l - 1}}$$

where LD_{kji} denotes the demand for labour type j (j=skilled, unskilled) by labour aggregate k (k=s,w) in sector i.

Given the above definitions, the demands for the individual labour types are given as follows.

(12c) $$LD_{kji} = LD_{ki}\lambda_{kji}\left(\frac{w_{kji}}{w_{ki}}\right)^{-\sigma_{ki}^{l}}$$

(12d) $$LD_{ki} = LD_{i}\lambda_{i}\left(\frac{w_{ki}}{w_{k}}\right)^{-\sigma_{i}^{l}}$$

where

(12e) $$w_{ki} = \left(\sum_{j}\lambda_{kji}w_{kji}^{(1-\sigma_{ki}^{l})}\right)^{\frac{1}{(1-\sigma_{ki}^{l})}}$$

(12f) $$w_{i} = \left(\sum_{k}\lambda_{ki}w_{ki}^{(1-\sigma_{1}^{l})}\right)^{\frac{1}{(1-\sigma_{1}^{l})}}$$

Given the demands for labour of different skill types among the salaried workers in (12d), the demands for immigrant and Greek salaried workers can be obtained in exactly the same fashion as in (12d).

The wages of each labour type are denoted above by w_{kji} (k=s,w, j=skilled, unskilled)). They can differ by sector by a constant differential from the average wage of the given type.

(13) $$w_{kji} = \Lambda_{i}w_{kj}(1+s\text{sec}_{i})$$

where the parameters Λ_i are constants specific to each sector i, and $ssec_i$ is the rate of social security contributions of firms in the home country in sector i for wage labour. The variable w_{ki} denotes the average wage for the economy for the given labour type indexed by ki.

The value added can be found simply by adding the returns to labour and capital.

(14) $$VA_i = w_i L_i + r_{Ki} K_i$$

The zero profit condition of the production system is

(15) $$PS_i XS_i = \sum_j PC_j NI_{ji} + r_{Ki} K_i + w_i LD_i + p_E ED_i$$

where the last term is the cost of energy for the sector.

Under the assumption that the capital stock of the current period is fixed, the above system determines the supply of output, the demand for intermediates inputs, the demand for labour (of different types) and the return to capital, given the supply price of the sector output PS_i , the price of labour, and the prices of the intermediate products.

The price that producers in sector i face is given by the market price of the good produced by the sector minus any indirect taxes plus any subsidies.

(16) $$PS_i = P_i(1 - tind_i + subs_i)$$

where $tind_i$ is the indirect tax rate for sector i, $subs_i$ is the subsidy rate for sector i, and P_i is the average market price for the good sold by the sector.

3.2 Allocation of Domestic Production to the Domestic and Export Markets

The production of sector i is sold in the domestic and rest of the world markets, so that there are effectively two markets to which producers sell. The producers are assumed to make allocations of their production between the domestic and the foreign markets according to a nested constant elasticity of transformation (CET) allocation system. The allocation is based on different prices obtained in domestic and foreign markets, because of differentiated products demanded in the different markets. The

export product is homogeneous in the sense that the same product is sold in all external markets.

Assume that the CET allocation function is given as follows:

$$XS_i = CET(XD_i, XE_i, \tau_{1i}) = \left(\beta_{11i}^{-\frac{1}{\tau_{1i}}} XD_i^{\frac{(1+\tau_{1i})}{\tau_{1i}}} + \beta_{12i}^{\frac{1}{\tau_{1i}}} XE_i^{\frac{(1+\tau_{1i})}{\tau_{1i}}} \right)^{\frac{\tau_{1i}}{(1+\tau_{1i})}} \quad (17)$$

where XD_i , and XE_i denote the supplies of the sector to the domestic and non-domestic markets respectively, and the τ_i, and β_{1i} parameters are constant.

Maximization of producers' profit from sales to the two markets under the restriction (17), yields the allocation functions as follows.

$$XD_i = XS_i \beta_{11i} \left(\frac{PD_i}{P_i} \right)^{\tau_{1i}} \quad (18)$$

$$XE_i = XS_i \beta_{12i} \left(\frac{PE_i}{P_i} \right)^{\tau_{1i}} \quad (19)$$

where PD and PE are the prices for the goods sold in the domestic market and export markets respectively. The average price received for the product of sector i , P_i is equal to:

$$P_i = \left(\beta_{11i} PD_i^{(1+\tau_{1i})} + \beta_{12i} PE_i^{(1+\tau_{1i})} \right)^{\frac{1}{(1+\tau_{1i})}} \quad (20)$$

This price is the same price that enters in (16). Price PD is the domestic price for the good produced for the domestic market (a non-traded good). The price PE is determined by the equilibrium between the country's supply of exportable good i and the world demand for that good, which is given by a function of the ration between the world price of the domestic good and the exogenous international price (EXR is the country's exchange rate).

$$DEXP_i = EXP_{i,0} \cdot \left(\frac{PE_i / EXR}{PWE_i} \right)^{\eta_i} \quad (21)$$

3.3 Demand for Imports

The goods demanded in the domestic market of the country are composites of the domestically produced and supplied goods, and imported goods that are differentiated from products provided by domestic suppliers. It is assumed that the aggregation function of the domestic and the imported good is nested CES in the so-called Armington fashion. Denote the total domestic demand for the composite good of sector i as DC_i , the demand for the imported good as DM_i , and the demand for the domestically produced good by DD_i,

The demand for the aggregate composite good DC_i is given by a CES function of DM_i and the domestic good

$$(22)\quad DC_i = \left(\zeta_{1i}^{1/\sigma_{4i}} DM_i^{\frac{\sigma_{4i}-1}{\sigma_{4i}}} + \zeta_{2i}^{1/\sigma_{4i}} DD_i^{\frac{\sigma_{4i}-1}{\sigma_{4i}}} \right)^{\frac{\sigma_{4i}}{\sigma_{4i}-1}}$$

If consumers are assumed to minimize their expenditure for purchases subject to (22) then the demands for the two goods are given by the following:

$$(23)\quad DM_i = DC_i \zeta_{1i} \left(\frac{PM_i}{PC_i} \right)^{-\sigma_{4i}}$$

$$(24)\quad DD_i = DC_i \zeta_{2i} \left(\frac{PD_i}{PC_i} \right)^{-\sigma_{4i}}$$

where PC is the composite price of the good available in the domestic market.

$$(25)\quad PC_i = \left(\zeta_{1i} PD_i^{1-\sigma_{4i}} + \zeta_{2i} PM_i^{1-\sigma_{4i}} \right)^{\frac{1}{1-\sigma_{4i}}}$$

The world price of the imported good i is assumed exogenous, while the domestic price of the imported good is given by

$$(26)\quad PM_i = PM_i^* EXR(1 + tar_i)$$

where PM* is the world price and tar denotes the tariff equivalent of any border measures that affect the imports of good i.

It is clear with the above specification that in essence the product produced by a given sector is assumed to be differentiated from the product destined for the domestic market.

3.4 Incomes and Expenditures of Firms

In this section we specify how the incomes of firms (private as well as those under state control) in the country are determined. The income of firms consists of the value added of capital, plus the production subsidies. Denote the income of firms by YFIRMS. This is the sum of the income of firms in each sector. Then we have:

(27) $$YFIRMS = \sum_I YFIRMS_I = \sum_I (r_{Ki} K_i + subs_i P_i \cdot XS_i)$$

Firms pay direct taxes, and they divide the remaining after tax income among distributed profits and savings. Denote by TXDIRF the amount of direct taxes paid by firms, by DISTPROF the amount of distibuted profits of firms, and by SAVF the savings, or retained earnings of firms. Then we have the following relations.

(28) $$DISTPROF_h = \sum_i DISTPROF_{ih} = \sum_i (1 - txdirf_i) \cdot YFIRMS_i \cdot dprof_i$$

$$SAVFIRMS = [\sum_i (1 - txdirf_i) \cdot YFIRMS_i \cdot (1 - dprof_i)]$$

(29) $$-\sum_i shfcap_{fi} \cdot DISPROF_i$$

In (28), the parameter $dprof_i$ denotes the share of firm net profits that are distributed as dividends to shareholders. These dividends accrue to domestic households as well as foreign corporations that happen to own part of the capital of the sector. In (29) this is shown, as the savings of the firms are composed of the retained earnings minus the portion of domestic distributed profits sent abroad.

3.5 Income and Expenditure of Households

Households receive monetary income from wage labour, from distributed profits, and from transfers from the government and abroad. We denote the income of household type h as YHH_h.

$$YHH_h = \sum_{k,j} w_{kj} \cdot LS_{kj}^h + TRFOR_h + YHR_h =$$

$$\sum_{k,j} w_{kj} \cdot LS_{kj}^h + TRFOR_h + (1 - shfor) \cdot DISTPROF + GTANSFHH_h \cdot CPI \quad (31)$$

In (31) $LS^h{}_{kj}$ denotes the supply of labour of type kj (see the earlier equations concerning labour types) by the household of type h to the market, and YHR_h denotes the rest of household income except wages. The variable $GTANSFHH_h$ denotes the government transfers to households of type h. The multiplication by the consumer price index CPI for the home country (to be defined later) implies that there is price indexation of the government benefits. $TRFOR_{kh}$ denotes the transfers from country k to the households of type h of the home country. These can be remittances, or could be income from labour working abroad.

Households pay direct taxes on labour income and transfer income received and at different rates. Income of households from enterprises is taxed at the source, namely the firms themselves and is not taxed again when it accrues to households. The remainder of household income, namely disposable income, is split among consumption expenditures, transfers abroad, and savings.

$$TXDIRHH_h = txdir_h w \sum_{kj} w_{kj} LS_{kj}^h + txdir_h tr \cdot GTANSFHH_h \cdot CPI \quad (32)$$

$$YDISP_h = YHH_h - TXDIRHH_h \quad (33)$$

In the actual model direct taxes follow a graduated scale designed to correspond to the actual tax brackets in Greece. There are different tax rates for the various income tax brackets, and these are reflected in the model.

Transfers of income of immigrant households to foreign countries are simply determined by a share of disposable income of immigrant households that is sent abroad.

(34) $$TRFOR_h = \phi_h YDISP_h$$

where the constant φ_h denotes the proportion of disposable income of immigrant households of type h that is sent as remittances abroad. The total transfers abroad are equal to the sum over h of the transfers abroad.

Total expenditure of each class of households h is determined by a consumption function of the following form.

(35) $$EPC_h = \alpha_h EPC_{h,-1} \cdot \left(\frac{YDPC_h}{YDPC_{h,-1}} \right)^{\mu_h} \left(\frac{EPC_{h,-1}}{YDPC_{h,-1}} \right)^{-\nu_h}$$

where EPC is the per capita real consumption expenditure of household type h in the current period, YDPC is the real per capita disposable income of household type h, and the -1 in the subscript indicates one year lagged values of the variables. The assumption is that current consumption reacts to current and lagged income and consumption.

Savings is just the difference between disposable income and consumption expenditures.

(36) $$SAVH_h = YDISP_h - E_h$$

In the next step households allocate their total expenditure among spending in durable and non-durable goods. Non-durable goods include goods and services directly consumed by households (food, clothing, health, etc.) and goods and services related to energy, such as spending for electricity, car fuel, etc.

Expenditure on durables EXD is determined by first determining the desirable levels of stock of each durable good

(37) $$STDUR_{j,h} = \gamma_{j,h} + \frac{\beta_{j,h}}{PDUR_{j,h}} (YDISP_h - \sum_{i=ND} PHC_i DHC_{hi0})$$

where PDUR is the price of durable good j for household type h (determined by the relevant consumption matrix), PHC are the consumer prices, DHC is the minimum consumption for each type of non-durable consumer good, and γ is the minimum amount of the desirable durable good by each class of household.

The actual demand for durable good type j by household type h is determined by a simple stock adjustment equation.

(38) $$DHD_{j,h} = STDUR_{j,h} - (1-\delta_j)STDUR_{j,h,-1}$$

where δ is a depreciation rate. The last two terms are predetermined for a given period.

Once the demand for durables is computed, then one can compute the demand for energy goods linked to durables.

(39) $$DELND_{i,j,h} = \mu_{i,j,h} \cdot STDUR_{j,h}$$

where the index i ranges only over the energy goods.

We can also compute the demand for nonenergy non-durable goods linked to durables.

(40) $$DNELD_{i,j,h} = \kappa_{i,j,h} \cdot STDUR_{j,h}$$

Given the demands for the above, the expenditure on non-durables that is not linked to durables, is equal to disposable income minus the expenditure on durables and all non-durables linked to durables.

(41) $$YEXP_h = E_h - EXD_h - EXNDLD_h$$

Given that YEXP is total consumer expenditure on non-durables, the demand for the different consumer non-durable goods that is not linked to durables is given by a LES system. Denote by DHC_{hi} the consumer demand by a household of type h for a product type i, and by PHC_i the corresponding price. Then we have the following specification for consumer demands.

(42) $$DHC_{hi} = DHC_{hi0} + \frac{m_{hi}}{PHC_i}\left(YEXP_h - \sum_i DHC_{hi0}PHC_i\right)$$

The total demand for a product of type k is just the sum of the demands in (42) over all household types.

(42a) $$DHC_i = \sum_h DHC_{hi}, \quad DHC_i = \sum_h DHC_{hi}$$

If the consumers demand m consumer products then the demands for the composite products of the various sectors for consumer demand are given as follows.

(43) $$DCC_i = \sum_k trc_{ik} DHC_k$$

where the constants in (43) are transformation or transition coefficients indicating the make up of the different consumed goods from the respective producer goods. It holds that.

(44) $$\sum_i trc_{ik} = 1$$

with specification (43), consumer prices can be derived from the prices of the composite goods of the sectors.

(45) $$PHC_k = (\sum_i trc_{ik} PC_i)(1 + tva_k)(1 + exc_k)$$

where tva is the rate of value added tax on final goods, and exc is an excise tax on consumer goods.

3.6 Labour supply

Each household type will be assumed to have a given fixed supply of the two types of labour, namely unskilled and skilled. For skilled labour, the household will allocate its fixed supply of labour to the self-employed and salaried labour markets. The allocation will be done as follows. Denote the household specific endowments of labour of the two types as LE_j, where j=skilled or unskilled. The household specific index h is suppressed here, but whatever follows pertains to all classes of households that are indexed by h. For the first two types of labour the following allocation mechanism, namely the supply of labour in the two different markets, is specified.

(46a) $$LS_{kj} = LE_j \frac{\alpha_{kj} \left(\frac{w_{kj}}{w_{kj}^0} \right)^{\sigma_{lj}-1}}{q_j}$$

where

(46b) $$q_j = \sum_k a_{kj} \left(\frac{w_{kj}}{w_{kj}^0} \right)^{\sigma_{lj}-1}$$

and where the superscript 0 denotes a base year value. In the above equations, the elasticity parameter σ must be larger than 1, in order for the allocation to be larger toward the labour sector with the larger reward. Also the sum of the two α constants must be equal to one. This allocation mechanism is simple, and if the relative wages do not change, or if the elasticity σ is equal to 1, then it amounts to fixed allocations to each labour market. Finally the index refers to either the self-employed or the salaried market. For the unskilled labour type, the allocation is similar.

3.7 Investment

There are four types of investments in the model, namely households' investments in housing, business investment (both fixed and for capital goods), public investments and investments in inventories. Each of these is analyzed separately.

3.7.1 Investment in Housing

Households' demand for housing investment is given by a function of real disposable income and the real interest rates on housing loans and returns on monetary savings (the alternative investment). If we denote by VINVH the value of households housing investment, by PINVH the purchase price of housing, and by INVH the real amount of housing investment, then we have.

(47) $$VINVH = PINVH \cdot INVH$$

The purchase price of housing is given by a weighted average of prices of the products of the various sectors when they are purchased for investment

(48) $$PINVH = \sum_i bhous_i \cdot PCINV_i$$

where $bhous_i$ are technical coefficients that sum to 1, and the purchase price of the good of a sector for investment purposes is

(49) $$PCINV_i = PC_i \cdot (1 + tva_i)$$

The demand for the product of sector i for housing investment is simply

(50) $$DINVH_i = bhous_i \cdot INVH$$

The demand for housing by a given household class is given by the following function.

(51) $$INVH_h = \alpha_h INVH_{h,0}\left(\frac{YDPC_h}{YDPC_{h,0}}\right)^{\theta_h}$$

The total demand for housing investment is just the sum of the demand by different households.

3.7.2 Business Investment

Denote the cost of purchasing a unit of capital of sector i as PK_i , the current rate of profit of sector i as r_{Ki} , the interest rate as ρ, and the rate of depreciation as δ (possibly with a subscript i). Then the demand for business investment in sector i (namely the demand for new capital by destination denoted by $INVDEST_i$) is given by the following partial adjustment specification

(52) $$INVDEST_i = \mu_i \cdot K_i \cdot \left(\frac{r_{Ki}/\lambda_i}{PK_i \cdot (\rho+\delta_i)}\right)^{\gamma_i} - 1 - \delta_i - GR_i$$

where GR_i is the expected rate of growth of real GDP.

The purchase price of new capital is given by weighed averages of the effective prices of the composite goods:

(53) $$PK_i = \sum_k \beta_{ki} PCINV_k$$

where the β_{ki} are capital coefficients. The demand for the good of sector i for investment by the various sectors is then given by the following specification.

(54) $$INVOR_j = \sum_k \beta_{jk} INVDEST_k$$

3.7.3 Government Investments

These are exogenous. Total government investment is given by GINV in real terms. Then the demand for investment of sector i for public investment is given by a fixed share of that.

(55) $$INVG_i = \beta_{gov,i} GINV$$

3.7.4 Investments in Inventories

It is assumed that desired inventories are a fixed share of total volume of production X. Then the changes in inventories, are given by the difference between the desired inventories of the current and last period.

(56) $$\Delta STOCK_i = STOCK_i - STOCK_{i,t-1} = ast_i(XS_i - XS_{i,t-1})$$

The total demand of the good of sector i for investment is equal to the sum of the demands for different purposes.

(57) $$INV_i = DINVH_i + INVOR_i + INVG_i + \Delta STOCK_i$$

3.8 Total demand for Domestic Composite and Market Equilibrium

The total demand for the composite product of sector i that is demanded in the home country is equal to the sum of the demands for intermediate and final uses.

(58) $$DC_i = \sum_k NI_{ik} + DCC_i + DCG_i + INV_i$$

In (58) the term DCG_i denotes the real demand for the product of sector i by the government sector. This is assumed exogenous in the model. The total demand for the composite is subsequently split between imports and demand for the domestically produced product. In a standard CGE with flexible prices the market equilibrium in goods is given by the equality of the domestic component of DC with the domestically supplied component of total production, by the following equation.

(59) $DD_i = XD_i$ (determines PD_i)

The other domestic balancing equation is that for the labour market. In that market the total supply of labour in the domestic market for each skill type is equated to the total demand.

(60) $$LS_{kj} = \sum_i LD_{kji}$$ (determines w_{kj})

The final balancing equations are those for the exportable products. If it is assumed that there is only one world price for the exportable product of sector i, then this price is determined by the equilibrium of the total supply and demand for this exportable product.

(61) $XE_i = DEXP_i$ (determines PWE_i)

3.9 Ex-Post Balances

Once equilibrium in the model is achieved the ex-post savings-investment identity must be satisfied. This states that total savings in the economy must be equal to total investments in equilibrium, or

(62) $SAV = SAVF + SAVH + SAVG + SAVFOR = VINV$

In (52) SAV denotes the total savings in the economy that is composed of firms' savings, household savings, government savings and foreign savings. The right hand side of the equation denotes the value of total investment. The firm and household savings have been defined in equations (29) and (36) respectively. Government savings are equal to total government receipts minus total government payments. This is equal to the following.

(63)

$$SAVG = \sum_i (tind_i - subs_i) P_i XS_i + \sum_i tar_i \cdot EXR \cdot PMW_i^* \cdot DM_i + txdirf \cdot YFIRMS + TXDIRHH +$$
$$\sum_k [\frac{PHC_i}{(1+tva_k)(1+exc_k)} tva_k DHC_k] + INVH \cdot \sum_h (bhous_i \cdot PC_i \cdot tva_i) +$$
$$\sum_k \frac{PHC_k}{(1+exc_k)} \cdot exc_k \cdot DHC_k + \sum_i s\sec \cdot \lambda_i \cdot w_i \cdot LD_i -$$
$$\sum_i PC_i \cdot DCG_i - \sum_i \exp subs_i \cdot EXR \cdot PW_i^* \cdot XE_i$$
$$-GTRANSFHH \cdot CPI$$

Foreign "savings" is given by the difference between the income of the foreign sector (namely all receipts of the foreign sector from the domestic market) and all payments of the foreign sector to domestic entities. The quantity of foreign savings is expressed in domestic currency and is equal to the following.

(64) $SAFVFOR/EXR = \sum_i PW_i^* \cdot DM_i - \sum_i PXE_i \cdot XE_i - \sum_i shfcap_i \cdot DISTPROF_i - FCAP$

In (56) the term FCAP denotes the autonomous net foreign capital inflow into the country. If the exchange rate is exogenously set, then SAVFOR must be set equal to zero and FCAP is a balancing variable that denotes the necessary net foreign

capital inflow to accommodate the given exchange rate. If, on the other hand a flexible exchange rate regime is assumed, then the variable EXR is endogenous, and FCAP is exogenous, and setting SAVFOR in (56) equal to zero gives an equilibrium value for the exchange rate.

The value of investment that has to equal total savings is the following.

$$VINV = PINVH \cdot INVH + \sum_i PK_i \cdot INVDEST_i + \sum_i PC_i \cdot INVG_i + \sum_i PC_i \cdot \Delta STOCK_i \quad (65)$$

The model as outlined above has many structural features that are desirable for analyzing structural adjustment policies for a country like Greece. It includes rich institutional detail, in the sense that it separates various types of households, firms, and the public sector. It also includes several types of labour, again something that is relevant for Greece. The mapping of factor ownership into household types allows the exploration of distributional impacts of various policies.

4. Closure of the model

Closure refers to the way the macro system equations indicated above are balanced, namely how the equilibrium is achieved, and reflects one's beliefs about the way the economy works. If one believes that the economy works and that the various markets balance by adjusting prices so as to equilibrate supply and demand, that is, one assumes a basically neoclassical way of the functioning of the economy, then the proper "closure" of the model is to let prices adjust freely to balance supplies and demands. There are other ways, however, in which equilibrium can be achieved in the economy. For instance one may assume a "Keynesian" closure, via which all prices in the system are fixed, and what adjusts to bring about equilibrium are the quantities demanded. In such a case the possibility arises of unemployment of various factors of production, both capital and labour. This idea is close to the idea of "nominal rigidity"

that characterizes some macro models. Another Keynesian idea is that the volume of investment is not determined by available savings in the economy, but rather autonomously via investment equations.

Notice that, as described above, the model is homogeneous of degree zero in all prices. Hence, if the model is to "close" in a neoclassical fashion, namely by adjustment on all prices in the various markets, then a normalization rule is needed. There are several possibilities. One is to set the exchange rate equal to one. This, however, implies that one cannot undertake simulations with devaluation. Another possibility is to set the CPI equal to one. Yet a third possibility is to set the price of public current spending equal to one. Another one is to set the GDP deflator equal to one. However, balancing only via prices is not the only option available for this model. There are a variety of other closure rules that can be applied, and this, as mentioned above, depends on how one thinks the economy behaves (for a full discussion of closures and other issues relevant to structuralist CGE models (see Taylor, 1990; 2004).

For Greece, and in the context of the economic crisis, one of the main issues has been the flexibility of wages and prices. Most salaries in Greece are set via some kind of wage bargaining, and hence are determined exogenously. Nevertheless, there are some parts of the labour market that behave as if they equilibrate by wage adjustment, and these are mostly the uncontrolled sectors of the labour market, namely those involving self-employed labour. In the product markets, prices seem to be highly sticky downwards in most sectors, and this is manifested by the fact that consumer prices have in fact increased between 2008 and 2013 by about 10 percent, despite a 25 percent decline in real GDP.

At this point we should note that the performance of the CGE-type models depends not so much on their detail as regards sectors and institutions but rather on their closure rules. These rules, the specification of which is crucial for the behaviour of such models, refer to the basic assumptions about the behaviour of the economy and affect three types of markets: (a) the manner in which the labour market adjusts; (b) how investment is determined; (c) how demand adjusts to supply in the various sectors, and; (d) how the external sector adjusts.

In our model, the labour market is assumed to adjust in two alternative ways. The first approach is neoclassical adjustment, whereby the average nominal wages for each type of work adjust so as to maintain equilibrium between labour supply and demand, which in turn are endogenously determined by real wages. In this case the market clears through prices (neoclassical closure rule).

The second approach incorporates New-Keynesian features for some types of work, for which nominal wages remain unchanged in the short term (possibly because of collective bargaining or for other reasons causing rigidity, such as labour regulations) and employment in the short term is determined endogenously. Such a situation could create unintended unemployment for certain jobs, well above the assumed steady-state unemployment that would be consistent with the fundamentals of the Greek economy. There is a long-standing disagreement among the different schools of economic thought as to the appropriate rule of labour market adjustment. It would seem safe to assume that some segments of the labour market are more flexible than others. For example, the low-skill segment is likely to be less flexible than the high-skill segment, since the former is often associated with higher trade union penetration. For the purposes of our analysis, we assume varying degrees of flexibility for individual market segments. In particular we assume that the two self-employed labour markets adjust in a neoclassical fashion. We assume that the other 4 labour markets, which are all of the salaried type, are characterized by nominal wage rigidity, and hence adjust through quantities which causes unemployment.

The above assumptions are rather extreme but are meant to approximate reality as we do not know the degree of flexibility in each market and there are many tacit forms of flexibility that are not easily observed. After the financial crisis, the shortage of bank liquidity constraints, the decline in production as a result of subdued demand and labour market reforms to make the market more flexible, Greece has experienced a tacit transformation of industrial relations, as in most countries of the world: in order to avoid losing their jobs, workers have more easily accepted, temporarily, flexible forms of employment or even work rotation arrangements (temporary layoffs), with corresponding downward adjustments of their wages. It should also be noted that some firms, trying to buy time to adjust to the new situation, introduced work rotation schemes and mandatory leaves, eliminated overtime work and decided on temporary layoffs or temporary suspension of business. In Greece, employers and

employees in many firms, mainly export-oriented, have "agreed" on work rotation and part-time work, to enable such firms to adapt to the shrunken world demand.

In the closure rule regarding investment, first the investment functions are specified, and then total saving is assumed to adjust to the given levels of real investment. This is a Keynesian-type rule. A neoclassical rule, instead, would mean that the aggregate level of investment would be determined by the existing stock of saving. A Keynesian structure of investment appears to be more appropriate, as in the past few years banks, while not having funds for working capital financing, seem to have had funds available for investment lending. Thus investment is assumed to be demand-side rather than supply-side constrained. There is no empirical evidence for this, and our assumption is based on discussions with informed bankers.

On price adjustment, the assumption is made that all sectors behave as if prices are nominally fixed. The adjustment is made through a capacity utilization variable that is entered multiplicatively in the capital variable K and is allowed to vary freely to accommodate the amount of demand of the product of the sector. This is clearly a Keynesian assumption.

The last closure rule refers to the external sector. It is assumed that the exchange rate is fixed, and that the elasticity of demand of Greek exports is high but not infinite and funds available from abroad (remittances, foreign capital inflows, transfers from the European Union etc.) are treated as exogenous.

It is clear from the above that the model is a blend of neoclassical and Keynesian assumptions. Hence it can be considered as a hybrid structuralist model. In order to understand its behaviour better, the results will be contrasted between this model and the fully neoclassical version, where all prices are determined endogenously.

5. The 2004 Social Accounting Matrix

The statistical information for the construction of the 2004 SAM for the Greek economy, were obtained from the 2004 input-output table of the Greek Statistical Service (GSS), the GSS national household survey of 2004-5, the quarterly labour force surveys of 2004 from the GSS, the survey of the incomes and living standards

of the European Union (EU-SILC) of 2004, the 2002-5 survey of borrowing of households of the Bank of Greece, and several other statistical sources.

Methodologically the Greek SAM for 2004 draws upon the work of Pyatt and Round (1977, 1988), Pyatt and Roe (1977), Pyatt and Thorbecke (1976) and many others. The SAM for 2004 draws upon earlier SAM construction for Greece of Sarris, Zografakis and Karfakis (2004). Its construction follows the principles of the European System of Accounts (Eurostat, 1995)

The concise form of the SAM is illustrated in table 1. Each entry corresponds to several rows and columns, and these are indicated in the top of each column. Every row corresponds to a column and the row sums and column sums of the respective columns must be the same. Each row indicates the expenditures or outflows of the account represented by the row, while each column represents the incomes or flows of receipts of the account. In other words each column represents the supply side of each account and each row the demand side.

Table 1. Summary SAM for Greece 2004 (all figures in million euro of 2004)

Source: Computed by authors

					EXPENDITURES										
					CURRENT ACCOUNTS						CAPITAL ACCOUNTS				
							INSTITUTIONS				INSTITUTIONAS				
					INDUSTRIES (NACE)	PRODUCTION FACTORS	HOUSEHOLDS	ENTERPRISES	PUBLIC	REST OF WORLD	HOUSEHOLDS	ENTERPRISES	PUBLIC	STOCK CHANGES	TOTAL
					A	B	C	D	E	F	G	H	I	J	K
					15	7	15	1	1	1	15	1	1	1	
INCOMES	CURRENT ACCOUNTS	PRODUCTS		1	15	A1 INTERMEDIATE USES 102,654	B1	C1 PRIVATE CONSUMPTION 111,010	D1 ENTERPRISE CONSUMPTION 0	E1 PUBLIC CONSUMPTION 27,789	F1 EXPORTS TOURISM CONSUMPTION 35,132	G1 INVESTMENTS 8,637	H1 INVESTMETNS 26,906	I1 INVESTMEN 6,853	J1 STOCK CHANGES 32	*K1 TOTAL DEMAND* 319,013
		PRODUCTION FACTORS		2	7	A2 DISTRIBUTION OF VALUE ADDED 147,196	B2	C2	D2	E2	F2 FACTOR INCOMES FROM REST OF WORLD 5,461	G2	H2	I2	J2	*K2 FACTOR INCOME* 152,657
		INSTITUTIONS	HOUSEHOLDS	3	15	A3	B3 DISTRIBUTION OF FACTOR INCOMES TO HOUSEHOLDS 76,653	C3 TRANSFERS FROM HOUSEHOLDS 1,433	D3 TRANSFERS FROM ENTERPR. 41,046	E3 TRANSFERS FROM PUBLIC 37,717	F3 TRANSFERS FROM REST OF WORLD 2,447	G3	H3	I3	J3	*K3 HOUSEHOLD INCOMES* 159,295
			ENTERPRISES	4	1	A4	B4 DISTRIBUTION OF FACTOR INCOMES TO ENTERPRISES 67,015			E4 TRANSFERS FROM PUBLIC 421	F4	G4	H4	I4	J4	*K4 ENTERPRISE INCOME* 67,436
			PUBLIC	5	1	A5 PUBLIC REVENUES 19,973	B5 DISTRIBUTION OF FACT INCOMES TO PUBLIC 2,241	C5 TAXES AND SOC. SECURITY 33,827	D5 DIRECT TAXES 5,927	E5	F5	G5	H5	I5	J5	*K5 PUBLIC INCOME* 61,968
			REST OF THE WORLD	6	1	A6 IMPORTS 49,190	B6 DISTRIBUTION OF FACTOR INCOMES TO REST OF WORLD 6,749	C6 TRANSFERS TO REST OF WORLD 2,283	D6 TRANSFERS TO REST OF WORLD 808	E6 TRANSFERS TO REST OF WORLD 0	F6	G6	H6	I6	J6	*K6 REST OF WORLD INCOME* 59,030
		SAVINGS		7	1	A7	B7	C7 GROSS SAVINGS OF INSTITUTIONS 10,742	19,655	-3,959	15,990	G7				*K7 SAVINGS* 42,428
		TOTAL		*9*		*A9 TOTAL SUPPLY* 319,013	*B8 DISTRIBUTION OF FACTOR INCOMES* 152,657	*C8 USE OF INCOMES OF INSTITUTIONS* 159,295	67,436	61,968	*F8 EXPENDITURES OF REST OF WORLD* 59,030	G8 TOTAL INVESTMENTS OF INSTITUTIONS 8,637	26,906	6,853	32	

Statistical problems arise because the entries in the rows and columns must all be valued at the same prices, something that is not normally the case in the available statistics, and appropriate adjustments and transformations to the raw data must be made. There are five different prices at which transactions can be valued, namely basic prices (sum of intermediate costs and value added costs), producer prices (basic prices plus production taxes), buyers prices (producer prices plus trade margins and consumption taxes), cif prices (world prices at port of entry), and domestic prices of imported goods (cif prices plus import taxes). The SAM exhibited in table 1 is valued at producer prices.

The sectors included in the 2004 SAM are indicated in table 2. As illustrated in table 1, each sector produces only one product. In practice a sector may produce products that belong to several sectors (joint or secondary production), and adjustments have to be made on the basis of what is known as the Make-Matrix. Similarly final demand may involve products that are made up of several sectoral outputs. This also has to be taken into account for the final demand systems.

Table 2. The sectors included in the Greek SAM of 2004

1: Agriculture, Forestry, Fishing
2: Mining, Electricity, Water, Oil, Natural Gas
3: Food and Beverage Manufacturing
4: Textile manufacturing, Treatment of skins
5: Treatment of timber, Publications, Printing
6: Intermediate Good Manufacturing
7: Capital Good Manufacturing
8: Construction
9: Commerce
10: Tourism Services, Recreation
11: Transport, Communications
12: Real estate and other market services
13: Public Administration
14: Education
15: Health

Value added is the difference between the gross output of a sector and all intermediate uses. Value added is composed of rewards to various factors. Table 3 indicates the contribution to value added of the various factors, namely the detail in cell A2 (the table presents actually the transpose of cell A2 for ease of exposition).

Table 3. Contribution of various factors to value added (mil EUR)

	Immigrant labour		Greek labour				Total	Total	Total value added
			Employees		Self-employed		Labour	Capital	
	Low-skilled	High-skilled	Low-skilled	High-skilled	Low-skilled	High-skilled			
	L_1	**L_2**	**L_3**	**L_4**	**L_5**	**L_6**	**L**	**K**	
Agriculture, forestry and fishing	326.9	17.8	714.7	120.2	3,977.8	115.3	5,272.7	3,319.4	8,592.1
Mining, Electricity, Water	23.0	6.1	1,130.1	771.1	22.8	1.7	1,954.7	3,012.0	4,966.7
Food and Beverage Manufacturing	123.5	4.4	999.0	461.8	17.1	84.7	1,690.5	2,328.0	4,018.5
Textile manufacturing	87.2	10.4	740.8	194.9	9.4	69.1	1,111.8	1,120.9	2,232.7
Wood, furniture, paper, printing and publishing	44.4	16.7	539.9	404.2	10.3	210.6	1,226.1	762.9	1,989.0
Other intermediate Good Manufacturing	50.9	14.6	922.3	459.8	13.9	74.4	1,536.0	1,003.1	2,539.1
Capital Goods Manufacturing	190.0	24.0	1,364.3	857.4	21.1	221.2	2,678.0	1,844.4	4,522.4
Construction	1,478.9	193.5	2,192.4	251.1	1,397.1	382.3	5,895.4	6,878.3	12,773.6
Wholesale and retail trade	197.8	49.5	2,358.7	1,665.7	3,792.7	1,210.6	9,274.9	11,053.3	20,328.2
Tourism Services, Recreation	845.1	231.6	2,579.8	1,273.3	1,501.4	555.4	6,986.5	11,656.0	18,642.5
Transport, Communications	74.6	41.2	2,607.8	2,004.1	948.2	105.8	5,781.7	8,674.6	14,456.3
Real estate and other market services	84.5	53.2	1,720.0	3,920.4	454.9	2,477.5	8,710.6	16,049.3	24,759.9
Public administration	1.3	26.6	5,301.1	6,076.2	0.0	0.0	11,405.3	16.9	11,422.2
Education	4.3	26.1	484.5	6,990.9	31.8	76.3	7,613.9	185.1	7,799.0
Health	18.4	114.4	1,091.3	3,011.7	0.4	1,278.4	5,514.7	2,639.1	8,153.8
Total	**3,550.9**	**830.4**	**24,746.7**	**28,462.7**	**12,199.0**	**6,863.0**	**76,652.6**	**70,543.3**	**147,195.9**

Source. Computed by authors

A major difficulty that arises in the SAM is the mapping of the factor incomes to household types. This is because there is no direct data for this type of transformation. The relevant mapping, which is the detail of (the transpose of) cell B3 in the SAM of table 1, is indicated in table 4, and is crucial in the distributional analysis, as it reflects the ownership of factors by the different classes of households.

The concise SAM illustrated in table 1 hides considerable more detail, which is not shown for lack of space, but is reflected in the model, as indicated earlier.

6. Calibration of the model

Calibration of the model entails the fitting of the model to the one-year SAM. The procedure entails assumptions about the various elasticities involved, and then utilization of the entries of the SAM in order to derive the values of the constants of the model. Consider, for instance, the allocation system for production to domestic and exportable products illustrated in equations (17)-(20). From equations (18) and (19) it follows that the share of the value of total production of a sector P_i. XS_i that is accounted by the domestic and export products is as follows.

$$\frac{PD_i \cdot XD_i}{P_i \cdot XS_i} = \beta_{11i} \cdot \left(\frac{PD_i}{P_i} \right)^{1+\tau_{1i}} \tag{66a}$$

$$\frac{P_i \cdot XE_i}{P_i \cdot XS_i} = \beta_{12i} \cdot \left(\frac{PE_i}{P_i} \right)^{1+\tau_{1i}} \tag{66b}$$

In the base year we can assume without loss of specificity that the prices PD as well as PWE and EXR are all equal to 1. Equation (20) then ensures, under the assumption that the sum of the two β parameters in (66a,b) is equal to 1, that P is also equal to 1. Equations (66a) and (66b) then can be used to compute the two β parameters in (66a,b) directly from the base year SAM. The same procedure can be utilized to compute all the various parameters of the model, given assumptions about the various elasticities, budget shares of different households etc. Normally the assumptions about the elasticities follow econometrically derived elasticities from other studies, and sensitivity analysis is performed to examine the sensitivity of the model to these assumptions.

It is clear that this calibration procedure does not ensure that the comparative static results that are simulated are close to the actual changes that have been observed in the real world, as the values of the elasticities assumed are in many case guesstimates. This is something well known about this type of CGE model, and is due to the fact that the model is not dynamic. There are techniques of validating dynamic CGE models (see Dixon and Rimmer, 2013) but these cannot be applied in this case as the model is basically static. Nevertheless, what can be done is to simulate the model to see whether the comparative static results are close, at least in direction and relative

magnitude, to observed outcomes, in order to obtain a first idea about the validity of the model. More detailed validation can be done when the model is extended to a dynamic one. Building, however, a dynamic multisectoral CGE for Greece with the detail of the static CGE is relegated to future research.

Table 4. Distribution of labour incomes to households (million Euro)

	Immigrant labour		Greek labour				Total
			Employees		Self-employed		
	Low-skilled L_1	High-skilled L_2	Low-skilled L_3	High-skilled L_4	Low-skilled L_5	High-skilled L_6	
Immigrant households	**3,369**	**717**	**13**	**66**	**0**	**0**	**4,165**
- Poor	983	185	4	0	0	0	1,172
- Middle Income	2,297	505	0	66	0	0	2,868
- Rich	89	26	9	0	0	0	125
Greek Households	**181**	**114**	**24,734**	**28,397**	**12,199**	**6,863**	**72,488**
Agricultural households							
- Poor	11	0	305	12	1,487	0	1,815
- Middle Income	5	0	1,939	549	4,088	0	6,581
- Rich	0	0	286	557	1,149	0	1,992
Urban low-skilled *households*							
- Poor	0	0	879	72	0	0	952
- Middle Income	21	6	13,108	1,980	2,088	155	17,359
- Rich	0	0	3,369	1,066	743	449	5,627
Urban high-skilled households							
- Poor	0	20	8	214	0	0	242
- Middle Income	7	8	533	9,817	0	3,068	13,433
- Rich	8	43	462	10,141	0	2,312	12,966
Non - working households							
- Poor	17	0	407	90	707	0	1,221
- Middle Income	103	17	2,957	2,760	1,937	0	7,774
- Rich	9	19	481	1,138	0	879	2,526
Total Households	**3,551**	**830**	**24,747**	**28,463**	**12,199**	**6,863**	**76,653**
- Poor	1,011.0	205.0	1,603.0	388.0	2,194.0	0.0	5,402.0
- Middle Income	2,433.0	536.0	18,537.0	15,172.0	8,113.0	3,223.0	48,015.0
- Rich	106.0	88.0	4,607.0	12,902.0	1,892.0	3,640.0	23,236.0

Source: Computed by authors

7. Empirical simulations

In this section we explore the comparative statics of the model. In order to do this, we must define the exogenous changes that are to be simulated, as well as some of the endogenous changes that have been observed, in order to examine how the model performs. Table 5 presents such a table for a variety of economic aggregates between 2008-13. The size of the crisis is apparent in the sense that GDP has declined by almost 25 percent within this period, employment has declined by 24 percent, and gross capital formation declined by 64 percent. The magnitudes also indicate some of the exogenous changes in aggregate variables, such as the reduction in social benefits and social transfers.

Despite the fact, as we indicated earlier, that the model is not supposed to track the economic crisis well, it is designed to indicate medium-term comparative static changes.

Table 5. Percentage changes in Greek economic aggregates 2008-2013 (current prices)

Variable	Change
GDP at factor cost	-24.5
Final consumption expenditure	-25.7
Exports	3.2
Imports	-25.1
Total government expenditure	-5.8
Gross fixed capital formation total	-64.4
Gross savings	-13.2
Compensation of employees	-28.0
Cost of labour	-50 to +29% simple average -22%
Employment	-24.3
Total government revenue	-6.8
Taxes on income and wealth	-6.1
Government gross capital formation	-59.0
Social benefits	-13.4
Social transfers in kind	-32.8
Social contributions	-20.4
Subsidies	538.6
Annual CPI	10.1

Source: Authors' calculations from data in Greek National Statistical Service

Table 6 indicates the scenarios that were simulated to represent the policy measures adopted in response to the crisis. The idea is that we simulate changes comparable to those that have occurred since 2008, in order to see whether the model is capable of explaining the large changes in endogenous magnitudes that have been observed. A final scenario designated as "All" in the subsequent tables simulates all of the changes in S1-S8 together. This is supposed to represent in some sense the full stabilization and adjustment programme that has been implemented in Greece during 2008-13.

Table 6. The various scenarios simulated with the model

cenario Name	Variables changed	Assumed percent change
S1	Government Consumption	-26%
S2	Public Investment	-40%
S3	Indirect Taxes	+20%
S4	VAT	+21%
S5	Direct Tax rates by Income Brackets	0.05 (from 0) 0.20 (from 0.15 0.35 (from 0.3) 0.40 (from 0.35)
S6	Social Benefits	-50%
S7	Unemployment Benefits	-50%
S8	Nominal Wages	-20%

Source: Authors' computations

Table 7 exhibits the impact on the main macroeconomic aggregates. It can be seen that the combination of all scenarios implies a decrease in real GDP at factor cost of 8.2 percent, a decline in real private investment of 8.3 percent, a decline in real private consumption of 2.9 percent, a decline in imports of 7.3, a decline in exports of 1.3 percent, a huge decline in private household savings of 271 percent, a decline in government expenditures of 40.2 percent, including a decline of public transfers to households of 54.7 percent, a decline in government revenues of 1 percent and a large decline in the public sector deficit of 29.7 percent. These changes are in the same direction as the changes actually observed; they are, however, of smaller magnitude, which can probably be explained by the fact that the economy simulated in the CGE is somewhat less rigid than the Greek economy (in other words the elasticities take larger values in the model than are probably true in reality). It can be seen from the table that the main scenario that contributes to these results is the first one, namely the cut in total government consumption expenditures.

Table 9 presents the simulated changes in total employment in thousands of employees. The total simulated effect is that 157 000 employees have lost their jobs, which is around 3 percent of base employment; this compares to to an actual decline of 24.3 percent reported in table 5. The model predicts larger declines in Greek self-employment (5.6 percent) compared to that of Greek salaried employees (2.4 percent) and immigrant employees (3.6 percent). The maintenance of employment levels in the model is due to the large decline in salaried wages (20 % on average) in the face of nominal price rigidity, a situation that favors the substitution of salaried over self-employed workers. That this is the case can be seen from scenario 8, which simulates an exogenous large decline in salaries only, which leads to increases in salaried employees and a decline in self-employed workers. Again, it appears that the scenario that contributes mostly to the decline in employment is scenario 1, namely the decline in government current expenditures.

Table 10 indicates employment changes by sector. It can be seen in the "All" scenario that the sectors that suffer the largest decrease in employment are the construction, education and the public sector. The reason that the public sector appears to be impacted severely is that in the model it is treated as a normal producing sector, and its demand for labour is a result of the decreased public expenditures that

reduce the demand for the product of the public sector. This is, of course, not the case in the real world, where most public employees are sheltered from unemployment by the permanent nature of their contracts, but this is not reflected in the model. Notable also is the increase in employment in tourism, agriculture, food manufacturing and trade. These increases are largely caused by the decrease in labour costs that impacts a lot on these largely labour-intensive sectors.

Table 11 indicates the gross output changes by sector of economic activity. The "All" scenario suggests that all sectors are negatively affected by the policy package, with the ones with the largest declines being in education, the public sector, construction and health. The largest contributor to these results is simulation S1, namely the large decline in public current expenditures.

Table 12, indicates the impacts on real disposable incomes of the different classes of households. The results indicate that the "All" scenario affects all household classes negatively. The largest reductions in real disposable incomes (remember the number of households and members are kept constant in each class) are among non-working households (-37.5 percent), namely households with a head who is a pensioner, then immigrant households (-33.2 percent). All other households are affected to a lesser extent, with declines in disposable incomes of around 20 percent. It is notable that among all households it is the poorest that exhibit the largest decline in disposable income, while those at the top the lowest. The model thus suggests that the policies implemented have been largely regressive.

We elaborate more on the individual scenarios in order to highlight the workings of the model and how the effects are produced. Concerning first scenario S1, An exogenous decline in public expenditures is implemented in the model by reducing the final demand for government expenditures in all sectors, whose final demand is made up in part by government expenditures. In the SAM and model, government final demand expenditures are a part of final demand for mainly three sectors, namely public administration and defense (sector 13), education (sector 14), and health (sector 15)[4]. The government expenditures for the product of these sectors is reduced by the same proportional amount as total government expenditures.

The reduction in final demand for these sectors affects their production, which, as can be seen in table 10 declines considerably albeit not proportionately to the overall decline in public expenditure. This is because, government consumption differs, as part of total demand, in these sectors, the largest being in public administration, which, as expected, sees the largest decline in production. The decline in the production of these three sectors affects the demand for mainly salaried highly skilled employees, who are disproportionately employed in these three sectors. As seen from table 9, about half of the decline in total employment under this scenario is accounted for by the decline in the demand for high-skilled Greek workers, and this decline accounts for more than 10 percent of the base year skilled Greek employment. However, these three sectors also employ a significant amount of low skilled workers, who in turn also see a significant drop in employment, albeit much lower in percentage terms (about 5 percent) than that of skilled workers. Greek self-employed as well as immigrant workers are hardly affected in this scenario, as these are not

[4] There is another sector whose final demand is affected by government expenditures (sector 12, real estate and other market services), but the government final demand is a very small part of the demand for the product of this sector, and although it is considered in the empirical analysis, it is not worth treating it separately in the overall discussion.

employed much in the three sectors affected by the public sector expenditure cuts. The main influence on these workers comes about indirectly through the decline in demand and production of sectors who are demanded as intermediate products by the three sectors above, or whose demand arising from private consumption expenditures is negatively affected by the decline in incomes of the workers in the three directly affected sectors.

The decline in final government expenditures and the attendant decline in output of the three affected sectors affects real disposable incomes of households mainly in the urban sector, as indicated in table 12. It can be seen there, that the bulk of the real income declines affects urban households headed by high skilled workers and also urban households headed by low skilled workers, but all other types of households are negatively affected. The real disposable income declines from this policy are fairly evenly distributed among poor, middle income and rich households as can be seen at the bottom of column S1 in table 12. Hence decreases in government expenditures as a stabilization policy are neither regressive nor progressive but rather neutral in terms of their distributional impacts.

Despite these real disposable income declines, real private consumption is not affected by much (only by -0.4 percent as can be seen in table 7 column S1), and the bulk of the real income decline is reflected in huge declines in private household savings (-38.6 percent in table 7 column S1). This seems quite reasonable and according to expectations, as most households in the face of declines in real income would strive to maintain real consumption by reducing savings. The decline in private household savings is reflected in a large decline in private household investment (-4.3 percent in table 7 column S1).

The public sector deficit, as can be seen in column S1 of table 8 declines considerably from 6.43 percent of GDP in the reference scenario to 3.54 percent in the simulated scenario, implying that this policy measure is effective at reducing public sector deficit, without producing adverse distributional impacts. The reduction is not as large as might be inferred by the sizeable simulated reduction in public expenditures (which is 26 percent of the reference public expenditures), and this is because the public revenues are considerable reduced (-5.7 percent change as seen in table 7), and this comes about from reduced receipts from the various direct and indirect taxes (table 8), including almost a halving of the VAT tax collections.

Scenario S2, which involves a large simulated decrease in public investment, produces a much smaller decline in real GDP (-1.7 percent) but a very large (more than 10 percent) decline in the construction sector, which is the sector affected by this policy measure. As can be also seen in table 12, this policy is quite regressive, as the bulk of employed people in the construction sector are low skilled, as can be seen in table 3.

Increases in indirect tax rates simulated in scenarios S3 and S4 lead to miniscule changes in real GDP at factor cost, increases in GDP at market prices, because of the increases in indirect taxes, very little employment loss, a significant reduction in the public sector deficit, and real income changes that are fairly progressive as is indicated in table 12. Hence these types of policies are quite appropriate for stabilization and adjustment, without creating adverse distributional impacts.

Increases in all direct tax rates, simulated in S5, lead to small declines in GDP, smaller declines in the government deficit, very small changes in employment, mainly

of low-skilled Greeks, evenly low reductions in employment across sectors, and a large, and mildly regressive, decline in real disposable incomes (table 12). The decline in real incomes under this scenario is considerably larger than under the public expenditure reduction scenario S1.

Scenario S6, which involves significant reductions in social benefits (by 50 percent from the reference value), is the worst scenario from almost all perspectives, and especially a distributional perspective. While it produces significant reductions in public expenditures and in fact a surplus of 2.71 percent of GDP, it leads to the third largest decline in GDP (-1.2 percent), the largest reduction in real private consumption (-1.4 percent), significant declines in household investment (-9.7 percent), and private household savings (-141 percent), a modest reduction in employment (-1.1 percent of the reference employment), but a very regressive impact on real household disposable incomes. While total real incomes of households in the economy decline by 13.79 percent. the real incomes of the poor decline by a whopping 22.3 percent, those of the middle-income households by 14.39 percent, while those of the richer households by only 8.97 percent. This appears to be a very inappropriate and highly regressive policy for stabilization and adjustment from a distributional perspective, as it impacts mostly on the weakest and poorest of the households in Greece. From table 12, in fact, it can be seen that such a policy affects very negatively (by -27.7 percent) the real incomes of the households headed by a non-working (ie pensioned) individual.

The large declines in unemployment benefits, simulated in S7, do not seem to have a large impact on the economy, but are regressive as can be seen in table 12.

Finally scenario S8 simulates a 20 percent decline in nominal wages of all types of workers, whose wages are nominally fixed (and this involves four of our six labour types). This is a beneficial scenario from a GDP point of view as it increase real GDP by 0.7 percent, which happens largely though increased employment and production of several sectors that depend on salaried employees, such as manufacturing, construction, and all services. Total employment increases substantially under this scenario (by almost 6 percent from the reference scenario), as one would expect, but the public sector deficit increases to 8.3 percent of GDP at market prices, compared to 6.4 percent of GDP in the reference scenario. The reason for this is large reductions in receipts from direct and indirect taxes, as real household disposable income increases for most types of households and for all households together (table 12) are mainly reflected in increases in household savings and not consumption. Increased household savings happen in the face of almost unchanged household consumption, and despite real wage declines of 16.6 percent.

The final column in all tables simulates the impact of all policies together. It can be seen that the combination of all measures leads to a reversal of the public sector deficit to a substantial surplus, as has been the case in the real experience. All revenue sources from taxes of the government decline, because of the decline in economic activity. The basic contributor to the outcome of the reversal of the public sector deficit seems to be scenario 6, namely the exogenous assumed reduction in social benefits by 50% since social benefits take a large proportion of total public sector expenditure. It appears in fact that this has been a leading cause of the reduction in the public sector deficit in Greece. As discussed above, however, this has been the most regressive of all stabilization policies, leading to the further impoverishment of the poorest households.

Table 7 Simulated changes in key macroeconomic aggregates

	REF	S1	S2	S3	S4	S5	S6	S7	S8	All
	Bill €	percentage changes at constant prices except where indicated otherwise								
Real GDP at factor cost	149.0	-4.9	-1.7	-0.1	-0.2	-0.6	-1.2	-0.2	0.8	-8.2
Real GDP at market prices	**168.9**	**-4.5**	**-1.7**	**0.9**	**1.5**	**-0.6**	**-1.3**	**-0.2**	**0.7**	**-5.3**
Real private investments	34.8	-2.3	-2.4	-1.0	-0.8	-1.9	-3.1	-0.6	3.3	-8.3
- Firms	26.4	-1.7	-1.8	-0.9	-0.3	-0.5	-1.0	-0.2	3.7	-2.9
- Households	8.4	-4.3	-4.2	-1.4	-2.4	-6.2	-9.7	-1.8	1.9	-25.4
Public investment expenditures	6.4	0.0	-40.0	0.0	0.0	0.0	0.0	0.0	0.0	-40.0
Real total private consumption	94.3	-0.4	-0.1	-0.1	-0.2	-0.6	-1.4	-0.2	0.1	-2.9
Real government consumption	27.5	-26.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-26.0
Value of exports (Total)	35.1	-0.3	-0.3	-0.1	-0.1	-0.1	-0.3	-0.1	-0.1	-1.3
Value of imports (Total)	49.2	-2.2	-2.1	-0.5	-0.3	-0.7	-1.5	-0.2	0.1	-7.3
Total private household savings	10.8	-38.6	-13.8	-9.1	-18.5	-56.3	-141.0	-25.6	12.3	-271.3
GDP deflator (Index)	100.0	0.34	0.28	-0.45	0.07	0.12	0.27	0.05	0.11	0.85
Consumer Price Index (Index)	100.0	-0.02	-0.01	0.70	2.45	-0.03	-0.04	-0.01	0.01	3.02
Real Wages, Total (Index)	100.0	-1.48	-0.24	-0.66	-2.21	-0.11	-0.27	-0.04	-16.57	-21.09
Expenditures of government	75.5	-11.7	-4.2	0.3	1.2	-0.2	-25.0	-4.6	2.4	-40.2
- Transfers to households	37.4	-4.2	-1.3	0.6	2.1	-0.5	-50.5	-9.3	4.9	-54.7
Revenues of government	64.8	-5.7	-1.5	2.4	4.5	8.9	-5.7	-1.1	-2.1	-1.0
Public sector deficit	10.8	-5.1	-2.2	-1.3	-2.0	-6.0	-15.2	-2.8	3.2	-29.7

Source: Authors' calculations based on the CGE model.

Table 8. Simulated changes in key public sector aggregates

	REF	S1	S2	S3	S4	S5	S6	S7	S8	All
Direct taxes from households	17.6	8.2	9.0	9.3	9.5	15.4	6.3	8.7	9.8	10.3
-changes in bill €		-9.4	-8.5	-8.3	-8.1	-2.1	-11.2	-8.8	-7.7	-7.3
Direct taxes from enterprises	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.4	6.2	5.8
-changes in bill €		0.0	0.0	0.0	0.1	0.1	0.0	0.1	0.9	0.5
VAT	27.8	13.8	13.7	14.0	16.7	13.8	13.6	13.9	13.9	16.0
-changes in bill €		-14.0	-14.1	-13.8	-11.1	-14.0	-14.2	-13.9	-13.9	-11.8
Other indirect taxes	17.3	8.5	8.6	10.4	8.7	8.6	8.6	8.7	8.7	9.8
-changes in bill €		-8.8	-8.7	-7.0	-8.7	-8.7	-8.8	-8.7	-8.7	-7.6
Tax of Duties	0.8	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
-changes in bill €		-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.4	-0.5
Social Contributions	43.2	20.6	22.4	22.7	22.7	22.6	22.5	22.7	19.7	17.3
-changes in bill €		-22.7	-20.9	-20.6	-20.6	-20.7	-20.8	-20.6	-23.5	-26.0
Subsidies	-5.8	-2.9	-3.0	-2.9	-3.0	-2.9	-2.9	-3.0	-2.9	-2.9
-changes in bill €		2.8	2.8	2.8	2.8	2.8	2.9	2.8	2.8	2.9
Public sector deficit	-10.8	-5.7	-8.6	-9.4	-8.7	-4.8	4.5	-8.0	-13.9	19.0
- as a % of GDP at market prices	-6.43%	-3.54%	-5.19%	-5.62%	-5.14%	-2.88%	2.71%	-4.79%	-8.27%	11.88%
Current account deficit	16.0	14.5	14.6	15.7	15.8	15.5	14.9	15.8	15.9	10.9
-as a % of GDP at market prices	9.56%	9.06%	8.88%	9.34%	9.31%	9.31%	9.03%	9.48%	9.46%	6.85%

Source: Authors' calculations based on CGE model.

Table 9 Simulated changes in total employment

	REF	S1	S2	S3	S4	S5	S6	S7	S8	All
	,000	Absolute changes (‘000)								
Employment (total)	**4,519.0**	**-230.5**	**-72.7**	**-8.4**	**-11.5**	**-24.0**	**-49.3**	**-8.4**	**269.5**	**-157.4**
Greek Employees	**2,766.6**	**-195.0**	**-44.0**	**-3.6**	**-1.9**	**-16.0**	**-33.5**	**-5.7**	**251.9**	**-67.6**
Low-skilled	1,680.1	-83.0	-34.3	-2.9	-1.7	-11.4	-23.7	-4.0	165.3	-7.0
High-skilled	1,086.5	-112.0	-9.7	-0.7	-0.1	-4.6	-9.7	-1.6	86.6	-60.6
Greek Self-employed	**1,289.6**	**-11.6**	**-9.3**	**-3.3**	**-8.5**	**-3.3**	**-7.2**	**-1.2**	**-30.2**	**-72.9**
Low-skilled	984.6	-6.0	-7.6	-2.6	-6.5	-2.7	-5.8	-1.0	-21.6	-52.5
High-skilled	305.1	-5.6	-1.7	-0.7	-2.0	-0.7	-1.4	-0.2	-8.6	-20.4
Immigrant Employees	**462.7**	**-23.9**	**-19.4**	**-1.5**	**-1.1**	**-4.6**	**-8.6**	**-1.5**	**47.8**	**-16.8**
Low-skilled	388.1	-19.0	-17.2	-1.3	-1.0	-4.0	-7.4	-1.3	40.5	-14.3
High-skilled	74.6	-4.8	-2.2	-0.1	-0.1	-0.6	-1.1	-0.2	7.3	-2.5

Source: Authors’ calculations based on CGE model.

Table 10. Simulated changes in employment by sector

	REF	S1	S2	S3	S4	S5	S6	S7	S8	All
	,000	percentage changes %								
Agriculture, forestry and fishing	559.0	-0.4	0.0	-0.3	-0.2	-0.4	-1.1	-0.2	4.0	1.2
Mining, Electricity, Water	63.1	-1.9	-1.4	-0.6	-0.3	-0.6	-1.2	-0.2	4.9	-1.2
Food and Beverage Manufacturing	126.2	-0.3	0.0	-0.4	-0.2	-0.4	-1.1	-0.2	6.7	3.9
Textile manufacturing	91.1	-0.2	0.1	0.1	-0.4	-0.3	-0.6	-0.1	5.4	4.0
Wood, furniture, paper, printing and publishing	88.1	-1.3	-2.3	-0.2	-0.4	-0.6	-1.2	-0.2	4.4	-2.1
Other intermediate Good Manufacturing	155.6	-1.5	-3.6	-0.3	-0.4	-0.7	-1.3	-0.2	5.5	-2.6
Capital Goods Manufacturing	113.8	-1.8	-0.9	-0.4	-0.4	-0.3	-0.6	-0.1	6.2	1.3
Construction	410.7	-1.9	-10.2	-0.8	-0.8	-1.9	-3.0	-0.5	8.5	-11.4
Wholesale and retail trade	766.1	-1.0	-2.0	-0.2	-0.3	-0.7	-1.5	-0.3	7.3	0.9
Tourism Services, Recreation	292.7	-0.3	0.0	0.2	-0.2	-0.2	-0.5	-0.1	6.9	5.7
Transport, Communications	271.2	-0.9	-0.3	0.0	-0.2	-0.3	-0.6	-0.1	4.6	2.2
Real estate activities	393.4	-1.7	-1.1	-0.3	-0.2	-0.6	-1.3	-0.2	5.6	-0.1
Public administration	505.2	-18.2	0.0	0.0	-0.1	-0.1	-0.3	0.0	5.8	-14.1
Education	252.0	-19.1	0.0	0.0	0.0	-0.1	-0.1	0.0	4.1	-16.0
Health	200.3	-10.3	-0.1	0.1	0.1	-0.3	-0.7	-0.1	6.7	-5.3
Total	***4,288***	**-5.1**	**-1.6**	**-0.2**	**-0.3**	**-0.5**	**-1.1**	**-0.2**	**6.0**	**-3.5**

Source: Authors' calculations based on CGE model.

Table 11. Simulated changes in gross output by sectors

	REF	S1	S2	S3	S4	S5	S6	S7	S8	All
	Bill €	percentage changes %								
Agriculture, forestry and fishing	6.73	-0.50	-0.12	-0.29	-0.17	-0.43	-1.22	-0.20	0.00	-2.90
Mining, Electricity, Water	5.77	-1.94	-1.43	-0.42	-0.30	-0.58	-1.25	-0.21	-0.10	-5.95
Food and Beverage Manufacturing	3.83	-0.60	-0.18	-0.26	-0.15	-0.53	-1.39	-0.23	1.31	-2.04
Textile manufacturing	2.57	-0.57	-0.15	0.18	-0.36	-0.41	-0.90	-0.15	1.17	-1.19
Wood, furniture, paper, printing and publishing	1.79	-1.65	-2.59	-0.19	-0.26	-0.75	-1.44	-0.25	0.75	-6.21
Other intermediate Good Manufacturing	4.60	-2.06	-4.39	-0.25	-0.34	-0.94	-1.66	-0.29	1.29	-8.36
Capital Goods Manufacturing	3.02	-2.67	-1.35	-0.44	-0.34	-0.51	-1.02	-0.17	2.66	-3.98
Construction	13.01	-1.99	-10.32	-0.76	-0.78	-1.90	-3.09	-0.56	2.52	-16.42
Wholesale and retail trade	20.72	-1.12	-2.12	-0.10	-0.31	-0.75	-1.64	-0.28	0.92	-5.32
Tourism Services, Recreation	12.71	-0.46	-0.08	0.24	-0.20	-0.31	-0.71	-0.12	0.53	-1.14
Transport, Communications	14.58	-1.25	-0.59	-0.02	-0.15	-0.38	-0.88	-0.15	0.06	-3.27
Real estate activities	25.33	-2.07	-1.19	-0.26	-0.15	-0.65	-1.43	-0.24	0.06	-5.79
Public administration	18.23	-18.28	-0.09	0.07	-0.05	-0.14	-0.34	-0.06	1.37	-17.81
Education	7.83	-19.29	-0.04	0.05	0.04	-0.12	-0.15	-0.03	0.48	-19.16
Health	8.25	-10.28	-0.06	0.18	0.14	-0.27	-0.72	-0.12	0.80	-10.45
Total	***149.0***	**-4.92**	**-1.74**	**-0.14**	**-0.21**	**-0.60**	**-1.22**	**-0.21**	**0.80**	**-8.19**

Source: Authors' calculations based on CGE model.

Table 12. Simulated impacts on real disposable incomes of households

	REF	S1	S2	S3	S4	S5	S6	S7	S8	All
	Bill €	percentage changes %								
Immigrant households	**3.6**	**-5.42**	**-4.86**	**-1.27**	**-3.06**	**-6.92**	**-3.94**	**-0.71**	**-10.24**	**-33.20**
- Poor	1.1	-4.77	-4.47	-1.09	-2.69	-6.07	-3.51	-0.63	-9.85	-30.07
- Middle Income	2.4	-5.76	-5.08	-1.37	-3.25	-7.36	-4.17	-0.75	-10.44	-34.82
- Rich	0.1	-4.66	-3.91	-1.06	-2.77	-6.27	-3.20	-0.57	-9.75	-30.10
Agricultural households	**13.2**	**-2.50**	**-1.64**	**-1.14**	**-2.32**	**-5.92**	**-6.98**	**-1.27**	**1.17**	**-19.67**
- Poor	2.2	-2.39	-2.05	-1.04	-2.16	-5.67	-8.05	-1.46	-0.19	-21.70
- Middle Income	8.9	-2.44	-1.57	-1.15	-2.32	-5.79	-6.87	-1.25	1.59	-19.07
- Rich	2.1	-2.83	-1.50	-1.20	-2.50	-6.72	-6.30	-1.15	0.81	-20.06
Urban* low-skilled *households	**30.9**	**-3.72**	**-1.45**	**-1.27**	**-2.50**	**-5.89**	**-4.28**	**-0.78**	**1.00**	**-18.06**
- Poor	1.3	-4.36	-1.50	-1.10	-2.31	-5.46	-7.57	-1.38	-0.39	-22.64
- Middle Income	22.8	-3.95	-1.55	-1.28	-2.47	-5.71	-4.63	-0.84	0.78	-18.75
- Rich	6.8	-2.84	-1.12	-1.27	-2.65	-6.57	-2.47	-0.45	2.00	-14.87
Urban high-skilled households	**24.1**	**-5.19**	**-0.87**	**-1.03**	**-2.50**	**-5.37**	**-2.25**	**-0.40**	**-2.95**	**-19.85**
- Poor	0.2	-8.24	-1.06	-0.98	-2.49	-5.42	-1.39	-0.24	-7.87	-25.52
- Middle Income	12.1	-5.53	-0.90	-0.95	-2.42	-5.52	-2.19	-0.39	-4.35	-20.56
- Rich	11.8	-4.78	-0.85	-1.11	-2.59	-5.20	-2.32	-0.42	-1.43	-19.01
Non - working households	**50.0**	**-3.30**	**-1.17**	**-0.67**	**-1.40**	**-5.12**	**-27.72**	**-4.97**	**4.16**	**-37.53**
- Poor	6.4	-3.53	-1.41	-0.36	-1.05	-5.49	-34.20	-6.30	4.74	-43.61
- Middle Income	34.3	-3.30	-1.16	-0.67	-1.41	-5.63	-27.82	-4.93	3.94	-37.69
- Rich	9.3	-3.13	-1.02	-0.89	-1.61	-2.95	-22.91	-4.22	4.53	-32.73
Total households	**121.8**	**-3.76**	**-1.34**	**-0.96**	**-2.05**	**-5.50**	**-13.78**	**-2.48**	**1.20**	**-27.03**
- Poor	11.2	-3.62	-1.85	-0.66	-1.60	-5.58	-22.32	-4.10	1.48	-35.22
- Middle Income	80.5	-3.80	-1.39	-0.96	-2.01	-5.71	-14.39	-2.56	1.12	-27.61
- Rich	30.1	-3.70	-1.02	-1.09	-2.30	-4.93	-8.97	-1.65	1.31	-22.41

Source: Authors' calculations based on CGE model.

8. The model results with different closure rules

It is clear from the above that the model as simulated can help to understand the contribution of different policies to the economic crisis. As discussed earlier, however, the simulated results should depend a lot on the closure rule. To explore this, the simulations were also run under two different closure rules. The first assumed that only wages were rigid (simulated as exogenously determined), but not prices, while the second assumed flexibility in both prices and wages, namely a traditional neoclassical closure. Tables 13-19 compare the results of the "All" scenario for all the variables exhibited in tables 12-18, under the three different closure rules.

Table 13 Simulated changes in key macroeconomic aggregates from the Greek stabilization package under different closure rules

	REF	Nominal wages and prices exogenous	Nominal wages exogenous	Prices and wages endogenous
	(Bill €)	percentage changes %		
Real GDP at factor cost	149.0	-8.2	-7.8	-6.1
Real GDP at market prices	**168.9**	**-5.3**	**-5.2**	**-3.9**
Real private investments	34.8	-8.3	-25.6	-29.7
- Firms	26.4	-2.9	-19.2	-22.5
- Households	8.4	-25.4	-45.7	-52.3
Public investment expenditures	6.4	-40.0	-40.0	-40.0
Real total private consumption	94.3	-2.9	-3.7	-4.0
Real government consumption	27.5	-26.0	-26.0	-26.0
Value of exports (Total)	35.1	-1.3	4.7	8.3
Value of imports (Total)	49.2	-7.3	-16.7	-21.3
Total private household savings	10.8	-271.3	-264.6	-256.5
GDP deflator (Index)	100.0	0.85	-31.60	-45.28
Consumer Price Index (Index)	100.0	3.02	-23.48	-35.08
Real Wages, Total (Index)	100.0	-21.09	0.60	-9.66
Expenditures of government	75.5	-40.2	-57.6	-65.4
Transfers to households	37.4	-54.7	-69.0	-72.5
Revenues of government	64.8	-1.0	-27.8	-41.4
Public sector deficit	10.8	-29.7	-25.5	-22.6

Source: Authors' calculations based on CGE model.

Table 14. Simulated changes in key macroeconomic aggregates under different closure rules

	REF	Nominal wages and prices exogenous	Nominal wages exogenous	Prices and wages endogenous
Direct taxes from households	**19.6**	**10.3**	**5.1**	**3.5**
-changes in bill €		-9.4	-14.6	-16.1
Direct taxes from enterprises	**5.8**	**5.8**	**2.9**	**2.5**
-Changes in bill €		0.0	-3.0	-3.4
VAT	**30.0**	**16.0**	**12.8**	**11.3**
-Changes in bill €		-14.0	-17.2	-18.7
Other indirect taxes	**18.6**	**9.8**	**7.6**	**6.6**
-Changes in bill €		-8.8	-11.0	-12.0
Tax of Duties	**0.8**	**0.3**	**0.3**	**0.3**
-Changes in bill €		-0.5	-0.5	-0.5
Social Contributions	**40.0**	**17.3**	**15.4**	**11.3**
-Changes in bill €		-22.7	-24.6	-28.6
Subsidies	**-5.7**	**-2.9**	**-2.2**	**-1.9**
-Changes in bill €		2.8	3.5	3.8
Public sector deficit	**-10.8**	**19.0**	**14.7**	**11.8**
- as a % of GDP at market prices	-6.4%	11.9%	13.6%	13.4%
Current account deficit	**16.0**	**10.9**	**12.5**	**13.2**
-as a % of GDP at market prices	9.6%	6.9%	11.6%	15.1%

Source: Authors' calculations based on CGE model.

Table 15 Simulated change in real wages by employment status and skills under different closure rules

	Nominal wages and prices exogenous	Nominal wages exogenous	Prices and wages endogenous
	percentage changes %		
Real wages employees (immigrants)			
Low-skilled	-3.02	23.48	-12.1
High-skilled	-3.02	23.48	-11.1
Real wages employees (Greeks)			
Low-skilled	-3.02	23.48	-8.1
High-skilled	-3.02	23.48	-11.5
Real wages self-employed (Greeks)			
Low-skilled	-13.2	-4.8	-6.8
High-skilled	-16.4	-7.0	-10.2

Source: Authors' calculations based on CGE model.

Table 16 Simulated changes in employment under different closure rules

	REF	Nominal wages and prices exogenous	Nominal wages exogenous	Prices and wages endogenous
	,000	percentage changes %		
Employment (total)	**4,519.0**	**-157.4**	**-497.8**	**-298.7**
Greek Employees	**2,766.6**	**-67.6**	**-377.8**	**-197.6**
Low-skilled	1,680.1	-7.0	-212.6	-104.6
High-skilled	1,086.5	-60.6	-165.2	-93.0
Greek Self-employed	**1,289.6**	**-72.9**	**-36.8**	**-63.1**
Low-skilled	984.6	-52.5	-25.4	-42.9
High-skilled	305.1	-20.4	-11.4	-20.2
Immigrant Employees	**462.7**	**-16.8**	**-83.2**	**-38.0**
Low-skilled	388.1	-14.3	-70.9	-32.2
High-skilled	74.6	-2.5	-12.3	-5.8

Source: Authors' calculations based on CGE model.

Table 17 Simulated changes in employment by sector under different closure rules

	REF	Nominal wages and prices exogenous	Nominal wages exogenous	Prices and wages endogenous
	,000	percentage changes %		
Agriculture, forestry and fishing	567.8	1.2	-1.1	3.5
Mining, Electricity, Water	63.5	-1.2	-5.7	-0.2
Food and Beverage Manufacturing	131.5	3.9	-0.3	8.3
Textile manufacturing	94.9	4.0	2.4	10.4
Wood, furniture,, paper,, printing and publishing	87.4	-2.1	-5.9	-0.4
Other intermediate Good Manufacturing	153.8	-2.6	-6.9	-0.3
Capital Goods Manufacturing	117.4	1.3	-5.0	0.8
Construction	371.1	-11.4	-29.1	-26.5
Wholesale and retail trade	780.8	0.9	-11.4	-6.9
Tourism Services, Recreation	310.2	5.7	-0.6	6.9
Transport, Communications	279.5	2.2	-0.8	5.0
Real estate activities	399.9	-0.1	-8.8	-4.9
Public administration	530.7	-14.1	-20.6	-17.9
Education	261.8	-16.0	-19.8	-19.0
Health	211.3	-5.3	-13.3	-8.3
Total	***4,362***	**-3.5**	**-11.0**	**-6.6**

Source: Authors' calculations based on CGE model.

Table 18 Simulated changes in gross output by sectors under different closure rules

	REF	Nominal wages and prices exogenous	Nominal wages exogenous	Prices and wages endogenous
	bill €	percentage changes %		
Agriculture, forestry and fishing	6.73	-2.90	-0.05	2.02
Mining, Electricity, Water	5.77	-5.95	-3.07	-1.40
Food and Beverage Manufacturing	3.83	-2.04	-1.06	2.50
Textile manufacturing	2.57	-1.19	0.27	4.21
Wood, furniture, paper, printing and publishing	1.79	-6.21	-4.86	-0.89
Other intermediate Good Manufacturing	4.60	-8.36	-5.84	-2.48
Capital Goods Manufacturing	3.02	-3.98	-5.12	-1.82
Construction	13.01	-16.42	-21.55	-22.56
Wholesale and retail trade	20.72	-5.32	-5.89	-4.71
Tourism Services, Recreation	12.71	-1.14	-0.14	1.38
Transport, Communications	14.58	-3.27	-0.61	1.76
Real estate activities	25.33	-5.79	-3.50	-2.09
Public administration	18.23	-17.81	-18.94	-17.13
Education	7.83	-19.16	-20.13	-18.64
Health	8.25	-10.45	-9.66	-6.96
Total	***149.0***	**-8.19**	**-7.77**	**-6.10**

Source: Authors' calculations based on CGE model.

Table 19 Simulated impacts on real disposable incomes of households under different closure rules

	REF	Nominal wages and prices exogenous	Nominal wages exogenous	Prices and wages endogenous
	bill €	percentage changes %		
Immigrant households	3.6	-33.20	-19.55	-23.30
- Poor	1.1	-30.07	-16.84	-20.38
- Middle Income	2.4	-34.82	-21.03	-24.84
- Rich	0.1	-30.10	-15.18	-19.61
Agricultural households	13.2	-19.67	-19.42	-18.09
- Poor	2.2	-21.70	-19.26	-18.24
- Middle Income	8.9	-19.07	-20.66	-19.32
- Rich	2.1	-20.06	-14.22	-12.60
Urban low-skilled *households*	30.9	-18.06	-19.26	-18.93
- Poor	1.3	-22.64	-21.05	-20.58
- Middle Income	22.8	-18.75	-20.27	-19.81
- Rich	6.8	-14.87	-15.51	-15.69
Urban high-skilled households	24.1	-19.85	-12.10	-13.89
- Poor	0.2	-25.52	-15.25	-19.24
- Middle Income	12.1	-20.56	-11.35	-15.01
- Rich	11.8	-19.01	-12.80	-12.65
Non - working households	50.0	-37.53	-33.98	-28.68
- Poor	6.4	-43.61	-37.81	-31.83
- Middle Income	34.3	-37.69	-34.87	-29.75
- Rich	9.3	-32.73	-28.02	-22.58
Total households	121.8	-27.03	-23.91	-21.98
- Poor	11.2	-35.22	-29.72	-26.50
- Middle Income	80.5	-27.61	-25.23	-23.42
- Rich	30.1	-22.41	-18.21	-16.42

Source: Authors' calculations based on CGE model.

The main results to contrast in the tables are the ones in the column representing the simulations of tables 12-18 (column 3 in most of the tables 13-19) and the last column. This is because these columns represent the most rigid economic structure, and the most flexible structure. In table 13 it can be seen that all magnitudes except those referring to prices have the same direction of change. However, the flexible structure implies a very large decline in prices (both the GDP deflator and the consumer price index decline by more than 35 percent). On the other hand, real wages change by much less, as the decline in prices makes up for nominal wage declines. It is this that leads to a decline in real GDP, albeit not as large as in the rigid structure scenario. This aspect of the flexible structure seems rather unrealistic, and suggests that the rigid structure maybe a better representation of the Greek economy. It can also be seen that the flexible structure predicts a much larger decline in private investments and government revenues. On the external front, the flexible structure predicts a much larger decline in imports and an increase in exports, compared to the rigid structure.

Table 14 indicates that under the flexible structure taxes decline by more than under the rigid scenario, while the public sector deficit becomes a larger surplus. Table 15, indicates that real wages under the flexible scenario do not decline by much, while they are seen to decline by more in the categories that allow wage flexibility under the rigid structure scenario. For the categories where wages are assumed fixed, the real wages decline by the increase in the consumer price index. This is what results in positive real wage increases for the economy depicted in the middle column.

Table 16 indicates that employment declines by more than is indicated under the rigid structure, namely by -6.1 percent. This is still a lot less than what has been experienced in the real economy, and is due to the labour supply reduction in the flexible model due to the wage decreases. Table 17 indicates larger employment declines under the flexible structure compared to the rigid structure, while table 18 indicates that the output of the various sectors under the flexible structure does not always decline as is the case under the rigid structure. This is due to the fact that the flexible economy implies a lot more labour mobility across sectors.

The final table 19 indicates that real household disposable incomes seem to decline by less under the flexible structure, but the hierarchy of impacts is largely preserved, with the poor households exhibiting larger real disposable income declines compared to the rich. In other words the flexible model preserves the lack of progressivity of the stabilization programme policies.

9. Summary and conclusions

The paper has presented the structure of a static computable general equilibrium model of an economy that attempts to portray key features of the Greek economy in crisis, and used it to simulate the impacts of the stabilization and adjustment policies adopted in Greece during the period 2008-13. While the structural assumptions concerning the various aspects of the economy are rather standard, the closure rules discussed are not. The closure rule that was adopted, based on the apparent assumed structure of the Greek economy is a hybrid Keynesian and neoclassical one. The model was calibrated with a detailed social accounting matrix of 2004, and with its help a large set of simulation experiments were conducted mimicking the large exogenous changes that have affected the Greek economy during the stabilization programme implemented since 2010. The results suggest that the model, especially

the version with the closure rules that resemble a Keynesian economy, seems to reproduce well the general pattern of changes that have occurred in the crisis.

A finding that has been little documented before is that the stabilization policy package is regressive. Sensitivity analysis with a more flexible economic structure indicated that while the general simulation results, including the regressivity of the stabilization policy package, remain under the flexible structure, there are some aspects that make the hybrid model preferable. Considerably more simulations, especially with a dynamic model, however, are needed to have larger confidence in such a model. The payoff is a model where sectoral and distributional detail is well represented, something that is necessary for the investigation and application of policies of stabilization and development that favour the lower-income groups of society..

In terms of the various stabilization policies, and if we take the criteria of GDP change, public sector deficit, and progressivity, as the major ones to consider, the policies of an across the board decline in public expenditures, a large decline in public investments, and a large decline in social spending (which includes mainly pensions), have the largest negative impact on GDP, but they differ considerably among them in terms of their employment and especially distributional implications. The uniform public sector expenditure decline creates the largest decrease in employment, while the policy of decreases in public investments and social spending have much smaller employment reduction implications.

In terms of changes in government deficits, the government spending reduction policy has the effect of halving the public sector deficit, while the reduction in public investments reduces the public sector deficit by much less. The social spending cut policy on the other hand reverses a public sector deficit to a surplus., and this is compatible with the fact that in Greece a very large portion of public spending is social spending, especially pensions. On the other hand in terms of distributional implications, all three types of policies have a significantly negative impact on total real disposable household incomes. However, the largest total decrease in real disposable incomes is found with the policy of large declines in social spending. Similarly this policy has a devastatingly regressive real income effect, with the real disposable incomes of the poor declining by almost three times more than those of the rich. This policy is also what drives the mainly regressive outcome of the scenario which simulates all the policies together. By contrast the policy of government spending reductions is distributionally neutral, while that of decreases in public investments is actually progressive.

From the above it appears that the mixture of policies adopted during the stabilization programme by the Greek government has resulted in a large GDP decrease, a large employment decline, and as a painful consequence, a substantial decrease in public sector deficit, but at the cost of very large decreases in private real incomes and an even larger increase in income inequality. It remains to be seen whether there can be other policy packages that can achieve similar public sector deficit reductions without the adverse income and distributional implications.

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