DEBT, GOVERNMENT SIZE AND PUBLIC EXPENDITURE IN A HETEROGENEOUS-AGENT FRAMEWORK

Miguel Viegas

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Supervised by:
Álvaro Aguiar
Ana Paula Ribeiro

Faculdade de Economia do Porto

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Biography

Miguel Viegas was born in Paris, France , 27 June 1969. He is Doctor in Veterinary Medicine (DMV) at the Faculdade de Medicina Veterinária, Universidade Técnica de Lisboa, May 1993. From 1993 to 2010 he worked as a practitioner of veterinary medicine, in intensive livestock production. He is Graduate in Economics by the Universidade de Aveiro in 2004, and entered the Doctoral Program in Economics in Economy the same year at the Faculdade de Economia do Porto, Universidade do Porto. He currently lectures as an invited Assistant at the Departamento de Economia e Gestão, Universidade de Aveiro.

Abstract

The present thesis aims at studying the welfare impacts of debt and public expenditure in a heterogeneous-agents framework. Given that fiscal policies have direct and indirect effects on welfare inequality, the use of heterogeneous-agents models is a requirement for the research approach. Starting from a basic growth model with idiosyncratic shocks and incomplete capital markets, we extend the micro-founded model by Aiyagari and McGrattan (1998) in order to analyze the impacts on welfare (and inequality) of several dimensions of public sector intervention. We follow a comparative static analysis to give insights on optimal government size, expenditure composition and deficit financing, together with a dynamic approach to mimic debt consolidation episodes.

We conclude that the larger the size of government, the larger the optimal debt-level is and, consequently, the higher welfare inequality is. Concerning spending composition, the substitution of unproductive spending by transfers is, to a certain extent, welfare-enhancing and improves inequality while shifts towards productive spending are always welfare-enhancing. We also confirm that fiscal consolidation based on unproductive expenditures are welfare superior; moreover, welfare is further enhanced the lower the tax effort is and the more public expenditure is biased towards investment.

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Chapter 1

Introduction

Developed economies, as the ones belonging to the European and Monetary Union (EMU), have exhibited a sustained growth of the debt-to-output ratios in the recent past. As shown in Figure 1.1, this results from governments permanently incurring in fiscal deficits. However, countries have, recently, made efforts to correct this trajectory by pursuing fiscal consolidations. This was the case of the late 1990s, in the awake of the EMU, and of recent mid-2000 years, before the current crisis.

There is a large consensus that high public debt levels should be avoided: among other reasons, 1) large debt levels usually reflect pro-cyclical and, thus, destabilizing fiscal policy; 2) the additional pressure on demand for funds pushes real long-term interest rates up, crowding-out private investment; 3) default risks are amplified and the interest rate risk-premia become positively correlated with government indebtedness and 4) high debt levels pass on the tax burden to future generations which turns out to be particularly unfair in the case indebtedness results from current-expenditure-based deficits.

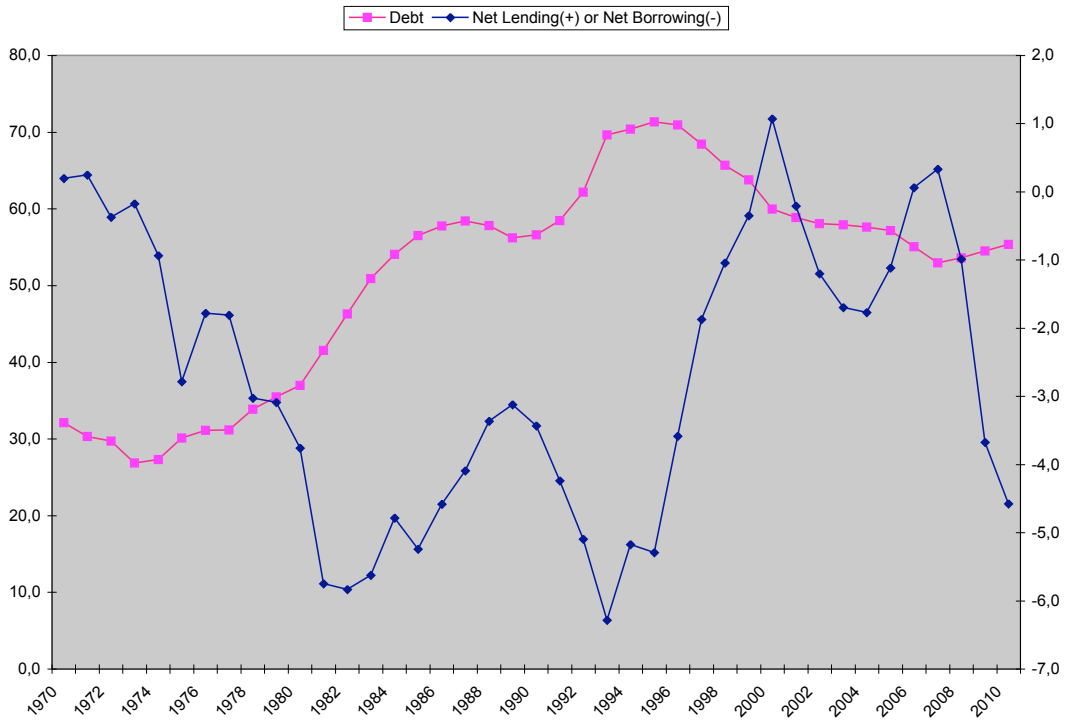


Figure 1.1: Debt and net lending paths on OCDE countries

What appears to be less consensual is: i) whether there is an optimal government size, regarding expenditures, for instance, and ii) how does the quality of expenditures meaningfully contributes to welfare. Moreover, and regarding the financing of government expenditure, discussion is still in place on iii) whether there is a maximum debt threshold level above which social welfare diminishes and, if yes, iv) how should debt consolidation be enforced in order to minimize eventual transition costs.

In recent past, the size of government in industrial countries has expanded, especially due to expenditure associated with the building of the welfare state (for a complete historical perspective we recommend Tanzi and Schuknecht (2000) and Tanzi (1997a)). Throughout time, the general attitude towards the role of the government has changed. What are the arguments for the existence of a public sector? What is the ideal size of the government? And what is the ideal composition of public expenditure? In the XIX century, classical economists recommended a minimal state. The gov-

ernment role was then limited to the supply of some public services (national defense, police and administration, in order to protect individual and property rights). In 1913, just before World War I, the general government average expenditure in the most important industrialized countries represented about 13% of GDP (Tanzi and Schuknecht (2000)). During the inter-war period, many European countries introduced their social security systems. In response to the great depression, seen by many as resulting from a failure of the market economy, most governments launched huge public expenditure programs. Back then, public expenditure has increased to an average of 22.8% of GDP (Tanzi and Schuknecht (2000)). The post-World War II period represents the last and the most impressive wave of public expenditure growth, supported by a strong theoretical body that enhanced an active role for governments. Musgrave (1959) attributes the allocative, stabilizing and re-distributive functions to a modern government. The theory of public goods (Samuelson (1954)) and the concept of externalities (first defined in Pigou (1952)) have lent further support to the allocative function. The Keynesian and New-Keynesian theory advocate the role of fiscal policy for stabilization purposes. And, finally, the welfare state ideology highlighted income distribution as one of the most important roles of the government in the European industrialized countries. By 1996, the average public expenditure represented 45% of GDP (Tanzi and Schuknecht (2000)). Along with this impressive spending growth, and especially from the oil shocks of the seventies onwards, governments started to exhibit persistent budget deficits feeding explosive paths for public debt.

Looking backwards, it seems that, despite the huge public resources spent, the three core functions of government have not been performed adequately. Recession, inflation and unemployment continue to affect all economies. The inequality measures have ceased to improve. High tax levels disturb private incentive and promotes inefficient allocation of the resources of the economy. Several authors (Schuknecht et al. (2003), Afonso et al. (2008), Barro (1991) among others), supported by empirical evidence of cost-benefit analysis, plead for the necessity of governments to lose some weight. However, not all kinds of government spending must be treated alike when it comes

to reforming public finance (e.g.,Afonso et al. (2005)). Certain core expenditure like those associated to public investment (R&D, human capital, among others) together with governance and legal framework, seem to be essential to promote long-run growth (see, for a comprehensive review, Barrios and Schaechter (2008)). A certain basic level of redistribution and social support also has a large consensus; however, when distributive spending becomes too high it can undermine market efficiency and growth (e.g., Afonso and Furceri (2008), Barrios and Schaechter (2008), European-Commission (2002)). Other authors sustain that government should not replace the market in the production of goods and services like health, education, energy, transports, or in insurance and pension systems (see, e.g., Tanzi (1997b) and Buchanan and Musgrave (1999)).

As regards how government expenditure should be financed, this issue is of particular relevance in the European context, namely among the EU countries belonging to the EMU or looking forward to it. The EU Treaty has established a fiscal rule aiming at debt-stabilization convergence towards the 60% debt-to-output ratio. The existence of such rules and the successive efforts to avoid large public indebtedness, clearly testifies that public debt is non-neutral to welfare. During mid and late 90s, most countries have engaged in fiscal consolidations aiming to stop or even invert the sustained debt growth of the previous 30 years or so. Now, struggling against the financial crisis, the economies are, once again, relying in expansionary fiscal policy to ease the pain. In the near future, the issue of how to best pursue a fiscal consolidation will become crucial regarding the fiscal policy stance. In this regard, several amount of research has both studied the mechanisms and has empirically assessed the conditions for successful consolidations relying, for instance, in those generating potential non-Keynesian effects (see, among others, Ardagna (2004), Alesina and Perotti (1997) and Giavazzi and Pagano (1990)).

Besides non-neutrality on main macroeconomic variables and, thus, on overall welfare, fiscal policy stance impinges, in particular, in wealth and income distribution. There is a vast body of theoretical and empirical literature on wealth and income distribution that relates, to some extent, fiscal

policy variables and inequality. According to Tanzi (1998), the main systemic factors that influence inequality have evolved and depend on the social and economic context. In traditional, relatively stable societies, social norms, institutions and inheritance play the principal role in driving inequality - the government influence was minimal. In turn, in more open societies, with modern economies, such factors loose strength and government size and expenditure composition is expected to impinge, both directly and indirectly, on inequality. While transfers, subsidies and a progressive tax system correct for inequality, directly (Afonso et al. (2008); Benabou (2000) among others), expenditure on the provision of public services such as education, health, or even R&D may, indirectly affect inequality via the effects on earning abilities and growth. In fact, efficient spending on education and health, among others, may bring a more homogenous distribution of income as these human-capital-augmenting services are delivered below market prices (see, for instance Afonso et al. (2008); Chu et al. (2000); Smeeding (2000); Ayala et al. (1999); Tanzi (1998)). Other authors argue that the principal way of governments to improve income distribution consists in promoting economic growth and macroeconomic stabilization (e.g. Alesina (1998a)).

Additionally the way public expenditure is financed, also have crucial impacts on equality. There are several studies on the relationship between the quality of public finances (size, expenditure composition, governance and legal framework) and growth (see, for a comprehensive review, Barrios and Schaechter (2008)) which, together with the vast amount of literature relating growth with inequality (Scully (2008); Tanzi and Chalk (2002); Benabou (2002); Barro (2000); Benabou (1996); Kuznets (1955), among others) provide intuition on the mechanisms through which fiscal policy may impinge on inequality.

Also, regardless of the fiscal instrument, the way governments perform their stabilization role may also have redistributive effects. Empirical evidence points that the lowest income classes are increasingly vulnerable relative to the richer (Forster and Pearson (2002)) and shows a positive relationship between Business Cycles, economic growth and wage/income dispersion (Afonso and Furceri (2008)).

Finally, deficit financing, through taxes or debt issuing is not irrelevant, especially if Ricardian equivalence does not hold (arguments for the failure of the Ricardian equivalence proposition are studied, among others, in Bernheim (1987); Barsky et al. (1986); Hubbard and Judd (1986); Barro (1974)). On the one hand, government indebtedness may put upward pressure on real interest rates, improving the relative wealth of the richer. On the other hand, debt lessens private sector credit constraints that are especially binding for the poorer, potentially improving welfare inequality.

In this context, we aim at producing some light on the optimal size of government as well as on the welfare-enhancing ability of several fiscal instruments - transfer, productive and unproductive expenditure and debt- using a heterogeneous-agent framework to enable capturing inequality effects. We also want to provide insights on the optimal composition of public expenditure. For practical policy-making use, we develop an analytical framework that allows assessing, for instance, the adequacy of the 60% debt-to-output ratio criterion in the EU context. And finally, we use our baseline model to simulate different consolidation strategies of public finances. In this regard, the model chosen should be able to capture the mechanisms leading to eventual adjustment costs implied by a convergence of current public debt-to-output ratios towards the optimal levels. By relying on the welfare criterion presented in Floden (2001) and Aiyagari and McGrattan (1998), we compare welfare across different combinations of debt and transfer, different public spending composition and across different consolidation plans, identifying consumption level effects, uncertainty and inequality effects. Regarding the latter, we further complement the analysis of different policy strategies through the computation of several inequality measures.

On the methodological side, there are two strands of literature on modeling fiscal policy impacts. One relies on extensions of the representative agent framework (see, for instance, Gali et al. (2007, 2004), Christoffel et al. (2005); Coenen and Straub (2005)). The other, more recently developed, uses heterogeneous-agents modeling (Benabou (2002), Floden (2001) and Aiyagari and McGrattan (1998), among others) and are of particular interest for the study of inequality effects. These models are able to generate

a distribution of wealth that reasonably fits empirical data. Two dominant types of models have been used to study the distribution of wealth (Rios-Rull and Quadrini (1997)): the dynastic models, which include a continuum of infinitely-lived agent, and the life cycle model that includes overlapping generation of finitely-lived agents.

Heterogeneous-agent models enable to anticipate the consequence of policy on wealth or income distribution and inequality indicators. Besides, heterogeneous-agent models help us understand the channel by which policy measures influence household's behavior and the aggregate consequences of it. In a standard way, as a source for agent-heterogeneity, models combine individual productivity shocks (mimicking, for instance, the transitions of an individual in the labor market as in, Imrohoroglu (1989)) with imperfect capital markets where households face credit restrictions. There is a considerable literature that emphasizes the existence of precautionary savings and liquidity or borrowing constraints. Supported by empirical facts, Aiyagari (1995) stresses the importance of uninsured idiosyncratic risk. First of all, individual consumption change much more than aggregate consumption. Second, households mobility from one wealth echelon to another, implies large idiosyncratic shocks. Third, portfolio composition of the lower-wealth households usually exhibits a large share of low-return risk-free assets while that of the wealthier present a large share of high-return risky assets showing that stock markets are far from being perfect. Moreover, evidence of liquidity constraints can be found in Hayashi (1985a) and Hayashi (1985b). The combination of idiosyncratic uncertainty, imperfect insurance markets and liquidity constraint generate a powerful motive for precautionary saving which leads to an equilibrium interest rate lower than the rate of time preference prevailing in the complete market or representative agent model, to a higher saving rate above the so-called golden rule and eventually to an excess level of capital. For a survey on heterogeneous-agents models, see Storesletten et al. (2009), Rios-Rull (1995) among others.

Thus, for instance, uncertainty and credit restrictions lead the way for a non-neutral debt level: postponed taxes may improve consumption smoothing, either through lightening credit constrains or by having positive impacts

on real interest rates and thus, on savings income. Consequently, consumption smoothing means positive insurance gains against uncertainty, increasing welfare. Positive effects are also expected on the level of consumption: a rise in debt can make economy closer to the golden rule if households save too much. In addition, the composition of deficit is also non-neutral in the presence of heterogeneous agents: for a given debt-to-output ratio, increasing individuals fiscal instruments appears to have specific impacts regarding efficiency, inequality and consumption smoothing.

Therefore, we use a general equilibrium model with heterogeneous agents capable of exploring, theoretically, the relationship between fiscal policy variables and inequality, given the fact that heterogeneous-agents models improve on those using the representative-agent when the existence of significant cross-sectional dispersion across individuals (firms and workers) is considered relevant. Seminal works using heterogeneous-agent models date from late 80s-early 90s and were developed by Bewley (1983), Imrohoroglu (1989), Huggett (1993), Aiyagari (1995) and Krusell and Smith (1998). In particular, we build a micro-founded model based on Aiyagari and McGrattan (1998) and Floden (2001). This is a dynastic model where infinitely-lived rational agents are hit by idiosyncratic wage shocks in an incomplete capital market. The model includes government, with policy captured by a dynamic budget constraint, and optimizing firms endowed with a neoclassical Cobb-Douglas productive function. In order to smooth consumption/leisure, private agents optimally accumulate savings in "good times" and spend them during "bad times". Besides allowing for taxes levied on labour and capital, we decompose government expenditure into transfers to private sector, and productive and unproductive spending. While productive expenditure is included in the production function and, through this channel, augments the global productivity of the economy, unproductive spending is solely utility-augmenting. With our model calibrated in order to meet average fiscal policy variables for the EU countries, we aim to a better understand of the channels through which government influences household's behavior and to assess the aggregate and the distributive consequences of its policies.

Our research approach includes two stages of model simulations. In the

first stage, and based on the welfare criterion presented in Floden (2001), and Aiyagari and McGrattan (1998), we conduct a welfare analysis comparing across different government-sizes and across different menus of government spending (static analysis across steady-states). We also explore the decomposition of the welfare effects according to the methodology proposed by Floden (2001) into the consumption/leisure level effect, the uncertainty and the inequality effects.

In the second stage, we simulate the equilibrium path of the economy between two different steady states, for a given fiscal adjustment path imposed to the economy, using the methodology in Rios-Rull (1999), Auerbach and Kotlikoff (1987), Ljungqvist and Sargent (2004), and Quadrini et al. (2009). The main objective is to simulate transition paths imposed by different debt consolidation strategies: e.g. revenue *versus* expenditure based, gradual *versus* "cold shower". Such simulation exercises proceeds in three stages: (1) solving for the long-run initial steady state of the economy (before the change in the political stance), (2) solving for the long-run steady state toward which the economy will eventually converges after full effects of the policy change occur, and (3) solving for the transition path of the economy between the two steady states. Simulations are conducted under a closed economy framework and further extended to a two-open economy model with different-size countries. We assess eventual transition costs and analyse who becomes worse or better off after the consolidation strategy. Finally, we conduct an empirical exercise in order to replicate some of the consolidation episodes observed in the EU during the past two decades while assessing their corresponding welfare impacts.

There is a lot of empirical and theoretical work about the optimal size and composition of government expenditure. However, among the theoretical studies, very few use the heterogeneous framework as we do. Some use overlapping generation models (Auerbach and Kotlikoff (1987)). Other use the dynasty model, but are focused on very specific items such as the optimal tax level or the optimal tax combination between taxes on consumption and capital, or social security models (Aiyagari (1995),Heathcote (2005)or Huggett and Parra (2008)). None of them, to our knowledge, treats gov-

ernment size globally, neither the optimal spending composition. We have not come across dynastic heterogeneous models capable of simulating fiscal consolidation processes, either in a close or open economy.

The thesis is organized as follows. In chapter 2 we proceed with a theoretical review of fiscal policy stance and of heterogeneous-agents models, covering both conceptual and methodological backgrounds. Chapter 3 is totally dedicated to the model description, presenting also computation measures for overall welfare and welfare decomposition assessments. In chapter 4 we proceed with a static comparative analysis across different steady states, arguing on optimal debt and spending levels and on expenditure composition. The dynamics of several consolidation strategies are dissected in chapter 5, and in chapter 6 we identify some of the successful fiscal adjustments occurred in the European Union between 1990 and 2008 in order to mimic them using our model and to compare them from a social welfare point of view. Finally, chapter 7 presents the final remarks.

Chapter 2

Fiscal policy stance and heterogenous-agents models: a theoretical review

Throughout this chapter, we proceed with a theoretical review of the two broad macroeconomic areas related to both conceptual and methodological backgrounds for the present work: fiscal policy stance and heterogeneous-agent models. The first area embraces government size, the public spending composition and fiscal consolidation aspects. Starting with the theory of the state and its several main functions, we review the literature about optimal size of government, optimal spending composition and optimal debt financing. We also review literature on fiscal consolidation processes, namely on how different fiscal adjustment strategies affect the probability of success and how they impinge on macroeconomic variables. Finally, in the third section of the present chapter, we focus on the methodological issues of our thesis, by covering the recent literature on heterogenous-agents models, namely those that have inspired our research approach.

2.1 Size and composition of government expenditure: brief review of theories and of recent European evidence.

The role of the state as perceived by economists and policy makers has evolved remarkably over the last centuries. Hobbes (1651) sustained that only law and order provided by the state can avoid the "state of nature" characterized by a chaos in which every individual fights for himself. The theory of a minimal state is based on the classical economy of the XVIII century. Adam Smith described three essential functions that should be accomplished by the Kingdom (Adam Smith, 1776, "The wealth of Nations"): the country's defense against foreign invasions, the protection of individuals against any injustice committed by other members of the community and the supply of several institutions and public infrastructures that are not supplied by the market. Currently there is a consensus about some core functions of government. The first one consists on establishing rules and institutions able to enforce contracts and to defend property rights. The second one is to promote market efficiency, correcting market failures and improving the quality and dissemination of information. The last core function concerns the provision of public goods when private provision is not possible nor socially sufficient.

During the inter-war period and later one between 1960 and 1980, the world experienced an unprecedented enthusiasm for active expenditure policies. The Great Depression and the Keynesian revolution, the challenge of socialism and the theory of public goods and externalities can be considered both at practical and theoretical level, as the major contributions to the construction of the welfare state theory (Tanzi and Schuknecht (2000)). According to Briggs (1961) a welfare state is a state in which organized power is deliberately used (through politics and administration) in an effort to modify the outcome of market forces in at least three directions: by guaranteeing a minimum income, by narrowing the extent of insecurity (for example, in sickness, old age, and unemployment) and by offering the best standards

available in a certain range of services (i.e. optimal and comprehensive access to services). Beside the core functions mentioned above, the government is also in charge of promoting macroeconomic stabilization and of guaranteeing a minimal level of equity in income distribution. According to those enlarged limits of the state, beyond the restrict scope of law and order, Musgrave (1959) divides governmental economic activity into three branches: the allocation of resources to promote efficiency, the distribution of income via an integrated tax and transfer system, and the stabilization of the overall economy.

Throughout the last decades, the unlimited growth of governments has not always corresponded to any of the three core functions mentioned above, and when such was the case, expenditures were more inefficient. Thus, skepticism about the state's role emerged in the late 1960s and 1970s (Tanzi and Schuknecht (2000)). Back then, several failures of government policies became evident to a growing number of academics and policy makers. Government was facing an increasing difficulty to allocate resources efficiently, to improve redistributive policies and failed to stabilize the economies during the stagflation of the 1970s. The need to correct market failures gave rise to the need to correct government failures. Some sort of naive view of a"benevolent" government has been questioned by the Theory of Public Choice which emerged as a distinctive field in Economics in the second half of XX century with major contributions of Buchanan (1969), Arrow (1963) among others. The 1980s mark a turnover favouring a smaller roles for government, reflecting a consensus that the size of the state has exceeded an optimal level, undermining economic growth.

Public spending has risen sharply during the past three decades attaining a historical peak well above 50% of GDP during the nineties in many of the OCDE countries(European-Commission (2002), Tanzi and Schuknecht (2000) and Tanzi (1997a)). At the beginning of the 1970s, public spending in EU member states ranged between 35% and 40% of GDP. Later, it rose sharply following the two oil price shocks of the 1970s. After stabilizing in the second half of the 1980s, when high GDP growth rates were recorded, it rose again to a peak of almost 53% of GDP in 1993. Thus, in line with

this growing path of government expenditures, developed economies, in particular the ones belonging to the EMU, have exhibited a sustained growth of the debt-to-output ratios in the recent past. This results from governments permanently incurring in fiscal deficits. Government debts started to grow in an explosive path in the 1970s, during which the differential between interest and output growth rate was reversed. As a consequence, the high interest rate burden affected strongly most of the EU economies since then: while, before the 1970s, debt service did not represent more than $1-2\%$ of GDP, during the 1990s, debt service represented more than 4% of GDP. The Maastricht Treaty, approved in 1992, and the subsequent fiscal convergence process forced governments to regain control of public spending which, as a share of GDP fell, on average, by seven percentage points between 1993 and 2000. Finally, the present period, marked by an international crisis, is putting again strong pressure on public authorities who are devoting impressive quantities of resources to support the economy in an attempt to avoid financial collapse.

A large proportion of this growth occurred in Europe especially during the sixties and seventies and is explained by the amount of public resources devoted to social protection, reflecting an increasing preference for redistribution especially when compared with the economy of the United States (US) or Japan. Between 1970 and 1980, public spending on social transfer rose from 10% to 16% of GDP. This increase corresponds to a generalization of welfare benefit on a larger proportion of population. From the mid-1980s onwards, more pressure on social expenditure comes from the ageing population and the rise in old-age dependency ratio (European-Commission (2002)). Instead public investment has fallen steady. In 1975, public investment in EU countries represented 4% of GDP. In 1998 it was less than 2.5% of GDP(source: AMECO database).

The examination of public expenditure spent on the basic functions of the minimal state, namely those planned to improve the allocation of resources (defense, justice, education, health-care, R&D, public infrastructure), shows a very similar level in EU countries and in the US, representing between 14% and 18% of GDP (European-Commission (2002) and Gwartney

et al. (1998)). This level has remained practically constant over the past 30 years. The main differences in the total expenditure across countries must be found on the redistributive function. In 2001, spending on social transfer in EU countries amounts to 16% of GDP against 11% in Japan and the US (European-Commission (2002)).

Why does public spending grow so much? There is an vast literature concerning the determinants of the increase in government spending (Alesina et al. (2008), European-Commission (2002), Tanzi and Schuknecht (2000), Alesina (1998b), Alesina and Perotti (1997) and Alesina and Perotti (1995b)). The main determinants can be classified into economic and political arguments.

The first economic argument states that public expenditures increase with *per capita* income growth. The notion that there is a long-run tendency for government expenditure to grow with economic activity was first put forward by Wagner back in late 19th century. Since then, economists have named "Wagner's Law" as the positive relationship between government spending and income (Borcherding et al. (2001), Borcherding (1985)). As disposable income increases, higher provision of some public goods and services (such as education, healthcare, etc.) are demanded by voters, which leads to more government spending (European-Commission (2002)). A second economic motivation is that government expenditures ratchet up in response to crises, but usually fail to revert to the pre-crisis level (Higgs (1987)). This hysteresis effect has been used to describe the government expenditure growth in the EU countries during the three decades following the two oil shocks: public spending went up, remaining stable afterwards even when the shocks had already ceased (European-Commission (2002)). A third economic explanation is known as the price effect and argues that the cost of providing public goods and services rises faster in the public sector compared with the private sector (European-Commission (2002)). Total government spending is obtained by multiplying the quantity of goods and services provided by the public sector with the respective prices. By comparing an index of prices for public expenditure (compensation of employees, intermediate consumption

and gross capital formation) with a general consumer price index, the European Commission (European-Commission (2002)) estimated a positive price effect in Italy (public goods and services prices has increased faster than the private consumers index) between 1970 and 1990. The price effect is null in UK and negative in France (public goods and services prices has increased less relative to the private consumers index) (European-Commission (2002)).

There are also several political economy explanations that support the incentive to an increasing size of government. Some authors argue that government-size grows because median income is less than average income, and then, the median voter prefers a larger government providing more redistribution (Meltzer and Richard (1981)). Others highlight the rent-seeking-effects and the role of lobby interests in influencing the political outcome to their own advantage (Persson et al. (2003), Persson and Tabellini (2001)). Finally, a third line of arguments investigates the relationship between the political process and the ability of government to control public spending. Persson and Tabellini (2001) argue that public spending tends to be higher in proportional electoral systems (against majoritarian ones) and in parliamentarian regimes (against presidential ones) where the effect of such lobbying activity is stronger. Alesina and Perotti (1995b) study the budget formation process and discuss the enforceability of a balanced budget law. Alesina et al. (2002) find no evidence of a systematic electoral penalty in popularity for governments that engage themselves in a fiscal adjustment process.

All these arguments motivate the above mentioned deficit bias which has fed the impressive growing path of public debt observed in most EU countries during the last decades.

The optimal size of government. The debate about the optimal size of the public sector is one of the oldest and most enduring in economics. The existence of a public sector is supported by the need to provide legal and physical infrastructure to enhance markets efficiency and to provide a limited basket of public goods. Most economists also agree that when governments act beyond these core functions, some adverse effects may impinge on the economy and undermine economic growth. Despite the absence of con-

sensus in defining the optimal government size, several authors, relying on empirical evidence, argue that most of EU governments have exceeded the optimal level, depressing economic activity (see among others Barrios and Schaechter (2008), de Avila and Strauch (2003), Heitger (2001) and Folster and Henrekson (1999)). Tanzi (1997b) compares across OCDE countries, using economic and regulatory efficiency indicators (*eg.* GDP growth, inflation, unemployment rate) and also social indicators (*eg.* United Nation Human Development Indicator, inequality measures, life expectancy) to conclude that countries that spend more do not necessarily perform better. As stated in most macroeconomics manuals, public expenditures beyond a reasonable level depress economic growth because of the negative effects of higher taxes on labour supply and investment. Besides which, public spending and its effects on aggregate demand can generate an external disequilibrium by two different channels, first through the inflation channel which hurts the domestic exportation competitiveness and second by the increased demand for imported products or services. Gradually, those external deficits are solved in the asset markets through which important shares of domestic wealth become property of foreign agents. Moreover, as deficits of the government budget persist, large public debt appears, raising real interest rate and crowding-out private investment. Besides, when expenditure exceeds revenue, agents perceive the current fiscal policy as unsustainable and increase their savings, protecting themselves against future tax increases, therefore canceling the multiplier effect of the fiscal expansion. A complete review of those multiple channels by which the excessive presence of government affects the economy can be seen in Loureiro (2008). For the links between high public debt and growth see Tanzi and Chalk (2002).

Tentative quantification of the optimal government size is found in Buti et al. (2003). Using a particular model, they conclude that a public expenditure level of 35% of GDP, for small open economies, and 40% of GDP, for large open economies, maximise economic growth without harming the stabilization function of the government. Gwartney et al. (1998), Tanzi (1997b) and Scully (1994) estimate that a public spending level around 15-18% of GDP is sufficient to promote the core functions of government defined above.

Moreover, Tanzi (1997b) stands that a public expenditure of 30% of GDP adequately guarantes the three core functions of governments. Concerning public debt, some recent literature, based on heterogeneous-agents (Floden (2001), Aiyagari and McGrattan (1998)), attempts to reach an optimal level of debt. Such analysis is based on the failure of Ricardian Equivalence, on the rational for public investment and the welfare effects of public debt. In such models, government indebtedness puts upward pressure on real interest rate, improving saving incentives and raising the relative wealth of the richer ones. On the other hand, debt lessens private sector credit constraints that are especially binding for the poorer, potentially improving welfare inequality. Aiyagari and McGrattan (1998) reach to an optimal debt level of 60% of GDP for the US economy. Floden (2001) modeling the idiosyncratic process for the Swedish economy reaches an optimal combination of social transfers and public debt, with optimal levels of respectively 23% and -100% of GDP.

Apparently, government size and expenditure composition is expected to impinge, both directly and indirectly, on inequality. While transfers, subsidies and a progressive tax system correct for inequality directly, expenditure on the provision of public services such as education, health, or even R&D may, indirectly affect inequality through the effects on earning abilities and growth. In fact, efficient spending on education and health, among others, may bring a more homogenous distribution of income as these human-capital-augmenting services are delivered below market prices (see, for instance Afonso et al. (2008); Chu et al. (2000); Smeeding (2000); Ayala et al. (1999)).

Besides total spending, the composition of public expenditure is non-neutral and has been studied in great detail by a growing number of authors. Each type of expenditure has a specific aim and has, consequently, different impacts on the economy. Public spending on education is taken as an input determinant for economic growth since Lucas (1988). Public spending in physical infrastructures and in R&D activities has also been referred as growth-promoting, respectively by Auschauer (1989) and Barro (1990), while more recent studies are not conclusive on the effect of public investment (*e.g.* Afonso and Furceri (2008) and Fuente (1997)). By contrast, the literature

usually associates redistributive spending with a negative impact on economic growth, mostly due to the disincentive effects affecting labour, human capital or investment (see among others Afonso and Furceri (2008), Barrios and Schaechter (2008) and European-Commission (2002)), while some basic social safety nets can be growth-enhancing, as they reduce the need for precautionary savings and improve the ability for risk taking (Afonso and Furceri (2008)). Other expenditures, such as unconditional payment of unemployment or other social benefits paid during a large period can represent an important disincentive to work leading to long-term unemployment rates (Lamo and Strauch (2002)). Beside the known relationship between the quality of public finances (size, expenditure composition, governance and legal framework) and growth (see, for a comprehensive review, Barrios and Schaechter (2008)) there is a vast amount of literature relating growth with inequality (Scully (2008); Tanzi and Chalk (2002); Benabou (2002); Barro (2000); Benabou (1996); Kuznets (1955), among others) providing intuition on the mechanisms through which fiscal policy may impinge on inequality. Also through this channel, and given that the quality of public finances affects growth, government size and expenditure composition may indirectly affect inequality. Afonso et al. (2008), relating the expenditure composition and income distribution, stress the relevance of policies acting directly through taxes and subsidies and policies acting indirectly via earning opportunities, human capital and institutions.

2.2 The case for fiscal consolidation processes: European institutional framework and lessons for best practices

The Lisbon strategy, launched at the European Council held in Lisbon on 23-24 March 2000, was built with the aim of leading Europe into a competitive, dynamic and knowledge-based economy. The approved document included several main lines of action, among which the consensual need for macroeconomic policy coordination regarding fiscal consolidation, quality and sus-

tainability of public finances (European-Commission (2005)).

In order to recast the Lisbon strategy, the European Council of March 2005 approved a set of broad economic guidelines focused on growth and job creation (see the 22 and 23 March European Council Brussels Presidency conclusions[1]. Concerning government size and the spending composition, the macroeconomic guidelines clearly point to a consolidation process with a redirection of public expenditure towards productive areas, with spending favoring the allocative function at the expense of the redistributive function. Guideline no. one encourages member states to pursue fiscal consolidation plans and structural reforms in order to a sustainable fiscal path. Guideline no. 2 , taking into consideration the cost of ageing population, recommends that each member state should undertake a "satisfactory pace of government debt reduction to strengthen public finances", along side with some structural reforms in pension and healthcare systems, as well as in the labour market. Guideline no. 3 predicting a growth-and-employment-oriented allocation of public resources, states the necessity of "re-direct the composition of public expenditure towards growth-enhancing categories". Guideline no. 4 recommends the promotion of greater coherence between macroeconomic, structural and employment policies. Finally the Guideline no. 5 recommends tax and benefit systems more employment friendly, "improving incentives and making work pay", which clearly points to smaller size governments. For a full description of all guidelines see European-Commission (2005) and European-Commission (2007a).

Putting together these approved recommendations with the recent-past situation in which governments, have further indebted themselves to avoid financial crashes, it becomes obvious that consolidation plans will soon return to most policy agendas. While the necessity of correcting public finances appears as relatively consensual, several experiences in the EU during the last decades do not allow a clear design of a unique and costless strategy. The extensive literature on fiscal consolidations apparently concludes that successful processes are more likely to arise when non-keynesian effects are involved.

[1]http://www.consilium.europa.eu/uedocs/cms-data/docs/pressdata/en/ec/84335.pdf

In order to empirically (and theoretically) assess a consolidation plan, one needs to define the meaning of a successful consolidation. In line with the European-Commission (2007b), this implies having a measure of consolidation, a reference period and criteria that enable the distinction between success and failure. First a good consolidation measure must capture the discretionary component of fiscal policy. The primary deficit as a share of GDP, despite its simplicity, ignores the cyclically induced fluctuations. Also, the interest expenditure is not considered discretionary. A better measure is, thus, the cyclically-adjusted primary budget balance (CAPB), derived as the difference between the nominal primary balance and the corresponding cyclical component (see European-Commission (2007b) and European-Commission (2004) for technical details).

According to Alesina and Ardagna (1998) "a period of fiscal adjustment is a year in which the CAPB improves by at least 2% of GDP, or a period of two consecutive years in which the cyclically adjusted primary balance improves by at least 1.5% of GDP per year, in both years". The same limits are used in Ardagna (2008). The European-Commission (2007b) also distinguishes a "cold shower" from a gradual consolidation plan. In the first case, there has to be an improvement of the CAPB of at least 1.5% of GDP in one single year, while in the second case the consolidation is achieved over a period of three years, during which CAPB cannot deteriorate more than 0.5% of GDP compared to the year before.

However, there are other indicators of discretionary fiscal policy used in the literature as the one proposed by Blanchard (1990b) and named the "Blanchard Fiscal Impulse", BFI (see Alesina and Perotti (1995a)). This indicator isolates the discretionary components of the primary nominal budget balance by calculating the balance that would have prevailed if the unemployment rate had remained equal to that of the previous year. Alesina and Perotti (1995a) and Alesina and Perotti (1997) consider a small adjustment when the BFI in one year stands between -1.5 and -0.5 % of GDP, and a very tight or strong adjustment when the BFI is less than -1.5% of GDP.

Regarding the criteria of success, most of the indicators rely on the level of debt or of the CAPB behaviour after the consolidation episode. Ardagna

(2008) and Alesina and Perotti (1995a) consider that a consolidation has succeeded if, three years after the fiscal adjustment, the ratio of the debt-to-GDP is 5 percentage points below its level in the year of the fiscal adjustment. Alesina and Ardagna (1998) and Alesina and Perotti (1997) add a second criteria: "in the three years after the tight period the ratio of the cyclically-adjusted primary deficit over GDP is on average at least 2 percent of GDP below the last year of the tight period". European-Commission (2007b) considers a successful consolidation when the CAPB does not deteriorate by more than 0.75% of GDP in cumulative terms during the three years after the end of the consolidation episode.

Over the last decades, an extensive body of empirical work has been done in order to isolate the main determinants of successful fiscal consolidations. It is beyond the purpose of this work to fully describe all the relevant references on fiscal adjustments. We will therefore mention only the principal factors commonly considered in the literature, as crucial for a successful fiscal consolidation (for details see the reviewing European-Commission (2007b):

Composition of fiscal consolidation: expenditure based consolidations are seen to be more effective than revenue-based ones. Concerning the type of expenditure, the wage bill cut and social transfers seem to be particularly effective (Zaghini (1999), Alesina and Ardagna (1998), Alesina and Perotti (1997) and Alesina and Perotti (1995a)) among others.

Size of fiscal consolidation: there is no consensus on the relationship between the size of debt adjustment and the likelihood of successfull consolidation. Zaghini (1999) argues that the size of the fiscal contraction is not significantly different in successful and unsuccessful episodes. Alesina and Ardagna (1998) find that the success of a consolidation process is much more influenced by the composition rather than by the size of its fiscal contraction. Ardagna (2004), on contrary, shows that the success of fiscal adjustments depends crucially on the size of the fiscal contraction. Furthermore, Alesina and Ardagna (1998) and Giavazzi and Pagano (1995) stress that the likelihood of an expansionary adjustment during a consolidation (non-keynesian effects) is strongly influenced by the size of fiscal contraction.

Initial conditions: most authors have found that initial severe fiscal im-

balances in pair with adverse macroeconomic conditions not only contribute to trigger the consolidation episode but also contribute to the likelihood of its success (Ardagna (2004), Zaghini (1999) and Alesina and Ardagna (1998)).

Political factors: according to Alesina and Perotti (1995a) coalition governments enhance the probability of successful fiscal adjustments when compared to a single party government. Alesina et al. (2002) also confirm the coalition government positive effect. They also conclude that sustainable fiscal adjustment based on sensitive expenditure like wages or social transfers do not affect negatively the government popularity. During a period of fiscal adjustment, a government that relies on such spending cuts may in fact last longer. Other political aspects are tested in European-Commission (2007b) such as the realization of elections the year before, the size of majority in parliament and the Herfindahl index measuring the degree of concentration in parliament with respect to the number of political parties. Non of them were found to be statistically significant.

Fiscal governance and structural reforms: according to European-Commission (2007b) the association between the composition of fiscal consolidation and its success is loosing some power in favour of determinants related to fiscal governance and structural reforms. For fiscal governance the European-Commission (2007b) includes fiscal rule and budgetary procedure indexes which identify respectively the part of general government finances that is governed by numerical rules for the deficit (and the debt) and the features involved in the national budget procedures. Concerning the budgetary procedure Hallerberg et al. (2004) distinguish between the delegation approach, that consists on the delegation of power concentrated normally on the minister of finance, and the contract approach, that requires the pre-establishment of budgetary targets and rules normally among several political parties. The authors claim that the former is more appropriate for single party majorities while the latter is more functional in coalition governments. Naturally, the impact of fiscal rules is different depending on the type of budget procedures. The structural reforms affect the overall public expenditure through the privatization of services provided by the government, and also the labour market, the public pension systems, employment protection legis-

lation and unemployment benefits (European-Commission (2007b), Hauptmeier et al. (2006), Nicoletti and Scarpetta (2003) and Nunziata (2001)).

Other determinants have also been tested, like the monetary and exchange rate policies (Alesina and Ardagna (1998), Alesina and Perotti (1995a)) or the role of economic growth (Ardagna (2004)) but without robust and definitive results . Finally, Zaghini (1999) finds a positive correlation between length and success of tightening fiscal adjustments. Complementarily European-Commission (2007b) tries to justify why do more gradual fiscal adjustments end up being more successful when compared with "cold shower" strategies. First, gradual adjustment is more likely to occur when it comes just after an earlier episode of fiscal consolidation (in the last three years). Second, gradual adjustment is also usually associated to more serious initial fiscal imbalances. And third, fiscal consolidation based on social sensitive expenditures like those affecting wage bill are usually implemented in a more gradual way. Concerning the probability of success, European-Commission (2007b) estimates a slight positive effect for "cold shower" strategies, although not statistically significant.

There is a wide strand of literature relating most of those above-mentioned determinants with potential non-keynesian effects acting as mechanisms to the success of fiscal consolidation. The non-keynesian effects of fiscal consolidation were first described in Giavazzi and Pagano (1990) who noted an acceleration in growth just after government drastically reduced budget deficit in Denmark and Ireland during the 1980s. According to the traditional keynesian approach, loosening fiscal policy has an expansionary effects on private consumption and economic activity and the reverse applies. This is the called multiplier effect which size may be, even in the Keynesian framework, adversely affected by a number of factors such as the crowding out effect, full used productive capacity, flexible exchange rates and free capital mobility regimes . Also, in a seminal paper, Barro (1974), introducing the concept of "Ricardian Equivalence", argued that a tax cut may be fully compensated by the private sector that internalizes debt issuing to be repaid in the future with an increased tax burden. In these circumstances tax cut fails to stimulate private consumption and is neutral to economic activity.

The non-keynesian effects are rooted on the forward-looking perspective of agents who base their decision on their expected future income resulting from the perception of changes in the government inter-temporal budget constraint. Under rational expectations agents follow public finance and budget policy outcome, and accordingly build their own expectations about income, wealth and, in the case of firms,factors prices (for a comprehensive review of literature see Briotti (2005), European-Commission (2003) and Hemming et al. (2002)).

The demand-side channel of the non-Keynesian effects of fiscal policy has been described in several seminal articles. In the presence of distortionary taxes, current expenditure cuts lead to an expected increase in permanent income, since the future lower taxes reduce the dead-weight loss (Blanchard (1990a)). Giavazzi and Pagano (1995) and Bertola and Drazen (1993) refer the non-Keynesian effect triggered by large and credible consolidation plans resulting from severe and unsustainable fiscal imbalances. Finally, a credible fiscal consolidation can reduce the interest rate risk premia. Aggregate demand expands both through investment and consumption (Dermott and Wescott (1996), Giavazzi and Pagano (1990) and Feldstein (1982)). The consumption channel implies several important assumptions: taxes must be distortionary, consumers have to be forward-looking, and must not be liquidity constrained. In these circumstances this demand-side effect might outweigh the traditional Keynesian multiplier effects on demand and activity.

Through the investment channel, also known as the supply-side effect of fiscal consolidations, the relevant agent are firms whose investment decisions are based on rational expectations about future profits, which depends strongly, among other factors, on labour costs. From a neo-classical point of view, taxes affect disposable income and induce opposite income and substitution effects on labour supply at the individual level. The liquid effect on the aggregate labour supply depends on the consumption-leisure elasticity of substitution. Most studies find it very small. Moving to a typical European unionised labour market, the tax influence becomes much more significant especially with higher taxes because union will fight for higher pre-taxes real wages (Briotti (2005)). A reduction in the government wage bill, as well

as a reduction in government transfers will contribute to wage moderation through a spill-over effect in the private labour market. This will increase profits and investment. Non-Keynesian effects through the investment channel rest crucially on the consolidation composition, namely if it is based on expenditure cuts (wage and transfer) or increased taxes, and also on the success of structural reforms in the labour market (details of the supply-side channel can be found, among others, in Alesina and Ardagna (1998), Alesina et al. (1999), Alesina and Ardagna (1998), Alesina and Perotti (1997) and Alesina and Perotti (1995a)).

Thus, non-keynesian effects may crucially contribute to successful (expansionary) consolidations. Factors affecting the credibility of government fiscal effort and agents' expectations, namely the size of consolidation and the degree of fiscal imbalances and public debt level, are critical conditions for the occurrence of non-Keynesian effects through the demand-side channel. The composition of the adjustment along with the implementation of structural reforms on the labour market are key determinants for the supply-side effects to operate (European-Commission (2003)).

2.3 Heterogeneous-agent models: historical background

Since fiscal policy is, as mentioned above, expected to impinge both directly and indirectly on inequality, the use of heterogeneous-agent models becomes a basic requirement to capture endogenous changes in wealth and income distribution. During the post war decades, macroeconomic analysis was dominated by the Keynesian revolution ("The General Theory of Employment, Interest and money" 1936). This framework seemed quite successful in explaining macroeconomic fluctuation until the 1970s. Models built on broad theoretical and empirical generalizations exploring the connections between the main macroeconomic variables such as output, inflation, unemployment or consumption, were unable to explain new phenomena like the simultaneous occurrence of inflation and unemployment ocurred in the

seventies. Robert Lucas, in his seminal work (Lucas (1976)) argues that the effects of macroeconomic policy could not be analysed without explicit microeconomic foundations, leading the way to dynamic stochastic general equilibrium models based on rational decisions of the individuals. To derive robust conclusions about private sector reaction to economic policy, it is necessary to model carefully the behaviour of economic agents, namely consumers and firms and policy actions. Kydland and Prescott (1982), and all the subsequent quantitative macroeconomic models, mark a new paradigm for macroeconomic analysis based on microeconomic foundations. However all models were based on a representative agent.

The next step was obvious. If we accept the principle that macroeconomic model robustness depends on microeconomic roots, and considering the existence of significant cross-sectional dispersion among individuals (firms and workers), heterogeneity had to necessarily enter the macro research agenda. For a survey about heterogeneous-agent models see Storesletten et al. (2009), Rios-Rull (1995), Ljungqvist and Sargent (2004) and Cagetti and Nardi (2008). Of course, this became possible with the outcome of fast computers and new numerical methods. For technical and mathematical aspects see Huggett (1993), Krusell and Smith (2006), Rios-Rull (1995) and Rios-Rull (1999).

Seminal works using heterogeneous-agents models date from late 80s-early 90s, developed by Bewley (1983), Imrohoroglu (1989), Huggett (1993), Aiyagari (1995) and Krusell and Smith (1998). These first heterogeneous-agent models intended to shed some light on the aggregate consequences of individual heterogeneity. Bewley (1983), who first created this type of model, uses it on assess a set of classical issues in the monetary theory. Imrohoroglu (1989) estimates the magnitude of the costs of business cycles in a heterogeneous-agent model. Huggett (1993) starts from the incapacity of the representative agent model to solve the equity premium puzzle. Representative-agent economies, as pointed by Mehra and Prescott (1985), predict a risk free rate that is too large and an equity premium that is too small. In a heterogeneous-agent model with idiosyncratic shocks, borrowing constraints and incomplete markets, households insure themselves with pre-

cautionary saving, buying risk free assets, pushing interest rate under the level that would prevail with a full insurance situation. Thus, the resulting risk-free interest rate is closer to reality. While in Bewley (1983) agents simply hold fiat money, in Huggett (1993), household has access to a centralized loan market where borrowing or lending is possible at some equilibrium price. In Aiyagari (1995) a similar version of savings problem is used with private sector represented by a neoclassical production function. Physical capital represents the single asset that agents can hold to insure themselves. The equilibrium interest rate is obtained when aggregate investment equals aggregate saving. In his seminal paper, Aiyagari (1995) builds his model in order to proceed to a quantitative analysis of the importance of individual risk for aggregate saving. For its baseline parameterization Aiyagari found that this contribution is relatively modest representing at most 3%. However with higher values for risk aversion, this contribution can be much more significant. Krusell and Smith (1998) modify Aiyagari's model by adding an aggregate productivity shock hitting the production function. They found that fluctuations in wealth distribution has a small effect on the aggregate level of savings and investment, and thus, distribution effects are small.

Later, risk and heterogeneity continue to mark the research agenda on several core macro issues such as fiscal policy, asset prices and portfolio choice and insurance frameworks. Storesletten et al. (2009) describe the Standard Incomplete Markets (SIM) model as the main workhorse for studying heterogeneity in macroeconomics. In the SIM model, a continuum of agents is hit by an idiosyncratic shock on wage. At the individual level, agents maximize utility by choosing the levels of consumption, savings and labor supply. Equilibrium prices are determined by aggregation of individual decision, when aggregate labor supply and savings clear the labor and capital markets respectively. Over time, the SIM model was extended in several directions (Storesletten et al. (2009)). The first extension was concerned with the creation of additional sources of heterogeneity in order to match the empirical inequality verified empirically, which normally exceeds the SIM model outcomes. Krusell and Smith (1998) introduce an idiosyncratic shock on individual discount rate and manage to generate a more realistic wealth

distribution: patient agents save more and become wealthier while impatient people become poorer. Rios-Rull and Quadrini (1997) extended the model as to introduce a social security system and the bequest motive on order to replicate the small savings level among the low wealth population and the high level of savings of the wealthy segments of population (two features that ordinary SIM based models cannot explain or reproduce). As a last example, Huggett et al. (2006) use a human capital model with learning ability to replicate earning distribution.

A second wave of extensions introduce government or public sector in the model. With this supplementary block the heterogeneous-agent framework has allowed to test the robustness of several crucial results herded from the representative agent models. Beside distributional effects on aggregate variables, another major purpose of heterogeneous-agent model concerns inequality *per se*, which has become a major issue on the political debate. It is important for a government to understand the welfare distribution effects of any policy program. Moreover, many important issues like social security system, aging problem or wage dispersion cannot be modeled without heterogeneity. Numerous examples can be found in the literature. Aiyagari (1995) try to estimate the optimal level of capital tax rate. Precautionary savings, usually, lead to an over-accumulation level of physical capital in equilibrium. Taxing capital may contribute to bring back capital to the golden rule level. Heathcote (2005) uses the heterogeneous-agent framework with aggregate shocks to test the Ricardian equivalence. Nishiyama and Smetters (2005) consider the alternatives of taxing labor or consumption and the respective welfare distributional impacts. Other authors apply heterogeneous framework to social security systems - Huggett and Parra (2008), Hong and Rios-Rull (2007), Imrohoroglu and Joines (1995) among others. Aiyagari and McGrattan (1998) and Floden (2001) explore the insurance effects of public debt and social transfers across households. Finally, other authors have explored models with governments in which policy programs or outcomes cease to be exogenous. Since agents are different and their distribution is endogenous, the natural sequence consists on bringing politico-economic aspects into the heterogeneous-agent model. Government policies become

endogenous because they are determined by a collective choice made by heterogeneous rational and self-interested agents. Agent behavior can also be influenced by the state of the economy, the income or wealth distribution and the perceived future policy outcomes. Krusell and Rios-Rull (2007) calibrated a model to match U.S. data. Each consumer votes for a tax rate in order to maximize his lifetime utility. The total size of social transfers generated by their political-economy model represents a good approximation to the data. Benabou (2000) considers others puzzling realities. Countries with more unequal income distribution also spend less in redistributive policies, which can be interpreted as if people vote deliberately for inequality. In a stochastic growth model with incomplete asset market, agents vote over redistributive policies. The crucial aspects are that, first, redistribution is welfare enhancing only up to a certain level of inequality, and second, the propensities to vote increases with income and education. Krusell et al. (1996) use the political-equilibrium theory in growth model to compare consumption and income tax systems. Finally, Storesletten et al. (2005) use the political framework with heterogeneous-agent to argue about the evolution of the transfer system in the short and the long run. They find that redistribution tends to move away from the optimal solution as the political influence of young agents is lower and as the altruistic concern and risk-aversion are smaller. Many other papers explore these political issues, some of which with overlapping generation models (Storesletten et al. (2007)).

All the references mentioned above concern steady state equilibrium. But, in order to model fiscal consolidation processes, we are also interested in modeling economies that are off steady state equilibria. Auerbach and Kotlikoff (1987) lead the way to deterministic transition using an overlapping generation framework. Krusell and Rios-Rull (2002) use political economic models in an overlapping generation framework to simulate transition of east Europe centralized economies to free market regimes. Contrary to the steady state approach and the comparative static analysis, the literature exploring transition economies using dynamic analysis with heterogeneous-agent dynastic models is much more scarce. Heathcote and Domeij (2004) simulate transition with the SIM model in order to replicate an unanticipated reduction of

capital income tax, leaving labor income tax free to accommodate the government budget constraint. They obtain a positive welfare gain despite the uneven distribution of the tax cut burden. Imrohoroglu et al. (2008) start from the actual U.S. government tax regime and simulate several tax reforms using a dynastic model. Their objective is to study the welfare effect and simultaneously, isolate the groups who benefit from those who don't. Finally Quadrini et al. (2009), simulate transition path with a SIM model to follow the consequences of a financial integration between countries who differ in their financial markets development.

For our model, and besides Auerbach and Kotlikoff (1987), we follow extensively Ljungqvist and Sargent (2004) and Rios-Rull (1999). Against this background, in the next chapter, we describe the model in great detail.

Chapter 3

Model description

In the present chapter, we build a micro-founded model based on Aiyagari and McGrattan (1998), and also used in Floden (2001). This is a dynastic model that includes a continuum of infinitely-lived rational agents who are hit by idiosyncratic wage shocks in an incomplete capital market. The model includes government, with policy captured by a dynamic budget constraint, and optimizing firms endowed with a neoclassical Cobb-Douglas productive function. In order to smooth consumption/leisure, private agents optimally accumulate savings in 'good times" spending them during "bad times". Besides allowing for taxes levied on labour and capital, we decompose government expenditure into transfers to private sector, and productive and unproductive spending. While productive expenditure is included in the production function and, through this channel, augments the global productivity of the economy, unproductive spending is solely utility-augmenting. With our model we aim to a better understand of the channels through which government influences household's behavior and to assess the aggregate and the distributive consequences of its policies. Based on the welfare criterion presented in Floden (2001), and Aiyagari and McGrattan (1998), we conduct a welfare analysis comparing different combinations of debt, expenditures and transfer, and considering different public spending compositions (static analysis across steady-states). We also explore the decomposition of the welfare effects according to the methodology proposed by Floden (2001):

the consumption/leisure level effect, the uncertainty effect and the inequality effects.

In the literature, measurement of inequality is not standard and usually involves the use of complement indicators (e.g., income or wealth Gini coefficients, income share-poorest 2 quintiles, poverty rate), given the difficulty in finding a variable compact enough to capture individual welfare[1]. Another major problem in inequality assessment is the choice of the time period over which a chosen variable is measured. Enlarging the reference period will *ceteris paribus* reduce inequality (Cowell (2009)). Normally the fiscal year is used as the reference period because it constitutes the natural accounting period for several income sources (Jenkins and Kerm (2008)). The third and last problem concerns the sample unit on which the chosen variable is measured. Normally, income or consumption can be measured on households, families or at an individual level: while labour earnings pose no problem since wages are paid on a individual basis, social transfer, tax payments or even capital earnings, should be included on a household basis . The standard practice is to adopt the household unit assuming that welfare, income or consumption are equally spread among household's members (Jenkins and Kerm (2008)).

In our work, which is based on a theoretical model, many of these practical problems do not apply. We treat households on a yearly basis. As for inequality measures, we detail the dynamics of the distribution by calculating additional inequality measures based not only on wealth (asset holdings), disposable income (labour and capital net of tax income plus social transfers) and consumption, but also on leisure to complement the results obtained for the overall welfare inequality effect. For each of these variables we calculate the corresponding Gini coefficient.

On the one hand, the model predicts that a rise in unproductive expenditure and in transfers improve utility up until a certain point as they impinge positively on inequality and uncertainty, but negatively on the welfare level. On the other hand, debt brings a positive insurance effect but

[1]For a broad survey about inequality measure see Cowell (2009); Jenkins and Kerm (2008).

impinges negatively on welfare level and inequality. We also find that, given government consumption, optimal combination of debt and social transfer levels are smaller than the values observed in the EU countries during the last decades; moreover, the optimal debt-to-output level rises with the size of government (as measured by the expenditures on output ratio) and, thus, implies larger inequality. Finally, for a given level of public debt, (i) substituting unproductive spending by transfers is welfare enhancing and improves inequality but only up to a lower bound of unproductive spending; (ii) substituting unproductive by productive spending is always welfare enhancing and has no impact on any inequality measure; and (iii) shifting transfers for productive expenditure is always welfare enhancing for a sufficiently high output elasticity of public investment and impacts negatively on inequality welfare.

3.1 Model Description

As we said, the model is built from a standard growth model modified to include a role for government together with an uninsured idiosyncratic risk and liquidity/ borrowing constraints.

We modify the original Aiyagari and McGrattan (1998); Floden (2001) model, breaking up the government expenditure into productive and unproductive. The former is introduced in the utility function and the latter in the production function. We also use a different approach for the calibration of the idiosyncratic shock. The model is composed by three sectors: households, firms and the government.

3.1.1 Households

There is a continuum of infinitely-lived agents of unit mass who receive after tax wage payments, $\overline{w}$, after tax interest from savings, $\overline{r}a$, and transfers, TR, from the government. Following Barro (1973); Floden (2001) and Floden (2003), we consider that beside private consumption c, and leisure, l,unproductive government spending G_u also increases households' utility at

decreasing returns and according to a parameter ϑ. In each period, agents are hit by idiosyncratic shocks e_t which determines the productivity level. Borrowing is allowed only up to a certain limit b and complete capital market is ruled out. This implies that agents have to ensure themselves by saving during "good times" ($a_{t+1} - a_t > 0$) while, during "bad times", savings are negative ($a_{t+1} - a_t < 0$). Each agent is endowed with one unit of time and solves the double problem of choosing between labor and leisure, and between consumption and saving.

Each household solves the following optimization problem:

$$\max_{c_t, l_t, a_{t+1}} E\left[\sum_{t=0}^{\infty} \beta^t (u_1(c_t, l_t) + \vartheta u_2(G_{ut}))|a_0, e_0\right] \tag{3.1.1}$$

Subject to:

$$c_t + a_{t+1} = \overline{w}_t(1 - l_t)e_t + (1 + \overline{r}_t)a_t + TR_t \ , \ c_t \geq 0, \ a_t \geq -b_t \tag{3.1.2}$$

where the household's instant utility functions are specified as:

$$u_1(c_t, l_t) = \frac{c_t^{1-\mu} \exp(-(1-\mu)\zeta(1-l_t)^{1+\gamma})}{1-\mu} \tag{3.1.3}$$

where μ represents the risk aversion, ζ is constant calibrated in order to match an average labor supply of 0.3, and $\frac{1}{\gamma}$ represents the labor supply elasticity. The unproductive expenditure G_u utility is given by the function:

$$u_2(G_u) = \frac{G_u^{1-\mu}}{1-\mu} \tag{3.1.4}$$

The productivity shock e_t is an idiosyncratic shock that evolves stochastically over time according to the following process: the natural logarithm of e_t is represented by an AR(1) process with a serial correlation coefficient ρ and a standard deviation σ:

$$\log(e_t) = \rho \log(e_{t-1}) + \epsilon_t \tag{3.1.5}$$

The procedure of Tauchen (1986) is used to approximate the auto regres-

sion of $\log(e_t)$ with a first-order Markov chain with seven states. The two main components of the Markov process are the productivity level vector *edu* and the 7×7 probability transition matrix *prob*.

3.1.2 Firms

The firms are characterized by the following neoclassic production function:

$$Y_t = F(K_t, N_t, G_{pt}) = (K_t)^{\alpha}(N_t)^{1-\alpha}(G_{pt})^{\eta} \tag{3.1.6}$$

where:
Y: *per capita* output
K: *per capita* capital stock
N: *per capita* labour supply
G_p: productive government spending.

Productive government spending is identified with the share of public gross investment on output, in line with Barro (1990); Auschauer (1989)[2], and enters as an input to private function.

The parameters α and η represent, respectively, the output elasticities of private capital and productive government expenditure. The production function exhibits constant returns to scale over private inputs but increasing returns over all inputs. Assuming competitive markets of goods and inputs, private factors are paid according to their marginal productivity and output is exhaustively distributed.

$$\overline{w_t} = (1 - \tau_t)w_t = (1 - \tau_t)F_N(K_t, N_t, G_{pt}) \tag{3.1.7}$$

$$\overline{r_t} = (1 - \tau_t)r_t = (1 - \tau_t)(F_K(K_t, N_t, G_{pt}) - \delta) \tag{3.1.8}$$

where τ is a proportional income tax rate levied on labour and capital, δ

[2]R. Barro, in a seminal paper (Barro (1990)) incorporates a public sector into a simple, constant return model of economic growth. The ratio of real public gross investment to real GDP, which is assumed to correspond to a flow of services identified as the measure of infrastructure services enters directly to the production function.

is the depreciation rate of capital and w and r stand respectively, for gross real wage and gross real interest rate.

3.1.3 Government

The government promotes both productive and unproductive expenditures, collects taxes and pays lump-sum transfers to households, facing the following budget constraint in real terms:

$$G_{ut} + G_{pt} + TR_t + r_t D_t = D_{t+1} - D_t + \tau_t(w_t N_t + r_t A_t) \tag{3.1.9}$$

where, G_{ut}, represents government final consumption (unproductive expenditure), G_{pt}, public gross investment (productive expenditure), TR_t, government transfers to households, and D_t, government debt.

$$A_t = D_t + K_t \tag{3.1.10}$$

represents the asset market clearing condition: asset holdings equalize private plus public debt.

3.2 Solving the model

First we transform the model in order to work with variables defined relative to output. Afterwards, we define the steady state equilibrium and describe the algorithm used for its computation following McGrattan (1996, 2003).

3.2.1 The model with variable defined relative to output

In order to transform the model we define: $k_t = \frac{K_t}{Y_t}$, $\tilde{w}_t = \frac{\overline{w}_t}{Y_t}$, $\tilde{c}_t = \frac{c_t}{Y_t}$, $\tilde{a}_t = \frac{a_t}{Y_t}$, $d_t = \frac{D_t}{Y_t}$, $\overline{a_t} = \frac{A_t}{Y_t}$, $tr_t = \frac{TR_t}{Y_t}$, $g_{ut} = \frac{G_{ut}}{Y_t}$, $g_{pt} = \frac{G_{pt}}{Y_t}$ and $\tilde{b}_t = \frac{b_t}{Y_t}$.

In steady-state, the model reaches a balanced growth equilibrium in which all variables, namely output (Y) private capital (K), public debt (D), and

all policy variables (TR, G_u, G_p, and the tax burden), evolve at the same growth rate.

First , we rewrite the household's budget constraint in the per product units form:

$$\frac{c_t}{Y_t} + \frac{a_{t+1}}{Y_t} = \frac{\overline{w_t}}{Y_t}(1 - l_l)e_t + (1 + \overline{r_t})\frac{a_t}{Y_t} + \frac{TR_t}{Y_t}$$

$\Longleftrightarrow$

$$\frac{c_t}{Y_t} + \frac{a_{t+1}}{Y_{t+1}}(1 + g) = \frac{\overline{w_t}}{Y_t}(1 - l_l)e_t + (1 + \overline{r_t})\frac{a_t}{Y_t} + \frac{TR_t}{Y_t}$$

where g is the steady state growth rate of output.

Using the definitions $c_t = \tilde{c}_t \times Y_t$ and $G_{ut} = g_{ut} \times Y_t$, the consumer's problem becomes:

$$\max_{\tilde{c}_t, l_t, \tilde{a}_{t+1}} E\left[\sum_{t=0}^{\infty} \beta^t Y_t^{1-\mu}(u_1(\tilde{c}_t, l_t) + \vartheta u_2(g_{ut}))|\tilde{a}_0, e_0\right] \tag{3.2.1}$$

Subject to:

$$\tilde{c}_t + (1+g)\tilde{a}_{t+1} = \tilde{w}_t(1-l_t)e_t + (1+\overline{r_t})\tilde{a}_t + tr_t \ , \ \tilde{c}_t \geq 0, \ \tilde{a}_t \geq -\tilde{b} \tag{3.2.2}$$

$$\tilde{w}_t = (1 - \tau_t)\frac{F_N(K_t, N_t, G_{pt})}{Y_t} \tag{3.2.3}$$

$$\overline{r_t} = (1 - \tau_t)(F_K(K_t, N_t, G_{pt}) - \delta) \tag{3.2.4}$$

Second by introducing the asset market clearing condition into the government budget constraint, and by using the definition of w_t and r_t together with the property of first degree homogeneity of the produc-

tion function, we can rewrite the government budget constraint as:

$$G_{ut} + G_{pt} + TR_t + (F_K(K_t, N_t, G_{pt}) - \delta)D_t =$$
$$D_{t+1} - D_t + \tau_t\Big(F_N(K_t, N_t, G_{pt})N_t + (F_K(K_t, N_t, G_{pt}) - \delta)(K_t + D_t)\Big)$$
$$\iff$$
$$G_{ut} + G_{pt} + TR_t + (1 - \tau_t)(F_K(K_t, N_t, G_{pt}) - \delta)D_t =$$
$$D_{t+1} - D_t + \tau_t\Big(F_N(K_t, N_t, G_{pt})N_t + F_K(K_t, N_t, G_{pt})K_t - \delta K_t\Big)$$
$$\iff$$
$$G_{ut} + G_{pt} + TR_t + (1 + \overline{r_t})D_t = D_{t+1} + \tau_t(Y_t - \delta K_t)$$

Now dividing by Y_t, we get the stationary government budget constraint:

$$g_{ut} + g_{pt} + tr_t + (\overline{r}_t + 1)d_t - (1 + g)d_{t+1} = \tau_t(1 - \delta k) \tag{3.2.5}$$

Third We divide the asset market clearing condition by the output to obtain its per product version:

$$\overline{a}_t = k_t + d_t \tag{3.2.6}$$

3.2.2 Solving the steady state equilibrium

Definition of the equilibrium During the stationary equilibrium, by definition, the economy moves at a constant rate. For a given level of d, tr, g_u and g_p, the steady state of this economy is characterized by:

- A tax rate: τ
- A government debt: $d = \frac{D}{Y}$
- An interest rate: r
- An after tax wage: w

- Two time invariant decision rules: for asset holdings by households (asset demand) and for labour supply, respectively:

$$\tilde{a}_{t+1} = \alpha(\tilde{a}_t, e_t) \tag{3.2.7}$$

$$(1 - l_t) = h(\tilde{a}_t, e_t) \tag{3.2.8}$$

- A stationary distribution of households across asset holdings and productivity shocks:

$$\lambda(\tilde{a}, e) \tag{3.2.9}$$

- An aggregate level of effective hours worked and asset holdings, respectively:

$$N = \int e_t h(\tilde{a}_t, e_t)\, d\lambda \tag{3.2.10}$$

$$\overline{a} = \int \alpha(\tilde{a}_t, e_t)\, d\lambda \tag{3.2.11}$$

...such that

1. Decision rules are the solution maximization problems for the household;
2. Government budget constraint is fulfilled;
3. Input markets clear;
4. Aggregate saving (asset demand) equals demand for capital from firms plus government debt (asset supply).

$$\int \alpha(\tilde{a}_t, e_t)\, d\lambda = k(r) + d \tag{3.2.12}$$

The steady state of this economy is characterized by a vector of prices $\{r, w\}$ which solve (3.2.12) and (3.2.10)

The expression $\int \alpha(\tilde{a}_t, e_t)\, d\lambda$ represents the *per capita* assets wanted by consumers (relative to *per capita* output) ; the expression $k(r^*) + d$ is the *per capita* supply of assets (capital plus government debt) relative to *per capita* output, expressed as a function of the interest rate; finally, $\int e_t h(\tilde{a}_t, e_t)\, d\lambda$ is the *per capita* effective labor supplied by households.

Algorithm for solving the steady state equilibrium

1. Inputs: $\beta, \mu, \zeta, \vartheta, \gamma, \rho, \sigma_e$, *edu*, *prob*, α, η, g_u, g_p, tr and d
2. Start with an initial guess for N (aggregate labour supply).
3. With N fixed, apply the bisection method Aiyagari (1994) to calculate the interest rate that clears the asset market as follows: we try a first guess for interest rate within some interval $[r_l, r_u]$.
4. Given the guess for interest rate, back out the private capital output ratio, the after tax wage and the tax rate, using the government budget constraint and the fact that input markets are perfectly competitive.

   ➟*Level of private capital per unit of output*:

$$Y = F(K, N, G_p) = K^\alpha N^{1-\alpha} G_p^\eta$$
$$r + \delta = \alpha K^{\alpha-1} N^{1-\alpha} G_p^\eta \iff \frac{r+\delta}{Y} = \frac{\alpha K^{\alpha-1} N^{1-\alpha} G_p^\eta}{K^\alpha N^{1-\alpha} G_p^\eta}$$
$$\frac{r+\delta}{Y} = \frac{\alpha}{K} \iff k = \frac{\alpha}{r+\delta}$$

   ➟*Wage per unit of output*:

$$Y = F(K, N, G_p) = K^\alpha N^{1-\alpha} G_p^\eta$$
$$w = (1-\alpha) K^\alpha N^{-\alpha} G_p^\eta \iff \frac{w}{Y} = \frac{(1-\alpha) K^\alpha N^{-\alpha} G_p^\eta}{K^\alpha N^{1-\alpha} G_p^\eta}$$
$$\tilde{w} = (1-\tau)\frac{w}{Y} = (1-\tau)\frac{1-\alpha}{N}$$

➟ *Tax rate*: tax rate is determined by combining the former results with the government budget constraint, under the assumption of $g = 0$:

$$\tau = \frac{g_u + g_p + tr + rd}{1 - \delta\frac{\alpha}{r+\delta} + rd}$$

5. We compute time invariant decision rules for the asset holdings by households (asset demand), for the labour supply and the stationary distribution of household: (3.2.7), (3.2.8) and (3.2.9).

   In order to obtain an numerical approximation for the decision rules that solve the first order conditions of the households maximisation problem and respective restrictions, we use the finite elements technique (McGrattan (1996))

6. We update interest rate using the bisection method (Aiyagari (1994)) until (3.2.12) is verified.

7. We update aggregate labour supply, N (step 2) until (3.2.10) is verified. We do it using a Newton-Raphson iterative scheme (McGrattan (2003)):

   $$N^{m+1} = N^m - J(N^m)^{-1} f(N^m)$$

   where

   $f(N) = \int e_t h(\tilde{a}_t, e_t)\, d\lambda - N$ and $J(N)$ is the corresponding jacobian matrix.

3.2.3 Solving the transition path between steady states

The analysis of a debt consolidation process requires moving between two steady states. Transition paths are thus in need to compare the dynamics of alternative debt consolidation strategies, expenditure or revenue-based, gradual or "cold shower" type, namely in terms of eventual aggregate transition costs as well as how these spread across households (who pays and who

benefits). In order to simulate transition paths imposed by a debt consolidation strategy we closely follow Quadrini et al. (2009), Ljungqvist and Sargent (2004), Rios-Rull (1999) and Auerbach and Kotlikoff (1987).

We consider the problem faced by a planner who inherits at time t a predetermined state vector, chooses a vector of control or decision variables for each period of some time interval, and is obliged to leave the state vector with a fixed and previously known value at the end of the planning period (Fuente (2000)). We present the expected life time utility maximisation problem in a recursive form, using the principle of optimality and the Bellman equation (as Quadrini et al. (2009)).

Let $\{r_t, \tilde{w}_t\}_{t=0}^{T}$ be a deterministic sequence of prices (interest rate and wage). Let $\{d_t, g_{ut}, g_{pt}, tr_t\}$ be a sequence of government policy. The optimal choice for the single agent' s maximisation problem can be written as:

$$V_t(e_t, \tilde{a}_t) = \max_{\tilde{c}_t, l_t \tilde{a}_{t+1}} \left[Y_t^{1-\mu}(u_1(\tilde{c}_t, l_t) + \vartheta u_2(g_{ut})) + \beta Y_{t+1}^{1-\mu} \sum_{e_{t+1}} V_{t+1}(e_{t+1}, \tilde{a}_{t+1}) \right] \tag{3.2.13}$$

Subject to: (3.1.6), (3.2.2), (3.2.3), (3.2.4), (3.2.5) and (3.2.6).
The solution to the agent's problem delivers all agents decision rules, namely for consumption, $\tilde{c}_t(e_t, \tilde{a}_t)$, leisure, $l_t(e_t, \tilde{a}_t)$, and savings, $\tilde{a}_{t+1}(e_t, \tilde{a}_t)$. These decision rules determine the evolution of the distribution of wealth over e and $\tilde{a}$, denoted $\lambda_t(e, \tilde{a})$.

The general equilibrium definition: consider an initial steady state composed by a set of fiscal policy variables $\{d_0, g_{u0}, g_{p0}, tr_0\}$, a vector of equilibrium prices, $\{r_0, \tilde{w}_0\}$, and a stationary distribution, $\lambda_0(\tilde{a}, e)$.

The general equilibrium is defined by a sequence of

- Government policy: $\{d_t, g_{ut}, g_{pt}, tr_t\}_{t=1}^{\infty}$
- Agents decisions: $\{\tilde{c}_t(\tilde{a}_t, e_t), l_t(\tilde{a}_t, e_t), \tilde{a}_{t+1}(\tilde{a}_t, e_t)\}_{t=1}^{\infty}$,
- Value Functions: $\{V_t(e_t, \tilde{a}_t)\}_{t=1}^{\infty}$
- Prices: $\{r_t, \tilde{w}_t\}_{t=1}^{\infty}$

- Distributions $\{\lambda_t(\tilde{a}_t, e_t)\}_{t=1}^{\infty}$

Such that

- Agent decision solves (3.2.13)
- Assets and labour markets clear:
  $\int \tilde{a}_t \, d\lambda = k(r) + d$ and $\int e_t(1 - l_t) \, d\lambda = N$, for all t
- The sequence of $\lambda_t(\tilde{a}_t, e_t)$ is consistent with the initial steady state, the agent decision and the idiosyncratic shock.

Algorithm for solving the transition path: the simulation of the transition equilibrium path of the economy, given a particular parameterization, typically proceeds in three stages (Auerbach and Kotlikoff (1987)):

1. Solving for the long-run initial steady state of the economy (before the change in the policy stance);
2. Solving for the long-run steady state towards which the economy will eventually converge after full-effects of the policy change occur;
3. Solving for the transition path of the economy between the two steady states.

In particular, the algorithm for running the third step follows Rios-Rull (1999) and involves the following steps: (i) Choose a double sequence of interest rate and wage for all the periods of transition (for instance, set a linear transition between the two steady state levels), $\tilde{w}_t$ and r_t; (ii) taking the double sequence of $\tilde{w}_t$ and r_t, solve backwards the value function and simulate the whole transition for the economy, updating the distribution according to agent's decisions, to obtain a sequence of asset demand values and a sequence of aggregate labour supply; (iii) adjust the double sequence in order to clear both asset and labour markets in all periods of transition; (iv) repeat step (ii) and (iii) until double sequence converges and both markets clear.

3.3 Social welfare computation

The stationary form also allows us to define household's problem in a recursive form. Define $V(e_0, \tilde{a}_0)$ as the optimal value for the expected life time utility maximization problem starting from an initial state $(e_0\tilde{a}_0)$. The value function V satisfies (3.2.13), now re-written in the following functional Bellman equation[3]:

$$V(e, \tilde{a}) = \max_{\tilde{c}, l, \tilde{a}'} \left[Y^{1-\mu}(u_1(\tilde{c}, l) + \vartheta u_2(g_u)) + \beta Y'^{1-\mu} \sum_{e'} V(e', \tilde{a}') \right] \quad (3.3.1)$$

Subject to: (3.1.6), (3.2.2), (3.2.3), (3.2.4), (3.2.5) and (3.2.6).

The utilitarian social welfare is defined as the solution of (3.3.1) across all households (i.e, conforming the stationary distribution):

$$U = \int E_0 \sum_{t=0}^{\infty} \beta^t u(c_t, l_t, G_{ut})\, d\lambda(a, e) \quad (3.3.2)$$

The utilitarian social welfare increases with consumption, leisure or government unproductive expenditure. Since the utility function is concave, the social welfare is influenced by the distribution, and then, more inequality or uncertainty will reduce welfare.

In order to measure the impact of policy in welfare across steady states, we decompose, following Floden (2001), the global welfare into three particular effects: the consumption level effect, the insurance effect and the inequality effect.

3.3.1 Decomposition of the steady state global welfare gain

Consider a policy change that moves an economy from steady state A to steady state B. The global welfare gain is measured as a percentage of lifetime consumption that households gain (or lose) from moving from economy

[3] x' means next period value of x.

instantly from A to B, and is defined by w_u in:

$$\int E_0 \sum_{t=0}^{\infty} \beta^t u((1+w_u)c_t^A, l_t^A, G_{ut}^A)\, d\lambda^A(a,e) = \int E_0 \sum_{t=0}^{\infty} \beta^t u(c_t^B, l_t^B, G_{ut}^B)\, d\lambda^B(a,e) \tag{3.3.3}$$

3.3.2 Certainty-equivalence

The certainty-equivalent levels of consumption $\overline{c}$ and leisure $\overline{l}$ represent the constant levels of consumption and leisure that would ensure an utility level equivalent to that expected under the uncertain utility flows in the future. The certainty-equivalent consumption and leisure bundle must solve, for each household:

$$\sum_{t=0}^{\infty} \beta^t u(\overline{c}_t, \overline{l}_t, G_{ut}) = E_0 \sum_{t=0}^{\infty} \beta^t u(c_t, l_t, G_{ut}) \tag{3.3.4}$$

As pointed in Floden (2001) the last equation does not define a unique combination of $\overline{c}$ and $\overline{l}$. To get an unique combination, we opt to set leisure at the level chosen by each household at $t = 0$. A second hypothesis was to use the average leisure level of the whole economy. The results are very similar and don't affect the conclusions.

3.3.3 Insurance effect

The insurance effect explores the time dimension of the utility function concavity. In order to remove the inequality effect, we compare the average level of consumption, C, and leisure, L, with the average of the certainty-equivalent corresponding levels, $\overline{C}$ and $\overline{L}$.

$$C = \int c\, d\lambda(a,e) \quad \overline{C} = \int \overline{c}\, d\lambda(a,e) \quad L = \int l\, d\lambda(a,e) \quad \overline{L} = \int \overline{l}\, d\lambda(a,e)$$

We define, p_{unc}, the cost of uncertainty and calculate it from the difference (in percent of life time consumption) between the utility evaluated at the average consumption and leisure, and that evaluated at the corresponding

certainty-equivalence levels:.

$$\sum_{t=0}^{\infty} \beta^t u((1-p_{unc})C, L, G_{ut}) = \sum_{t=0}^{\infty} \beta^t u(\overline{C}, \overline{L}, G_{ut}) \tag{3.3.5}$$

We define, w_{unc}, as the insurance effect, associated with moving from A to B:

$$w_{unc} = \frac{1-p_{unc}^B}{1-p_{unc}^A} - 1 \tag{3.3.6}$$

If uncertainty increases, $\overline{C}$ decreases and moves away from C and therefore p_{unc} increases. The insurance welfare effect will be negative ($w_{unc} < 0$), and a rise in uncertainty impacts negatively on global welfare.

3.3.4 Level effect

Defining the leisure-compensated consumption (Floden (2001)) in economy B, $\hat{C}^B$, as the consumption increment (or decrease) necessary to reach the level of utility in B, *ceteris paribus*, namely, leaving L^A and G_u^A unchanged.

$$\sum_{t=0}^{\infty} \beta^t u(\hat{C}^B, L^A, G_u^A) = \sum_{t=0}^{\infty} \beta^t u(C^B, L^B, G_u^B)$$

Let, w_{lev}, the welfare level effect associated with moving from A to B:

$$w_{lev} = \frac{\hat{C}^B}{C^A} - 1 \tag{3.3.7}$$

3.3.5 Inequality effect

The inequality effect explores the space dimension of the utility function concavity. We now use the certainty-equivalence variables to remove uncertainty from welfare. We define p_{ine} as the difference (in percent of life time consumption) between the utility of average certainty-equivalence of consumption and leisure, and the utility evaluated at the corresponding certainty-equivalence levels. It is equivalent to the level of consumption that people are willing to give up in order to promote an equal distribution of consumption and leisure,

maintaining the same level of social welfare.

$$\sum_{t=0}^{\infty} \beta^t u((1-p_{ine})\overline{C}, \overline{L}, G_{ut}) = \int \sum_{t=0}^{\infty} \beta^t u(\overline{c}, \overline{l}, G_{ut}) \tag{3.3.8}$$

Finally define w_{ine} as the inequality welfare effect associated with moving from A to B:

$$w_{ine} = \frac{1-p_{ine}^B}{1-p_{ine}^A} - 1 \tag{3.3.9}$$

A more unequal utility distribution will decrease the right side of (3.3.8) and raises p_{ine}. Thus a rise in inequality impacts negatively on global welfare ($w_{ine} < 0$). Floden (2001) notes that, an increase of uncertainty leaves the inequality unchanged because $\overline{C}$ and $\overline{L}$ change together with $\overline{c}$ and $\overline{l}$. Likewise inequality does not affect $\overline{C}$ and $\overline{L}$, and so, uncertainty is not affected by inequality.

As stated in the introduction we complement w_{ine} with several inequality measures. We specifically calculate the Gini coefficients for wealth, disposable income, consumption and leisure. Naturally, the specific inequality indexes about each of those variables do not always reveal the same tendency of the more complete welfare inequality in which composition reflects all source of utility (consumption and leisure).

Instead of the simple formula presented in Floden (2001) to decompose w_u into w_{level}, w_{unc} and w_{ine}, due to the inclusion of unproductive expenditures in the utility function, we get a munch more complex formula[4].

3.4 Calibration

The model presented above follows closely Aiyagari and McGrattan (1998) and Floden (2001). The model period is one year. Parameters calibration uses relevant literature while policy variables are calibrated using average EU countries values (EU15[5] in AMECO data source for the period between

[4]The formula is available upon request.

[5]Belgium, Denmark, Germany, Ireland, Greece, Spain, France, Italy, Luxembourg, Netherlands, Austria, Portugal, Finland, Sweden and United Kingdom.

1990 and 2008).

Preferences: for the risk-aversion parameter μ, we use a value of 1.5 which is commonly used in literature. For the inverse of labour supply elasticity, γ we follow Floden (2001) and set it to 2 which is equivalent to a wage elasticity of labour supply equal 0.5. The parameter ζ determines the fraction of time devoted to labour and is set in order to match an average labour supply of around 0.3 ($\zeta = 9.145$). Finally ϑ represents preferences toward public goods and services relative to private goods; for the baseline calibration we set$\vartheta = 0.1$. The use of larger value of $\vartheta = 0.1$ is not compatible with the level of policy variables observed in EU and developed countries.

Technology: the production function is inspired in Barro (1990) to incorporate productive government spending. For our baseline model we follow Auschauer (1989) and use a value of 0.3 for the output elasticity of productive government spending, η. For the capital share, α we use 0.3 (Aiyagari and McGrattan (1998); Floden (2001)).

Discount factor and interest rate : according to our model, $r = \frac{\alpha}{k} - \delta$. We set $\delta = 7.5\%$ as Aiyagari and McGrattan (1998). The variable k represents the capital output ratio and the steady state value is calibrated as to match the average value of the capital to output ratio of the EU15 countries (1990-2008)[6]. Thus, the steady state value for the real interest rate yields 2.8%. We calibrate the discount factor in order to reach an equilibrium with this real interest rate level, which implies $\beta = 0.981$.

Government: the government is characterized by a set of fiscal indicators $\{D, TR, G_u, G_p\}$. These are differently calibrated to capture different aspects of the public sector. Nevertheless, in our theoretical exercises, we use values close to the empirical reality of the UE15. Specific values will be released during simulations below in section 3.

[6]Source: AMECO database, $k = 2.9$.

The idiosyncratic shock: the idiosyncratic shock is described as Markov chain specification with seven states to match a first order autoregressive representation (Aiyagari (1994)). The relevant parameters for the process are the coefficient of variation, σ, and the serial correlation coefficient, ρ. Aiyagari (1994); Aiyagari and McGrattan (1998); Floden (2001) base their values of ρ and σ on empirical data for earnings and annual hours worked. Due to data unavailable to the EU15 average, we follow a different path. As Rios-Rull et al. (2003) we fix both parameters as to match the existent inequality in the EU15. Specifically, we use the income Gini index as a reference. Knowing that, in EU15 the income Gini index varies between 0.26 and 0.34, we will fix both parameters so that simulation outcome equals disposable income distribution (or at least the same Gini index). For the present paper we set $\rho = 0.8$ and $\sigma = 0.27$ which leads to an income Gini index of around 0.28.

Chapter 4

Optimal government expenditure and financing - Steady-State Analysis

This section gives insight on optimal government size and financing. In particular we want to assess how fiscal policy variables $\{g_u, g_p, tr, d\}$ impinge on welfare as well as how they affect inequality. In order to make such assessment, we produce a continuum of steady state equilibria that are characterized by different government behaviours. First, we consider different endowment on each of the fiscal policy instruments, allowing for a corresponding tax adjustment. Second we evaluate the impacts of a changing composition on policy instruments regarding fiscal policy inter-temporal structure: how do welfare and inequality indicators behave in face of more expenditure, financed through current taxes, relative to higher public debt? Third, for a given debt-to-output ratio, we study how a changing composition of government expenditure (intra-temporal substitution, for a fixed tax burden) impinges on welfare and inequality. Thus we find the optimal government composition of fiscal instruments (inter-temporal and intra-temporal) while assessing on how government expenditure and financing impacts on welfare inequality, as well as on several complementary inequality measures.

To solve for the steady state equilibrium, one must find the equilibrium

interest rate that clears the asset market, i.e. when aggregate asset demand from households (in order to save and insure themselves against the idiosyncratic earning shocks) equals the asset supply by government and firms (in order to search for funds to finance deficits and investment).

The equilibrium is represented by the intersection between asset supply/capital demand curve (government and firms) and asset demand/capital supply curve (household) shown in figure 4.1.

The supply curve is composed by a private share plus public debt. Increases (decreases) in public debt shift the asset supply curve to the right (left). The asset demand curve in positively sloped relative to interest rate. In order to understand what shifts in the asset demand curve we must examine each of its determinants individually, namely idiosyncratic shocks, debt, transfer and public expenditures (see Ljungqvist and Sargent (2004), for the details).

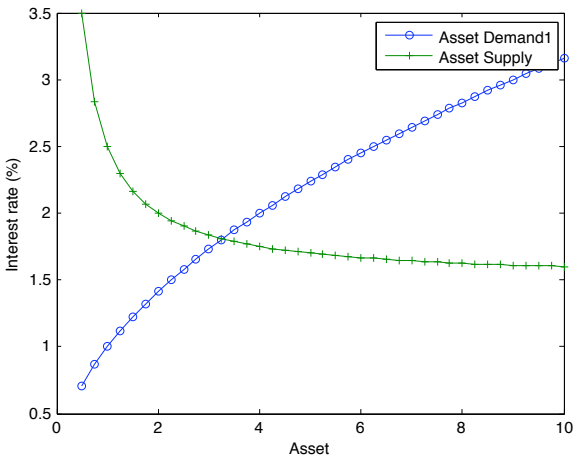


Figure 4.1: Asset market equilibrium

The idiosyncratic shock is characterized by the variance of the shock and by its persistence . When the variance of the shock or its persistence increases, assets demand increases induced by an increased need for insurance and shifts the asset demand curve to the right. Higher public debt or public expenditure requires more taxes to satisfy debt constraint; as such, this

implies less disposable income and shifts the asset demand curve to the left. Finally, the transfer effect is ambiguous. Transfers increase directly disposable income and pushes the demand curve to the right. But at the same time, the fiscal cost of transfers reduce disposable income, shifting the asset demand leftwards. If we derive disposable income in respect to transfer we find that the net effect depends on the sign of the expression (in steady-state):

$$\frac{\partial income}{\partial tr} = 1 - \frac{r\tilde{a}_t - we_t}{1 + rd - \frac{\delta\alpha}{r+\delta}} \tag{4.0.1}$$

Also, as real interest rate rises the household asset demand (capital supply) increases, which means that the asset demand curve has an upward slope. On the other side, asset supply from firms and government (capital demand) decreases with the interest rate, which means that the asset supply has a downward slope.

Combining all these effects on asset supply and asset demand curves makes it impossible to predict a final equilibrium. The solution is to solve the model numerically for all possible combination of idiosyncratic shock, debt, transfer and government expenditures using the algorithm presented in section (2).

4.1 Individual impact of policy variables

In order to better understand the channels through which fiscal variables $\{d, tr, g_u\}$ affect welfare and inequality, we calculate a sequence of steady state equilibria considering alternative values for a single instrument, leaving the others unchanged. It is worthwhile to note that, throughout these exercises, taxes adjust to fulfill the government budget constraint and thus, also impact on welfare. However tax impacts on inequality are only indirect, namely through their effect on labour supply, as they are not progressive in the model.

4.1.1 Public debt: d

In the following exercise, we set $tr = 7.5\%$ and $g_u + g_p = 20\%$. The choice is somehow arbitrary, but nevertheless, these values are very close to the optimal levels obtained in the next exercises, and they are compatible with average values for the EU countries. We calculate the steady state equilibria for a continuum of debt to output ratios between 0 and 100%. We decompose the welfare measure into the three effects (level, insurance and inequality) and follow the impact on main macro-variables across equilibria

In a standard deterministic representative agent growth model, the impact of government debt on welfare depends on the tax regime. With lump-sum tax, debt is neutral. While, with distorting tax, debt helps to smooth tax burden over time (Barro (1974, 1979); Aiyagari and McGrattan (1998)). In a heterogeneous-agent framework, government debt has an additional impact on welfare by providing further means to smooth consumption. By issuing debt, the government lessens agent's borrowing constraint (Aiyagari and McGrattan (1998)). Larger debt puts upward pressure on interest rates, making assets more profitable to hold and, thus, households become better insured against earning fluctuations. Naturally, higher debt (and interest rates) have also negative impacts on welfare: they imply higher taxes, crowding out private investment.

Figure 4.2: Macroeconomic variables across debt-to-output ratio

Figure 4.2 shows how the model adjusts several macroeconomic variables (vertical axis) for different values of the debt-to-output ratio (horizontal axis). Larger debt-to-output ratios (i.e. larger capital demand) imply larger interest and tax rates and lower after-tax wages. Total asset holdings increase but private capital is crowded out by public debt. Consumption, disposable income and output follow a similar decreasing path as debt-to-output ratio increase. In the labour market, the substitution effect dominates as aggregate labour supply decreases when net wage falls.

Figure 4.3 depicts the welfare assessment for different debt-to-output ratios, as well as its decomposition into level (w_{level}), insurance (w_{unc}) and inequality (w_{ine}) effects. As debt-to-output ratio increases, insurance increases (line with circles). As government issues debt, the consumer's borrowing constraint loosens (Aiyagari and McGrattan (1998) show analytically why) and

the interest rate increases. Saving becomes more profitable and the insurance capacity improves.

The level effect takes into consideration the consumption made, independently of how it is distributed. When debt output ratio increases, the welfare level effect (line with asterisk) is negative. This rules out the over-accumulation of private capital beyond the golden rule[1].

Finally the inequality effects (lines with crosses) are negative due to the interest rate increase which further benefits the assets owners in relation to the lower wealth classes. Welfare becomes more unequally distributed across households. Combining the three effects, the global welfare is hump shaped and peaks around $d = 50\%$.

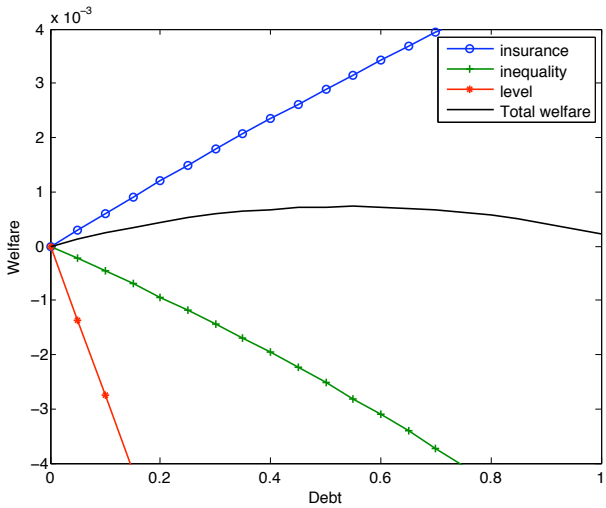


Figure 4.3: Welfare decomposition across debt-to-output ratio

Figure 4.4 provides additional measures to assess impacts on inequality. The inequality measures reflect mostly the debt-to-output ratio effect on interest rate and also the labour supply response. Debt lessens credit constraint and, thus, reduces the layer of households with zero or negative asset position, improving the wealth distribution (the wealth Gini index decreases). According to figure 4.4, the income Gini index goes down as debt climbs.

[1]Except for the nonexistence of over-accumulation of private capital all the findings are in line with Floden (2001).

The improvement on income distribution is due to the capital earnings and also to the labour market response. As debt increases, tax rate goes up affecting the after tax wage. The substitute effect dominates on labour market, but the elasticity of labour supply is higher among the wealthier who tend to switch more labour for leisure. Therefore, the income Gini index decreases.

As interest rate rises with debt-to-output ratio, capital earnings become more unequally distributed since wealthier households possess more assets (despite the improved asset distribution). However, the corresponding tax rise reduces net wages and, prevailing substitute effects, labour supply falls more among the wealthier households to whom labour supply elasticity relative to wage is higher. In balance, income dispersion improves with debt. In spite of the improvement of income and asset holding distribution, we have just seen that the overall inequality effect contributes negatively to welfare (figure 4.3 above).

This example shows how difficult it may be to find adequate definitions and measures of inequality. A theoretical model, where a welfare function is defined, enables a comprehensive identification of the three relevant sources of welfare inequality: consumption, leisure and unproductive expenditures (collective consumption): $\{c, l, g_u\}$. Collective consumption is not relevant because it is defined as a fraction of output distributed equally across households. As debt increases, consumption becomes more equally distributed in line with the disposable income and the asset holding. On the other hand, leisure distribution becomes more unequal, as a counterpart of the stronger labour supply response to the fall in the after tax wage by the wealthier. Imbalance of the two effects determines the sign of the overall inequality effect; in this case increase in leisure inequality dominates.

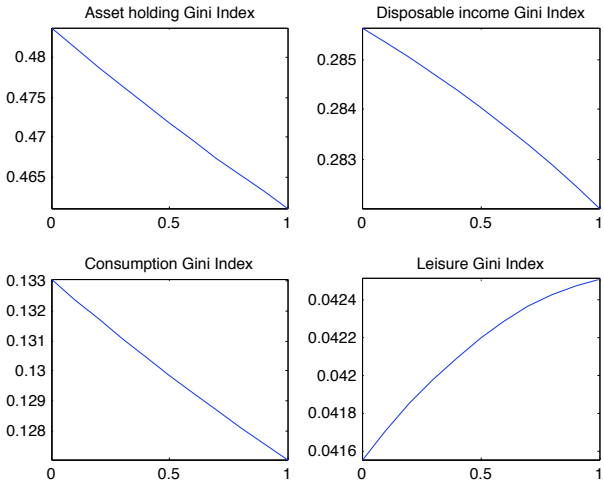


Figure 4.4: Gini Indexes across debt-to-output ratio

4.1.2 Social Transfers: tr

Consider now $d = 50\%$, $g_u + g_p = 20\%$ and the steady state equilibria for a continuum transfer to-output-ratios between 0 and 15%. Figure 4.5 depicts how macroeconomic variables (vertical axis) behaves for different transfers-to-output ratios (horizontal axis). Larger transfers-to-output ratios imply higher interest and tax rates. While larger debt-to-output ratios put pressure on the demand for capital (larger asset supply), larger transfers-to-output ratios reduce asset demand (reduces capital supply): total asset holdings fall with social transfers, not only because income is lower, but also because the need to hold assets for insurance motive is reduced as transfers become larger. Higher tax effort and interest rate depress private capital and net wages. Thus, consumption, disposable income and output follow a similar decreasing path with transfer-to-output rise. As with debt increase, the substitution effect dominates in the labour supply adjustment to a fall in net wages. Note that social transfers seem to cause more tax distortions in the economy when compared to debt. While transfers enter directly and fully in the government budget constraint, only the debt service enters the government budget constraint. Naturally, a one percent increase in transfer will be more tax demanding when compared to an identical increase in debt.

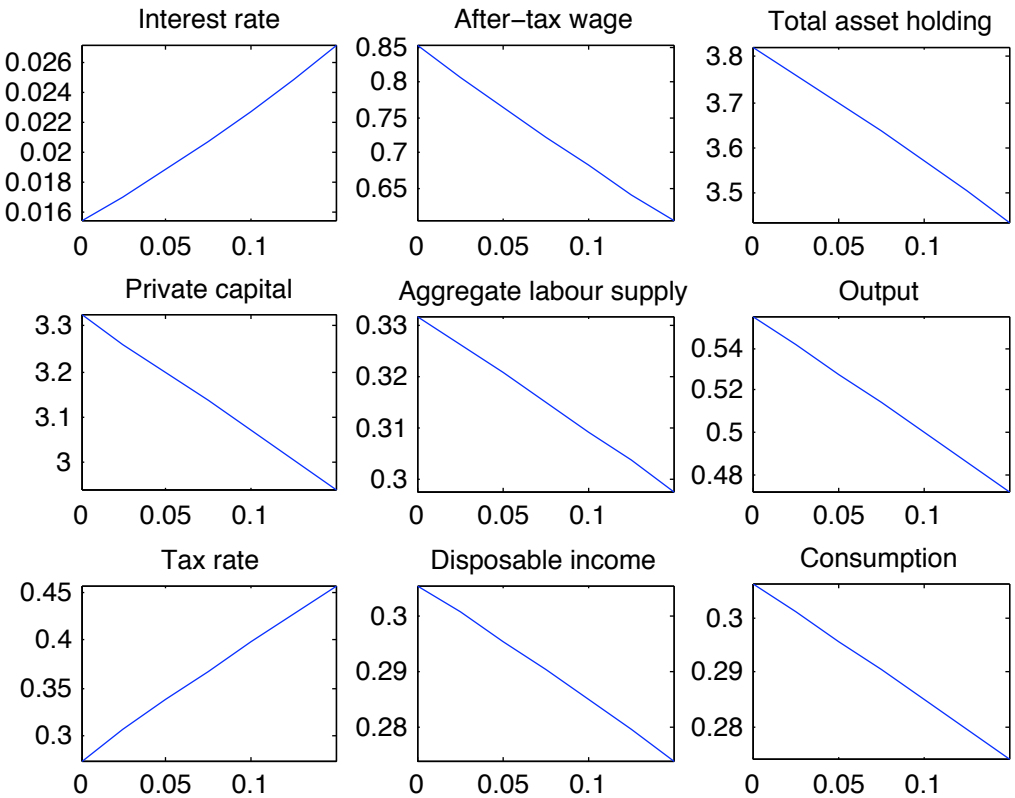


Figure 4.5: Macroeconomic variables across transfers-to-output ratio

Figure 4.6 shows how insurance (line with circles), consumption level (line with asterisk) and inequality (line with crosses) affect welfare across different transfer-to-output ratios. It is clear that larger transfer-to-output ratios imply a negative welfare level effect reflecting a lower labor supply and smaller savings. Insurance and inequality effects are positive. Larger social transfer means that a larger portion of income is granted (independent of the idiosyncratic shock) and thus uncertainty is lower. In this case the positive insurance effect comes directly through the income channel. Lump-sum social transfers benefit all population, but the poorest benefit proportionally more because they hold a lower amount of assets. Therefore the inequality effect on welfare is now positive. Combining the three effects, the total welfare measure maximizes with $tr = 8\%$.

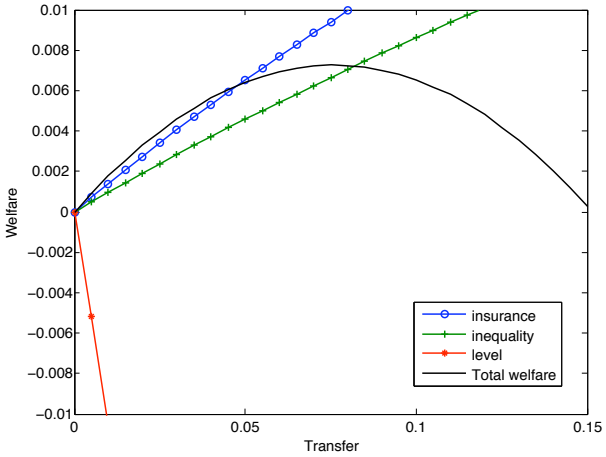


Figure 4.6: Welfare decomposition across transfer-to-output ratio

For a closer inspection on the impacts on inequality, figure 4.7 show how the Gini coefficient on asset holdings, disposable income, consumption and leisure, change across transfer-to-output ratios. Concerning the wealth (asset holdings) distribution, the Gini index is larger (higher inequality) for larger transfer-to-output ratios. Transfers, by reducing the need for insurance, affect especially the poorer: the fraction of households with negative or no wealth increases and the asset distribution becomes flatter. The effects on disposable income inequality are direct: transfers represent a lump sum element that make disposable income more homogeneous across households. As accorded before, overall inequality effect is positive while wealth and income inequality move in opposite ways with transfers. Apparently, disposable income effect on inequality dominates to reduce consumption inequality (figure 4.7). As for leisure, and in contrast with debt, inequality is smaller, the larger the transfer-to-output ratio is, as transfers rise, the poorer face stronger disincentive to work, increasing leisure relatively to the wealthier. Both consumption and leisure inequality is lower with larger transfers, making overall inequality (figure 4.6) welfare enhancing.

Figure 4.7: Gini Indexes across transfer-to-output ratio

4.1.3 Unproductive expenditure: g_u

Unproductive spending, g_u affects welfare directly as it delivers utility for private agents (e.g. public health education or law and order). In the following exercise, we set $d = 50\%$, $tr = 7.5\%$ and $g_p = 1.5\%$. As before, we calculate the steady state equilibria for a continuum of unproductive government expenditure in percentage of output (between 8.5% and 18.5%).

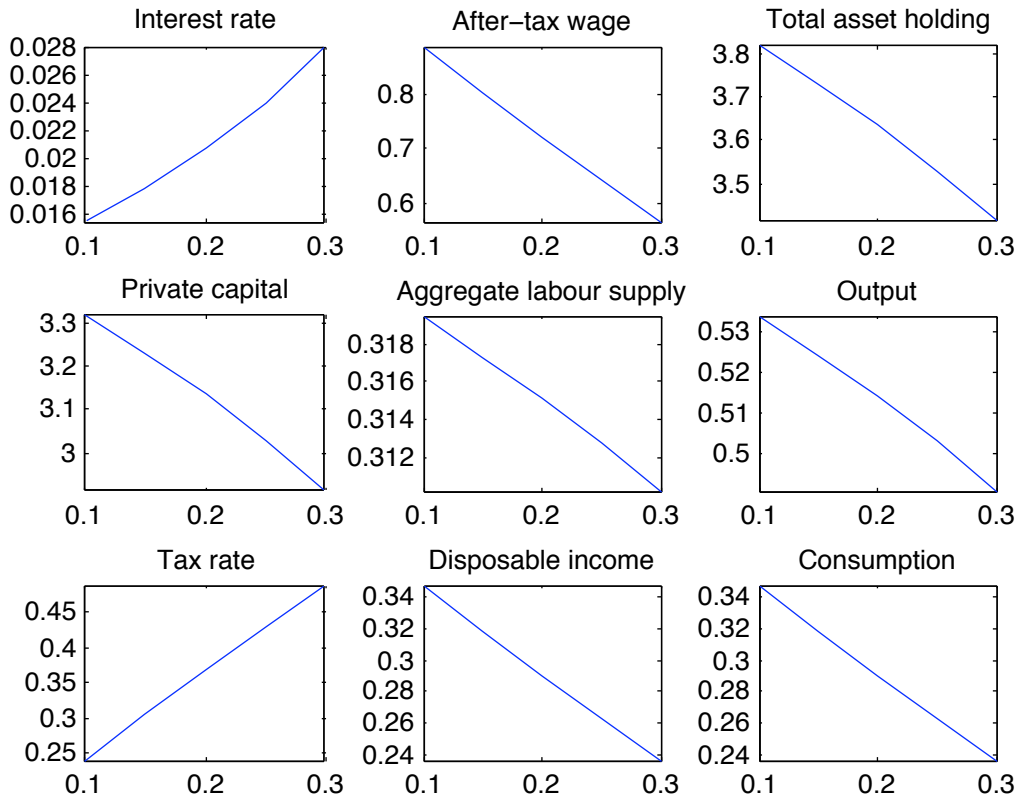


Figure 4.8: Macroeconomic variables across government expenditure: $g_u + g_p$

Figure 4.8 plots several macroeconomic variables (vertical axis) against government expenditure ($g_u + g_p$) as percentage of output (horizontal axis). Common to previous exercises, larger government expenditures imply higher tax and interest rates. Asset demand (supply of capital) lowers with government expenditures (the demand curve in figure 4.1 moves to the left, raising interest rate) mostly because g_u enables households with a constant (certain) flow of utility and the need for risk insurance, as with tr, is reduced[2]. As in previous cases, and for the same reasons, disposable income, output and labour supply is lower, the higher unproductive spending is.

[2]This income effect due to the income reduction also concurs to reduce the asset demand.

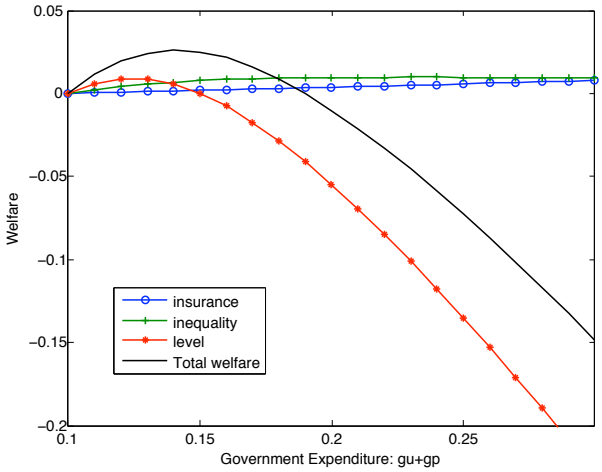


Figure 4.9: Welfare decomposition across government expenditure: $g_u + g_p$

Figure 4.9 plots total welfare as well as its components against government unproductive spending as percentage of output. The welfare level effect is positive for small increments of government expenditures. This means that, as explained in Aiyagari and McGrattan (1998) and Floden (2001), there is an over-accumulation of capital beyond the gold rule level which maximizes consumption. From about 12% of government spending, the distortion effect on labour and saving choices[3] dominates and the level effect turns negative. As for inequality and uncertainty, they both have a slight positive effect on welfare as government spending increases. Government delivers a constant (certain) flow of utility to households, reducing uncertainty. As for inequality, the mechanism is also direct - a larger endowment of public services is distributed evenly across households, reducing disparity in welfare. Combining the three effects, the global welfare reaches a maximum for a government expenditure of 14%. The importance of both these effects depends crucially on the value for the utility parameter concerning the unproductive government expenditure $\vartheta = 0.1$. Notice that the model is not capturing positive indirect effects in the welfare and inequality from public services, namely those on growth resulting for instance from human capital accumulation, nor those affecting the idiosyncratic shock.

[3]due to the increased tax needs to finance the government expenditure increment.

Figure 4.10 illustrates several inequality measures for different values of unproductive spending (as % of output). As with debt, disposable income and wealth (and thus, consumption) become more evenly distributed. The decrease of the wealth Gini coefficient reveals that asset selling affects more the wealthier, who are always in better condition to smooth consumption and leisure. The income Gini index decreases because of the dominance of the labour supply elasticity effect. Figure 4.11 plots labour supply across asset holdings for the two extreme values of government expenditures ($g_u = 8.5\%$ and $g_u = 18.5\%$). For larger values of g_u, after tax wage becomes smaller and the wealthier will work less in relation to the poorer. Thus, labour income becomes more equally distributed. Naturally, the opposite occurs concerning leisure in which distribution becomes less compressed (i.e. more unequally distributed) -see figure 4.10 . Unlike debt, consumption inequality effects slightly dominate and overall inequality has a modest positive impact on welfare as g_u rises.

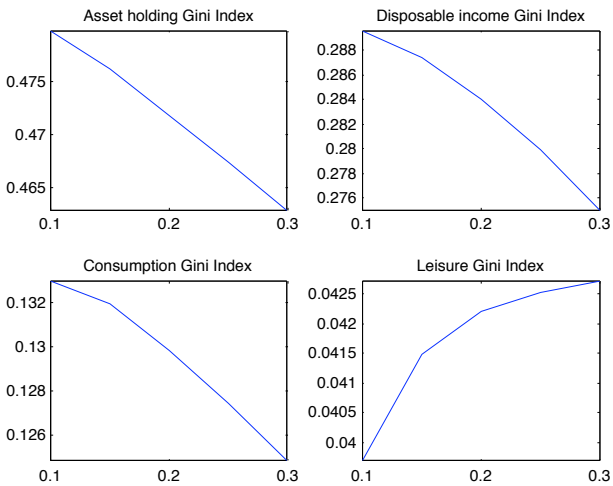


Figure 4.10: Gini Indexes across government expenditure: $g_u + g_p$

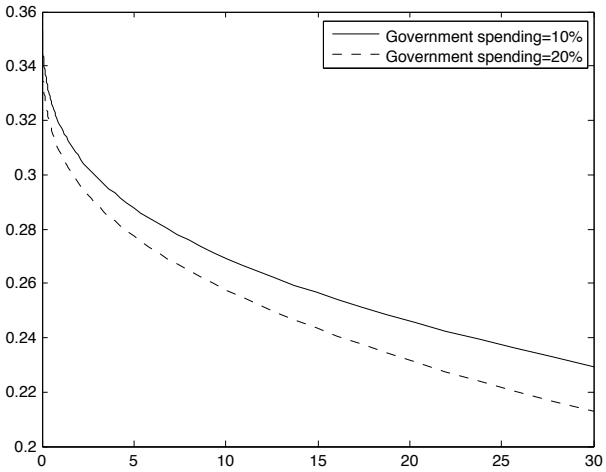


Figure 4.11: Labour supply against wealth

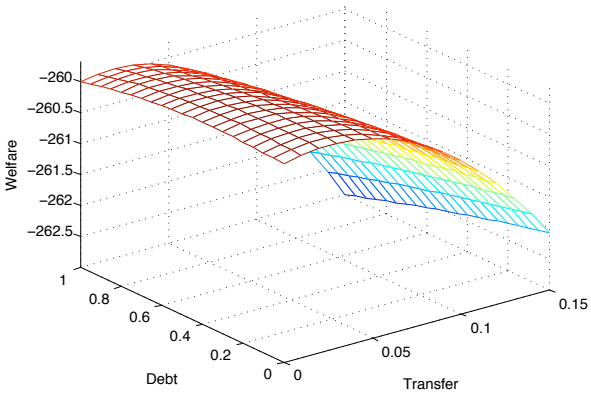
4.2 Optimal combination of social transfer, government spending and debt

In the last section we assessed the long run effects of changing debt, social transfers and unproductive expenditures on welfare and inequality. We've concluded that the three instruments discussed are welfare enhancing up to a certain amount (i.e. up to a certain interest and tax rates). We have also concluded that all instruments have a positive welfare insurance effect but only transfers and unproductive expenditures improve welfare distribution; debt inequality effects contribute negatively to welfare. Moreover, the contributions of unproductive expenditure to welfare insurance and inequality effects are almost negligible. Table 4.1 resumes the individual effects of the policy variables on each inequality measures.

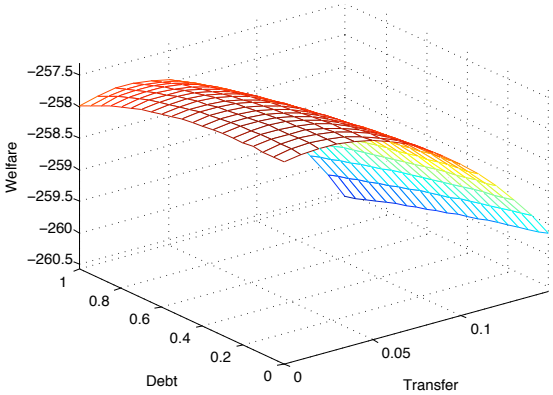
	d	tr	g_u
Wealth Gini	↘	↗	↘
Income Gini	↘	↘	↘
Consumption Gini	↘	↘	↘
Leisure Gini	↗	↘	↗
Welf. inequal.	$\ominus$	$\oplus$	$\oplus$

Table 4.1: Inequality effect of our fiscal instruments

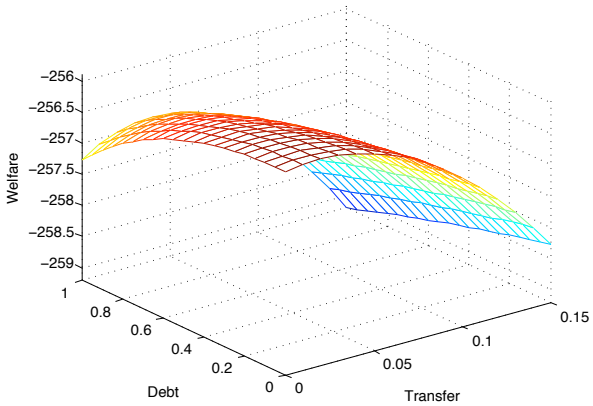
In this context, a crucial question arises: is the (inter-temporal) composition of government instruments meaningful to welfare and inequality? Does improving welfare precludes more tax-financed government expenditure or is public debt accumulation better? In the present section our exercises consists of assessing the optimal combination of debt and transfer for different levels of government spending. We opt to study the inequality trade-off effects between transfers and debt because calibration of utility-enhancing in government spending is less robust - in most of heterogeneous-agent models, government expenditures are excluded from the utility function. In this case, unproductive expenditure has negative effects on both welfare and inequality. In this exercise we thus consider three government sizes: large, $\{g_u + g_p = 0.20\}$, medium, $\{g_u + g_p = 0.175\}$ and small, $\{g_u + g_p = 0.15\}$, values taken among those observed for the EU countries. For each government size we calculate all steady states for a continuum of debt levels between $[0, 1.5]$ and transfer levels between $[0, 0.15]$ (all values are expressed in percent of output). Figure 4.12 plots combinations of d and tr for different government sizes in baseline scenario ($\vartheta = 0.1$). Figure 4.13 exhibits similar results but under the extreme scenario ($\vartheta = 0$), as in Aiyagari and McGrattan (1998); Floden (2001). Table 4.2 sums up, for each scenarios, the optimal debt and transfer combination, the corresponding welfare value and the inequality indicators.



(a) Large-size government: $g_u + g_p = 20.0\%$

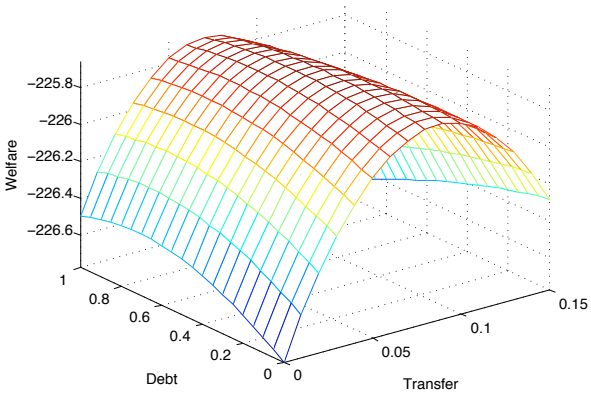


(b) Medium-size government: $g_u + g_p = 17.5\%$

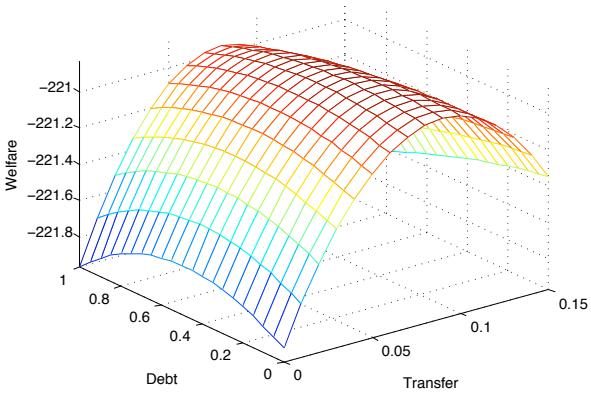


(c) Small-size government: $g_u + g_p = 15.0\%$

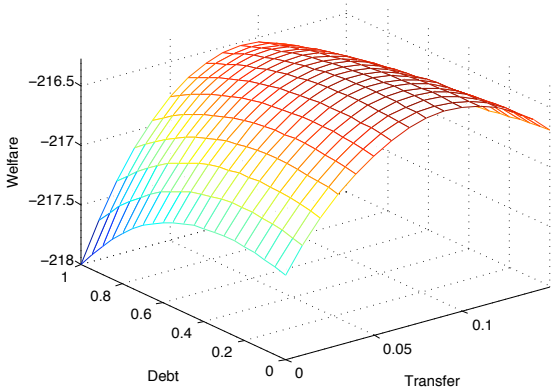
Figure 4.12: Unproductive expenditure in the utility function ($\vartheta = 0.1$)



(a) Large-size government: $g_u + g_p = 20.0\%$



(b) Medium-size government: $g_u + g_p = 17.5\%$



(c) Small-size government: $g_u + g_p = 15.0\%$

Figure 4.13: Unproductive expenditure out of the utility function ($\vartheta = 0$)

In both scenarios, as government size decreases, the optimal level of public debt decreases and social transfer remains rather stable. The optimal level of debt is for the smaller, medium and large government sizes, of 0%, 10% and 30% respectively for the baseline scenario (otherwise, 20%, 40% and 50%, respectively). Public debt becomes more relevant with a large size government to compensate for the utility loss associated with a large public spending. Social transfer optimal level maintains a constant level of 2% for the baseline scenario for all government sizes. For the alternative scenario ($\vartheta = 0$) the optimal level of social transfers is 9% for the small size government and 8% for the medium and large size government. Transfers end up being less elastic with government size than debt because the latter implies a smaller tax distortion (tax effort). As such, (as table 4.2 shows), government-size impinges negatively on welfare inequality. The insurance effect is welfare enhancing (due to the increased level of interest rate) and the level effect depresses welfare. In both scenarios tax and interest rates raise as government expenditure and debt augment. Both welfare and inequality measures reflect mostly the debt effect. According to the results condensed in table 4.2, wealth, income and consumption Gini coefficients decrease and the leisure Gini index increases[4]. Unproductive government expenditure distorts incentives significantly, especially from a determined value[5]. Debt, in which distortion effect is much smaller, can accommodate part of government spending increase. The tax increase necessary to finance the growing expenditure affects labour and saving decisions. Household will supply less labour, specially the upper wealth class, compressing the income distribution and pushing up the leisure Gini coefficient.

[4]The exception concerns the income Gini index with $\vartheta = 0$ and $g_u + g_p = 175.0\%$: it rises lightly because transfer decrease from 9 to 8% .

[5]About 12% with a debt output ratio of 50% and a transfer output ratio of 7.5% as we saw above in figure 4.9.

Unprod. expend. in the utility function: $\vartheta = 0.1$			
	$g_u + g_p = 0.15$	$g_u + g_p = 0.175$	$g_u + g_p = 0.20$
Debt	0.00	0.10	0.30
Transfer	0.02	0.02	0.02
Tax rate	0.2289	0.2624	0.2968
Interest rate	0.0124	0.0139	0.0159
Wealth Gini	0.4814	0.4766	0.4697
Income Gini	0.3178	0.3165	0.3147
Consumption Gini	0.1471	0.1455	0.1431
Leisure Gini	0.0417	0.0422	0.0428
Welfare	0.0000	-0.0129	-0.0340
Wlevel	0.0000	-0.0225	-0.0560
Winsurance	0.0000	+0.0017	+0.0041
Winequality	0.0000	-0.0005	-0.0017
Unprod. expend. off the utility function: $\vartheta = 0.0$			
	$g_u + g_p = 0.15$	$g_u + g_p = 0.175$	$g_u + g_p = 0.20$
Debt	0.20	0.40	0.50
Transfer	0.09	0.08	0.08
Tax rate	0.3200	0.3417	0.3742
Interest rate	0.0178	0.0192	0.0211
Wealth Gini	0.4847	0.4768	0.4724
Income Gini	0.2811	0.2837	0.2814
Consumption Gini	0.1327	0.1321	0.1304
Leisure Gini	0.0412	0.0418	0.0421
Welfare	0.0000	-0.0409	-0.0814
Wlevel	0.0000	-0.0449	-0.0981
Winsurance	0.0000	+0.0010	+0.0025
Winequality	0.0000	-0.0016	-0.0018

Table 4.2: The optimal combination of debt, transfers and government expenditure

4.3 Optimal composition of global government spending

We have concluded that the larger the size of government, the higher the optimal debt-to-output ratio is. However, this is achieved at higher inequality costs ($w_{ine} < 0$ when debt increases). At this stage, a final exercise is in order: given debt level, optimal or not, one should expect expenditure composition to affect total welfare and, in particular, welfare inequality. Thus, this section closes the steady state analysis by assessing optimal composition of government expenditure, i.e., setting aside the impacts on taxes and the corresponding second-order effects on leisure and income inequality operating through the labour supply channel.

We calculate a new series of steady states equilibria considering unproductive expenditure versus transfer, unproductive expenditure versus productive expenditure and finally, transfer versus productive expenditure. We repeat the exercises for different government sizes: a large-size government where total spending (G)[6] represents 30% of output; a medium-size government with $G = 25\%$ and a small-size government with $G = 20\%$. For all exercises we set a public debt output ratio, not necessary optimal, of 50%.

4.3.1 Unproductive expenditure(g_u) versus social transfers (tr)

Given a ceiling for total government expenditure, we substitute unproductive expenditure by social transfer. Productive expenditure remains constant ($g_p = 1.5\%$).

The large-size government case ($G = 30\%$): Table 4.3 shows the sequence of different (g_u, tr) combinations and the corresponding values for the welfare and for several inequality measures. Unproductive expenditures (g_u) varies from 28.5% to 8.5% of output while social transfers evolve progressively from zero to 20% of output.

[6] $G = g_u + g_p + tr$.

g_u	tr	wu	WG	IG	CG	LG	wine
0.2850	0.0000	0.0000	0.4518	0.3225	0.1425	0.0446	0.0000
0.2600	0.0250	0.0433	0.4583	0.3076	0.1381	0.0438	0.0026
0.2350	0.0500	0.0815	0.4643	0.2942	0.1340	0.0430	0.0048
0.2100	0.0750	0.1138	0.4696	0.2820	0.1302	0.0424	0.0069
0.1850	0.1000	0.1392	0.4745	0.2709	0.1265	0.0418	0.0087
0.1600	0.1250	0.1564	0.4789	0.2607	0.1231	0.0412	0.0103
0.1350	0.1500	0.1629	0.4831	0.2513	0.1198	0.0407	0.0118
0.1100	0.1750	0.1550	0.4869	0.2426	0.1167	0.0402	0.0131
0.0850	0.2000	0.1259	0.4904	0.2345	0.1138	0.0397	0.0143

Table 4.3: Unproductive expenditure versus social transfers: $G = 30\%$.
Notes: wu = global welfare - WG = Wealth Gini index - IG = Income Gini index - CG = consumption Gini index - LG = Leisure Gini index - wine = inequality welfare effect

The welfare analysis is represented in figure 4.14. The global welfare, which reflects the combination of the three effects described above, reaches a maximum with a combination of 15% for social transfers and 13.5% for unproductive expenditure . As we substitute unproductive expenditure by transfers, the welfare decomposition shows slight positive effects on equality and insurance, in line with the results obtained in (4.1). The hump shape of the welfare curve is determined by the level component of the welfare decomposition. The level effect, described above, corresponds to the private consumption level necessary, *ceteribus paribus* (namely with the initial values of leisure, social transfer and non productive expenditure), to equalize the global welfare level of utility of the subsequent combinations of transfer and unproductive expenditures. As we reduce the collective consumption (by reducing g_u), the household augments its private consumption in order to keep the same level of utility. The level effect is positive. However, for a sufficiently high transfer level, above 10%, the disincentive to work induced by higher transfer dominates and the level effect decreases and becomes negative. Endowed with more social transfers, households tend to save less and

supply less labour. Figure 4.15 shows the asset demand moving leftwards with interest rate rising and private capital falling[7]. The decreasing level of labour and private capital depresses output, affecting downwards the level component of welfare.

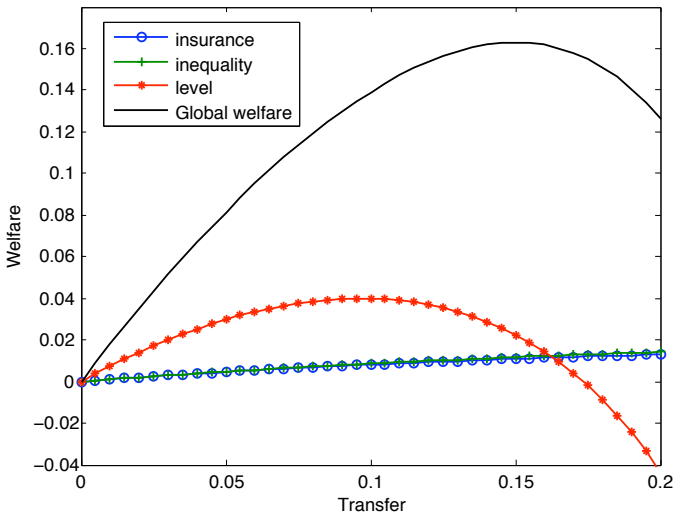


Figure 4.14: Welfare effects of alternative combinations of transfers and unproductive expenditures

The inequality impact reflects the dominant effect of social transfers (see table 4.1). Higher social transfers with less unproductive expenditure leads to higher wealth inequality increases because the need for insurance is smaller (asset holding is smaller). However, this affects strongly the lower wealth classes (wealth Gini index increases). The disposable income and consumption distributions become more equitable due to the direct effect of social transfers. The fall in the leisure Gini index indicates that the lower labour supply induced by more generous transfer payments, affects especially the poorest. By supplying less labour, they enjoy more leisure and the leisure distribution becomes more compressed. Naturally, the inequality component

[7]Asset demand and supply: the translation of the asset demand curve to the left results from the substitution of unproductive expenditure for social transfers. Therefore interest rate rises.

of welfare is positive and it increases steadily for larger transfer-to-output ratios, representing a benefit of 1.18% of lifetime private consumption for the optimal combination ($g_u = 0.1350, tr = 0.15$) in comparison to the initial case ($g_u = 0.285, tr = 0.00$).

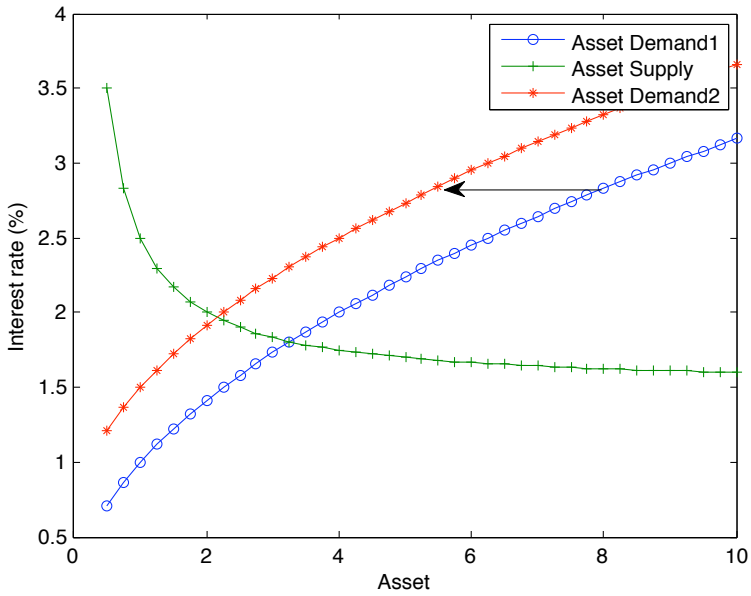


Figure 4.15: Impact on interest rate from substituting g_u for tr

The medium-size government ($G = 25\%$): Tables 4.4 show different combinations of g_u and tr for $G = 25\%$ and the corresponding welfare and inequality indicators. Figure 4.16 also depict the welfare decomposition.

The analysis is very similar to that provided for $G = 30\%$. As we substitute unproductive expenditures by transfers, the welfare decomposition shows slight positive effects on insurance and inequality. The level effect shows a slight hump shaped curve indicating a smaller but effective substitute effect between private and public consumption when compared with the previous case. The global welfare reaches a maximum with a combination of 10.5% for social transfer and 13% for unproductive expenditure[8]. As before,

[8]We use a spleen interpolation for the intermediate values of the table.

Gini indicators improve as transfers substitute government unproductive expenditures, except for the wealth Gini index.

g_u	tr	wu	WG	IG	CG	LG	wine
0.2350	0.0000	0.0000	0.4574	0.3238	0.1440	0.0440	0.0000
0.2100	0.0250	0.0342	0.4635	0.3100	0.1399	0.0433	0.0021
0.1850	0.0500	0.0617	0.4690	0.2974	0.1361	0.0426	0.0038
0.1600	0.0750	0.0812	0.4740	0.2859	0.1324	0.0419	0.0053
0.1350	0.1000	0.0904	0.4786	0.2753	0.1289	0.0413	0.0066
0.1100	0.1250	0.0857	0.4829	0.2655	0.1256	0.0407	0.0077
0.0850	0.1500	0.0608	0.4868	0.2564	0.1224	0.0401	0.0086
0.0600	0.1750	0.0028	0.4904	0.2479	0.1193	0.0396	0.0092
0.0350	0.2000	-0.1212	0.4938	0.2400	0.1163	0.0390	0.0097

Table 4.4: Unproductive expenditure versus social transfers: $G = 25\%$.
Note: see table 4.3

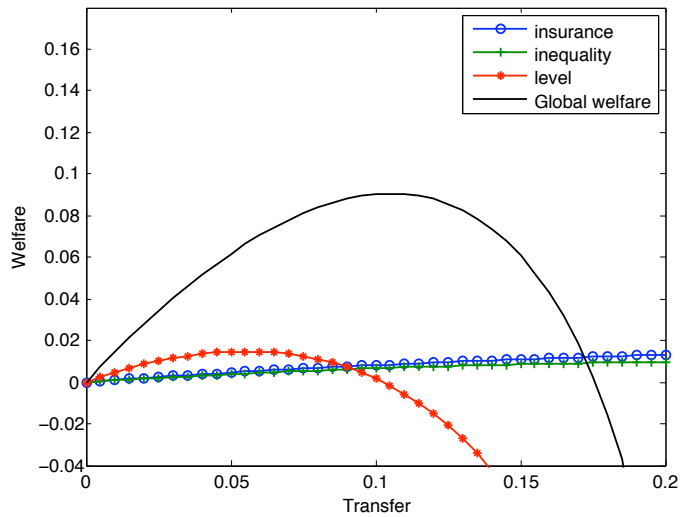


Figure 4.16: Unproductive expenditure versus social transfers: $G = 25\%$

The small-size government case ($G = 20\%$): Table 4.5) shows the sequence of the different combinations and the respective values for the welfare and the inequality measures.

The welfare analysis is represented in figure 4.17. The global welfare reaches a maximum with a combination of 6% for social transfer and 12.5% for unproductive expenditure. The welfare decomposition shows some qualitative differences. Concerning the level effect, the distortion effect dominates against the substitution effect (in which households substitute collective consumption for private consumption). The inequality effect, contrary to the precedent cases, achieves a maximum with a combination of $g_u = 8.5\%$ and $tr = 10\%$. Both g_u and tr improve the inequality effect of welfare. By substituting unproductive expenditure for transfer, the effect of transfer dominates for large and medium size governments. For small size governments, the transfer effect dominates and the inequality welfare effect improves up to the combination of$(g_u = 11\%, tr = 7.5\%)$. Thus, there is also a lower bound for $g_u(g_u = 11\%)$ below which unproductive expenditure effect dominates and the inequality welfare decreases for small-size government size.

g_u	tr	wu	WG	IG	CG	LG	wine
0.1850	0.0000	0.0000	0.4627	0.3249	0.1454	0.0432	0.0000
0.1600	0.0250	0.0220	0.4683	0.3118	0.1414	0.0424	0.0011
0.1350	0.0500	0.0339	0.4734	0.2998	0.1376	0.0416	0.0018
0.1100	0.0750	0.0322	0.4781	0.2887	0.1340	0.0408	0.0022
0.0850	0.1000	0.0108	0.4824	0.2785	0.1305	0.0400	0.0022
0.0600	0.1250	-0.0427	0.4863	0.2689	0.1271	0.0392	0.0017
0.0350	0.1500	-0.1599	0.4899	0.2599	0.1237	0.0384	0.0006

Table 4.5: Unproductive expenditure versus social transfers: $G = 20\%$
Note: see table 4.3

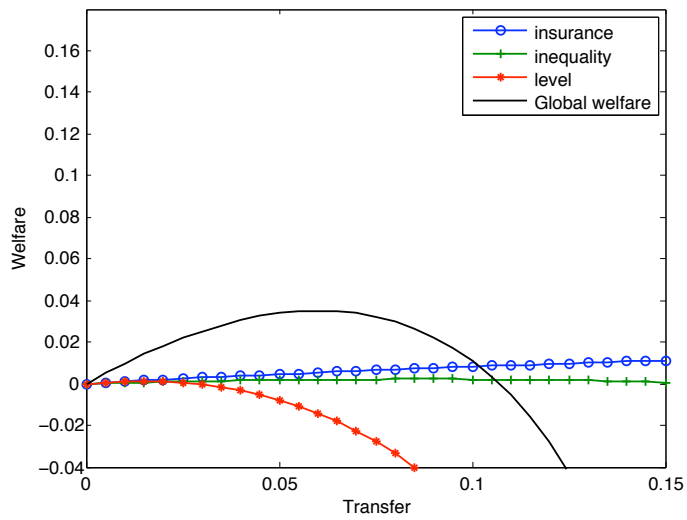


Figure 4.17: Unproductive expenditure versus social transfers: $G = 20\%$

In the three examples used above we conclude that a more transfer intensive composition of government spending improves welfare until a certain level (see the optimal composition for each government size in table 4.6). Substituting unproductive expenditures for transfer induces a positive level effect, more intense in the large governments and almost null in the small ones. This re-enforces the result obtained above, according to which the unproductive expenditures are welfare enhancing specially for moderate levels around 10-15%. For higher levels, the unproductive expenditure penalizes strongly the global welfare due to its severe disincentive effect on labour market and saving. Decreasing the unproductive expenditure from high level, like the large and medium size government, implies significant efficient gains, and consequently positive effects of the level welfare component. In the small size government, the efficient gains of the expenditure cut are canceled by the distortion effect of the social transfer increase. More transfers also induce a positive inequality effect and improve the distribution of income, consumption and leisure. A more transfer intensive government spending with its negative impact on saving, pushes up the wealth Gini.

Comparing the three optimal combinations (table 4.6), the global spend-

ing decreases from 30% to 20% of GDP inducing a welfare improvement. The welfare decomposition shows that the cited improvement is due mostly to a level effect (the other two components, inequality and insurance, are negative). This is not surprising as we already know the distortion effect of government spending. The optimal spending composition varies significantly. The unproductive expenditures remain stable but the social transfers fall down. In a larger government the optimal level of transfer is proportionally higher. When $G = 30\%$ (the larger government), the optimal level of social transfer represents 50% of global spending against 30% when $G = 20\%$ (the smaller government). This means that the marginal rate of substitution of government expenditure for social transfer is rising. The model points to a minimum level of unproductive expenditure that households are not willing to easily give up.

Concerning the inequality measures, we have already seen that the welfare distribution gets worse with increased government sizes. The Gini index variation reflect mostly the reduction of transfers (g_u remains stable and debt is fixed). As pointed out in table 4.1, when social transfer reduces, income, consumption and leisure Gini index increases, which means more unequal distributions, while the wealth Gini index decreases. The income distribution becomes more sparse mainly due to the social transfer. The consumption Gini index follows closely the income distribution. The leisure distribution is interesting because it allow us to also understand the change in labour distribution. We have seen that a pure tax effect induces a response in labour supply more visible among the upper wealth classes[9]. In the present case, both the leisure Gini index and the aggregate labour supply rise. The transfer cut affects more the poor who must work harder to keep their utility levels. By working more, they necessarily enjoy less leisure and the leisure distribution becomes more sparse (leisure Gini index rises).

[9]Section 4.1.3 explains why the Income Gini coefficient decreases when unproductive expenditures augments.

	$G = 0.30$	$G = 0.25$	$G = 0.20$
Debt	0.5000	0.5000	0.5000
Transfer	0.1500	0.1050	0.0600
g_u	0.1350	0.1300	0.1250
Tax rate	0.3981	0.3365	0.2732
Interest rate	0.0234	0.0197	0.0164
Wealth Gini	0.4831	0.4795	0.4754
Income Gini	0.2513	0.2732	0.2953
Consumption Gini	0.1198	0.1282	0.1362
Leisure Gini	0.0407	0.0412	0.0413
Welfare	0.0000	0.0606	0.1148
Wlevel	0.0000	0.1663	0.3438
Winsurance	0.0000	-0.0043	-0.0093
Winequality	0.0000	-0.0041	-0.0098

Table 4.6: Unproductive expenditure versus social transfers: resume

4.3.2 Unproductive (g_u) versus productive expenditure (g_p)

In this second exercise we set $tr = 7.5\%$ and $d = 50\%$ and calculate the equilibria for a series of combinations (g_u, g_p). As the results are similar across government sizes, we only report results for $G = 20\%$ in table 4.18. Figure 4.18 plots the corresponding welfare decomposition across productive expenditures, g_p. As it can be see in figure 4.18 exchanging unproductive for productive expenditure induces a productivity welfare effect through the production function. The other two components of the welfare decomposition are completely neutral. Note that since productive and unproductive expenditures are equally distributed among all population, the former through the production function and the latter through the utility function, changing the proportion of both policy instruments in the government budget has no consequence on distribution as it can be seen in the three mentioned tables.

Globally, substituting g_u for g_p is always welfare enhancing and has no impact on the inequality measures.

g_u	g_p	wu	WG	IG	CG	LG	wine
0.1100	0.0150	0.0000	0.4781	0.2887	0.1340	0.0408	0.0000
0.1050	0.0200	0.2883	0.4781	0.2887	0.1340	0.0408	0.0000
0.1000	0.0250	0.5699	0.4781	0.2887	0.1340	0.0408	0.0000
0.0950	0.0300	0.8456	0.4781	0.2887	0.1340	0.0408	0.0000
0.0900	0.0350	1.1151	0.4781	0.2887	0.1340	0.0408	0.0000

Table 4.7: Unproductive versus productive expenditure: $G = 20\%$
Note: see table 4.3.

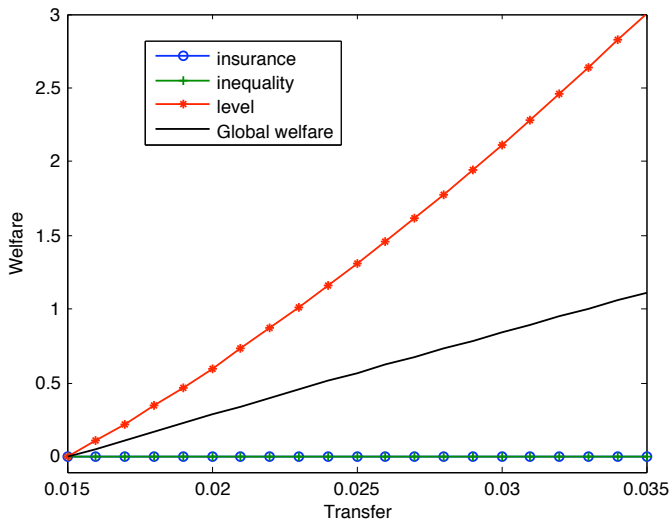


Figure 4.18: Welfare Decomposition across productive expenditures (g_p): $G = 20\%$

4.3.3 Social Transfer (tr) versus productive expenditure (g_p)

We now test several combinations of social transfers and productive expenditures, maintaining constant the level of global government spending. We set $G = 30\%$ and $d = 50\%$. Concerning the global spending, we fix, $g_u = 18.5\%$ and we start with a combination of $g_p = 1.5\%$ and $tr = 10\%$. From that starting point, we progressively switch transfers for productive expenditures. The results are similar for different levels of G, so we omit them. Table 4.8 and 4.9 exhibit the different (g_p, tr) combinations and the corresponding outcomes, for distinctive values of η ($\eta = 0.3$, (baseline case), and $\eta = 0.03$).

As we referred, the results depend strongly on output elasticity of government productive expenditures. Figures 4.19a and 4.19b show for $\eta = 0.3$ and $\eta = 0.03$ respectively the welfare decomposition effects through all combination of (g_p, tr).

g_p	tr	wu	WG	IG	CG	LG	wine
0.0150	0.1000	0.0000	0.4745	0.2709	0.1265	0.0418	0.0000
0.0200	0.0950	0.2784	0.4735	0.2731	0.1272	0.0419	-0.0003
0.0250	0.0900	0.5493	0.4726	0.2753	0.1280	0.0420	-0.0007
0.0300	0.0850	0.8149	0.4716	0.2775	0.1287	0.0421	-0.0010
0.0350	0.0800	1.0760	0.4706	0.2797	0.1294	0.0423	-0.0014
0.0400	0.0750	1.3334	0.4696	0.2820	0.1302	0.0424	-0.0018
0.0450	0.0700	1.5874	0.4686	0.2844	0.1309	0.0425	-0.0021
0.0500	0.0650	1.8384	0.4675	0.2868	0.1317	0.0426	-0.0025
0.0550	0.0600	2.0865	0.4665	0.2892	0.1325	0.0428	-0.0029
0.0600	0.0550	2.3317	0.4654	0.2917	0.1332	0.0429	-0.0033
0.0650	0.0500	2.5742	0.4643	0.2942	0.1340	0.0430	-0.0038
0.0700	0.0450	2.8138	0.4631	0.2968	0.1348	0.0432	-0.0042

Table 4.8: Productive expenditure versus Transfers: $G = 30\%$ and $\eta = 0.3$
Note: see table 4.3.

Under the baseline parameterization the welfare augments permanently

until social transfers are exhausted (see figure 4.19a). The level effect dominates through the productivity effect.

g_p	tr	wu	WG	IG	CG	LG	wine
0.0150	0.1000	0.0000	0.4745	0.2709	0.1265	0.0418	0.0000
0.0200	0.0950	0.0069	0.4735	0.2731	0.1272	0.0419	-0.0003
0.0250	0.0900	0.0104	0.4726	0.2753	0.1280	0.0420	-0.0007
0.0300	0.0850	0.0117	0.4716	0.2775	0.1287	0.0421	-0.0010
0.0350	0.0800	0.0113	0.4706	0.2797	0.1294	0.0423	-0.0014
0.0400	0.0750	0.0098	0.4696	0.2820	0.1302	0.0424	-0.0018
0.0450	0.0700	0.0073	0.4686	0.2844	0.1309	0.0425	-0.0021
0.0500	0.0650	0.0040	0.4675	0.2868	0.1317	0.0426	-0.0025
0.0550	0.0600	0.0001	0.4665	0.2892	0.1325	0.0428	-0.0029
0.0600	0.0550	-0.0044	0.4654	0.2917	0.1332	0.0429	-0.0033
0.0650	0.0500	-0.0093	0.4643	0.2942	0.1340	0.0430	-0.0038
0.0700	0.0450	-0.0146	0.4631	0.2968	0.1348	0.0432	-0.0042

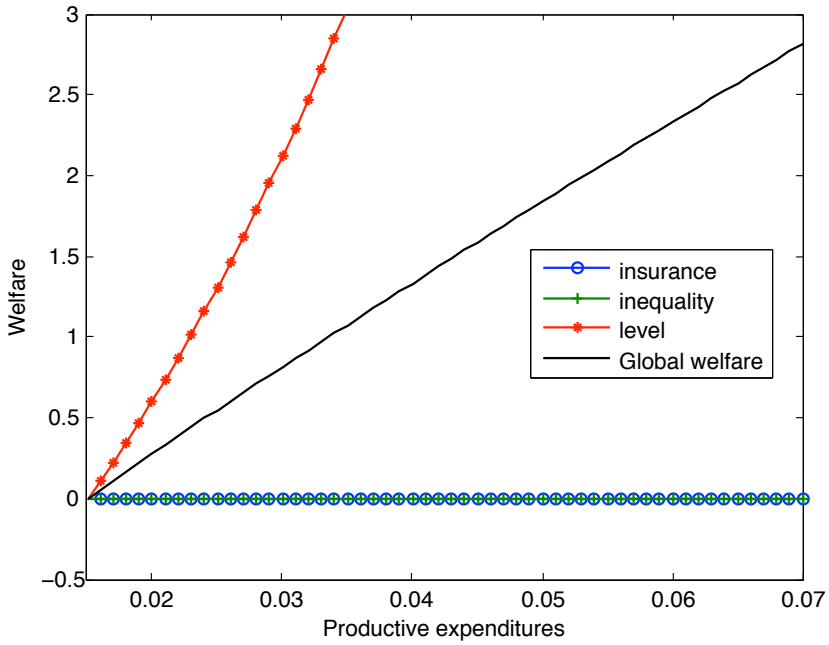
Table 4.9: Productive expenditure versus Transfers: $G = 30\%$ and $\eta = 0.03$
Note: see table 4.3.

Although not visible in the graph, the simulation shows a negative effect on the insurance and inequality components of welfare, caused by the fall in the interest rate and transfers. A small interest rate decrease reflects a high asset demand, recalling figure 4.15 but considering now an opposite move of the asset demand curve to the left. As transfer is substituted by public investment, households will work harder, will save more and consume more since output improves. Given that the productive expenditure does not affect the distribution, the changes occurring in inequality measure must be justified only by the progressive reduction of the social transfer level. With lower transfers, households, specially the poorer, have more need for precautionary savings - wealth Gini index decreases. On the other hand, the transfers cut directly induces a more unequal distribution of income and consumption. Finally, and as seen above, the transfer cut affects strongly

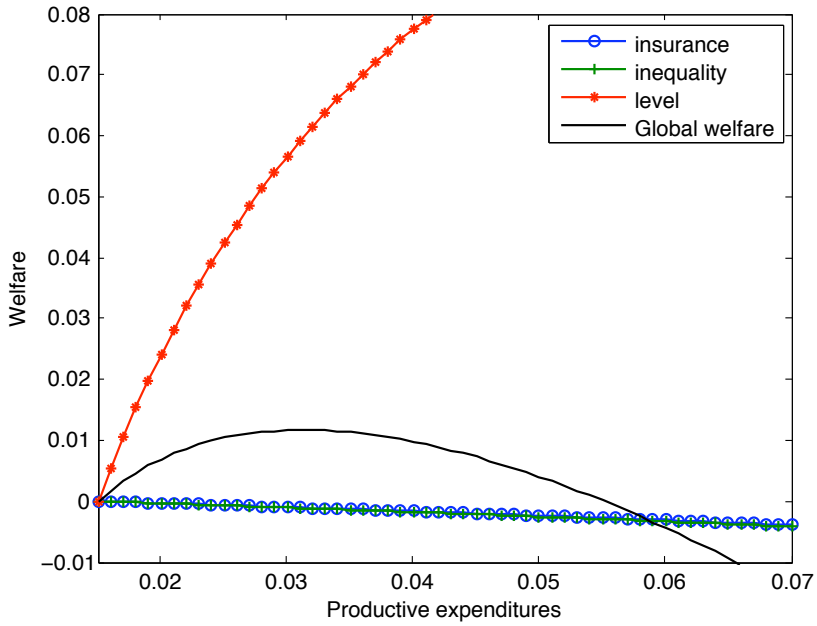
the poorest[10] inducing the latter to increase the labour supply. That explains why the leisure Gini index rises, and also why the welfare distribution, including consumption and leisure, worsens.

The results depend crucially on the productive expenditure elasticity in the production function. For η equal to 0.03, the productivity effect is much weaker, and the welfare level gain is not sufficiently high to compensate the negative effect on insurance and inequality. According to table 4.9 and as it can be observed in figure 4.19b the welfare is maximized with a combination of $g_p = 3.1\%$ and $tr = 8.4\%$. The dynamics are similar except for the fact that the efficiency effect of the productive expenditures is not so high as in baseline. Above a certain level, it can no longer compensate the utility loss due to lower transfer. As predictable, different η leave the household distribution unchanged because the output elasticity affects all household equally. All the Gini coefficients as well as the inequality effect of welfare, present the same values.

[10]The income reduction is proportionally stronger among the poor because by definition they own less assets.



(a) $\eta = 0.3$



(b) $\eta = 0.03$

Figure 4.19: Welfare decomposition: tr versus g_p

4.4 Extension: accounting for sovereign risk

The absence of any sovereign risk is a simplification hypothesis which can overestimate the optimal level of public debt. Our model allows the possibility of debt affecting the interest rate paid by the government. This analysis is based on theoretical argument about the credibility effect and the probability of government debt default but also on empirical data. We consider the real long-term interest rates of several European countries who have presented significant variation of gross debt level since the euro creation: Portugal, Greece, Italy, Ireland, Spain, Denmark and Belgium. We regress the differential of the real long-term interest rate between each country and Germany on debt. We use de AMECO database between 1991 and 2009. From the regression's we obtain positive values for the slopes of practically all the seven countries (Greece is the exception). In average, each percent of debt contributes, *ceteris paribus* to an increase of 0.04 percentage point of the real long-term interest rate. Figures 4.20 and 4.21 show four examples.

For our model, we introduced the sovereign risk as a growing factor depending on debt and affecting the government budget constraint. As the government debt augment, the interest payment increase more than proportionally by multiplying the interest rate paid by the government by $e^{\frac{d_t}{10}}$. The government budget constraint (in the per product version) becomes:

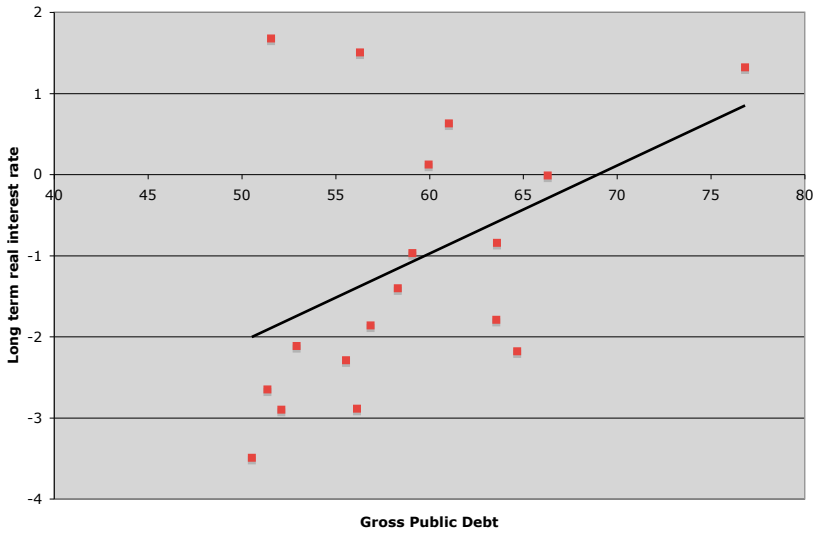
$$g_{ut} + g_{pt} + tr_t + (1 - \tau_t)r_t.e^{\frac{d_t}{10}}.d_t + d_t - (1 + g_t)d_{t+1} = \tau_t(1 - \delta k_t)$$

And the tax rate (in steady state with a constant deb output ratio):

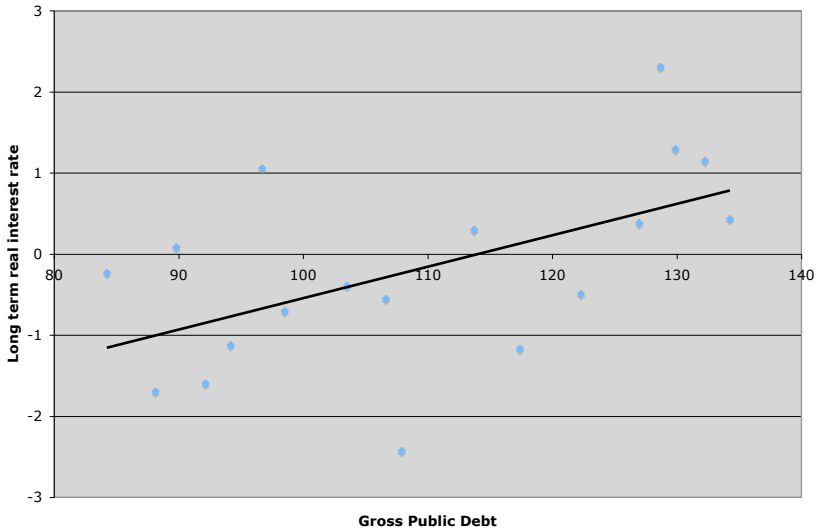
$$\tau = \frac{g_u + g_p + tr + (r.e^{\frac{d}{10}} - g_t)d}{1 - \delta\frac{\alpha}{r+\delta} + r.e^{\frac{d}{10}}.d}$$

In our simulations, by augmenting the government debt output ration from zero to 1, we obtain an average spread of 0.05 percentage point of real long-term interest rate which is very close to the dates (the spread is obtained

with the expression $r(e^{\frac{d_t}{10}} - 1))$.

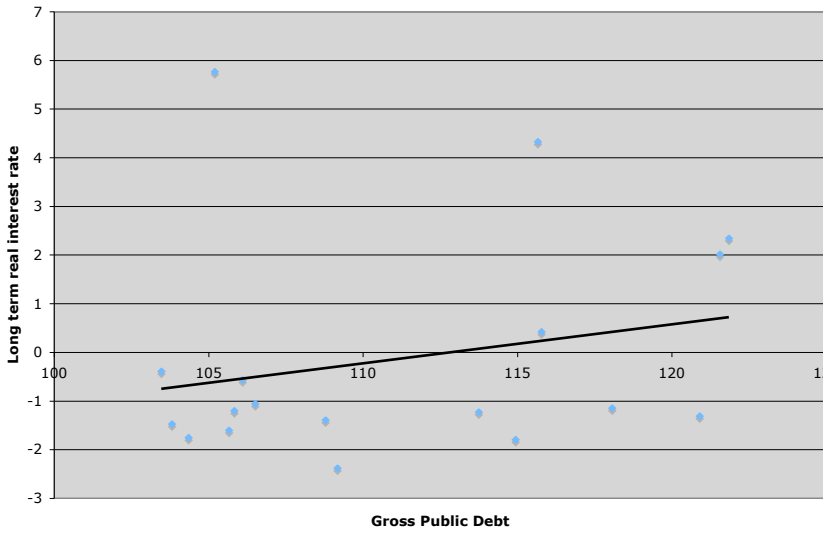


(a) Portugal

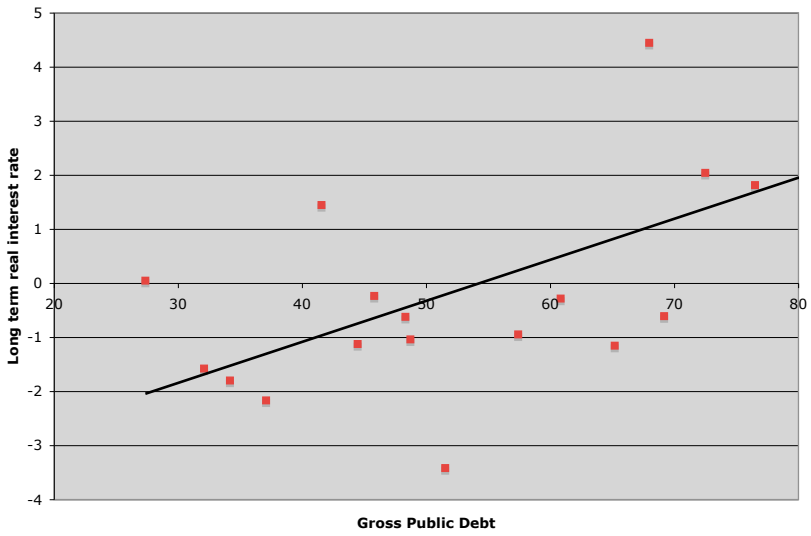


(b) Belgium

Figure 4.20: Gross Public Debt and long-term interest rate (1)



(a) Italy



(b) Denmark

Figure 4.21: Gross Public Debt and long-term interest rate (2)

With this modified model, we repeat the simulation in order to find the optimal combination of debt and transfer. We use the large government where $g_u + g_p = 0.2$ and $\vartheta = 0$. We omit other calibration because the results are similar. The objective of this section is only to advert for the existence of the effect of a growing debt on the government credibility and the probability

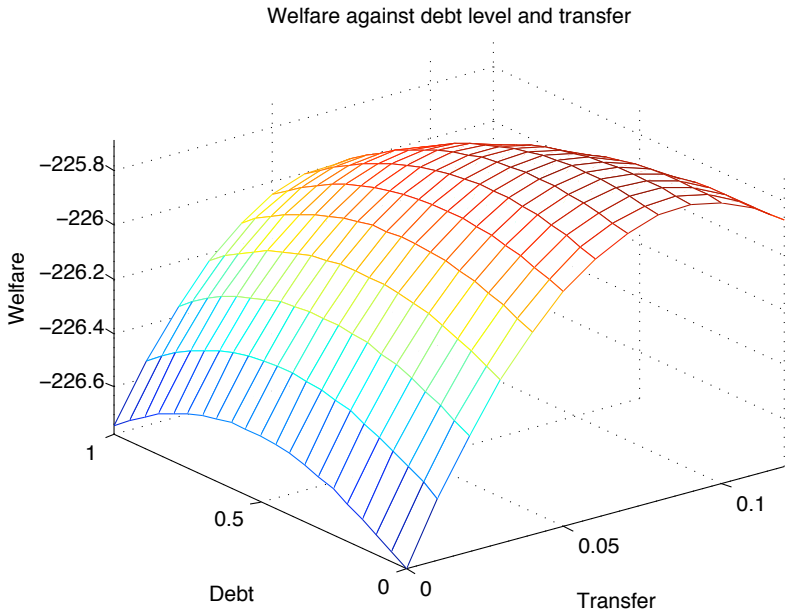


Figure 4.22: Large Government: $g_u + g_p = 20.0\%$. Optimal Combination: Debt=25% and Transfer=8%. Income Gini Index=0.29. Welfare=-225.7

of default perceived by the market.

The optimal combination of debt and social transfer is now: $d = 0.25$ and $tr = 0.08$. For the same calibration and without the sovereign risk, this optimal combination was $d = 0.50$ and $tr = 0.08$. This is an expected result since the sovereign risk provokes in increased debt services demanding an extra tax effort that hurts households and firms.

4.5 Summing up

Using a general equilibrium model with heterogeneous agents, calibrated according to the EU empirical reality, we exemplify the channels by which debt, social transfer, collective consumption and public gross investment affect social welfare and its distribution. Moreover, we explore the optimal combination of these policy variables in terms of social welfare, decomposing it on a level effect, an insurance effect and an inequality effect. We complement welfare inequality measure by calculating the Gini index on several standard

inequality variables such as wealth, disposable income and consumption, but also on leisure.

We find that a rise in unproductive expenditure and in transfers improve utility up until a certain point. Direct effects on utility and disposable income, respectively, impinge positively on inequality and uncertainty but (indirect) tax effects affect strongly labor supply, with negative impacts on the welfare level. On the other hand, debt brings a positive insurance effect through interest rate incentives on savings, but the dominance of this channel over alleviating credit constraint impinges negatively on welfare inequality. Welfare level effect is also negative due to side effects of taxes on labor supply. We also find that, for a calibration mimicking average unproductive and productive spending of the EU countries, optimal combination of debt and social transfer levels are smaller than the values observed in the EU countries during the last decades and, in the case of debt, optimal values are below the limits established by the Stability Growth Pact and they are larger, the larger the size of government (as measured by the expenditures on output ratio). Consequently, the larger government size is, the worse is welfare inequality. Most of heterogeneous-agent models rule out the presence of collective consumption from the household utility function. We find that, by including the utility flow from in-kind government transfers in the household's utility function, the optimal level of debt and transfers decrease significantly. Finally, for a given level of public debt and government size, we assess how (intra-temporal) composition of government expenditures impinges on welfare and related inequality measures: (i) substituting unproductive spending by transfers is welfare enhancing and improves inequality but only up to a lower bound of unproductive spending, rather inelastic (the smaller the government size is, unproductive expenditure cuts gradually dominate transfer welfare- and inequality-enhancing effects); (ii) substituting unproductive by productive spending is always welfare enhancing and has no impact on any inequality measure; and (iii), shifting transfers for productive expenditure is always welfare enhancing for a sufficiently high output elasticity of public investment; if not, there is an optimal maximum level of optimal productive expenditure. Since productive expenditure has no direct effects on inequality,

transfer reduction impacts negatively on inequality welfare. Finally, we extended the model by including a sovereign risk through which debt affect the interest rate paid by the government. We found that, in those circumstances the optimal debt level is substantially lower.

The results of this chapter rely only on steady state analysis, i.e., it does not account for a transition period, with welfare and related consequences in inequality, in between steady-states (i.e., fiscal arrangements). Considering the actual stance of public finances in most of the EU countries, we believe that the study of optimal fiscal consolidation strategies can be an important issue in the near future. This will be the object of the next chapter.

Finally, the model considers a closed economy, isolated from any foreign influence and assuming no possibility of government default. We believe that the inclusion of more than one country, eventually with different sizes, will bring more robustness to our results and also new insights, especially if we can mimic actual EU environment. We will discussed this issue in the next chapter.

Chapter 5

Debt consolidation processes - transition path analysis

Having found that the optimal debt level changes with either the size of the government and with the expenditure composition, the study of how a debt consolidation path should be implemented is now in order. The aim is to assess eventual welfare transition costs in between steady states, in particular, to assess welfare impacts of several strategies of debt consolidation (revenue-based, expenditure-based) as well as their impacts on several inequality measures. Moreover, the analysis provided in this chapter is extended to an open economy framework: implications are drawn for two different-size countries that engage in debt consolidation efforts in the context of a monetary union, where a common interest rate and perfect capital mobility hold.

We continue to consider the same economy as described in chapter 3. We define a common steady state, as a departure to all consolidation strategies whose fiscal policy variables, in % of GDP, are set at: $\{d_0 = 100\%,\ tr_0 = 10\%,\ g_{u0} = 20\%,\ g_{p0} = 2\%\}$. The consolidation process is exemplified by a reduction of government debt output ratio from 100% to 90% throughout a period of ten years (or of five years for simulating a cold shower strategy). Given model calibration and initial steady state, this consolidation process is part of an alienation process toward optimal debt level. The debt path, considered to be credible, is implemented by the government and is fully an-

nounced, previously, to the private agents. Thus households fully anticipated changes in the policy variables and make their decisions in order to maximize the utility throughout the transition period plus the final (life-long) steady state. We consider 4 basic strategies:

- A pure revenue-based strategy
- An expenditure-based strategy using social transfers
- An expenditure-based strategy using unproductive spending
- An expenditure-based strategy using productive spending

In the first part of this chapter we simulate each strategy in an autarky framework. We present the equilibrium path of the main macroeconomic variables and proceed with a welfare analysis, including inequality impacts. The second part of the chapter introduces open economy analysis. Only capital (not labour) moves across borders. For each strategy, we will simulate the consolidation process in each country, while the other acts passively. We first promote consolidation in the large size country, with the smaller acting passively. The third and last part of the chapter monitors differences relative to (alternative) cold shower strategies.

5.1 Closed economy analysis

In this section we apply the four consolidation strategies to a single country in autarky. This implies that any spill overs arising from debt consolidation are ruled out.

5.1.1 Revenue-based strategy

The pure revenue strategy puts all consolidation effort on the tax system. All the other fiscal policy variables (productive and unproductive expenditure and social transfers) remain constant at the initial steady state level $\{tr_0 = 10\%,\ g_{u0} = 20\%,\ g_{p0} = 2\%\}$, in percentage of GDP. As government makes public his intention to decrease debt and act consistently with

his project, households anticipate a new equilibrium with a lower interest rate and a lower tax rate and built an optimal path of decisions concerning consumption/savings and leisure/labour.

Figure 5.1 shows the dynamics of the model variables throughout transition. The debt path is imposed by the government as shown in the first panel of Figure 5.1. The interest rate is determined by the evolution of demand and supply of assets by the households. The asset supply side curve moves gradually to the left as debt decreases. The asset demand evolves according to households disposable income and their expectations about future income. The first dominant effect corresponds to the tax rate peak necessary to achieve debt reduction and makes the asset demand curve move rightward (total asset holding decreases). Thus, interest rate goes up. However following debt adjustment, wage and income gradually recover; asset demand increases, interest rate decreases and the households' asset holdings go up smoothly. The interest rate path crucially shapes private capital and output.

Summing up, after the consolidation episode, the interest rate lowers and the total assets held by households fall (originating a capital income loss). However, private capital rises (which implies a crowding in effect) and tax rate decreases originating the simultaneous occurrence of higher after tax wage and aggregate labour supply.

As for inequality (see Figure 5.2), the dynamics of the variables point to a negative effect, especially during the first half of transition. Both wealth, income and consumption Gini indexes climb during the debt adjustment, contrary to the leisure Gini index.. After that, inequality indexes correct but without reaching the initial levels (see Table 5.1). During the transition, the interest rate rise hurts more those who owe and benefit the asset holders. This results in more income and wealth inequality (the poorer are the first to sell assets or borrow). Despite the lower level of tax and interest rate in the final steady state, both Gini indexes indicate that increased inequality persists. The reason, as we have already pointed in the last chapter, roots in the labour market. Higher after tax wage levels increases, unevenly, aggregate labour supply: labour supply elasticity is higher among the wealthier who

will work proportionally harder, pushing up the income inequality measures.

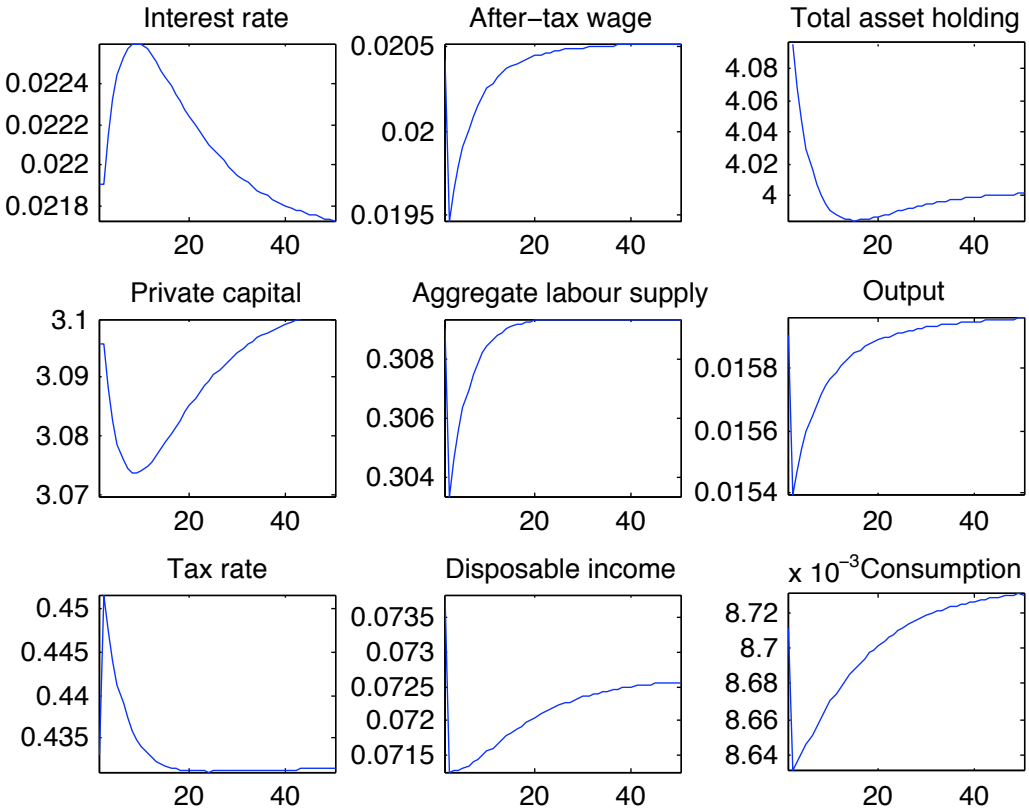


Figure 5.1: Dynamics of macroeconomic variables under a revenue-based consolidation

Concerning the welfare analysis (see Table 5.2), we conclude that, despite the welfare superiority of the final steady state the consolidation cost overcomes the benefit. The global welfare gain (transition plus final steady state) is negative. This is due to the negative effect on insurance capacity caused by the debt (and interest rate) decrease and also to the level effect.

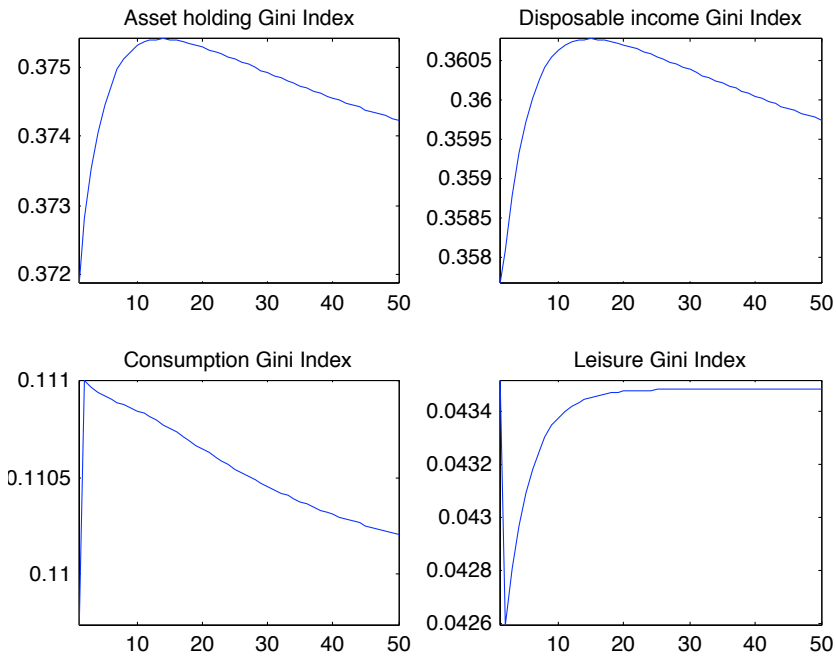


Figure 5.2: Dynamics of Gini indexes under a revenue-based consolidation

The inequality effect is also negative, although in a smooth way (a higher leisure equality is fully compensated by the rise in "income" inequality). Figure 5.3 plots the welfare gains of consolidation against wealth and also the initial distribution of wealth. Despite no significant differences in wealth distribution between initial and final steady states, the poorer are those who bear the burden of the consolidation effort whereas the wealthier even benefit from it (despite the negative global welfare effect).

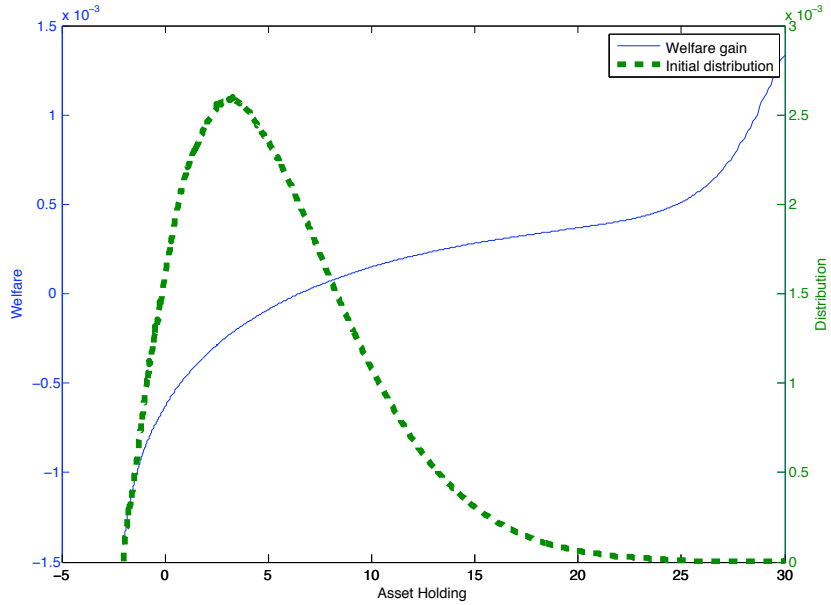


Figure 5.3: Welfare gain and Wealth distribution under a revenue-based consolidation

	CG	WG	IG	LG
Initial Steady State	0.1097	0.3719	0.3577	0.0435
Final Steady State	0.1099	0.3732	0.3587	0.0435

Table 5.1: Inequality measures under a revenue-based consolidation.
Notes: CG = Consumption Gini index - WG = Wealth Gini index - IG = Income Gini index - LG = Leisure Gini index

Welfare decomposition	W_{level}	W_{ins}	W_{ine}	WG
Transition + Final Steady State	-0.0348	-0.0331	-0.0001	-0.0002
Final Steady State	0.0056	-0.0002	0.0002	0.0022

Table 5.2: Welfare decomposition analysis under a revenue-based consolidation.
Notes: W_{level} = welfare level effect - W_{ins} = insurance welfare effect - W_{ine} = inequality welfare effect - WG = global welfare gain

5.1.2 Expenditure-based strategy: social transfers

The debt reduction is now obtained through a social transfer reduction of five percentage points (from 10% to 5%). Both debt and transfer path during transition are set beforehand. We set a path for transfer reduction in order to generate a pure consolidation strategy relying only on transfer. Beside debt and transfer paths, productive and unproductive expenditures remain constant at the initial steady state levels ($g_{u0} = 20\%,\ g_{p0} = 2\%$). Tax rate remains free in order to fulfill the government budget constraint.

Figure 5.4 depict, as before, the evolution of the main macroeconomic variables during transition. The interest rate dynamic is similar; debt decreases, the asset supply curve moves to the left and the asset demand curve moves in line with the household income fluctuation. The difference is that the income reduction is smaller, resulting only from the transfer reduction. The first interest rate peak is weaker and soon after the asset supply effect dominate, lowering interest rate.

Contrary to the revenue-based strategy, final aggregate asset holdings level exceeds the initial steady state level, despite debt reduction. The substitution of debt by private capital (crowding-in effect) is stronger under the transfer-based strategy. Moreover, the absence of significant interest peak (and naturally the reduction of the disincentive effects due to the tax rate decrease) eliminates the severe recession occurred under the pure revenue strategy. Private capital and output, after a very slight depression, increases constantly throughout transition. Facing lower social transfers and an increased after-tax wage, households have more incentive to supply more labour.

Comparatively with the pure revenue-based strategy, the transfer-based strategy endows the economy with substantially more capital and output, lower interest and tax rates and households work, consume and save more.

The inequality measures trajectories (see Figure 5.5) are similar to the pure revenue strategy, but obey to different determinants. The wealth Gini index hump shaped curve reflect the asset supply reduction and the lower interest rate caused by debt reduction which affect strongly the segments

of household closer to the liquid constraint limit. The income Gini index curve reflect the social transfer cut. Concerning the final steady state equilibrium (table 5.3) both Gini indexes end above the initial level, which means that inequality increased. The leisure Gini index reflects the labour supply dynamic. The increase labour supply affects strongly the poorest that are severely affected by the transfer cut, which spread the leisure distribution and raise the respective Gini index. Concerning the final steady state, table 5.3 illustrates, as in the revenue-based strategy, that consolidations reduces equality.

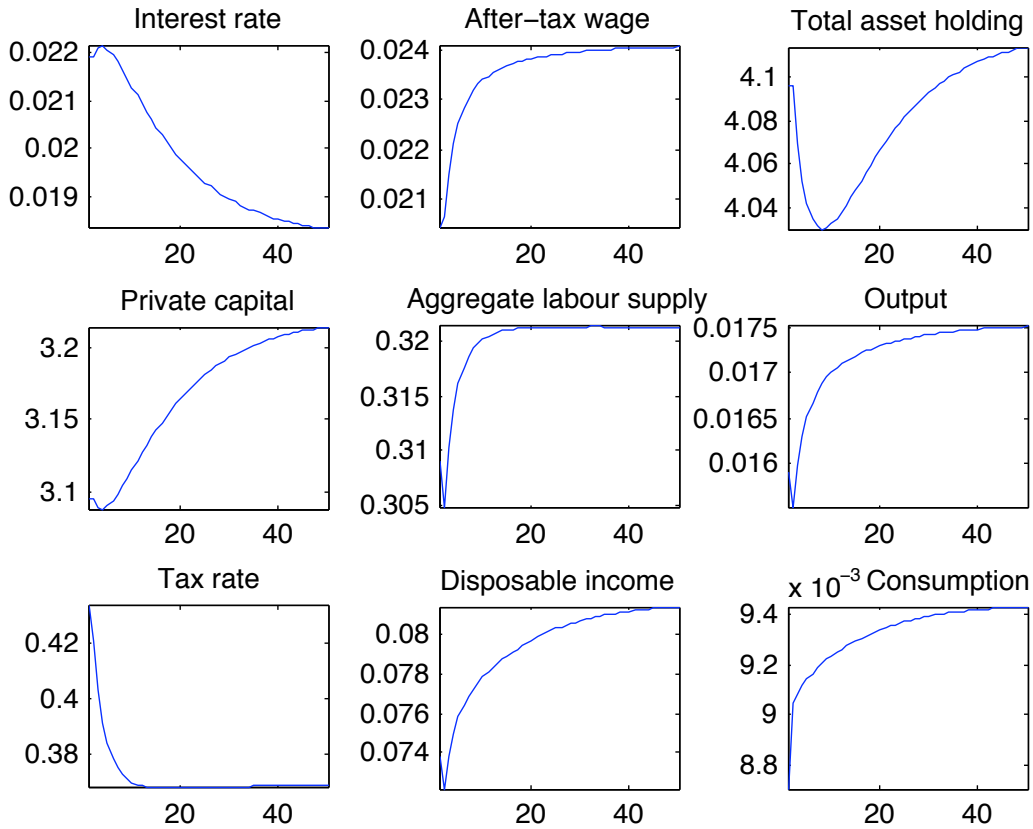


Figure 5.4: Dynamics of macroeconomic variables under a transfer-based consolidation

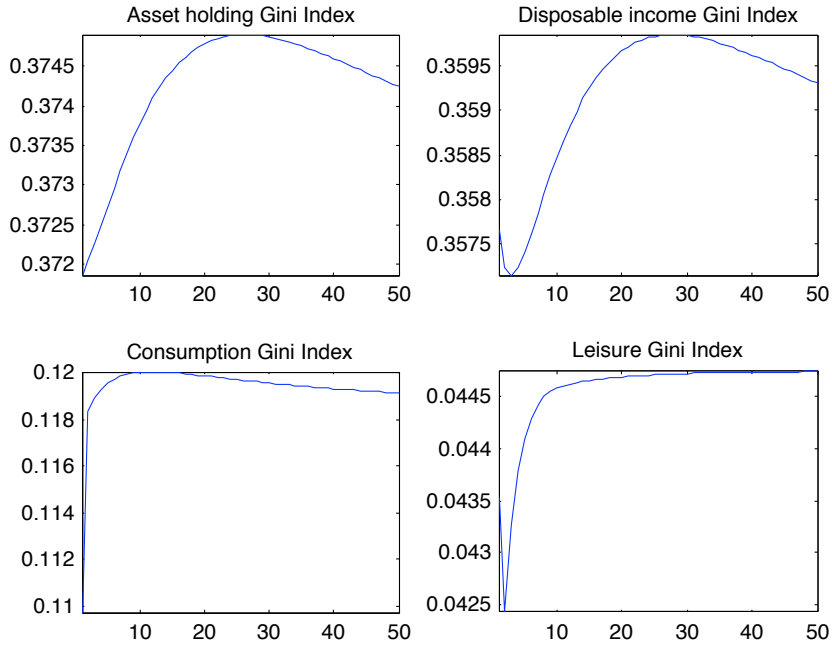


Figure 5.5: Dynamics of Gini indexes under a transfer-based consolidation

Unlike the pure revenue strategy, the consolidation materialized through the transfer based strategy is clearly welfare enhancing despite a positive transition cost (see Table 5.4) -note the positive gap between the final steady state welfare and the transition plus final steady state welfare. The welfare decomposition indicates a positive level effect and a negative insurance and inequality effects. The positive effect occurs because, contrary to the revenue-based case, the recession, during the first periods of the transition is almost negligible. The income loss due to the transfer cuts is soon compensated by the tax rate decrease. The negative insurance effect comes from the debt depletion and the fall of interest rate. Finally the social transfer cuts affects distribution and explains the negative inequality effect. Concerning the global welfare gain distribution across wealth (Figure 5.6), we can see that all households improve. However, the wealthier benefit more relative to the poorest. This is caused mainly to the transfer based strategy which affects the poorer proportionally more.

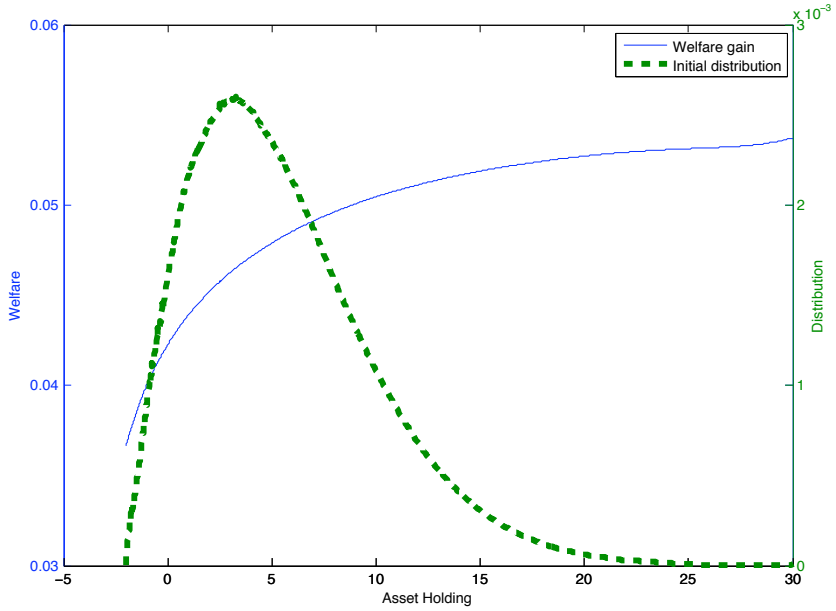


Figure 5.6: Wealth gain and Wealth distribution under a transfer-based consolidation

	CG	WG	IG	LG
Initial Steady State	0.1097	0.3719	0.3577	0.0435
Final Steady State	0.1187	0.3729	0.3580	0.0447

Table 5.3: Inequality measures under a transfer-based consolidation.
Note: see table 5.1

Welfare decomposition	W_{level}	W_{ins}	W_{ine}	WG
Transition + Final Steady State	0.0167	-0.1098	-0.0008	0.0520
Final Steady State	0.1773	-0.0066	-0.0005	0.0602

Table 5.4: Welfare decomposition analysis under a transfer-based consolidation.
Note: see table 5.2

5.1.3 Expenditure-based strategy: unproductive spending

The third strategy is based on a reduction of unproductive expenditure. The framework is similar to that of the transfer based strategy. We exogenously set the paths of debt and of unproductive expenditure in order to generate a pure consolidate strategy based exclusively on government spending. Unproductive expenditure reduces from 20% to 15%. Social transfer and productive expenditure maintain the same initial values as a percentage of GDP ($tr = 10\%$ and $g_p = 2\%$) while tax rate remains free to fulfill the government budget constraint. As a result, tax rate decreases following the consolidation path.

The interest rate dynamics (see Figures 5.7) is, as always, determined by the movement of asset demand and supply curves. The humped shaped curve results from three principal forces. Initially, households sell asset in order to compensate for the utility loss caused by the cut in the unproductive expenditure. The asset demand curve moves to the left and the interest rate rises. At the same time, government reduces debt, moving the asset supply curve to the left. This last effect dominates from the fifth year onward and thus, the interest rate starts falling down. After the ten year consolidation period, the asset supply curve stabilizes but the asset demand curve moves to the right shoved by the disposable income rise due to the tax rate reduction.

The compensation of the utility loss caused by the unproductive expenditure reduction has also impacts on the labour supply: in the first year of transition households choose to work less and therefore enjoy more leisure. However, afterward, labour supply recovers and ends above the initial steady state level. Output moves accordingly and there recovery is additionally helped by the interest rate decrease. Consumption first augments suddenly (the asset selling effect), and evolves steadily afterwards. The level of aggregate asset holding ends upward to the initial level which means that the private capital increase more than compensated the public debt reduction. As expected, disposable income dynamics mimics that of labour supply, with recovery strongly related to increased after tax wage.

The inequality measures trajectories presents the same hump shaped form. The wealth Gini curve reflect the asset supply reduction caused by debt reduction which affect the segments of household closer to the liquid constraint limit. The disposable income Gini index curve reflects the change in the asset holding distribution. The first drop of labour supply affect strongly the poorer (who are severely affect by the government spending cuts) which push down the leisure Gini index. Afterward the situation gradually reverses. Concerning the final steady state equilibrium (Table 5.5) all Gini indexes except the leisure one, end above the initial level, which means that inequality increased. [1]

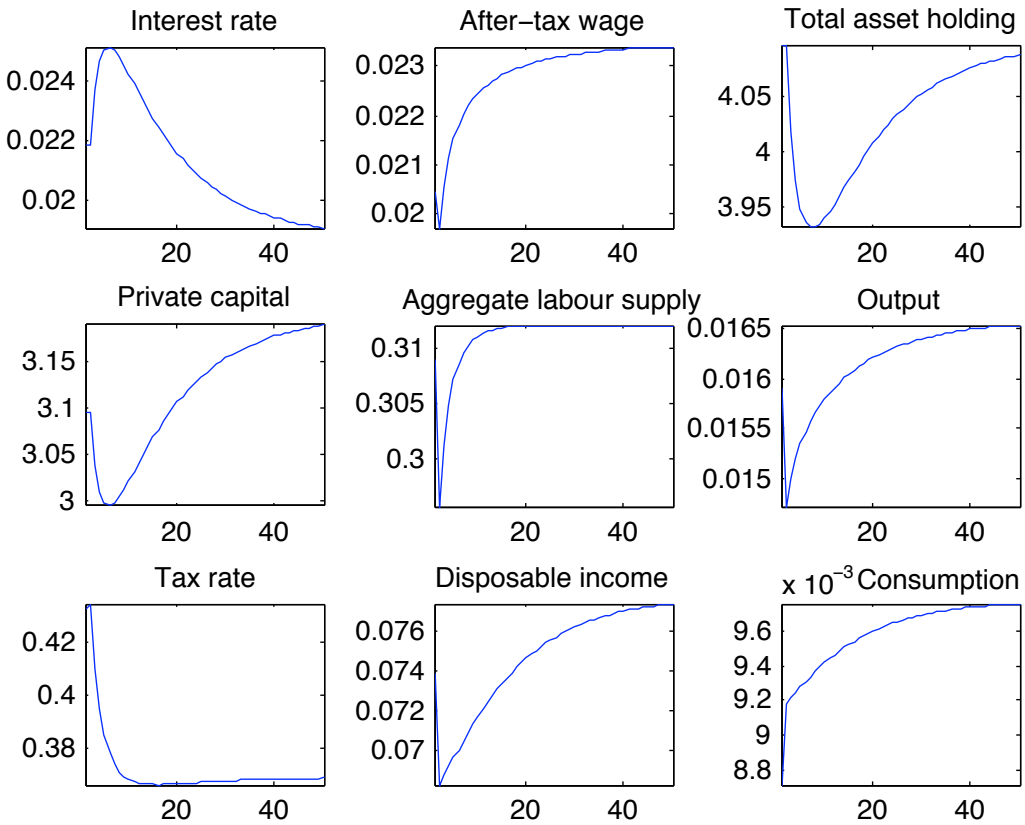


Figure 5.7: Dynamics of macroeconomic variables under an unproductive-spending-based consolidation

[1] The final Gini indexes concern only the final steady state and do not take into account the transition costs.

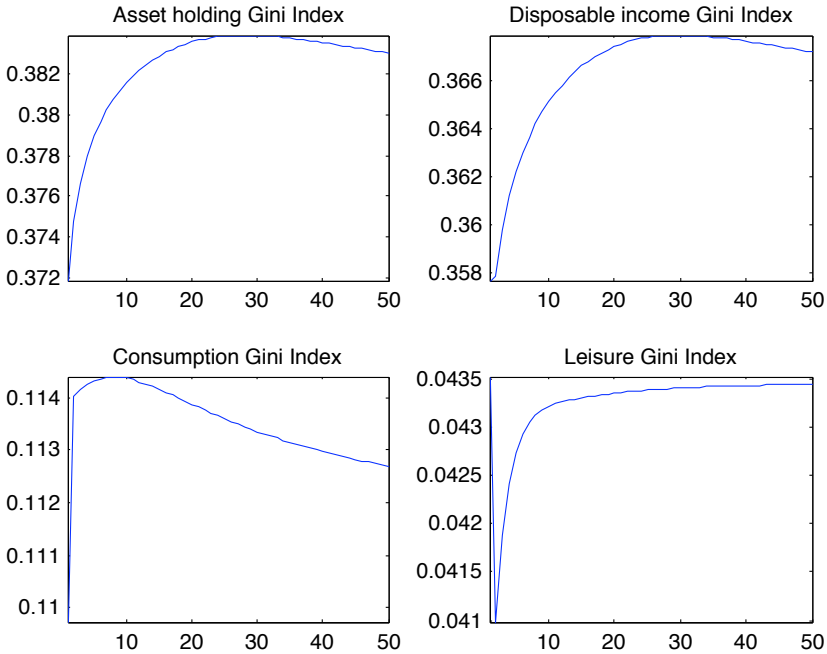


Figure 5.8: Dynamics of Gini indexes under an unproductive-spending-based consolidation

The pure spending strategy based on unproductive expenditure cuts (see Table 5.6) is, as the transfer-based one, welfare enhancing. It also involves a transition cost, but overall welfare gains are larger than these, in line with the transfer-based strategy. The main difference can be seen through the welfare decomposition. The unproductive expenditure based strategy implies a negative level effect because the economic recession is more severe. The insurance effect is also negative resulting from the debt consolidation process. On the other hand, the inequality effect, negative in the transfer and tax-based strategies, is now positive: cuts in the unproductive spending do not affect income directly representing an utility loss equally distributed across all population. Thus they don't affect economic choices. On the other hand, the tax and the interest rate decreasing paths improve in a stronger way the utility of the poorer. These facts can be confirmed by looking at Figure 5.9 where we plot the welfare gains against wealth and the respective wealth distribution. All people improve their lifetime utility, but the households who hold less quantities of asset or are in debt, benefit more compared with

the wealthier classes of society.

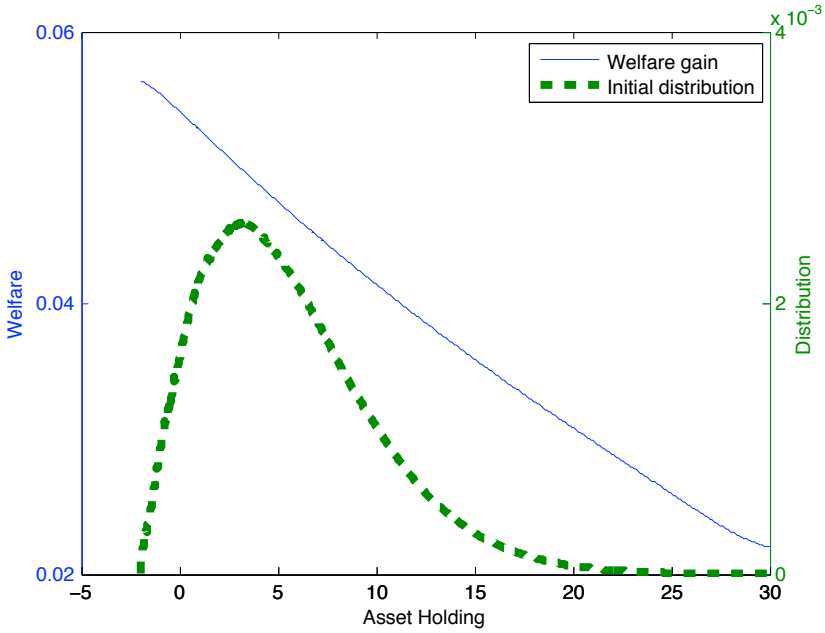


Figure 5.9: Wealth gain and Wealth distribution under an unproductive-spending-based consolidation

	CG	WG	IG	LG
Initial Steady State	0.1097	0.3719	0.3577	0.0435
Final Steady State	0.1121	0.3809	0.3652	0.0434

Table 5.5: Inequality measures under an unproductive-spending-based consolidation
Note: see table 5.1

Welfare decomposition	W_{level}	W_{ins}	W_{ine}	WG
Transition + Final Steady State	-0.0117	-0.1248	0.0065	0.0567
Final Steady State	0.1144	-0.0015	0.0004	0.0697

Table 5.6: Welfare decomposition analysis under an unproductive-spending-based consolidation
Note: see table 5.2

5.1.4 Expenditure based strategy: combined productive and unproductive spending

The fourth and last strategy consists in reducing the productive expenditure. Given the small magnitude of productive expenditures calibrated in our model with the value of public investment relative to GDP in Europe, the debt reduction path cannot be achieved through fully adjusting this instrument. In order to compare this strategy with the previous ones we consider a reduction in public investment of 0.5% (from 2% of GDP to 1.5%), complemented with a reduction of 4.5% of unproductive expenditure. Consistently we build a vector for g_p and g_u in order to produce a pure expenditure-based strategy, and social transfers keeps the same initial value ($tr = 10\%$). As before, tax rate is free to adjust in order to verify the government budget constraint. As debt and government expenditures decrease, tax rate also falls, following the consolidation path.

The dynamic of the process is shown in Figure 5.10. The reduction of the production expenditure has a strong impact on practically all the other macroeconomic variables. The output reduction dominates in reducing disposable income despite the tax rate reduction. Both asset supply and demand curves move to the left, at least until the end of the ten-year consolidation process. The supply curve effect dominates the first period and interest rate falls. From the tenth period onwards, the demand curve effect dominates and the interest rate rises to its final steady state level, but stays below the initial steady state level. Total asset holdings is measured as a percentage of output. In the first periods, output decays more quickly and the asset holdings rise. In the following periods the opposite occurs and the asset holdings decrease. The households smooth their welfare especially through labour supply. First, to compensate for the hit on the government expenditures that affect utility and consumption, they increase leisure (work less). In a second phase, labour supply rises again following the after tax-wage trajectory. Finally, after the last peak, the labour supply falls smoothly through the final steady state level following the interest rate and the private capital paths.

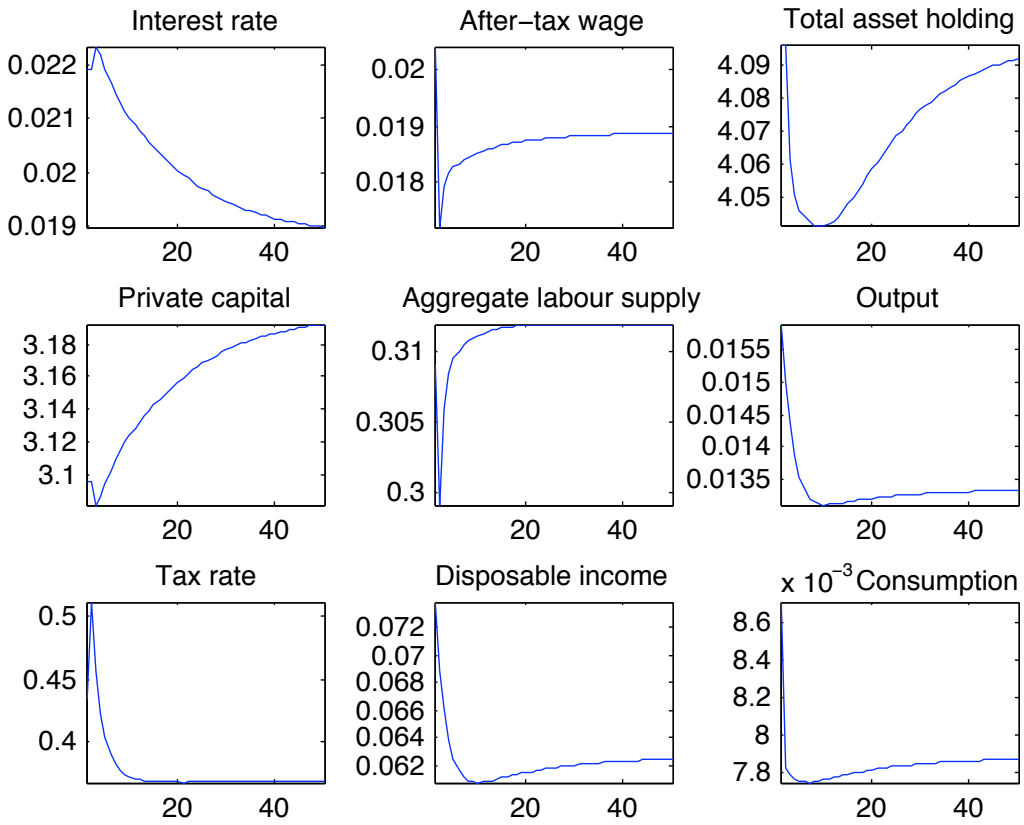


Figure 5.10: Dynamics of macroeconomic variables under a mixed expenditure-based consolidation

The inequality indexes dynamic (see Figure 5.11) reflects different specific channels. The decay of product, income and asset holdings and the labour supply responses increase inequality raising both wealth, income and consumption Gini indexes (the first peaks of disposable income Gini index correspond to a a sudden reduction of labour supply among the poorest household which cause the sharp decrease of leisure Gini index).

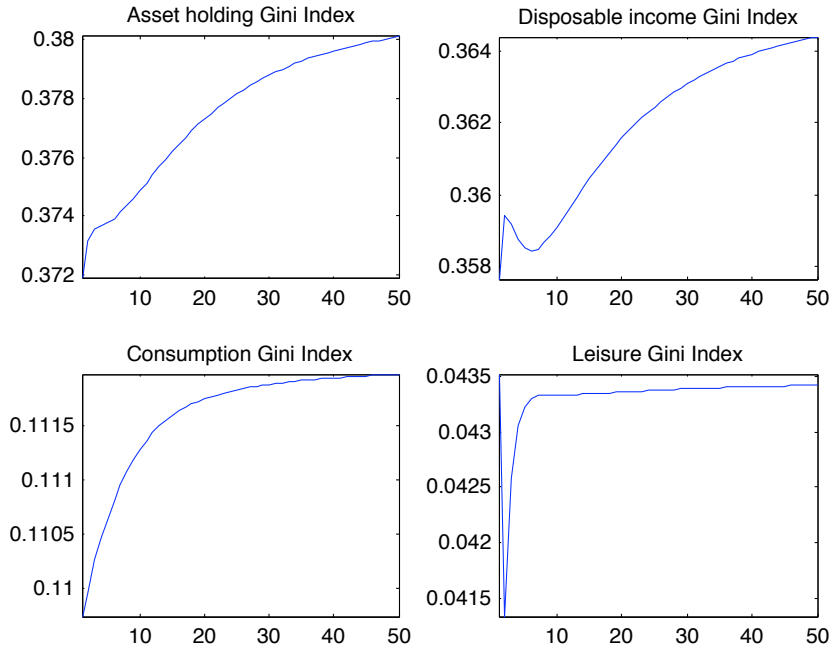


Figure 5.11: Dynamics of Gini indexes under a mixed expenditure-based consolidation

The spending strategy partially based on productive expenditure cuts is, contrary to the transfer or unproductive based, welfare decreasing (see Table 5.8). The main reason relies on the level effect which, in turn, reflects a strong productivity loss for the economy. As for the inequality, Figure 5.12 shows that the poorer face smaller welfare losses relative to the wealthier; thus, welfare inequality is reduced, despite the increased final level of several Gini indexes (see Table 5.7).

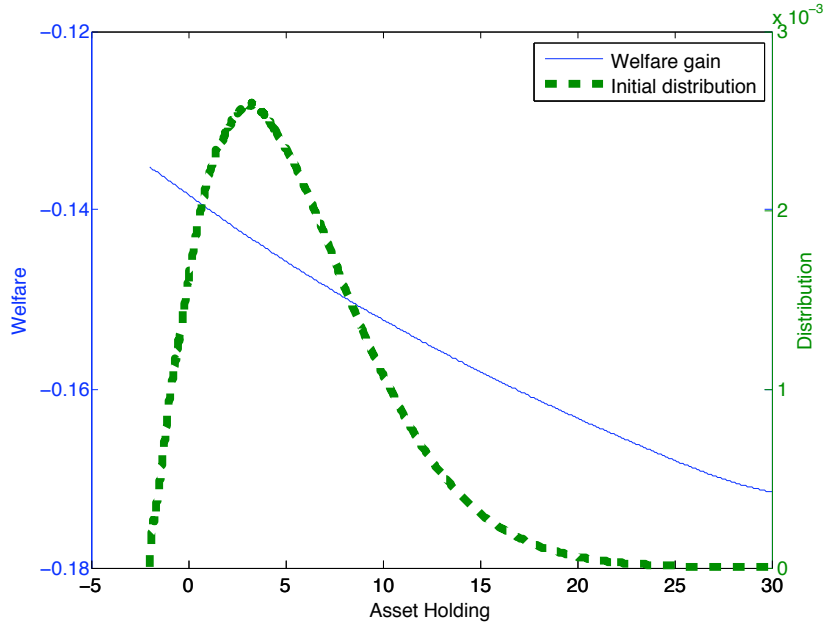


Figure 5.12: Wealth gain and Wealth distribution under a mixed expenditure-based consolidation

	CG	WG	IG	LG
Initial Steady State	0.1097	0.3719	0.3577	0.0435
Final Steady State	0.1121	0.3809	0.3652	0.0434

Table 5.7: Inequality measures under a mixed expenditure-based consolidation
Note: see table 5.1

Welfare decomposition	W_{level}	W_{ins}	W_{ine}	WG
Transition + Final Steady State	-0.1591	0.0533	0.0013	-0.1627
Final Steady State	-0.2945	-0.0020	0.0009	-0.1592

Table 5.8: Welfare decomposition analysis under a mixed expenditure-based consolidation
Note: see table 5.2

5.1.5 Extension 1: accounting for sovereign risk

As we have already mentioned in chapter 4, the baseline model assume zero probability of debt default and therefore, ignores sovereign risk. In this section, as we did in the analysis provided in chapter 4, we introduce the possibility of debt reduction to affect the interest rate paid by the government. This analysis is based on the same theoretical argument about the credibility effect and the same empirical data. As used before we introduce sovereign risk as a growing factor depending on debt and thus, affecting the government budget constraint. As government debt increases, the interest payment increases more than proportionally by multiplying the interest rate paid by the government by $e^{\frac{d_t}{10}}$. Recovering the government budget constraint (in unit of output terms):

$$g_{ut} + g_{pt} + tr_t + (1 - \tau_t)r_t.e^{\frac{d_t}{10}}.d_t + d_t - (1 + g_t)d_{t+1} = \tau_t(1 - \delta k_t)$$

And the corresponding tax rate dynamics:

$$\tau = \frac{g_{ut} + g_{pt} + tr_t + (1 + r.e^{\frac{d_t}{10}})d_t - (1 + g_t)d_{t+1}}{1 - \delta\frac{\alpha}{r+\delta} + r.e^{\frac{d_t}{10}}.d_t}$$

To account for sovereign risk, we have limited simulation to the welfare decreasing scenarios of consolidation in order to foresee any improvement resulting from consolidation effects.

Revenue based strategy Using this extension, we replicate the same revenue based strategy simulated above. The positive sovereign risk effect is stronger in the first year of consolidation (debt reduction is larger). By reducing the debt service, it relieves the government budget constraint and even allows a small tax cut. The income retreat that occurred in the baseline case has a much smaller magnitude in the present case. The asset supply curve move to the left is dominant and the interest rate decreases instead of increasing. This interest rate drop, in turn, boosts private capital, disposable income and output, which further contribute to relieve the government

budget constraint (see Figures 5.13).

Concerning the several inequality indexes (see Figures 5.14) both asset holdings and disposable income Gini indexes evolve similarly but smoothly. On the other hand the consumption and leisure Gini indexes paths are quite different. Consumption becomes more equally distributed contrary to leisure, which point that the labour supply reduction affect more the richer.

As it can be observed in Figure 5.15 and in Table 5.9, the global welfare gain, negative in the baseline case, now becomes positive. The main contribution comes from the insurance effect because of the reduced asset selling. The level and inequality effects also improve relative to baseline.

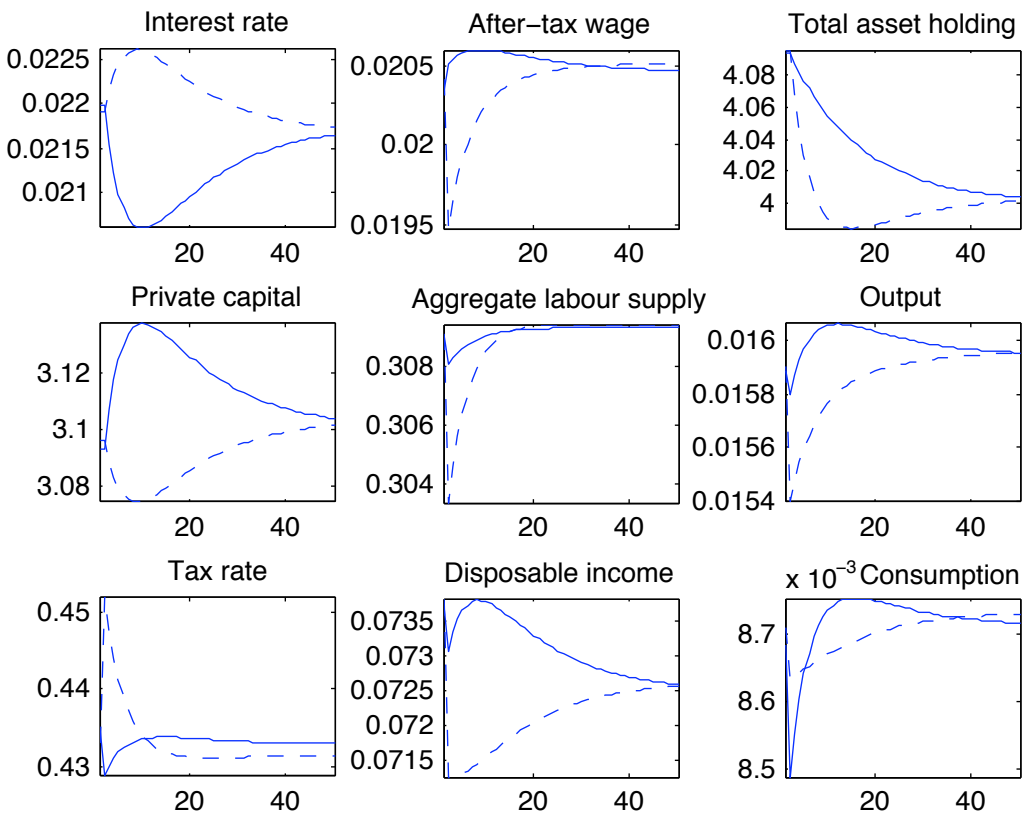


Figure 5.13: Dynamics of macroeconomic variables: revenue based consolidation in the presence (solid line) or in the absence (dashed line) of sovereign line

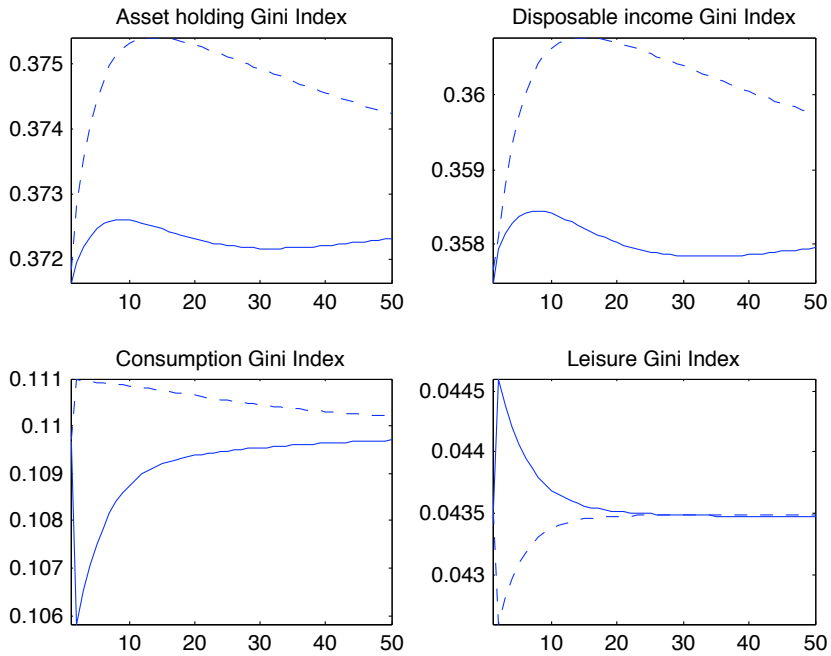


Figure 5.14: Dynamics of inequality: revenue based consolidation in the presence (solid line) or in the absence (dashed line) of sovereign line

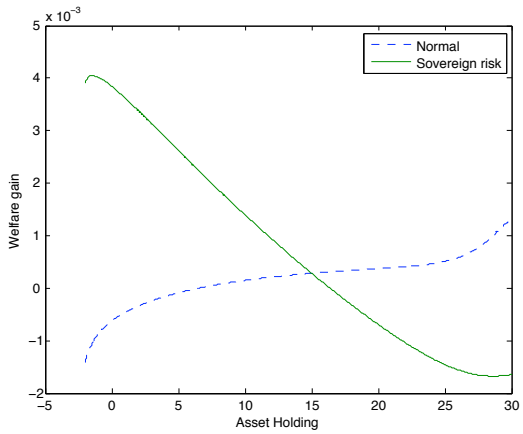


Figure 5.15: Welfare gain distribution under a revenue based consolidation in the presence (solid line) or in the absence (dashed line) of sovereign line

The welfare gain curves plotted in Figure 5.15, and the respective slopes, illustrate how the inequality effect turn from negative to positive. Under the baseline case, the wealthier fraction of population was relatively better off

with the consolidation plan (dashed curve with a positive slope). After including the sovereign risk effect, the poorer fraction of the households become better off relative to the wealthier (solid curve with a negative slope). This reenforces the idea that changes in the tax rate affect strongly the poorer.

Welfare decomposition	W_{level}	W_{ins}	W_{ine}	WG
Transition plus steady state (1)	-0.0348	-0.0331	-0.0001	-0.0002
Transition plus steady state (2)	-0.0249	0.0108	0.0003	0.0038

Table 5.9: Welfare decomposition analysis under a revenue-based consolidation: positive (2) *versus* no sovereign risk(1)
Note: see table 5.2

Productive expenditure based strategy In this case, the sovereign risk effect on interest rate unchained by the debt reduction process is not enough to invert the tax path as it happened under the revenue base strategy. The dynamics of the variables are similar, but more moderate, namely the on interest rate, income and output (see Figures 5.16). The asset demand remains steady and the asset supply reduction pushes even further down the interest rate, feeding a positive effect on private capital and output.

As the precedent revenue-based case, the presence of sovereign risk attenuates the wealth and disposable income Gini indexes and reverts the consumption and leisure Gini indexes path (see Figures 5.17).

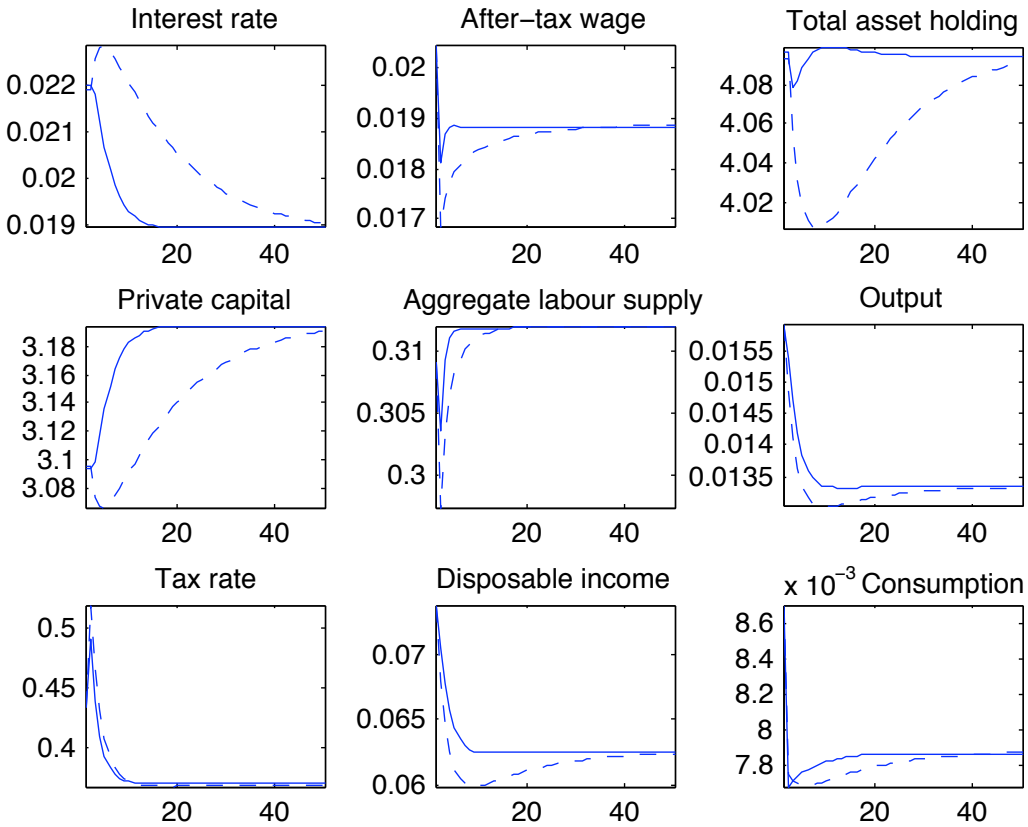


Figure 5.16: Dynamics of macroeconomic variables: mixed expenditure-based consolidation in the presence (solid line) or in the absence (dashed line) of sovereign line

The welfare analysis shows that the existence of a sovereign risk reduces welfare looses attached to the consolidation process (Table 5.10). However, the welfare balance is still negative, and the improvement is of the same magnitude to the one that applies to the revenue-based case. Sovereign risk reduction is welfare enhancing in all dimensions: level, insurance and inequality. In particular, the positive inequality effect is illustrated in Figure 5.18. The slope of the welfare gain curve stays with the same negative signal, but becomes even more negative.

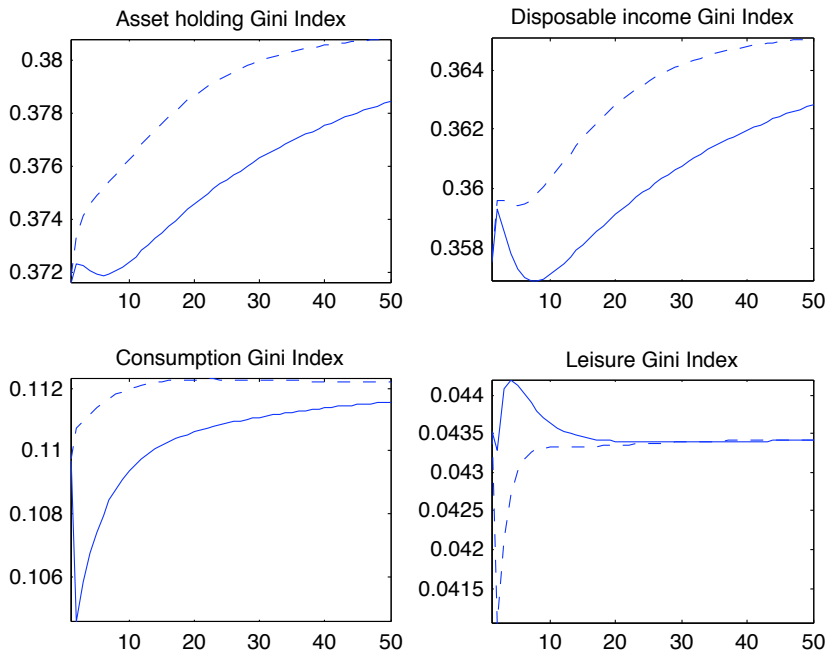


Figure 5.17: Dynamics of inequality: mixed expenditure-based consolidation in the presence (solid line) or in the absence (dashed line) of sovereign line

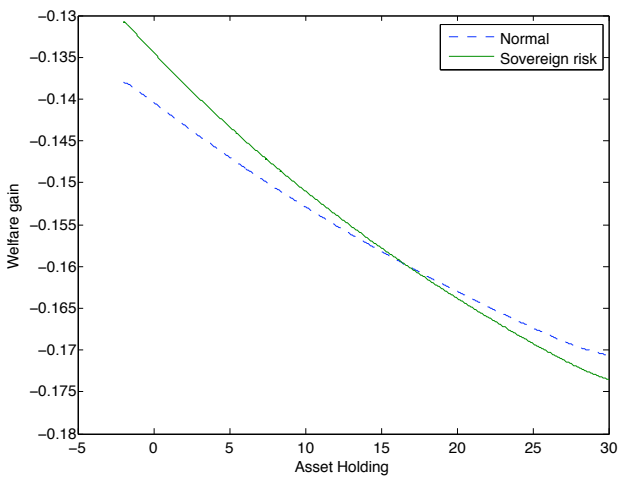


Figure 5.18: Welfare gain distribution under a revenue based consolidation in the presence (solid line) or in the absence (dashed line) of sovereign line

Welfare decomposition	W_{level}	W_{ins}	W_{ine}	WG
Transition (baseline)	-0.1591	0.0533	0.0013	-0.1627
Transition (Sov. Risk)	-0.0657	0.1061	0.0022	-0.1446

Table 5.10: Welfare decomposition analysis under a mixed expenditure-based consolidation: positive (2) *versus* no sovereign risk(1)
Note: see table 5.2

5.1.6 Extension 2: accounting for cold shower *versus* gradual strategies for debt consolidation

In this last section we proceed with comparing the gradual strategies of debt reduction with the cold shower approach. In order to do so, we built a sharper debt reduction path relative to the baseline paths defined in the simulation throughout the previous sections. Except for the pure revenue based strategy, we also exogenously adapt the instrument paths for the other strategies (social transfer, unproductive and productive expenditures) as to make fully comparable with the debt reduction path. In particular, debt reduces from 100% to 90%, but now through a period of five years and the instrument paths follow closely to enforce pure strategies relying on a single instrument. Transfers still reduce from 10% to 5% of GDP, unproductive expenditure from 20% to 15% and productive expenditure from 2% to 1.5%.

Table 5.11 shows the results for the "cold shower" strategies and compares with the outcomes obtained for the gradual strategies (normal) in the previous section. "Cold shower" dominates gradual debt consolidation for the four strategies based on revenue, transfer, productive and unproductive expenditures. The positive effect in the revenue based strategy is rather small. In the transfer and unproductive expenditure-based cases, the effect is more significant and supported, essentially, on the level effect. Concerning the productive expenditure-based strategy, the "cold shower" option induces a slight positive welfare gain relative to the baseline case. This positive effect accrues mostly from the level effects.

		W_{level}	W_{ins}	W_{ine}	WG
Revenue	Normal	-0.0348	-0.0331	-0.0001	-0.0002
	Cold Show.	-0.0431	-0.0487	-0.0000	0.0005
Transfer	Normal	0.0167	-0.1098	-0.0008	0.0520
	Cold Show.	0.0240	-0.1140	-0.0007	0.0538
g_u	Normal	-0.0117	-0.1248	0.0065	0.0567
	Cold Show.	-0.0020	-0.1397	0.0068	0.0600
g_p	Normal	-0.1591	0.0533	0.0013	-0.1627
	Cold Show.	-0.1560	0.0365	0.0013	-0.1620

Table 5.11: Normal *versus* Cold Shower: comparative welfare analysis

As Table 5.11 shows, a "cold shower" strategy is more adequate for implementing a tax-based consolidation process. Figure 5.24 and 5.20 show the compared dynamics of a tax-based consolidation under "cold shower" (solid line) and a gradual strategy (dashed line), regarding major macroeconomic and inequality-related variables, respectively. The steeper path of debt induce an accelerated transition: interest rate rise is attenuated because the asset supply curve moves leftward more quickly. Consequently, private capital falls by less. Labour supply decreases and concurs with the private capital decrease, for the fall in output. The output falls more strongly but the trajectory to the final equilibrium occurs quickly. The same occurs with almost all the other variables including the inequality measure (Figure 5.20). In balance welfare impacts are slightly positive.

Figure 5.21 confirms the positive effect of the "cold shower" effect on overall welfare as well as on its distribution in the tax-based case. The "cold shower" welfare gain curve maintains a positive slope, indicating that the wealthier benefit more relative to the poorer. But, the slope is clearly lower relative to the gradual strategy, and turns to negative in the upper wealth levels. In the same graph we also plot the distributions in the first year of transition (they are not distinctive from one another). Both level and slope differences are non-negligible as most of the population is concentrated in the medium-to-low range of assets (see the plot of the population distribution

across wealth in the first year of transition in Figure 5.21).

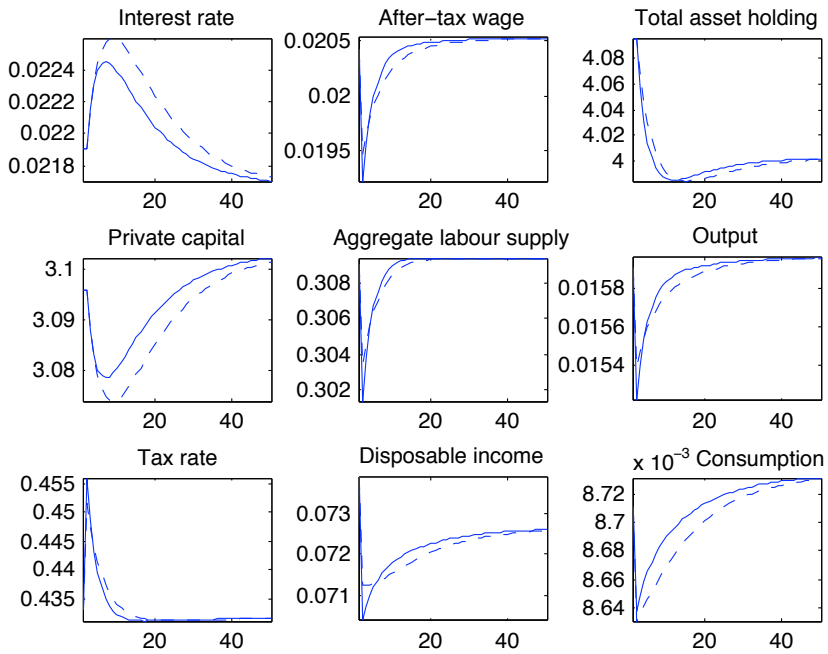


Figure 5.19: Revenue based strategy: normal (dashed line) *versus* cold shower (solid line)

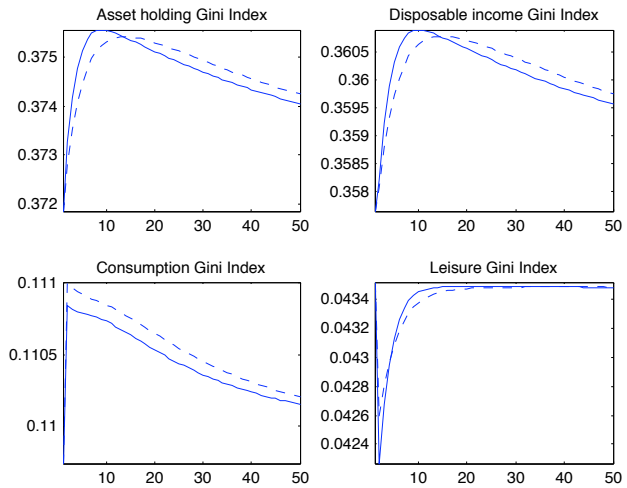


Figure 5.20: Gini coefficients under a Revenue based strategy: normal (dashed line) *versus* cold shower (solid line)

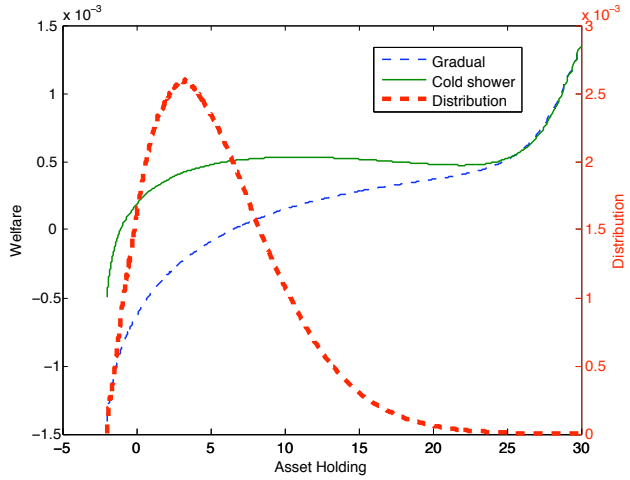


Figure 5.21: Welfare gains and wealth distribution under a tax-based strategy: Normal (dashed line) *versus* cold shower (solid line)

For the transfer and unproductive expenditure-based consolidation processes, the macroeconomic and inequality-related variables follows similar patterns described above. Like in the previous examples, the processes start running more suddenly and also have quicker stabilization. Interest rate doesn't rise as much and decays more intensively toward the new steady state equilibrium, with a clear advantage to the private capital accumulation and the activity of firms. Income and consumption, after sinking, recoup sooner and above the baseline case. Finally the Gini index doesn't rise so high, due to the accelerated process which wanes the humped shape curve.

The welfare analysis confirms the positive effect of the "cold shower" strategy in both transfer and unproductive expenditure-based cases benefiting all population. The level and inequality effects improve with the "cold shower" strategy because the recession is less severe. Tax and interest rate decrease quickly to their final steady state levels, benefiting relatively more the poorer. The insurance effect is affected negatively in both transfer and unproductive expenditure-based due to the stronger interest rate decay. Concerning the transfer-based case (Figure 5.22) the "cold shower" welfare gain curve stands above the gradual one, but keep a positive slope, meaning that the inequality effect continues to be negative. Figure 5.23 confirms the small increase of global welfare relative to the gradual strategy and also the same

positive inequality effect (the welfare gain curve slop continues to be positive, being inclusive steeper).

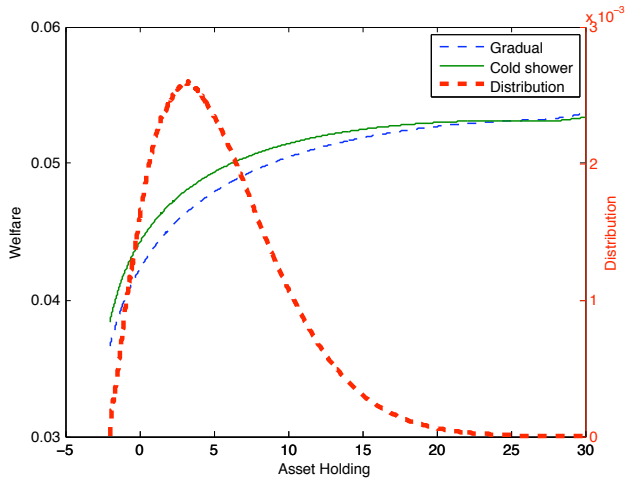


Figure 5.22: Welfare gains and wealth distribution under a transfer-based strategy: Normal (dashed line) *versus* cold shower (solid line)

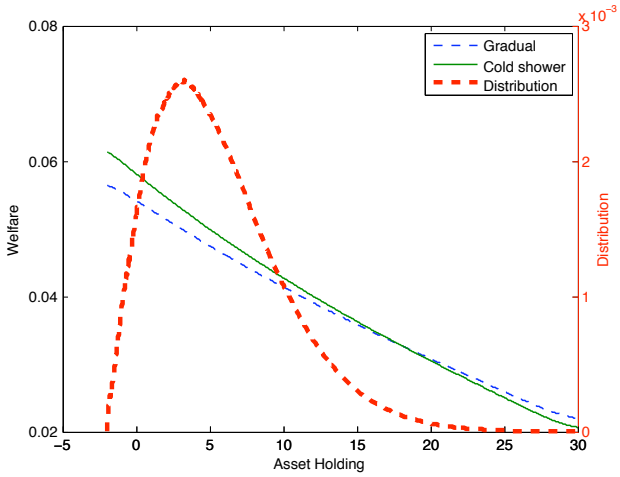


Figure 5.23: Welfare gains and wealth distribution under a unproductive expenditure-based strategy: Normal (dashed line) *versus* cold shower (solid line)

Figures 5.24 and 5.25 plot the path of mixed productive and unproductive expenditures-based consolidation, comparing the "cold shower" strategy

(solid line) with the baseline case (dashed line), in order to match the correspondent debt reduction from 100% to 90% of GDP. Both paths are very close and dominated by the productive expenditure cut. Despite the tax rate decrease allowed by the consolidation process, output, disposable income and consumption fall deeply due to the reduction of the global productivity. The welfare effect of the "cold shower" is positive due to the level effect while the insurance effect is negative and the inequality one is inexistent. Figure 5.26 plot both welfare gain curve across wealth. The "cold shower" curve stands slightly above the baseline curve and both slops continue to be negative. Both curves show clearly that the mixed expenditure based strategy on productive and unproductive expenditures is harmfull for all households and in both "cold shower" or gradual intensity.

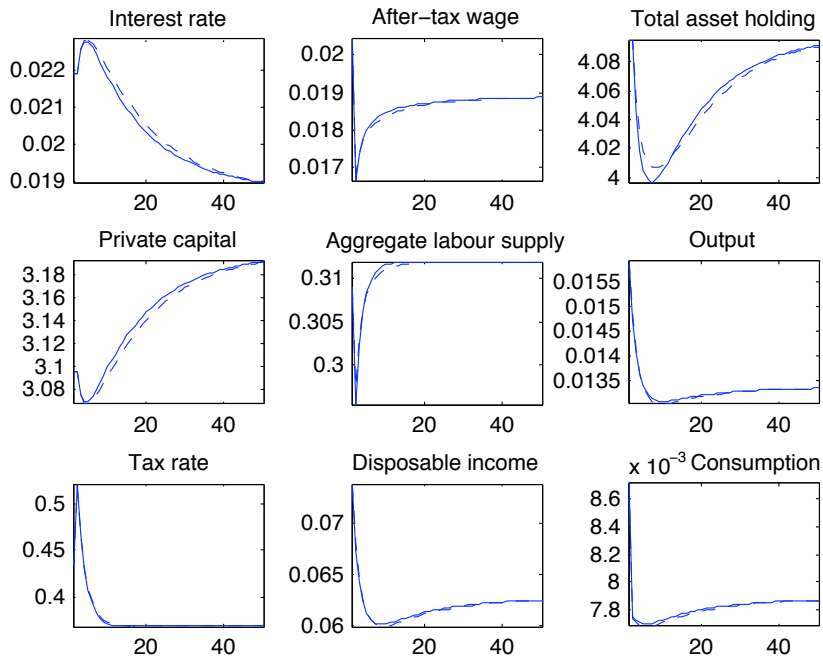


Figure 5.24: Mixed productive and unproductive expenditure-based strategy: normal (dashed line) *versus* cold shower (solid line)

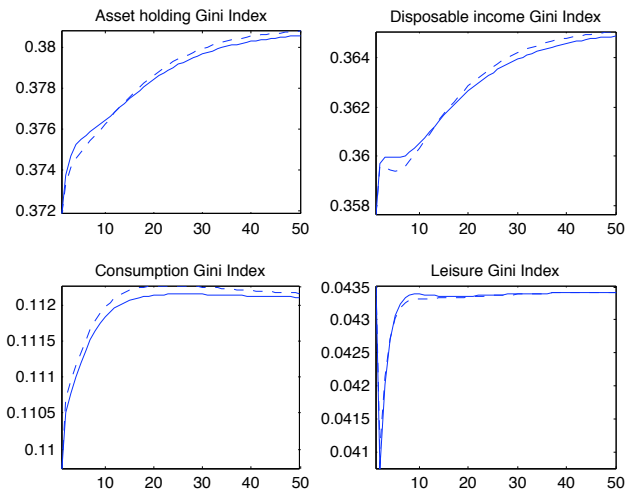


Figure 5.25: Gini coefficients under a mixed productive and unproductive expenditure-based strategy: normal (dashed line) *versus* cold shower (solid line)

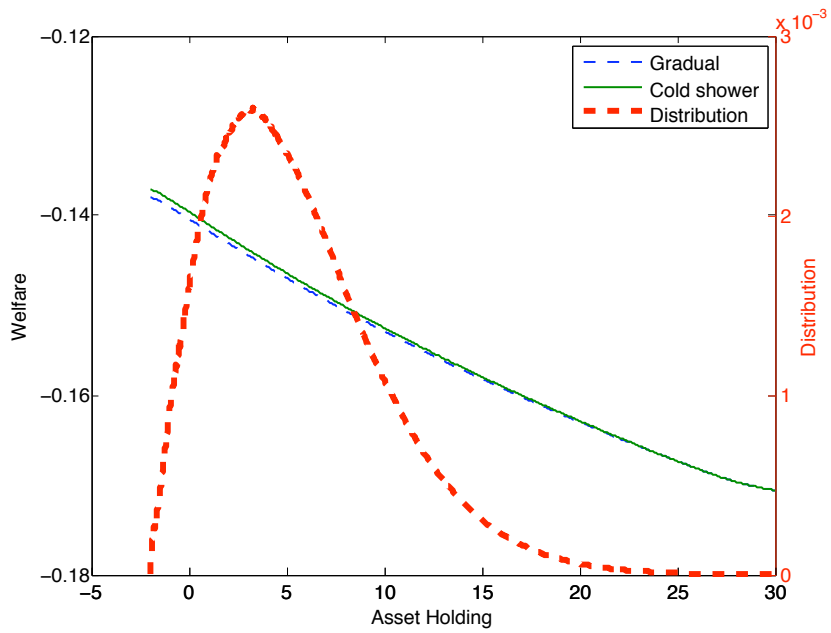


Figure 5.26: Welfare gains and wealth distribution under a mixed productive and unproductive expenditure-based strategy: Normal (dashed line) *versus* cold shower (solid line)

5.2 The open economy

Until now we have considered a single closed economy isolated from any external influence. In this section we proceed with considering two open economies in order to simulate transitions in an international framework with closely integrated economies. We believe that, for instance, this extension represents a more adequate description of the economies belonging to the Economic and Monetary Union (EMU). In particular, we only analyze the impacts in the model arising from complete financial integration, that is, those resulting from a common equilibrium interest rate. In this context, labour and goods and services markets are not integrated and only capital (private and public) flows freely across borders, clearing the aggregate asset market.

We assume that the two countries only differ in population size. The mass of agent is 0.1 in the small country and 0.9 in the large country (representing, for instance, the remaining countries of the EMU).We also assume the same productivity in both countries in order to simplify the analysis, despite the possibility conferred by the model to include in the production function a country-specific global productivity parameter (as in Quadrini et al. (2009)). In what follows we propose eight scenarios of consolidation resulting from combining the four alternative consolidation strategies, as defined before, with the consolidation process being implemented , alternatively by each country (large or small).

The global capital market with both asset demand and supply curves of the two economies is represented in Figure 5.27. The left cross represents the small economy and the right one the large one. Under a common interest rate, the asset demand equals the asset supply in each country and the financial account (net asset position) is balanced in each country. The flow of capital from abroad contributes positively to the financial account of a given country: the foreign ownership of domestic asset increases and the domestic country ends up with a negative net foreign asset position. When capital flows out of the country, the domestic ownership of foreign asset increases, resulting in a deficit in the financial account or a positive net foreign asset position.

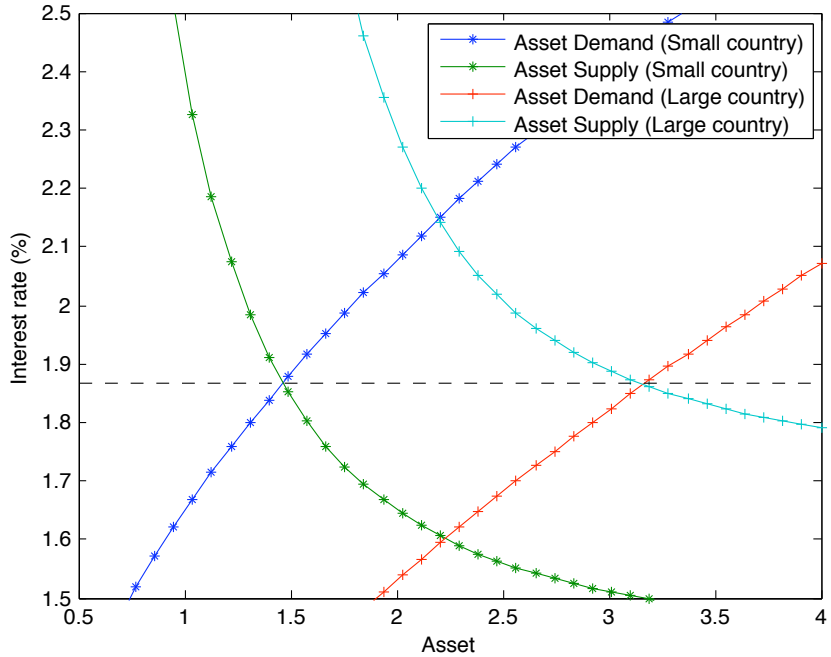


Figure 5.27: Initial steady state equilibrium in the asset market

5.2.1 Revenue based strategy

Following a pure tax-based consolidation process, we apply the debt-to-output ratio reduction path defined above, alternatively to the large and the small country while assuming that the other country reacts passively to the consolidation effort[2].

The large country consolidates

In this first exercise, the large economy implements the debt consolidation process. The small economy acts passively. The analysis is similar to the one for a closed economy except for the fact that now each country may accumulate negative or positive net foreign asset positions.

[2]This means that all policy parameters remains constant throughout all transition period: $\{tr_t, g_{ut}, g_{pt}\}$.

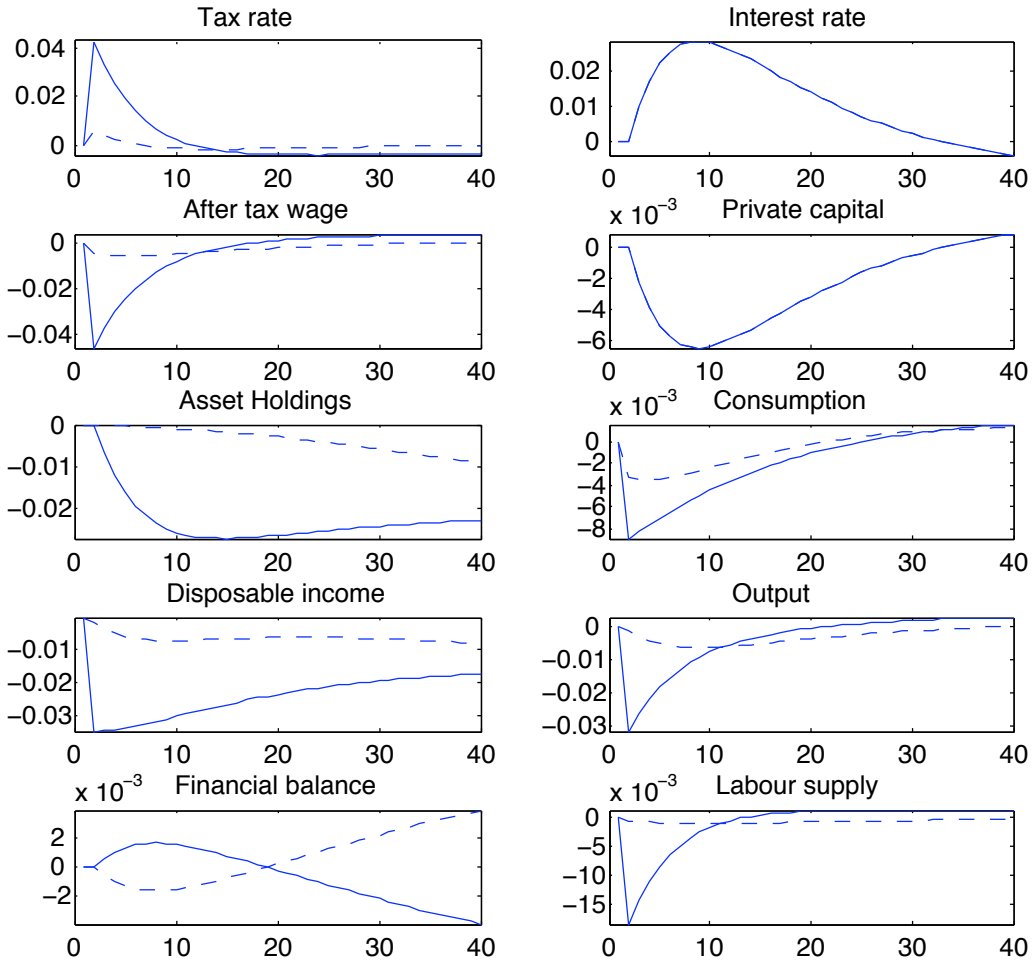


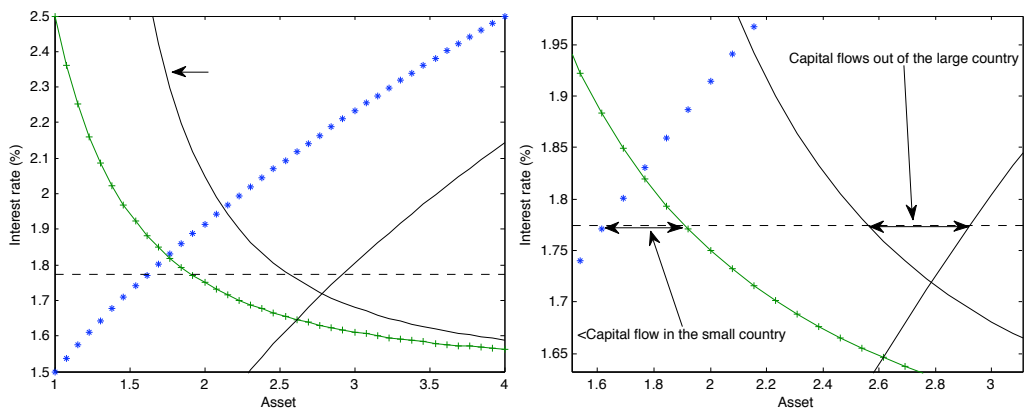
Figure 5.28: Dynamics of macroeconomic variables when the large economy implements a revenue-based consolidation: large country (solid line) and small country (dashed line)

Figure 5.28 shows the dynamics of the macroeconomic variables for each country, following a tax-based consolidation process in the large country (except for the financial account the variables are expressed in percentage deviation relative to the initial steady state). For the latter (solid line), the dynamics are similar to those in the closed economy framework.

Despite the absence of any consolidation process, the small economy bears a burden when the large economy consolidates. The recession caused by the interest rate rise is inevitable and requires a rise on the tax rate and, consequently a fall in disposable income. Tax rate ends up returning to its

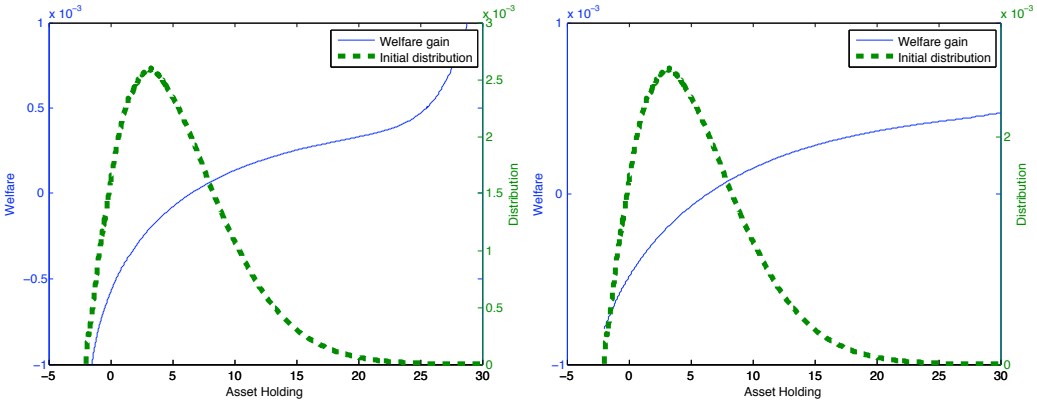
previous level because debt remains constant.

The capital movements across boarders reflect the dynamics of asset demand and supply in each country. During the first part of the transition, the income loss causes a contraction of the asset demand in the large economy. Asset supply exceeds demand and capital flows from the small to the large economy. The financial account of the large country becomes positive (negative foreign asset position) while that of the small country becomes negative (positive foreign asset position). Throughout the rest of transition, asset demand returns to its previous level in the large economy but the asset supply remains below initial steady state because of the permanent debt reduction and the interest rate falls below the initial steady state level. Figure 5.29 illustrate the final steady state where asset demand exceeds supply in the large economy, while the small economy where asset demand doesn't cover the domestic asset supply experiences the opposite: capital flows from the large country to the small one. The financial account ends negative in the large economy and positive in the other.



(a) Normal (b) Zoom

Figure 5.29: Final steady-state equilibrium in the asset market following a revenue-based consolidation in the large country



(a) Large country (b) Small Country

Figure 5.30: TheWelfare gain distribution across wealth when the large country follows a revenue-based consolidation

Regarding welfare decomposition, the consolidation plan is, as in the closed economy framework, harmful in all components for the large country (see Table 5.12). The consolidation plan drifted by the large economy also affects negatively the small economy. The latter faces a welfare loss due to the negative impact of the large country consolidation on the interest rate supported without enjoying the benefit of reducing debt. The welfare gain (or loss) against wealth (see Figure 5.30) repeats the same pattern shown in the closed economy case: the consolidation process harms deeply the poorer in both countries. These inequality effects are unambiguous since consolidation has not significantly changed the wealth distribution in both countries (results not reported).

Welfare decomposition	W_{level}	W_{ins}	W_{ine}	WG
	Large economy			
Transition + Final SS	-0.0343	-0.0333	-0.0000	-0.0002
Final Steady State	0.0054	-0.0002	0.0002	0.0023
	Small economy			
Transition + Final SS	-0.0044	0.0021	-0.0001	-0.0002
Final Steady State	0.0024	-0.0002	0.0002	-0.0010

Table 5.12: Welfare decomposition analysis when the large country follows a revenue-based consolidation

The small country consolidates

Now we consider the same revenue-based debt consolidation in the small economy. The large country, acting passively, is less affected by the debt consolidation process in the small country which has a small impact on the international capital market and on the equilibrium interest rate.

For the small country, where the consolidation occurs, the dynamic of the main macroeconomic variables are similar to those of the closed economy case (Figures 5.31). The transition path is dominated by the stressed tax peak necessary to match the debt reduction. The net wage falls deeply and so does the labor supply. Asset holding demands decreases and the interest rate climbs. Private capital falls and concurs with the labour supply retreat to a deep recession. After the debt has been reduced, all variables evolve gradually to the final steady state level. Interest rate and tax rate end in a level under the initial steady state.

The difference is mainly of quantitative order as the debt reduction impact is dissolved in the international capital market: the interest rate peak is smaller and the recession is less intense. Obviously, and due to the scale effect the impact of the debt consolidation plan on the large economy is very small (see Figure 5.31). Except for the capital movement, all the other variables changes in a negligible way.

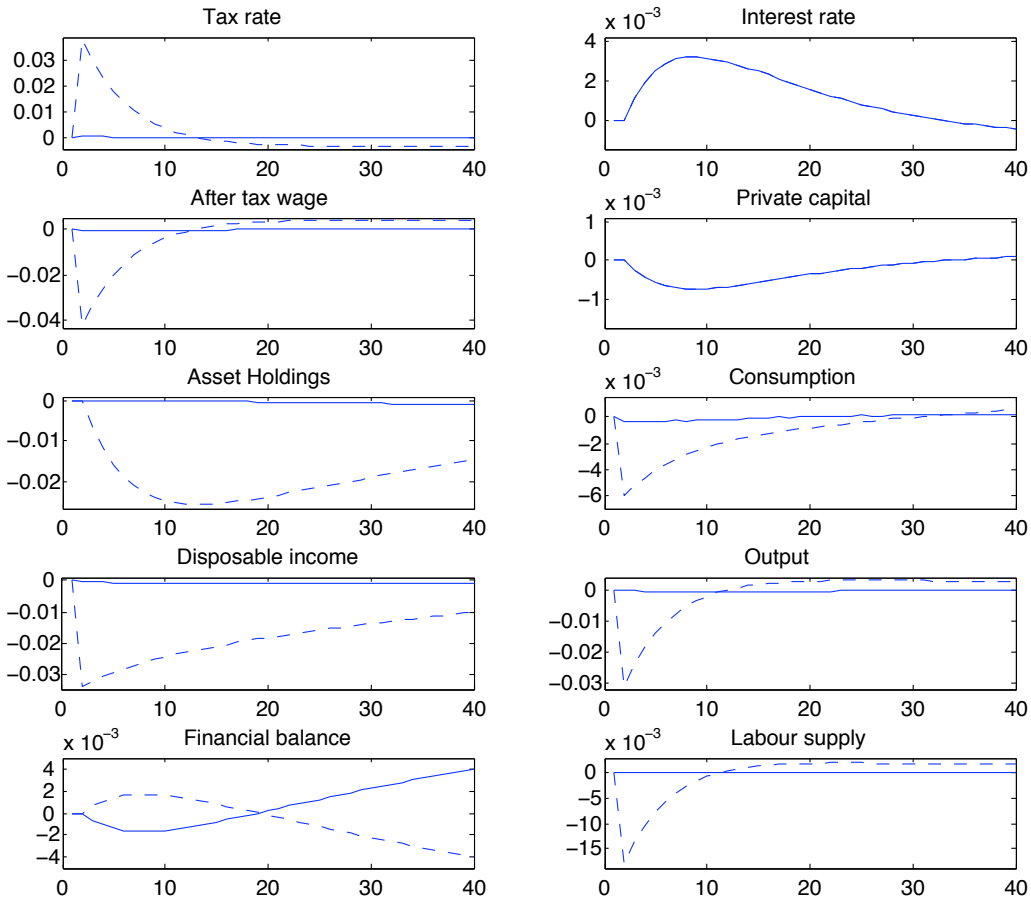
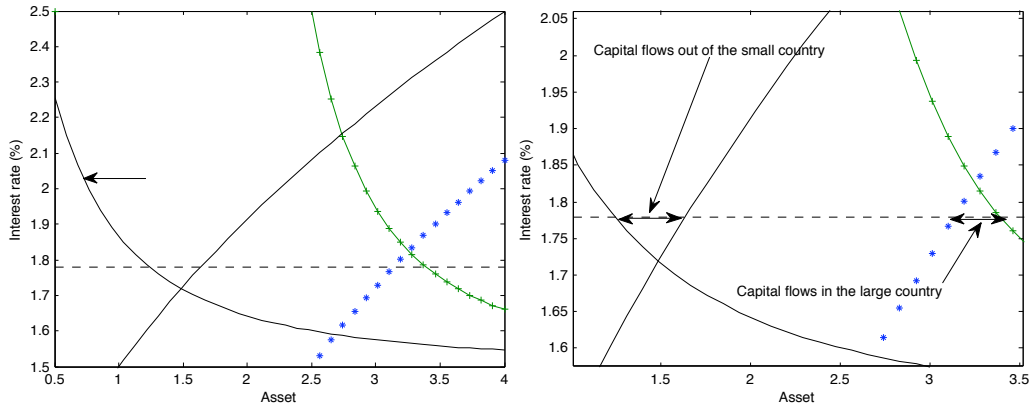


Figure 5.31: Dynamics of macroeconomic variables when the small economy implements a revenue-based consolidation: large country (solid line) and small country (dashed line)

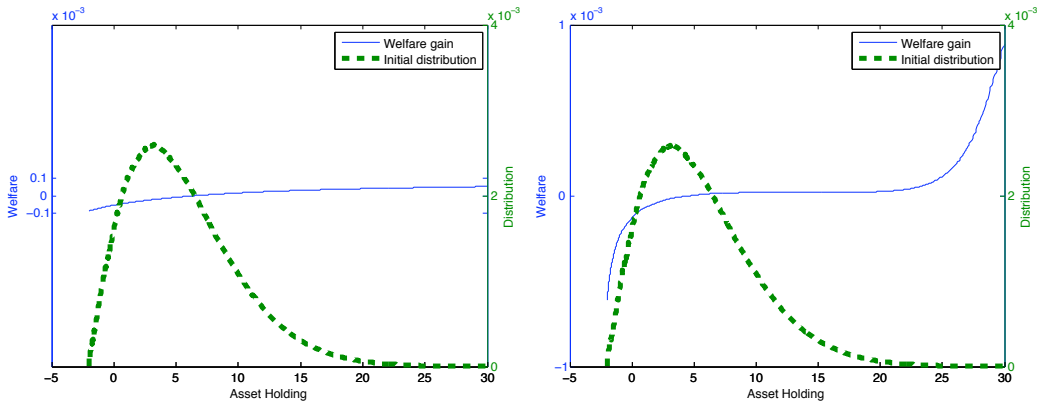
The situation concerning the capital movement is symmetrical when compared to the previous case (see Figure 5.32). During the initial part of transition, when the tax effort moves the asset demand to the left, the asset supply surpasses demand and capital flows into the small country, with foreign agents buying domestic assets. The financial account in the small economy shows a surplus whereas in the large economy it becomes negative. The situation is reversed as both economies evolve to the final steady state: the asset demand curve returns to its previous level in the small economy, but the supply curve remains leftward because of the permanent reduction of debt. Figure 5.32 shows the final steady state equilibrium, with a lower interest

rate. The asset demand exceeds supply in the small economy (financial account deficit) from which capital will flow to the large economy (financial account surplus) where the asset supply surpasses demand.



(a) Normal (b) Zoom

Figure 5.32: Final steady-state equilibrium in the asset market following a revenue-based consolidation in the large country



(a) Large country (b) Small country

Figure 5.33: TheWelfare gain distribution across wealth when the small country follows a revenue-based consolidation

Welfare decomposition	W_{level}	W_{ins}	W_{ine}	WG
	Large economy			
Transition + Final SS	-0.0005	0.0002	-0.0000	-0.0000
Final Steady State	0.0003	-0.0000	0.0000	-0.0001
	Small economy			
Transition + Final SS	-0.0305	-0.0352	0.0000	0.0001
Final Steady State	0.0033	0.0000	-0.0001	0.0032

Table 5.13: Welfare decomposition analysis when the small country follows a revenue-based consolidation

As expected the welfare analysis reveals a negligible effect on the large economy due to the small impact of the small economy consolidation plan (see Table 5.13). However, the welfare analysis of the small country points out an interesting aspect: contrary to the closed economy case, a revenue-based consolidation plan is barely welfare enhancing for a small open economy. Comparing with the closed economy case, we have seen that the impact of debt reduction and the corresponding tax and interest rate peaks are smaller. This means that the impact on private capital is now weaker and the recession smaller. This explains the improvement in the level and inequality welfare effect (a rise on interest rate is harmful to the poorer while it benefits the richer) relative to the closed-economy case (compare Tables 5.12 and 5.13).

The welfare gain distribution across wealth (see figure 5.33) exhibits a flatter curve for both countries compared with the closed-economy outcome. Also in this case, wealth distribution remains rather stable in both countries (results not reported).

5.2.2 Expenditure based strategy: social transfers

As before, in the closed-economy case, we set exogenous debt and transfer reducing paths as to simulate a pure expenditure strategy[3]. As in section 5.2.1, the strategy applies alternatively to the large and small country.

[3]see section 5.1.2 for the closed economy case.

The large country consolidates

In this first simulation the large economy follows with the consolidation process while the small economy acts passively, maintaining the same policy parameters. Figure 5.34 illustrates the dynamics of the main macroeconomic variables throughout the transition in both countries.

For the large country, which consolidates, the dynamic is similar to that exhibited in the closed-economy scenario (resulting from a scale effect and despite a slight dilution effect). Contrary to the disincentive scenario of the pure revenue-based strategy which affects negatively the capital accumulation and labour supply, the transfer-based consolidation encourages labour supply and savings. Concerning capital flows, the tendency is similar to the revenue-based case except for the smaller financial surplus in the large country during the initial phase of transition (the asset demand curve retreat in the large country is smaller).

With regard to the small economy the transition is driven by the interest rate and the financial account dynamic. The interest rate and private capital path are common to those in the large economy. Tax rate decreases slightly and progressively returns to its previous level, reflecting the impact of the interest rate dynamics on the debt service. Households sell assets as interest rate decreases, boosting private consumption and causing a sudden fall in labour supply. The trajectory of disposable income reflects mostly the decrease in the asset holdings and the corresponding loss of capital earning. After-tax wage and labour supply are determined by the tax rate path and return close to the initial steady state levels.

As for the financial account, the fall in the interest rate will increase the supply of asset from the private sector (since public debt is constant), and reduce the asset demand of households (saving becomes less interesting) in the small country. Net supply of assets is absorbed in the international market and the financial account exhibits a surplus as foreign agents buy domestic assets. In contrast, the large economy will present a symmetric situation with a positive net asset demand and capital will flow outwards.

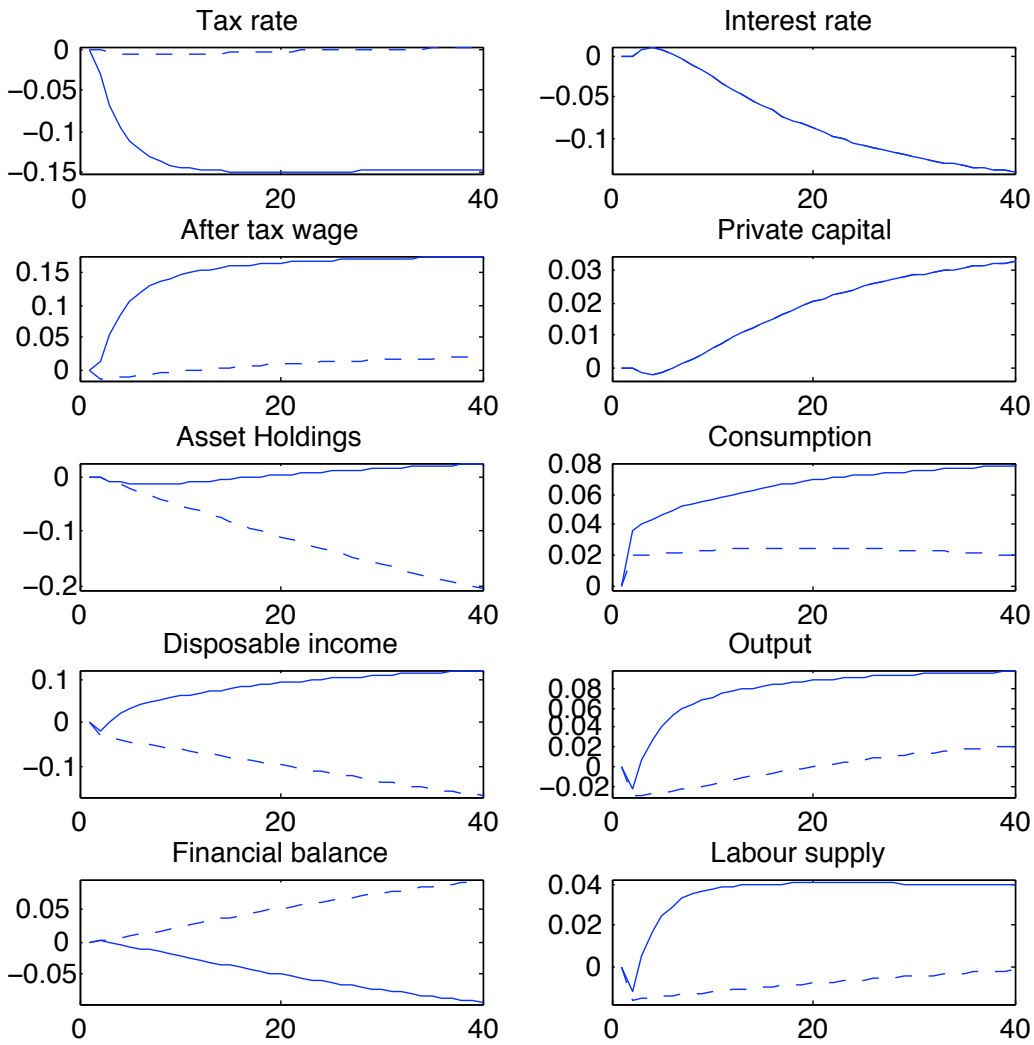
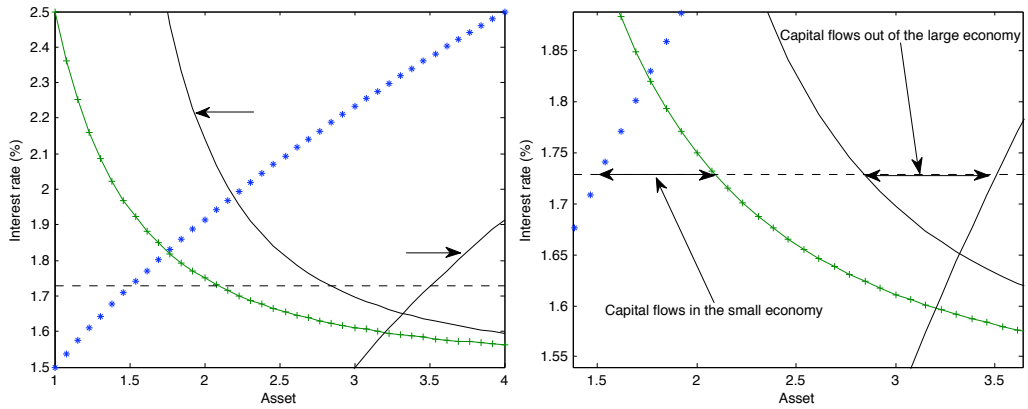


Figure 5.34: Dynamics of macroeconomic variables when the larger economy implements a transfer-based consolidation: large country (solid line) and small country (dashed line)

Figure 5.35 shows the final steady-state equilibrium in the asset market. Compared with the revenue-based strategy, the asset demand curve ends more rightward because the income effect is larger. Thus, interest rate further decreases, increasing the imbalance between asset supply and demand in each country. Consequently the quantity of capital flowing from the large to the small country is larger than under the revenue-based strategy. This increased quantity of capital flowing in the small country also affects the wealth and

income distribution. The lower wealth classes sells assets and, as shown in Figure 5.36 and Table 5.14, the wealth Gini index increases significantly in the small country, which in turn, affects the disposable income Gini index. These redistributive impacts in the small country are important in an open economy framework, especially for the expenditure-based strategies as shown in the sub-sections below.



(a) Normal (b) Zoom

Figure 5.35: Final steady-state equilibrium in the asset market following a transfer-based consolidation in the large country

The welfare analysis reveals that the consolidation is welfare enhancing for both countries (Table 5.15). For the large country, the positive welfare gain is slightly inferior to the one obtained in the closed economy case because of the dilution effect (note that the cost of transition is superior: $0.0617 - 0.0503 = 0.0114$). The level effect is positive because the economy produces more, the insurance effect is negative because of debt and interest rate reduction and the inequality effect is also negative because of direct impacts of the reduction in transfer. For the small country, the global welfare is also positive, exhibiting only insurances costs. Curiously the final steady state level of the small economy represents a worse equilibrium compared with the initial steady state. This may reflect the permanent outflow of capital earnings resulting from the capital ownership by foreigners.

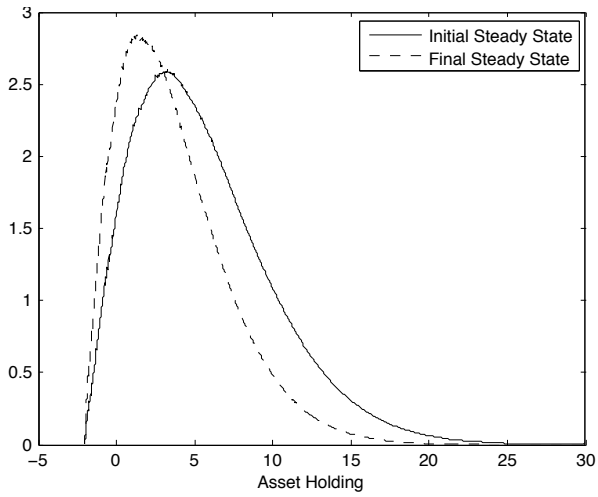
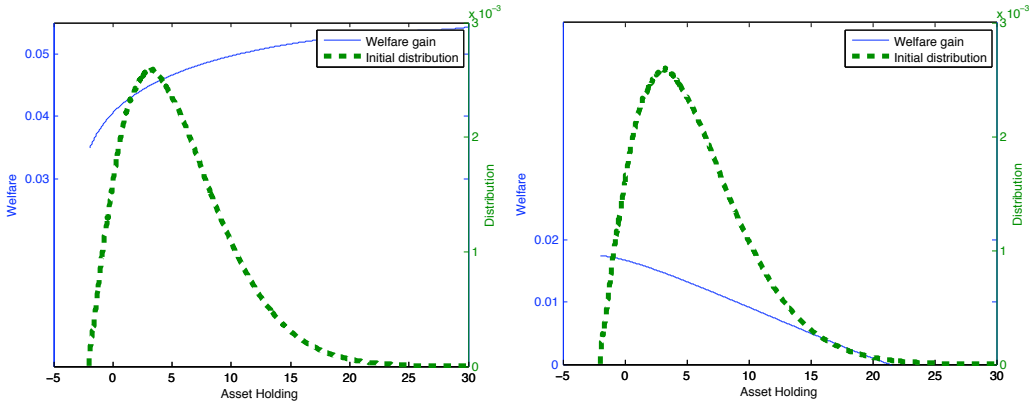


Figure 5.36: The initial and final wealth Distribution when the larger economy implements a transfer-based consolidation: small country

	Large economy			Small economy		
	CG	WG	IG	CG	WG	IG
Initial S.State	0.1097	0.3719	0.3577	0.1097	0.3719	0.3577
Final S.State	0.1183	0.3707	0.3662	0.1140	0.3959	0.3768

Table 5.14: Inequality measures when the larger economy implements a transfer-based consolidation

The distribution of welfare across wealth confirms the results obtained in the closed economy case. In the large economy where the consolidation occurs, the global welfare gain is positive for all population but larger for the richer (see Figure 5.37a). This is the direct consequence of the reduction in social transfers. In the small country (see Figure 5.37b), the global welfare gain is also positive but instead, affects more the poorer. This is mainly due to the interest rate fall which benefits the indebted relatively to net capital holders.



(a) Large country (b) Small country

Figure 5.37: TheWelfare gain distribution across wealth when the large country follows a transfer-based consolidation

Welfare decomposition	W_{level}	W_{ins}	W_{ine}	WG
	Large economy			
Transition + Final SS	0.0171	-0.1033	-0.0009	0.0503
Final Steady State	0.1730	-0.0029	-0.0042	0.0617
	Small economy			
Transition + Final SS	0.0032	-0.0612	0.0006	0.0163
Final Steady State	-0.0440	-0.0039	0.0037	-0.0059

Table 5.15: Welfare decomposition analysis when the large country follows a transfer-based consolidation

The small country consolidates

As before, let us apply the transfer based strategy to the small country. The transition paths of the variables (Figures 5.38) are obviously similar to the closed economy case. Due to the small size of the economy, the impact of the debt consolidation is minimal on interest rate, which is internationally set. Thus the impact on the large economy is practically inexistent. However the slight decrease of interest rate provokes an excess of asset supply in the large country. As the consolidation proceeds, capital flows outward the small

country to the large one, and the financial account presents a deficit in the small country and a surplus in the large economy.

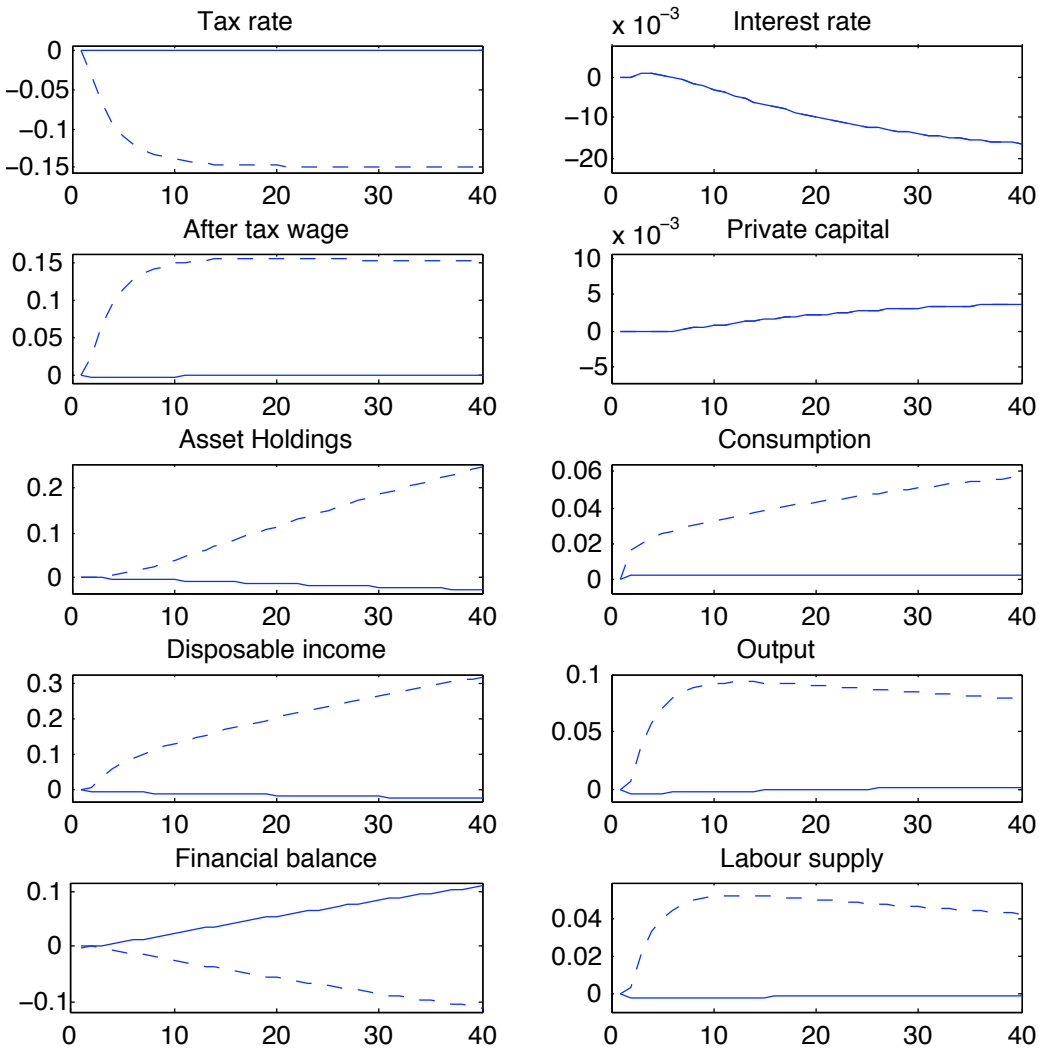
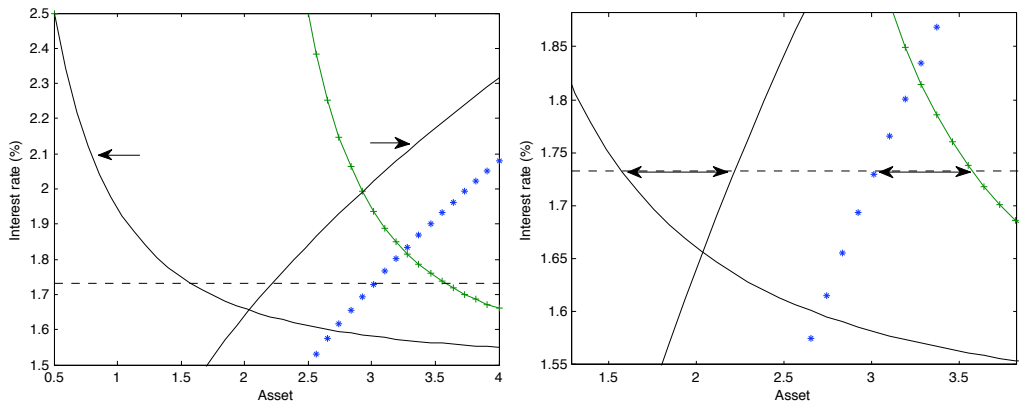


Figure 5.38: Dynamics of macroeconomic variables when the smaller economy implements a transfer-based consolidation: large country (solid line) and small country (dashed line)

Figure 5.39 shows the final steady state equilibrium. Because tax-cut effect dominates transfer reduction, asset demand curve moves rightward. The asset supply moves to the opposite direction due to the debt reduction. This excess of asset demand is filled with foreign assets and corresponds to a

flow of capital outward, from the small economy to the large one, where the decrease of interest rate causes an excess of asset supply.



(a) Normal (b) Zoom

Figure 5.39: Final steady-state equilibrium in the asset market following a transfer-based consolidation in the small country

The capital flow outward from the small country has a significant impact on wealth and income distribution. The aggregate asset holding rise in the consolidating economy (by buying foreign assets from the large country), affecting mostly the fraction of population with negative asset position in which the propensity to save is higher. Both wealth and income Gini indexes decreases (see Table 5.16 and Figure 5.40).

As before, a transfer-based consolidation by a small country is welfare enhancing for both economies (Table 5.17). As it would be predictable, the global welfare gain in the small economy is inferior to the closed economy case, due to the dilution effect. The welfare decomposition is similar to that of the closed economy, with a positive level effect (because the economy produces more), a negative insurance effect (debt and interest rate reduction) and a negative inequality effect caused by the transfer reduction. The welfare impact on the large economy is positive, although welfare in the final steady state is negative for the passive economy, reflecting, as the previous scenario, the outflows of capital earnings due the foreign ownership of domestic capitals.

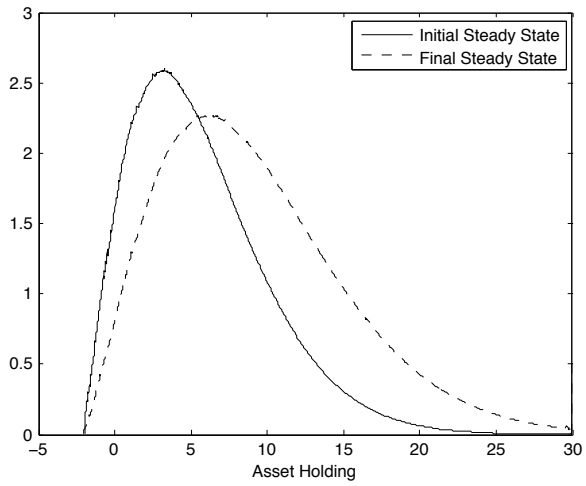
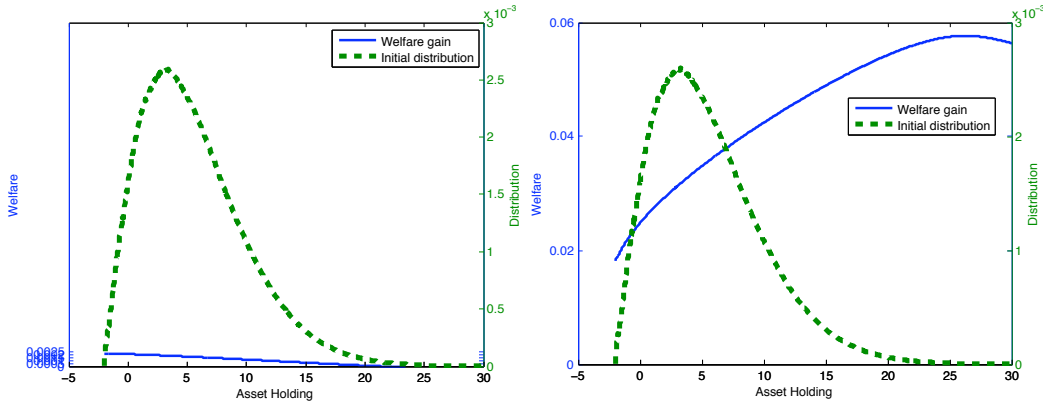


Figure 5.40: The initial and final wealth Distribution when the smaller economy implements a transfer-based consolidation: small country

	Large economy			Small economy		
	CG	WG	IG	CG	WG	IG
Initial S.State	0.1097	0.3719	0.3577	0.1097	0.3719	0.3577
Final S.State	0.1103	0.3759	0.3609	0.1149	0.3448	0.3345

Table 5.16: Inequality measures when the smaller economy implements a transfer-based consolidation

The situation concerning the welfare gain distribution among households is symmetric to the previous case. In the consolidating economy (the small country) everyone improves their situation but the wealthier benefit relatively more (Figure 5.41b). The global welfare gain in the passive economy is much smaller, but it still benefits relatively more the poorer reflecting the interest rate effect.



(a) Large economy accomodates (b) Small economy consolidates

Figure 5.41: The Welfare gain distribution across wealth when the small country follows a transfer-based consolidation

Welfare decomposition	W_{level}	W_{ins}	W_{ine}	WG
	Large economy			
Transition + Final SS	0.0003	-0.0079	0.0001	0.0021
Final Steady State	-0.0063	-0.0006	0.0006	-0.0023
	Small economy			
Transition + Final SS	0.0202	-0.0413	-0.0017	0.0355
Final Steady State	0.1343	0.0016	-0.0086	0.0944

Table 5.17: Welfare decomposition analysis when the small country follows a transfer-based consolidation

5.2.3 Expenditure-based strategy: unproductive spending

We still assume that unproductive spending is welfare enhancing ($\vartheta = 0.1$). This strategy follows a consolidation using an exogenous d and g_u path as in the closed economy case (debt reduces from 100% to 90% and unproductive expenditure from 20% to 15%) in order to simulate a pure expenditure-based strategy.

The large economy consolidates

The analysis of Figure 5.42 reveals the same dynamics as in the closed economy case for the large economy. First and to compensate for the direct loss of utility, households sell assets and increase their private consumption and second, they switch labour to leisure. Afterward, as tax and interest rate decreases, labour supply and private capital recover and output moves accordingly.

The small economy (see Figure 5.42) suffers a recession caused by the interest rate rise. Tax rate rises in response to the increased public debt services and to the drop of economic activity. After tax wage falls and so does labor supply. As the consolidation process evolves, tax rate falls and so does interest rate. Aggregate asset holdings decrease, pushing down the household disposable income. The increase in the level of consumption confirms that households are saving less due to the fall in the interest rate and despite the negative income effect.

Globally, with this consolidation strategy, there is a replacement of public consumption for private consumption. As the government size contracts, tax rate decrease, and the private sector enlarges augmenting the production, wages and the households disposable income.
Figure 5.43) describes the asset market dynamic. The first ten years of transition (Figure 5.43a) corresponding to the debt reduction. Both asset demand (due to the income loss) and supply (due to the public debt reduction) curves move to the left, but the demand effect is stronger pushing interest rate up. Capital flow from the small to the large country. Afterward (Figure 5.43b), while the supply curve stabilizes, the demand curve moves back to the right overshooting the initial level. Interest rate falls and capital flows from the large to the small economy.

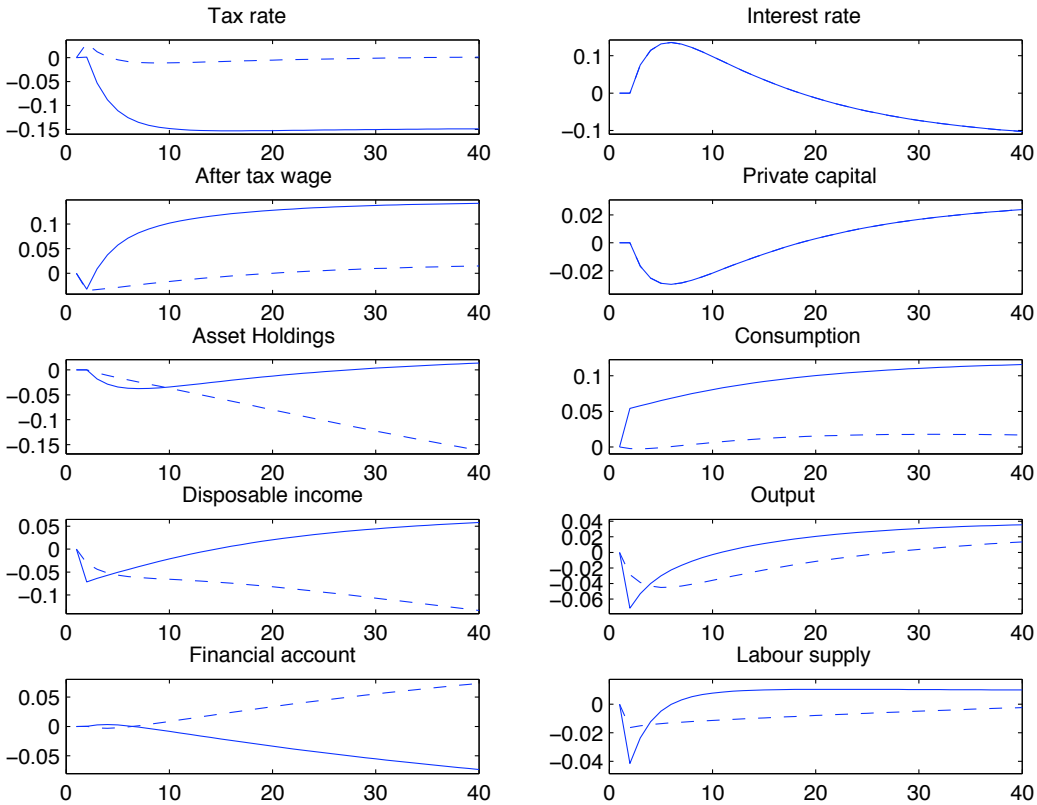
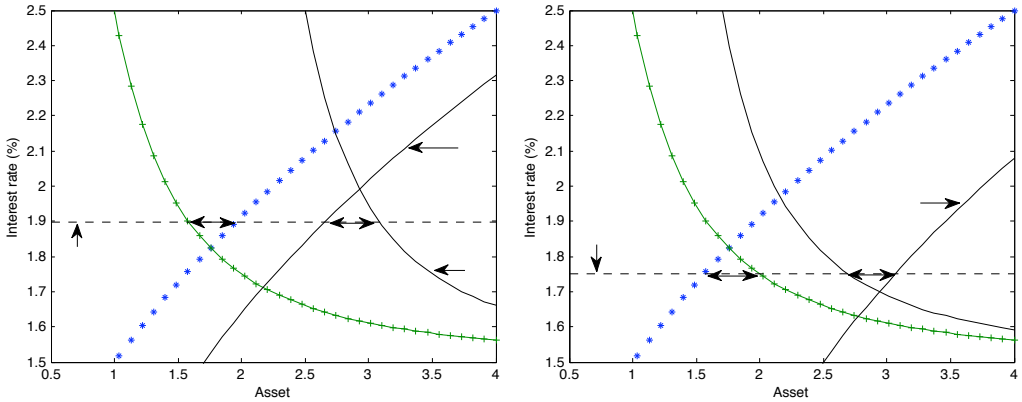


Figure 5.42: Dynamics of macroeconomic variables when the larger economy implements an unproductive expenditure-based consolidation: large country (solid line) and small country (dashed line)

The capital flow into the small country has the same impact on wealth and income distribution as the transfer-based strategy lead by the large economy (section 5.2.2). The aggregate asset holdings decrease in the small country (by selling assets to the large country households), affecting mostly the fraction of population with negative asset position. Both wealth and income Gini indexes decreases.

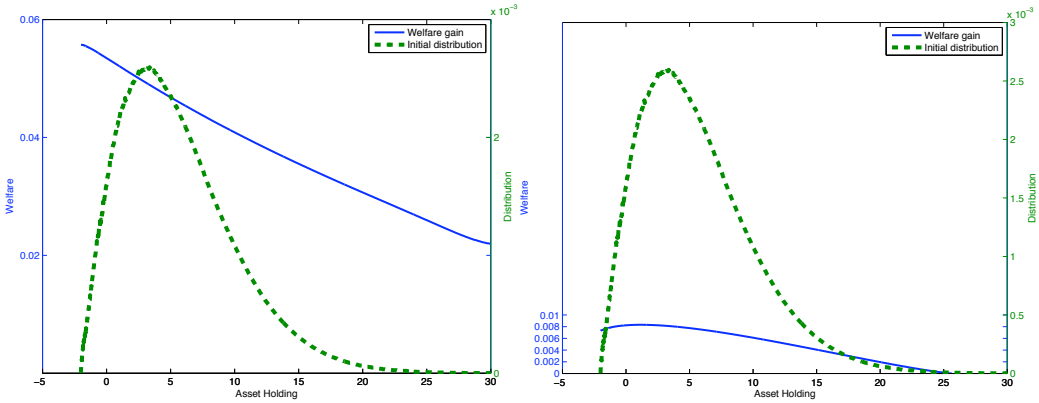


(a) First period Transition

(b) Final steady state

Figure 5.43: Dynamics of the asset market following an unproductive expenditure-based consolidation in the large country

The consolidation strategy is welfare enhancing in both economies (see Table 5.18). In the large economy and in line with the previous simulations, international capital flows reduce welfare gains in relation to a closed economy. The welfare decomposition reveals a negative level effect caused by the recession due to the hump shaped trajectory of interest rate. The uncertainty effect is also negative reflecting the asset selling and the interest rate fall. The inequality effect is positive reflecting a more equal distribution of welfare among population. This can also be seen in Figure 5.44a: welfare gains accrue relatively more to the poorer than to the richer. The small economy presents a similar pattern. The global welfare gain is positive, but smaller, and benefits relatively more the poorer. However the recession is relatively more severe and thus, the level effect is even more negative than in the large economy. The positive inequality effect in the small country can also be seen in Figure 5.44b. A bracket is in order relative to the inequality effects. The labour supply and the asset selling (more elastic among the richer and the poorer respectively) absorb most of the shock with a view to substituting public for private consumption while increasing inequality. Leisure inequality (results not reported) has the reverse effect on inequality and compensates in the global welfare.



(a) Large country (b) Small country

Figure 5.44: The Welfare gain distribution across wealth when the large country follows an unproductive expenditure-based consolidation

Welfare decomposition	W_{level}	W_{ins}	W_{ine}	WG
	Large economy			
Transition + Final SS	-0.0089	-0.1169	0.0009	0.0559
Final Steady State	0.1109	-0.0012	0.0001	0.0706
	Small economy			
Transition + Final SS	-0.0258	-0.0366	0.0002	0.0089
Final Steady State	0.0363	-0.0033	0.0031	-0.0062

Table 5.18: Welfare decomposition analysis when the large country follows an unproductive exenditure-based consolidation

The small economy consolidates

In the next simulation the small economy consolidates using the same unproductive based strategy, while the large economy reacts passively.

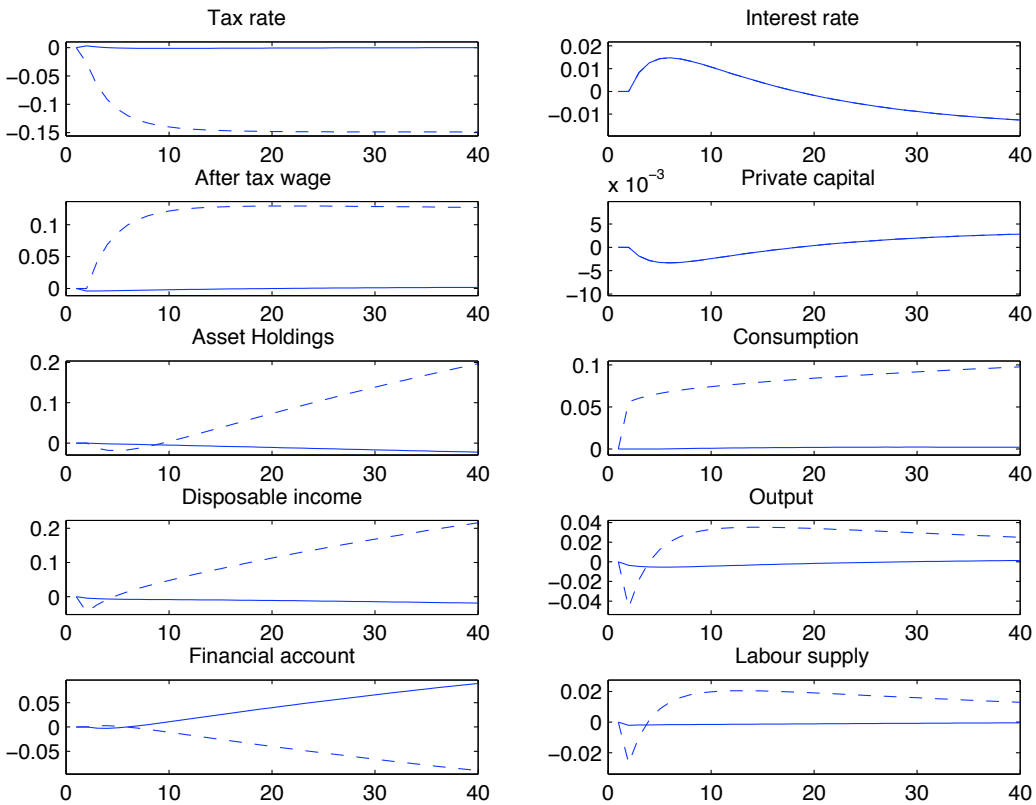


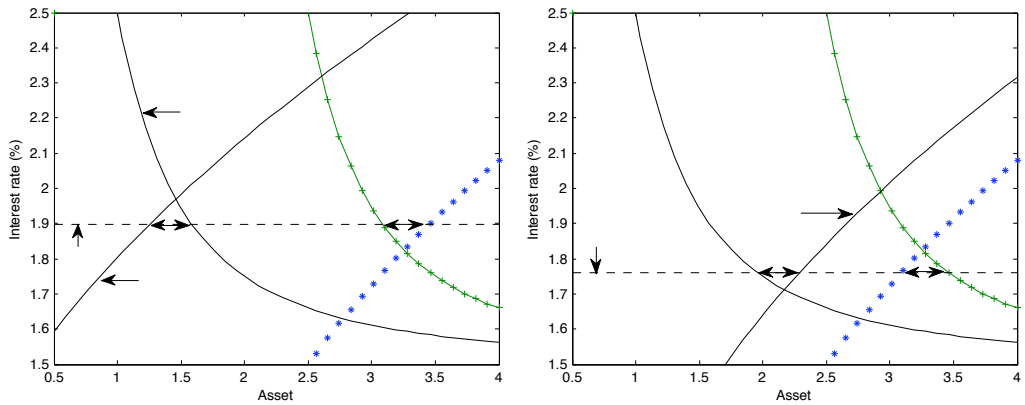
Figure 5.45: Dynamics of macroeconomic variables when the smaller economy implements an unproductive expenditure-based consolidation: large country (solid line) and small country (dashed line)

The dynamic is obviously very similar except for the reduced impact of the debt consolidation on international fixed interest rate (see Figure 5.45). This makes the transition much more favorable for a small economy when compared to the closed-economy case.

During the first ten years of transition (Figure 5.46a), both asset demand and supply curves move to the left in the small country where the consolidation process occurrs, but the demand effect is stronger pushing interest rate up. Capital flows from the large to the small country. Afterwards (Figure 5.46b), the supply curve stabilises but the demand curve moves back to the right exceeding the initial level. Interest rate falls down and capital flows from the small economy to the large one.

This important outflow of capital, and the consequent deficit in the small

country's financial account have important impacts on wealth distribution which is very similar to those described in the transfer-based consolidation strategy lead by the small country in section 5.2.2. As the financial account deficit grows, wealth and income Gini index decrease, improving both distributions.



(a) First period Transition (b) Final steady state

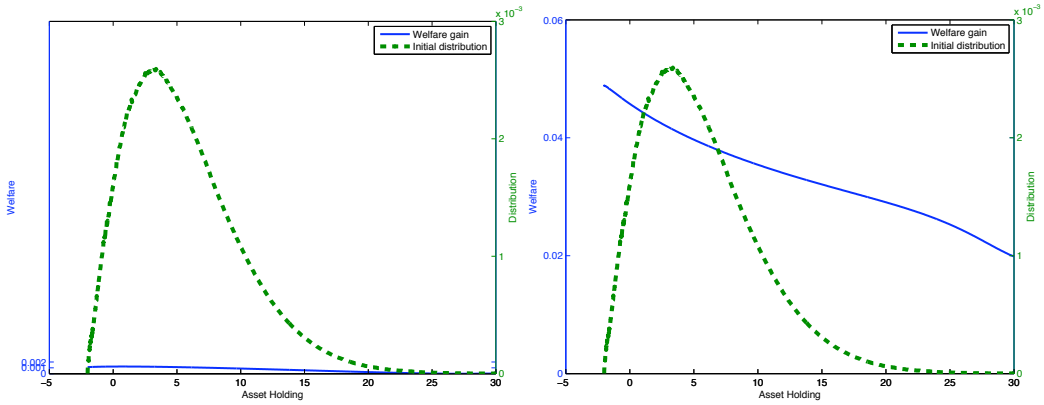
Figure 5.46: Dynamics of the asset market following an unproductive expenditure-based consolidation in the small country

The welfare analysis reveals a global positive effect for both countries, decomposed (Table 5.19) into a positive level effect, a negative insurance effect and an almost insignificant positive inequality effect. The negative insurance effect is mainly associated with the fall of interest rate. Note that, in this case, the global welfare effect is much relevant, which is explained by the dilution effect that avoids an exceeding interest rate rise and the respective longstanding recession and permits a stronger level effect.

As in the closed economy case, the consolidation is welfare enhancing for all population in the small country, benefiting more the poorer (see Figure 5.47b). Despite the reduction of public services, which affect negatively the welfare distribution, the response in the labour and asset market more than compensate, through private consumption and leisure, the poorer families, hurt by the cut of public services[4]. The rise of disposable income through

[4]The welfare function arguments are public (unproductive expenditures) and private

strong tax retreat, leads to more consumption and more savings pushing down the interest rate which also contributes to a positive inequality effect (those who owe, the poorer, are relatively better off). The global positive welfare distribution in the large economy (see Figure 5.47a) also shows a negative slope, although not really significant.



(a) Large country (b) Small country

Figure 5.47: The Welfare gain distribution across wealth when the small country follows an unproductive expenditure-based consolidation

Welfare decomposition	W_{level}	W_{ins}	W_{ine}	WG
	Large economy			
Transition + Final SS	0.0029	-0.0052	0.0000	0.0013
Final Steady State	0.0054	-0.0005	0.0005	-0.0020
	Small economy			
Transition + Final SS	0.0161	-0.0851	0.0007	0.0476
Final Steady State	0.0769	0.0022	-0.0035	0.0918

Table 5.19: Welfare decomposition analysis when the small country follows an unproductive exenditure-based consolidation

consumption and leisure.

5.2.4 Expenditure-based strategy: combined productive and unproductive spending

The fourth and last strategy consists in partially reducing productive expenditure. As before, we feed the same exogenous debt path with an exogenous path combining unproductive and productive expenditure reduction (productive expenditures reduce from 2% to 1.5% and unproductive from 20% to 15%). The vectors for g_p and g_u are consistent with a pure expenditure strategy excluding the needs of any tax effort during the imposed the debt reduction.

The large economy consolidates

In the first exercise the large economy consolidates and the small one accommodates. The transition pattern of macroeconomic variables is very similar to the closed economy case, in line with the precedent simulations (Figure 5.48). The initial tax peak corresponds to the break in the growth rate caused by the productive expenditure cut and also by the labour supply contraction explained by the leisure increment needed to maintain the utility level (note that there is simultaneously a cut on unproductive spending). Contrary to the pure unproductive expenditure based strategy where we recorded a substitution of public consumption by private consumption, in this case consumption falls mainly because of the productivity loss. The asset holdings is not very affected in the large economy. Financial account is determined essentially by the asset supply curve, which moves leftward in line with the government debt reduction. An excess of asset demand arises and causes a deficit on the financial account.

The small economy is affected by the underlying interest rate dynamic. Agents are forward looking and adjust their savings while anticipating a lower interest rate for the future. They sell assets, consume more and stabilize their choice for savings, consumption and labour-leisure as the interest rate evolves to its final steady state level. The fall in disposable income results from the gradual loss of capital earnings.

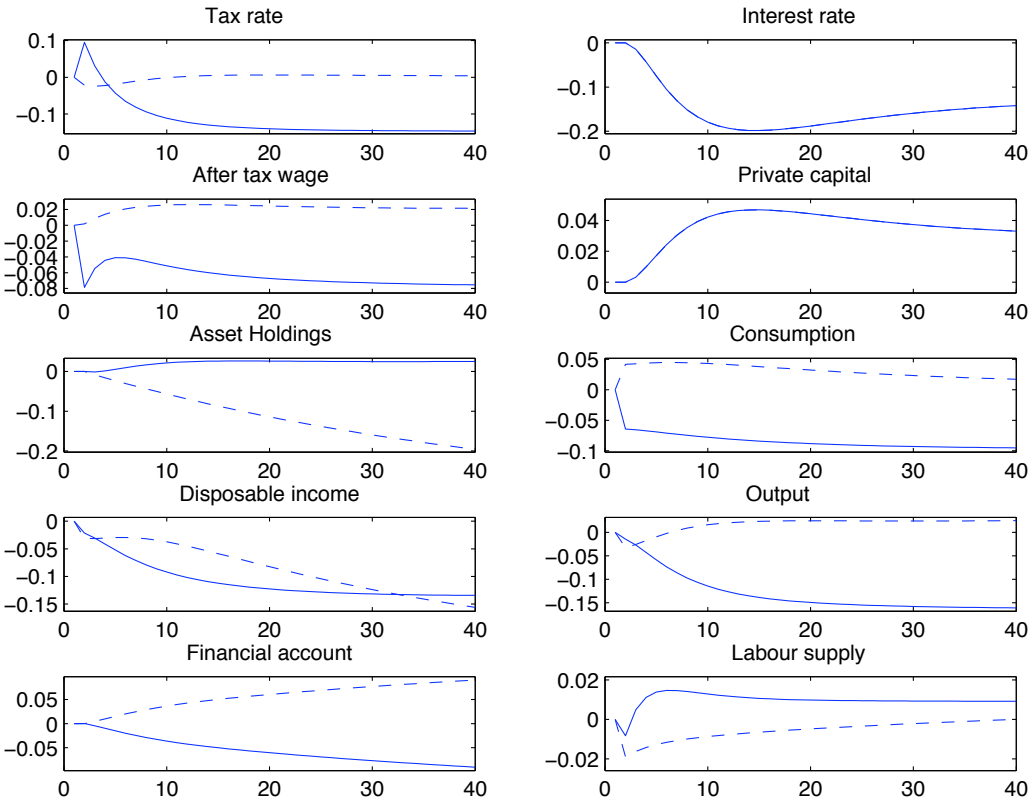
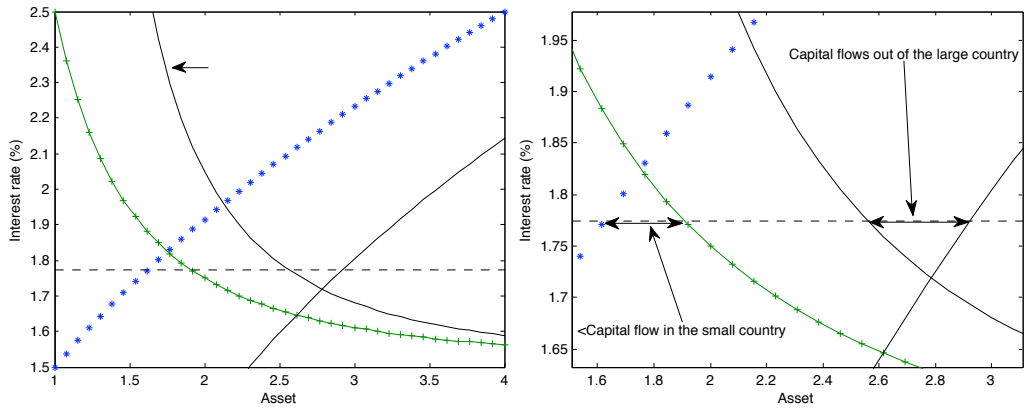


Figure 5.48: Dynamics of macroeconomic variables when the larger economy implements a combined productive and unproductive expenditure-based consolidation: large country (solid line) and small country (dashed line)

The final steady state equilibrium of asset market is described in Figure 5.49. Initially, the asset supply curve of the large country retreats more than the respective asset demand curve and interest rate decreases. After the debt reduction period (ten years) the demand curve moves back to the left and interest rate rises, but ends under the initial steady state level. As the asset demand curve of the large economy recoup, the excess of asset demand relative to the domestic supply creates a surplus in the financial account of the small country and a deficit in the large one.

The inequality analysis reveals a deterioration in both countries, especially in the smaller one, of wealth and disposable income Gini indexes in line with the previous expenditure-based strategies lead by the large country. In spite of the enhanced welfare equality throughout and resulting from

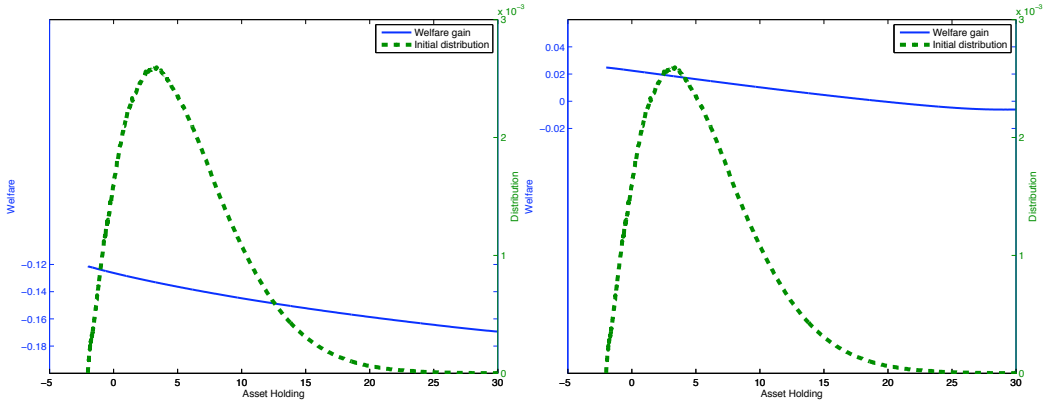
debt consolidation, disposable income and wealth inequality measures evolve unfavorably (results not reported). In the large economy, gradual losses in the disposable income throughout transition affect mainly the poorer. In the small economy the inequality indexes reflect the income reduction and the asset selling behaviour which affect more the lowest classes and augment both income and Gini indexes.



(a) Normal (b) Zoom

Figure 5.49: Final Steady state equilibrium of the asset market following a combined productive and unproductive expenditure-based consolidation in the large country

As in the closed-economy case, there is a global welfare loss for the large economy, mostly explained by the level effect caused by the productivity decay. The insurance and inequality effects are positive (Table 5.20) . The inequality effect of consolidation is also expressed in Figure 5.50a which plots the global welfare loss against wealth. All households lose but the richer ones lose more. In turn, the large country consolidation effort has a positive welfare impact on the small economy. The small economy benefits from the fall in interest rate but without bearing the cost. The welfare decomposition show a positive level effect, a negative insurance effect and a positive inequality effect. Also in this case, the welfare gain distribution benefits relatively more the poorer (see Figure 5.50b).



(a) Large country (b) Small country

Figure 5.50: The Welfare gain distribution across wealth when the large country follows a combined productive and unproductive expenditure-based consolidation

Welfare decomposition	W_{level}	W_{ins}	W_{ine}	WG
	Large economy			
Transition + Final SS	-0.0749	0.0653	0.0018	-0.1498
Final Steady State	-0.2968	-0.0012	0.0001	-0.1585
	Small economy			
Transition + Final SS	0.0138	-0.0904	0.0010	0.0206
Final Steady State	0.0363	-0.0033	0.0031	-0.0062

Table 5.20: Welfare decomposition analysis when the large country follows a combined productive and unproductive expenditure-based consolidation

The small economy consolidates

When the small country consolidates, the transition pattern is naturally very similar with the closed economy case (see Figure 5.51). As before, the tax effort is necessary to compensate the economic growth fall due to the cut in the productive expenditure. The scale difference between the two countries makes the consolidation impact on capital market weaker. The interest rate fall is smaller, private capital does not rise as much and the recession is, thus,

more intense. Households must work more, and labour supply increases, without avoiding a significant fall in consumption. Because of the dilution effect, the interest rate does not decrease as much as the closed-economy case, an important excess of asset demand arises and creates a deficit on the financial account.

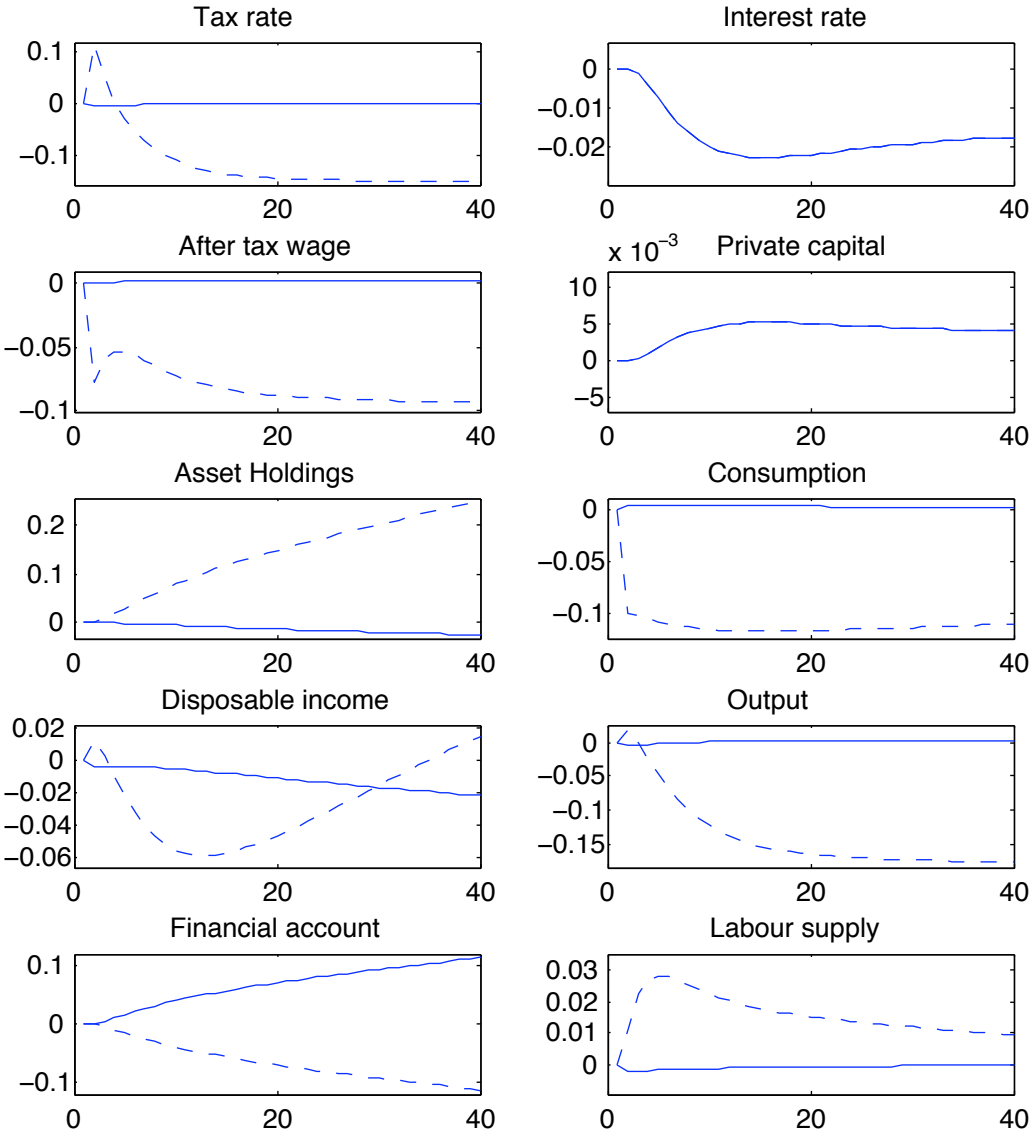
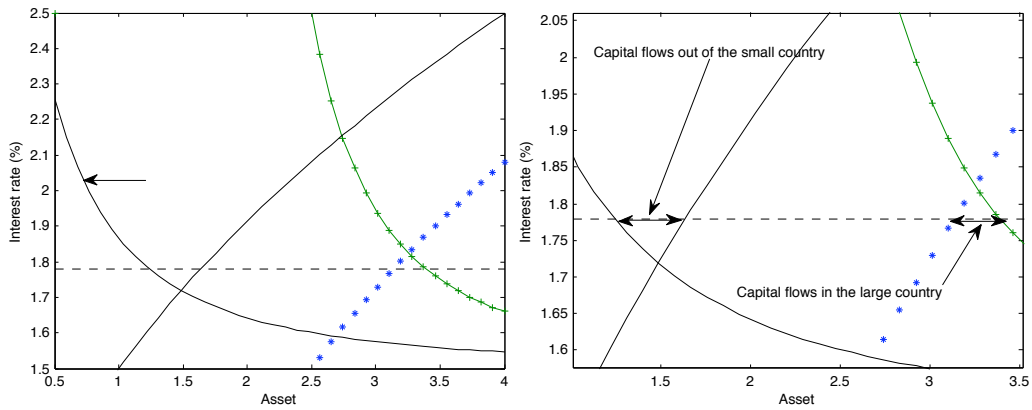


Figure 5.51: Dynamics of macroeconomic variables when the smaller economy implements a combined productive and unproductive expenditure-based consolidation: large country (solid line) and small country (dashed line)

This excess of asset demand is satisfied with foreign assets; asset holdings increase and the same happens with the respective capital earnings, pushing up the disposable income. The impact of the small country consolidation process on the large country is minimal . Complementarily to the capital outflow from the small country there is a financial account surplus in the large economy.

As shown in Figures 5.52 the excess of asset demand in the small country comes from the asset supply decrease due to the public debt reduction and also from the shift of the asset demand curve to the right due to the disposable income rise. The excess of asset supply in the large country is caused by the interest rate decrease.

As before, the outflow of capital from the small country has significant impacts on the respective wealth and disposable income distribution. Both Gini indexes decreases demonstrating that the increase of aggregate asset holding affects strongly the poorer (results not reported).

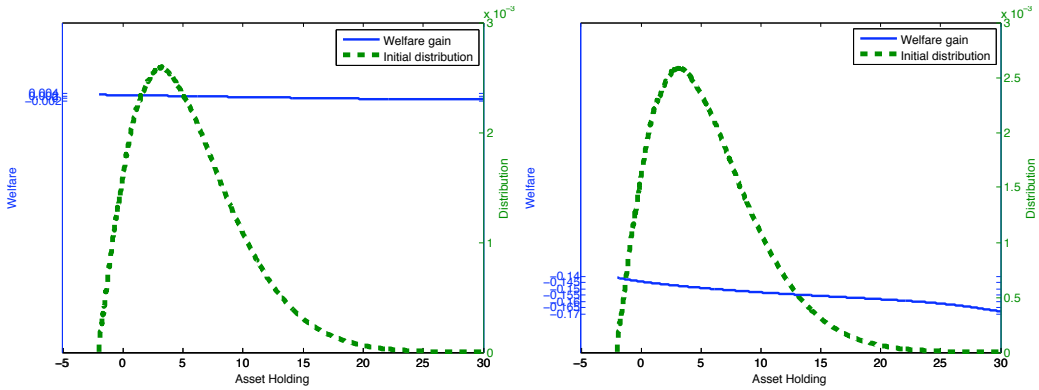


(a) Normal (b) Zoom

Figure 5.52: Final Steady state equilibrium of the asset market following a combined productive and unproductive expenditure-based consolidation in the large country

The global welfare gain of the transition is even more negative for the small economy, when compared to the closed economy case. In the closed economy case, the negative income effect reduces asset demand, pushing

down interest rate and recasting economic activity. In this case, because of the small country reduced scale, the consolidation plan affects interest rate only slightly. The recession, more severe, explains the worse global welfare effect (table 5.21). The insurance effect contributes positively to the welfare reflecting the increased asset holdings. In the large country the global welfare effect is not very significant, but still positive, and reflects the free rider effect of benefiting from the interest rate fall without bearing the consolidation costs. The insurance effect is negative reflecting the decreased level of asset holdings. In both countries the inequality effect is negligible, still positive. As shown in Figure 5.53 the welfare gain curves across wealth present slight positive slopes.



(a) Large country

(b) Small country

Figure 5.53: The Welfare gain distribution across wealth when the small country follows a combined productive and unproductive expenditure-based consolidation

Welfare decomposition	W_{level}	W_{ins}	W_{ine}	WG
Large economy				
Transition + Final SS	0.0014	-0.0118	0.0001	0.0026
Final Steady State	0.0054	-0.0005	0.0005	-0.0020
Small economy				
Transition + Final SS	-0.0864	0.1716	0.0009	-0.1656
Final Steady State	-0.3184	0.0022	-0.0035	-0.1419

Table 5.21: Welfare decomposition analysis when the small country follows a combined productive and unproductive expenditure-based consolidation

5.3 Summing up

Table 5.22 summarizes the results obtained for the closed economy framework. Only the consolidations based on transfer and unproductive spending are welfare enhancing. According to our simulations, both strategies involve a depletion in insurance, but while welfare gains are mainly driven by level effects under a transfer-based consolidation, positive redistributive effects are crucial for the welfare gains accruing from the unproductive spending based consolidation. Moreover, the latter strategy is welfare superior.

Both consolidation strategies imply a transition cost quantified as the global welfare gain difference between the final steady state and the all period embracing all the transition period plus the final steady state. The transition costs are mostly due to the recession episode and to the increased inequality observed at the first phase of transition.

The other two strategies are mostly penalized by a negative level effect cause by strong disincentive effect in the pure revenue-based strategy or by a decrease of global efficiency in the productive spending based strategy.

Strategy	W_{level}	W_{ins}	W_{ine}	WG
Revenue-based	-0,0348	-0.0331	-0.0001	-0.0002
Transfer-based	0.0167	-0.1098	-0.0008	0.0520
Unproductive spending-based	-0.0117	-0.1248	0.0065	0.0567
Productive spending-based	-0.1591	0.0533	0.0013	-0.1627

Table 5.22: Closed economy simulations: resume
Note: see table 5.2

Concerning the open economy framework we conclude that, from the point of view of the countries that implement a debt consolidation plan, the results qualitatively replicate those of the closed economy (see Table 5.23 for the global results). Given the dilution effect caused by the openness of both countries to capital circulation, the magnitude of all the variations is smaller . This dilution effect is, of course, greater when the small economy consolidates. However, and despite the reduced effects, the best strategy continues to be the unproductive expenditure based one. Contrary to the welfare decreasing impacts in a closed-economy framework, the revenue base strategy is practically welfare neutral in a open economy scenario. The mixed strategy based on productive expenditure still reveals to be the worst option in terms of welfare impacts. The welfare distribution also reveals the same (close economy) patterns. Transfer and revenue based strategies increase welfare inequality, while the expenditure based strategies improve welfare distribution.

For the country that passively adjusts when the other implements a debt consolidation process, and except for the revenue based strategy, we find a positive welfare effect in all cases. The most welfare-enhancing case occurs when the consolidating country follows a productive expenditure strategy (the worse consolidation strategy). The positive free riders is caused mainly by the interest rate reduction caused by the foreign consolidation process.

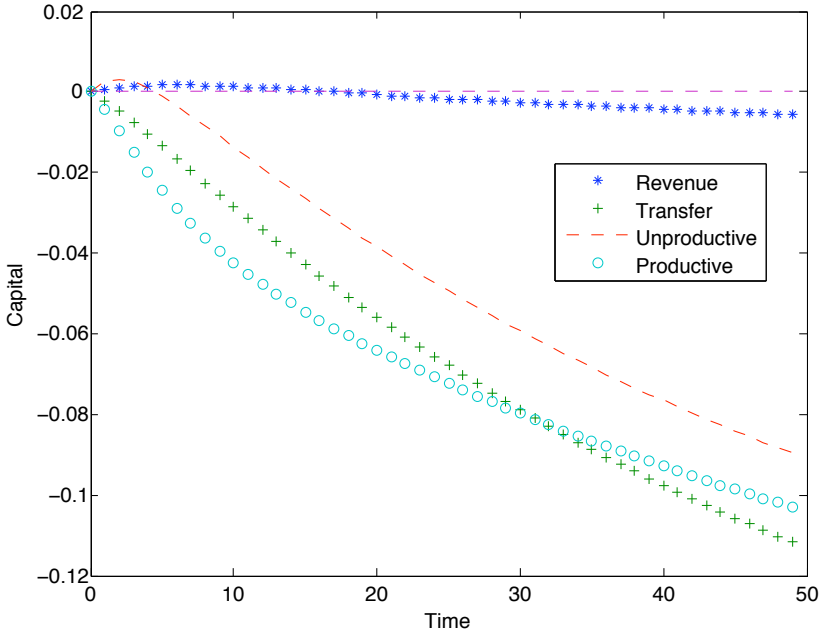


Figure 5.54: Financial account

The financial account exhibits a deficit for the country that consolidates, because the debt reduction induces an excess of asset demand. Capital flows out from the consolidating country to the other. Thus, the consolidating country buys foreign assets from the passive country where the lower interest rate generates an excess of asset supply from government and private firms. The transfer-based strategy is the one that provokes the smallest capital flow across boards. The largest capital flow occurs with the tax-based strategy (Figure 5.54). In the pure revenue and unproductive spending-based strategies, there is a sudden and significant asset demand reduction that creates an excess of asset supply during a short period - thus, the financial account presents a temporary surplus in the consolidating country.

Capital flows across boards have significant impacts on the distribution of wealth and disposable income in the small country. Aside the revenue-based strategy where the international capital movements are minimal, the pattern of the remaining expenditure-based is relatively constant. When the small economy acts passively, domestic households sells asset, especially the poorer one and both wealth and disposable Gini indexes rise, increasing wealth

and disposable inequality. Differently, when the small country consolidate, domestic households (especially the poorer, as before) buy foreign asset, both wealth and disposable Gini indexes fall, decreasing wealth and disposable inequality.

The inclusion of the sovereign risk improves the welfare gain of fiscal adjustments episodes through two channels. First, the increased reduction of interest rate boosts private investment and induces a positive level effect on welfare. Secondly, there is a positive inequality effect on welfare since lower interest rate benefits the poorer relative to the richer.

For the strategies based successively on revenue, transfer, productive and unproductive expenditures, the "Cold shower" effect enhances welfare gain in relation to gradual debt consolidations. This positive effect accrues mostly from the level effects. The "Cold shower" effect induces a steeper path and an accelerated transition over all macroeconomic variables. The recession is shorter and less intense. The lower interest rate peak, associated with the shorter hump of Gini index paths also induce a slight improvement on inequality.

	Revenue-based strategy				
	Country	W_{level}	W_{ins}	W_{ine}	WG
Large Cons.	Large	-0.0343	-0.0333	-0.0000	-0.0002
	Small	-0.0044	0.0021	-0.0001	-0.0002
Small Cons.	Large	-0.0005	0.0002	-0.0000	-0.0000
	Small	-0.0005	0.0002	-0.0000	-0.0000
	Transfer-based strategy				
	Country	W_{level}	W_{ins}	W_{ine}	WG
Large Cons.	Large	0.0171	-0.1033	-0.0009	0.0503
	Small	0.0032	-0.0612	0.0006	0.0163
Small Cons.	Large	0.0003	-0.0079	0.0001	0.0021
	Small	0.0202	-0.0413	-0.0017	0.0355
	Unproductive expenditures-based strategy				
	Country	W_{level}	W_{ins}	W_{ine}	WG
Large Cons.	Large	-0.0089	-0.1169	0.0009	0.0559
	Small	-0.0258	-0.0366	0.0002	0.0089
Small Cons.	Large	0.0029	-0.0052	0.0000	0.0013
	Small	0.0161	-0.0851	0.0007	0.0476
	Mixed expenditures-based strategy				
	Country	W_{level}	W_{ins}	W_{ine}	WG
Large Cons.	Large	-0.0749	0.0653	0.0018	-0.1498
	Small	0.0138	-0.0904	0.0010	0.0206
Small Cons.	Large	0.0014	-0.0118	0.0001	0.0026
	Small	-0.0864	0.1716	0.0009	-0.1656

Table 5.23: Open economy: synthesis

Chapter 6

Empirical application on some debt-consolidation episodes in the European Union

Based on the Delors report, approved at the European Council in Madrid in June 1989, the European Union Treaty (Maastricht Treaty) sets the eligible fiscal criteria on participation in the new currency, namely the observation of budget deficit and debt level below a certain reference values as a percentage of GDP (3% for the budget deficit and 60% for the debt). In line with the Maastricht spirit, reinforced later in 1997 with the Stability and Growth Pact (SGP), many European countries have launched, particularly during the nineties, ambitious consolidation plans to fulfill fiscal criteria in order to join the European Monetary Union (EMU).

This chapter's object is to characterize debt consolidation processes put forward by some European countries in order to assess eventual welfare costs related to them. Since debt consolidation strategies are not as pure as described theoretically in the previous chapters, we have to follow a criteria to identify consolidation processes and the related fiscal instruments to accomplish them. Using the Ameco database we analyze the public finances of the fifteen member countries of the European Union as in 1997 (EU15). We identify all the consolidation episodes from 1990 to 2008, according to a

given criterion. After that we characterize each episode according to ways through which debt control was operated (stock-flow adjustment, snow-ball effect, revenue, expenditure etc.). Finally, we use our model to simulate the relevant episodes, proceeding with the underlying welfare analysis. Relevant episodes refer to debt reduction episodes where the public sector actively changes policy instruments to achieve a consolidation path.

6.1 Identifying the successful consolidation strategies

In order to characterize debt consolidation processes, we proceed following the approach in a seminal paper by Alesina and Perotti (1995a). They isolate and characterize "significant fiscal impulses" in OCDE countries between 1960 and 1992, in order to study the determinants of successful budget consolidation processes. In particular, they define "significant" changes in fiscal policy stance using a cyclically adjusted measure of government primary balance and set several cut-off points. After isolating all "significant fiscal impulses", they fix another criterion do define successful and unsuccessful adjustment: an adjustment in year t is defined as successful if the gross debt/GDP ratio in year $t + 3$ is at least 5 percentage points of GDP lower than in year t.

In our approach, we apply the successful criteria used by Alesina and Perotti (1995a), but proceed backwards to detect all episodes of successful debt consolidation in each of the EU15 countries between 1990 and 2008. We start by identifying periods where debt-to-output ratios are, at least, five percentage points below the value observed three years before. Then, we proceed with identifying the determinants leading to such positive debt dynamics - primary deficit, snow-ball and stock-flow effects (for more details see European-Commission (2009)). Consolidation episodes are identified with a successful debt reduction period if the reduction in primary deficit dominates. We further analyze the budget composition in order to detect the main sources for primary balance adjustment.

Country	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Austria	60,95	64,10	68,27	68,29	64,41	64,77	67,19	66,42	67,01	66,36	65,43	64,75	63,71	61,98	59,45	62,52
Belgium	134,16	132,16	129,79	126,97	122,29	117,10	113,61	107,77	106,55	103,41	98,63	94,32	92,21	87,88	83,96	89,57
Denmark	80,06	76,50	72,46	69,17	65,19	60,81	57,39	51,70	47,42	46,84	45,81	44,46	37,07	31,28	26,84	33,34
Finland	55,29	57,83	56,67	56,88	53,78	48,19	45,53	43,79	42,29	41,31	44,39	44,19	41,42	39,24	35,08	33,38
France	46,24	49,36	55,48	58,00	59,28	59,43	58,81	57,33	56,88	58,82	62,91	64,87	66,36	63,66	63,80	68,01
Germany	45,84	48,01	55,60	58,43	59,65	60,29	60,85	59,69	58,75	60,33	63,82	65,63	67,84	67,59	65,07	65,88
Greece	100,51	98,51	99,20	101,60	104,06	102,60	102,51	101,82	102,91	101,45	97,85	98,55	98,83	95,87	94,83	97,63
Ireland	94,11	88,66	81,11	72,48	63,72	53,06	48,11	37,70	35,45	32,17	31,07	29,44	27,48	24,91	24,96	43,23
Italy	115,66	121,84	121,55	120,89	118,06	114,94	113,75	109,18	108,78	105,66	104,35	103,81	105,83	106,51	103,50	105,81
Luxembourg	5,99	5,50	7,44	7,78	7,73	7,40	6,69	6,40	6,53	6,52	6,24	6,33	6,07	6,72	6,90	14,67
Netherlands	78,48	75,74	76,08	74,10	68,18	65,71	61,13	53,78	50,73	50,53	52,00	52,45	51,82	47,39	45,63	58,23
Portugal	56,13	58,96	61,03	59,95	56,14	52,10	51,37	50,35	52,95	55,54	56,86	58,30	63,57	64,67	63,55	66,41
Spain	57,16	59,83	62,71	66,82	65,30	63,18	61,50	59,24	55,49	52,53	48,74	46,18	43,03	39,64	36,24	39,49
Sweden		72,40	72,09	72,07	69,15	69,09	64,79	53,57	54,44	52,59	52,27	51,22	51,03	45,87	40,50	38,02
United Kingdom	44,54	47,71	50,75	50,97	49,78	46,66	43,68	41,02	37,73	37,46	38,70	40,63	42,26	43,37	44,15	52,00

(a) Gross debt

Country	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Austria	4,80	7,76	12,00	7,34	0,31	-3,50	-1,09	2,01	2,24	-0,83	-0,99	-2,26	-2,65	-3,44	-5,30	-1,20
Belgium	8,52	5,14	1,20	-7,19	-9,86	-12,69	-13,36	-14,53	-10,55	-10,20	-9,13	-12,23	-11,20	-10,75	-10,36	-2,65
Denmark	18,07	13,68	4,48	-10,89	-11,30	-11,65	-11,78	-13,49	-13,39	-10,55	-5,89	-2,97	-9,77	-14,53	-17,61	-3,73
Finland	41,31	35,66	16,63	1,59	-4,05	-8,48	-11,35	-9,99	-5,90	-4,22	0,60	1,90	0,11	-5,15	-9,11	-8,04
France	11,04	13,37	15,76	11,76	9,92	3,94	0,81	-1,94	-2,55	0,01	5,58	7,99	7,54	0,74	-1,07	1,66
Germany		8,47	13,53	12,59	11,65	4,70	2,43	0,03	-1,54	-0,52	4,14	6,88	7,51	3,76	-0,56	-1,96
Greece	27,87	23,50	19,06	1,09	5,54	3,39	0,91	-2,24	0,32	-1,06	-3,97	-4,36	-2,62	-1,98	-3,72	-1,21
Ireland	0,94	-5,88	-10,44	-21,63	-24,94	-28,05	-24,36	-26,02	-17,61	-15,94	-6,63	-6,01	-4,69	-6,16	-4,48	15,76
Italy	21,01	23,80	16,35	5,23	-3,78	-6,61	-7,14	-8,88	-6,15	-8,09	-4,82	-4,97	0,17	2,15	-0,31	-0,01
Luxembourg	1,30	1,44	2,64	1,79	2,24	-0,03	-1,09	-1,33	-0,88	-0,18	-0,16	-0,20	-0,45	0,48	0,57	8,60
Netherlands	1,63	-0,83	-1,27	-4,38	-7,56	-10,36	-12,97	-14,40	-14,98	-10,60	-1,78	1,72	1,29	-4,61	-6,81	6,40
Portugal	0,80	1,29	9,34	3,82	-2,82	-8,93	-8,58	-5,79	0,84	4,18	6,51	5,36	8,02	7,81	5,24	2,85
Spain	14,52	16,42	16,86	9,66	5,47	0,47	-5,32	-6,06	-7,69	-8,97	-10,51	-9,31	-9,51	-9,09	-9,94	-3,53
Sweden					-3,25	-3,00	-7,28	-15,58	-14,65	-12,20	-1,30	-3,22	-1,56	-6,40	-10,73	-13,01
United Kingdom	11,28	14,06	12,24	6,43	2,07	-4,09	-7,30	-8,76	-8,94	-6,22	-2,32	2,91	4,80	4,67	3,52	9,73

(b) Debt dynamics: $\delta(d_t) = d_t - d_{t-3}$

Table 6.1: Debt reduction in EU15

Finally, we use our model to mimic each consolidation process while assessing the welfare costs involved.

Not surprisingly, along the period between 1990 and 2008, the debt reduction processes are the rule and not the exception. We found debt reduction episodes in eleven out of the EU15 countries (see Table 6.1). The exceptions are Germany, Greece, France and Luxembourg. As it would be expected, debt control episodes show significant differences. We can find debt control relying on the expenditure side, but in most of the countries, we find mixed strategies including cuts in public spending together with some tax effort. On the expenditure side, we also distinguish some countries that reduce current spending while others rely on cuts in public investment. Finally, some debt reduction episodes relied mainly on the snow-ball effect or on stock-flow adjustments.

In order to extract (active) fiscal consolidation processes, we decompose debt dynamics as usual (see among others, European-Commission (2009)):

$$D_t = D_{t-1}.(1 + i_t) + PD_t + SF_t \tag{6.1.1}$$

Where, D stands for government debt, PD, for general government primary deficit, SF, for the stock-flow adjustment, i, for nominal interest rate paid by the government.

Considering $Y = GDP$ at current market prices and n, nominal GDP growth rate, equation (6.1.1) can be re-written in terms of debt-to-output dynamics as:

$$\frac{D_t}{Y_t} - \frac{D_{t-1}}{Y_{t-1}} = \frac{D_{t-1}}{Y_{t-1}}.\frac{(i_t - n_t)}{(1 + n_t)} + \frac{PD_t}{Y_t} + \frac{SF_t}{Y_t} \tag{6.1.2}$$

Equation (6.1.2) shows that the change in the gross debt-to-output ratio depends on the primary deficit, the snow-ball effect (impact on the debt service due to the difference between nominal interest and output growth rates) and on stock-flow adjustments.

Country	**Debt Reduction (%)**	**P.D.**	**S.B.**	**S.F.**
Austria	5.30 (2004-2007)	-4.65	-1.01	+0.35
Belgium	50.20 (1993-2007)	-69.44	+27.73	-8.49
Denmark	53.22 (1993-2007)	-65.27	+16.42	-4.37
Finland1	14.38 (1995-2001)	-30.56	+1.77	+14.38
Finland2	11.01 (2003-2008)	-25.99	-2.31	+17.29
Ireland	69.63 (1991-2006)	-56.64	-36.82	+23.82
Italy	17.17 (2003-2008)	-35.41	+20.62	-2.94
Netherlands1	25.21 (1994-2002)	-26.12	-4.34	-3.43
Netherlands2	6.81 (2004-2007)	-7.45	-0.35	0.98
Portugal	10.68 (1995-2000)	-1.05	-1.46	-8.17
Spain	30.58 (1996-2007)	-25.30	-11.17	5.89
Sweden1	19.48 (2003-2008)	-27.95	+6.02	+2.45
Sweden2	14.25 (1996-2002)	-20.25	-2.48	+8.48
UK	13.51 (1996-2002)	-17.69	+2.82	+1.35

Table 6.2: Contributions to the debt reduction.
P.D. =Primary Deficit , S.B.=snow-ball effect , S.F.=Stock-flow adjustment

Table 6.2 shows debt decomposition into primary deficit, snow-ball and stock-flow adjustmentes. We identify active fiscal consolidations with debt reduction processes that are mainly driven by primary deficit control. Using this criterium we have selected only nine countries that have enforced debt consolidation process between 1990 and 2008 (see Table 6.2). Furthermore, we have identified for Finland, Netherlands and Sweden two consolidation processes. Portugal and Italy were excluded as debt reduction was mainly achieved through stock-flow adjustments and snow-ball effects, respectively. Concerning the Italian case the primary deficit has been apparently responsible for a significant part of debt reduction as it may be interpreted from Table 6.2. However a more careful examination leads to a very different conclusion. In fact, during the period between 1995 and 2002, the Italian government has presented constant and significant surplus of its primary balance. But this

surplus has been cancelled out by the snow ball effect resulting from an adverse combination of high interest rates and low growth rates (see Figure 6.1). The true origin of debt reduction comes from the decreasing snow-ball effect along the whole period, visible in the red column. For this reason, and despite the debt reduction, such a process doesn't consist of a real consolidation process, since that it does not result from any discretionary policy and thus cannot fit in our model.

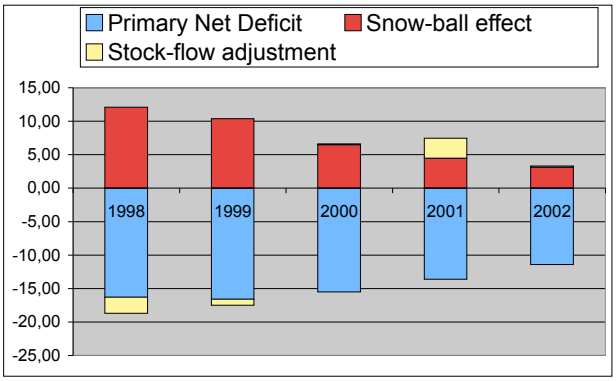
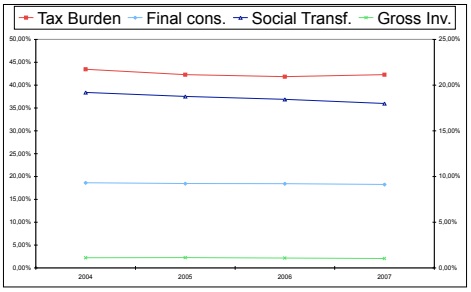


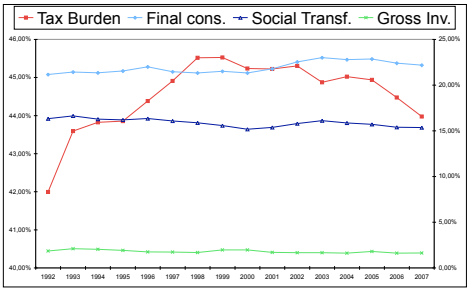
Figure 6.1: Contributions to the debt reduction: the Italian case

Concerning the budget deficit composition, we identify, on the revenue side, only a single instrument: the tax burden as defined in European-Commission (2009) - the sum of taxes on import and production levied both by general government or by the EU institutions, taxes on income and wealth, actual social contributions and capital taxes. On the expenditure side we identify three types of instruments: the final consumption, social transfers other than in kind and the gross capital formation. Final consumption consists of expenditure incurred by government on goods or services that are used for the direct satisfaction of individual needs, or the collective needs of members of the community, and results from the sum of the collective consumption with the social transfer in kind. Social transfers other than in kind"covers transfers to households, in cash, intended to relieve them from the financial burden of a number of risks or needs, made through collectively organized schemes" (European-Commission (2009)). Finally, gross capital formation "includes net acquisitions of fixed assets (dwellings, buildings and

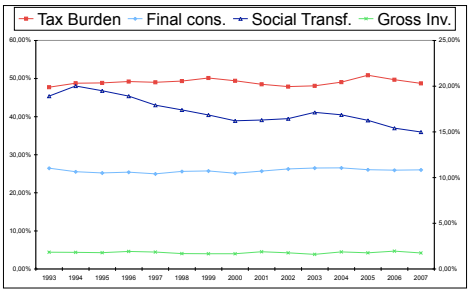
structures, machinery and equipment), plus certain additions to the value of non-produced assets. Fixed assets are tangible assets or intangible assets (mineral exploitation, computer software, entertainment, literary or artistic originals) produced as outputs from processes of production that are themselves used repeatedly, or continuously, in processes of production for more than one year"(European-Commission (2009)).



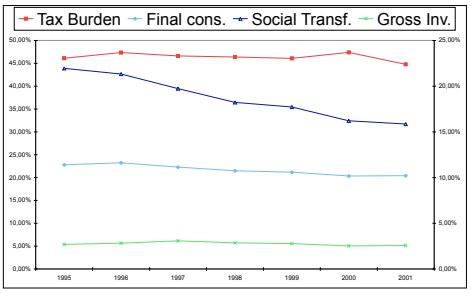
(a) Austria



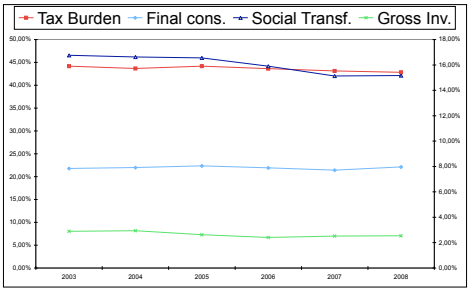
(b) Belgium



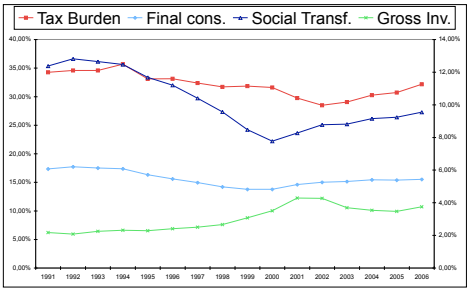
(c) Denmark



(d) Finland1

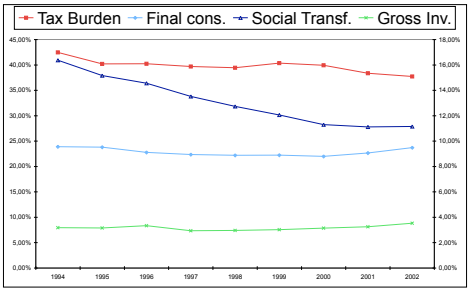


(e) Finland2

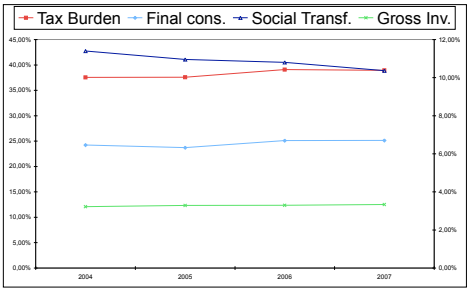


(f) Ireland

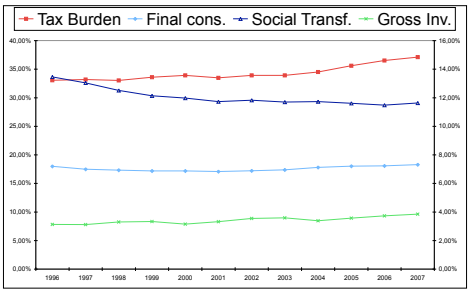
Figure 6.2: Budget decomposition: tax burden(left scale), final consumption (left scale), Social transfer other than in kind (right scale) and Gross Fixed Capital Formation (right scale)



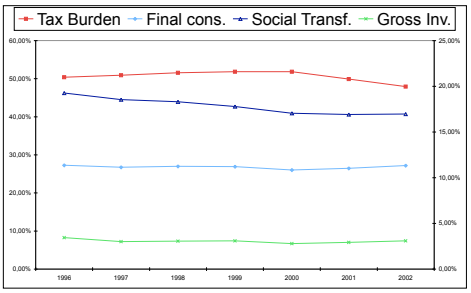
(a) Netherlands1



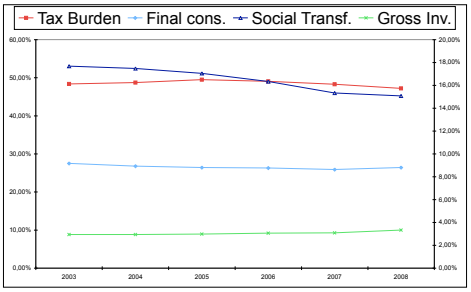
(b) Netherlands2



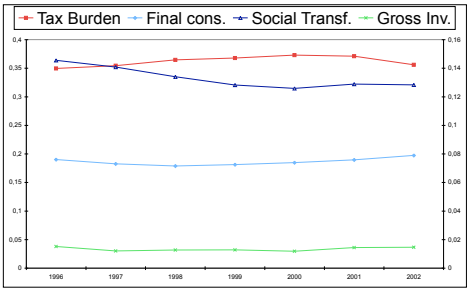
(c) Spain



(d) Sweden1



(e) Sweden2



(f) UK

Figure 6.3: Budget decomposition (continuation): tax burden(left scale), final consumption (left scale), Social transfer other than in kind (right scale) and Gross Fixed Capital Formation (right scale)

Figures 6.2 and 6.3 exhibit, for each consolidation episode, the evolution of the four fiscal instruments referred to above. Observing the different fiscal path, we characterize each consolidation process by classifying them as pure expenditure or revenue based, or mixed, identifying the fiscal instruments used.

			Initial values				Final values				
Country	**Weight**	**Period**	d_t	tr_t	g_u	g_p	d_t	tr_t	g_u	g_p	**Strategy Classification**
Austria	0.0242	2004-2007	64.75	19.20	18.50	1.05	59.45	17.99	18.50	1.05	Pure: $\searrow tr$
Belgium	0.0294	1993-2007	134.16	15.89	21.82	2.47	83.96	15.89	21.82	2.47	Pure revenue
Denmark	0.0198	1993-2007	80.60	19.00	25.00	1.80	26.84	15.00	25.00	1.80	Mixed: $\searrow tr$, $\nearrow tax$
Finland1	0.015	1995-2001	56.67	21.94	22.78	2.60	42.29	15.86	22.78	2.60	Pure: $\searrow tr$, $\searrow g_u$
Finland2	0.015	2003-2008	44.39	16.76	22.00	2.60	33.38	15.16	22.00	2.60	Mixed: $\searrow tr$, $\nearrow tax$
Ireland	0.0122	1991-2006	94.54	12.50	17.00	2.44	24.91	09.50	17.00	3.50	Mixed: $\searrow tr$, $\searrow g_u$, $\nearrow g_p$, $\nearrow tax$
Netherlands1	0.0479	1994-2002	75.74	16.37	22.84	3.17	50.53	11.15	22.84	3.17	Pure: $\searrow tr$
Netherlands2	0.0479	2004-2007	52.45	11.40	24.50	3.25	45.63	10.40	24.50	3.25	Mixed: $\searrow tr$, $\nearrow tax$
Spain	0.0787	1996-2007	66.82	13.50	17.50	3.50	36.24	11.60	17.50	3.50	Mixed: $\searrow tr$, $\nearrow tax$
Sweden1	0.0293	2003-2008	72.07	19.26	26.50	3.20	52.59	16.34	26.50	3.20	MIxed: $\searrow tr$, $\nearrow tax$
Sweden2	0.0293	1996-2002	52.27	17.68	27.50	3.20	38.02	15.07	27.50	3.20	Mixed: $\searrow tr$, $\searrow g_u$, $\nearrow tax$
UK	0.1391	1996-2002	50.97	14.50	19.50	1.50	37.46	12.80	19.50	1.50	Mixed: $\searrow tr$, $\nearrow tax$

Table 6.3: Classification of successful consolidation strategies

The twelve successful consolidation episodes that interest us are described in great detail in Table 6.3. Among them, we identify four pure strategies: one revenue-based (Belgium), two expenditure based relying on social transfers costs (Austria and Netherlands 1994-2002) and an expenditure-based strategy combining transfer and final consumption reductions in Finland (1995-2001). The remaining eight episodes are characterized by mixed strategies. Six of them are based on taxes and social transfers (Denmark, Finland 2003-2008, Netherlands 2004-2007, Spain, Sweden 2003-2008 and UK), one is based on taxes, social transfers and unproductive expenditures (Sweden 1996-2002). Finally, the Irish consolidation was achieved through tax increase and a reduction of both transfers and final consumption that, in turn, were reallocated to public investment.

6.2 Simulation and assessment of welfare gains

After having identified the twelve consolidation episodes driven mainly by primary deficit control, we proceed with the simulations using the model developed in chapter 3 and extensively used in chapter 5. We set up an international framework in which capital flows freely across borders. Our world economy is composed by the EU15 countries. The open economy version of our model (see Chapter 3 and 5) is formed by two blocks. The domestic block is formed by the consolidation country with weight given by the proportion of its GDP among EU15 (see 2nd column in Table 6.3). The second block acts passively and consists of all the others EU15 countries (EU15-1). We designate it as "the rest of the world". Debt and fiscal instruments are set to match each consolidation process during the identified period. Tax rate is, as before, endogenous, adjusting to verify the government budget constraint.

The dynamics of each episode represents a combination of the exercise provided above in the open economy section of chapter 5. All processes exhibit similar paths for the main macroeconomic variables from which we can distinguish an initial phase characterized by a temporary recession caused by an interest rate increase and a labour supply decrease. Disposable income falls and both wealth and disposable Gini index increase. In the second

phase, the economy evolves towards its final steady state. Interest and tax rates decrease, ending at a lower level in relation to the initial steady state, disposable income and asset holdings increase, exceeding both initial levels. Wealth and disposable Gini indexes decrease gradually to their final steady state level, lower than the initial level. As an example of the dynamic process explained above, Figure 6.4 exhibits the transition dynamics for the second Swedish consolidation episode (2003-2008).

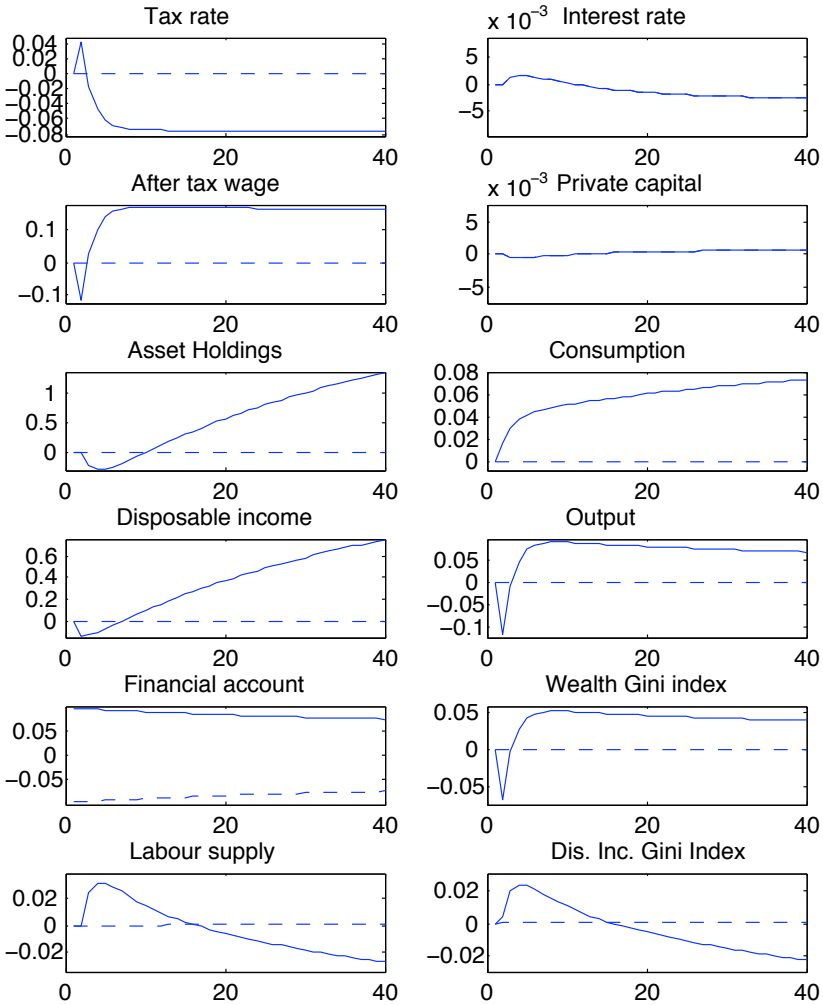


Figure 6.4: Dynamics of macroeconomic variables during fiscal consolidation in Sweden (2003-2008): Sweden (solid line) and EU15-1 (dashed line)

Table 6.4 summarizes for each country and period of debt consolidation,

debt reduction effort, debt consolidation strategy, overall welfare gains (transition plus steady state), the magnitude of transition costs relative to final steady state welfare gains, the Welfare Gain Intensity (WGI) and Total Spending Cut for each percentage point of debt reduction (TSC). Information in Table 6.4 is sorted by the WGI in a decreasing order. The welfare gain intensity is an indicator built in order to compare debt consolidation welfare gains across countries when consolidation efforts are of different magnitudes. In particular, WGI equals the welfare gain per percentage point of debt reduction. Total Spending Cut (TSC) refers to the combined reduction in social transfers and unproductive expenditure per each percentage point of debt reduction.

As expected, due to the pure tax-based strategy, debt consolidation in Belgium exhibits the lowest (almost null) welfare gains. All the other consolidation strategies entail positive welfare gains but all of them also involve positive welfare transition costs. The results of the welfare gain intensity show that: (1) debt-reduction process that involved reduction in unproductive spending were clearly welfare superior (Finland 1995-2001, Ireland, 1991-2006, and Sweden 2003-2008) and, among these, welfare is further enhanced (2) the lower tax effort (Finland) and (3) the more public expenditure is biased towards investment (Ireland). Another stylized feature is that, with the exception of the process that has involved a shift towards public investment, the higher TSC, the more welfare enhanced consolidation strategies were. The case of Ireland (1991-2006) shows that, shifting towards investment expenditures requires lower unproductive spending and social transfer cuts. Moreover, as productive expenditures have no effect on inequality, these strategies involve lower inequality costs during the initial consolidation periods. Transition costs also seem to be positively associated with taxes. The most successful strategies also tend to present lower transition costs.

Country	**Debt Reduction**	Strategy Classification	Welf. Gain	Trans Cost	WGI(*)	TSC (**)
Finland1	14.38 (1995-2001)	Pure: $\searrow tr$ and $\searrow g_u$	0.1064	39.9%	0.0074	0.0059
Ireland	69.63 (1991-2006)	Mixed: $\searrow tr$, $\searrow g_u$, $\nearrow g_p$ and $\nearrow tax$	0.4362	39.6%	0.0063	0.0006
Sweden2	14.25 (1996-2002)	Mixed: $\searrow tr$, $\searrow g_u$ and $\nearrow tax$	0.0495	33.5%	0.0035	0.0025
Austria	5.30 (2004-2007)	Pure: $\searrow tr$	0.0125	54.2%	0.0024	0.0023
Netherlands1	25.21 (1994-2002)	Pure: $\searrow tr$	0.0462	61.2%	0.0018	0.0021
Sweden1	19.48 (2003-2008)	Mixed: $\searrow tr$ and $\nearrow tax$	0.0348	36.7%	0.0018	0.0015
Finland2	11.01 (2003-2008)	Mixed: $\searrow tr$ and $\nearrow tax$	0.0165	52.9%	0.0015	0.0015
Netherlands2	6.81 (2004-2007)	Mixed: $\searrow tr$ and $\nearrow tax$	0.0096	61.0%	0.0014	0.0015
UK	13.51 (1996-2002)	Mixed: $\searrow tr$ and $\nearrow tax$	0.0181	57.3%	0.0013	0.0013
Denmark	53.22 (1993-2007)	Mixed: $\searrow tr$ and $\nearrow tax$	0.0386	56.6%	0.0007	0.0007
Spain	30.58 (1996-2007)	Mixed: $\searrow tr$ and $\nearrow tax$	0.0176	75.7%	0.0006	0.0006
Belgium	50.20 (1993-2007)	Pure revenue	0.0010	94.6%	0.0000	0.0000

Table 6.4: Consolidation strategies: welfare analysis
(*) WGI: welfare gain intensity
(**) TSC: total spending cut per percentage point of debt reduction

There is also a strong relation between interest and tax rates as the latter, affecting the disposable income, depresses the asset holdings demand, and raises the former. Both variables are also negatively associated with economic contraction. Figure 6.5 plots the tax and interest rates peak in each simulations along the respective recession, all measured in a percentage variation relative to the first period. We can see clearly four cases where the initial tax variation exceeds 10%: Belgium, Ireland, Spain and UK. In the case of the first three we can also observe a significant increase in interest rate and an important recession.

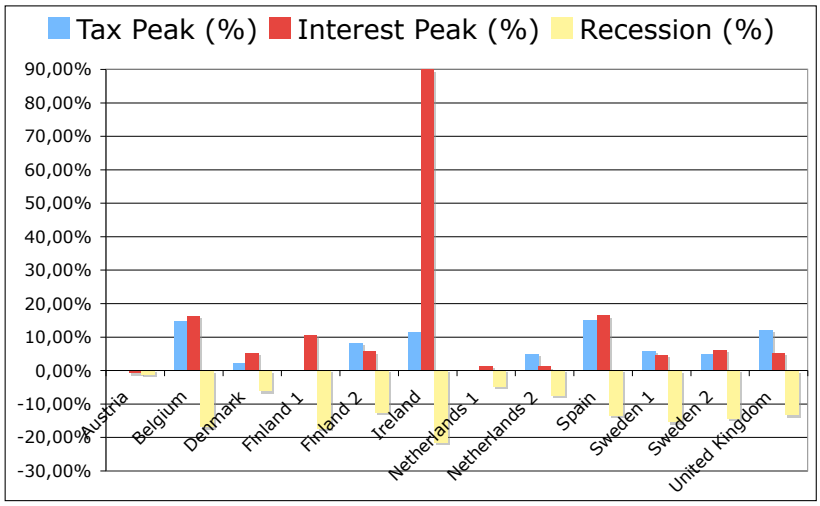


Figure 6.5: Tax and interest peaks and recession: measured in percentage variation relative to the initial period

The impacts on EU15-1 from each country consolidation is rather small, although positive in all cases, except during Belgium and Ireland's consolidation processes. As expected, most positive impacts on EU15-1 were produced by the consolidation efforts of the larger (in terms of GDP) countries, namely the UK. Table 6.5 sorts the EU15 by size (as measured by GDP weight in overall EU15 GDP) and illustrates the positive relationship between size and consolidation spillovers on the EU15-1 countries.

The positive spillover effects are mainly explained by the costless welfare gains obtained by the passive country that benefits from the interest rate decrease. However, in the Belgium tax-based case, the interest rate increased

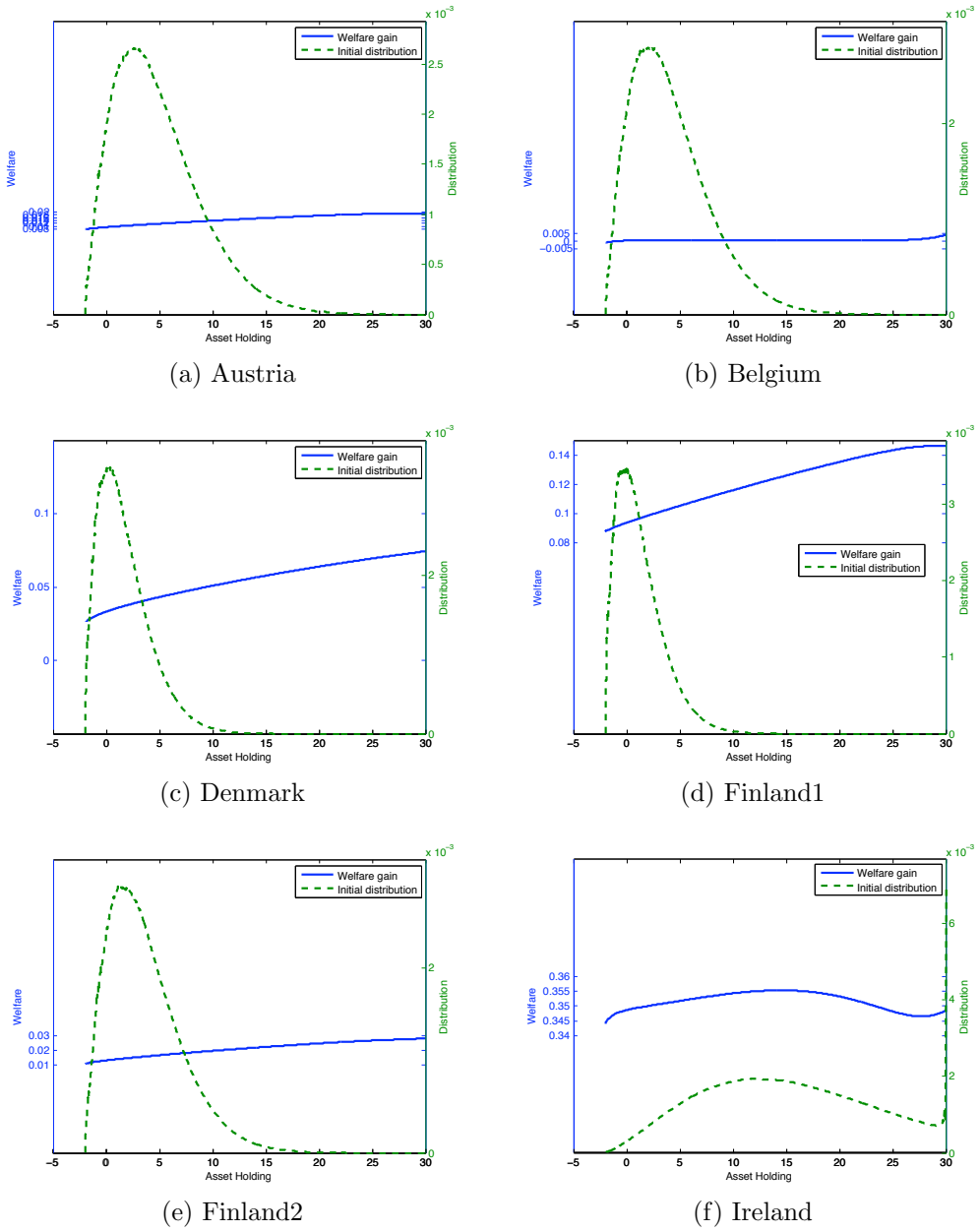
significantly during transition, provoking a severe recession that also affect the EU15-1 countries, canceling out the benefit of the lower level of the final steady state interest rate. The Irish case is also peculiar as it involved a huge flow of capital from the EU15-1 countries to the Irish economy, which explain a negative spillover effect.

Country	Weight	EU15 global welfare gain
United Kingdom	0.1391	0.0014
Spain	0.0787	0.0005
Netherlands 1	0.0479	0.0009
Netherlands 2	0.0479	0.0002
Belgium	0.0294	-0.0000
Sweden1	0.0293	0.0003
Sweden 2	0.0293	0.0002
Austria	0.0242	0.0001
Denmark	0.0198	0.0002
Finland 1	0.0150	0.0003
Finland 2	0.0150	0.0000
Ireland	0.0122	-0.0003

Table 6.5: Welfare effect of domestic consolidations on EU15-1

Figures 6.6 and 6.7 show for every consolidation episodes the welfare gain curve across wealth. As we have seen in chapter 4, the welfare distribution is affected negatively by debt and positively by transfer and unproductive expenditures (productive expenditures are neutral relative to distribution). Decreasing social transfers and unproductive expenditures, individually or grouped together, must lead to an unambiguous tendency towards a worse welfare distribution. Differently, a debt reduction must improve the welfare distribution. Apparently, in terms of welfare inequality, transfer and unproductive spending effects have dominated over debt effect in European consolidation efforts; despite debt reduction, welfare inequality across wealth increased, although not very significantly. For all consolidation processes

(except for the Irish case) the welfare gain curve across wealth is positively sloped. However, with the exception of Denmark, Finland (1995-2001) and Netherlands (1994-2002), welfare gain curves for the other countries are almost horizontal (see Figures 6.6 and 6.7).

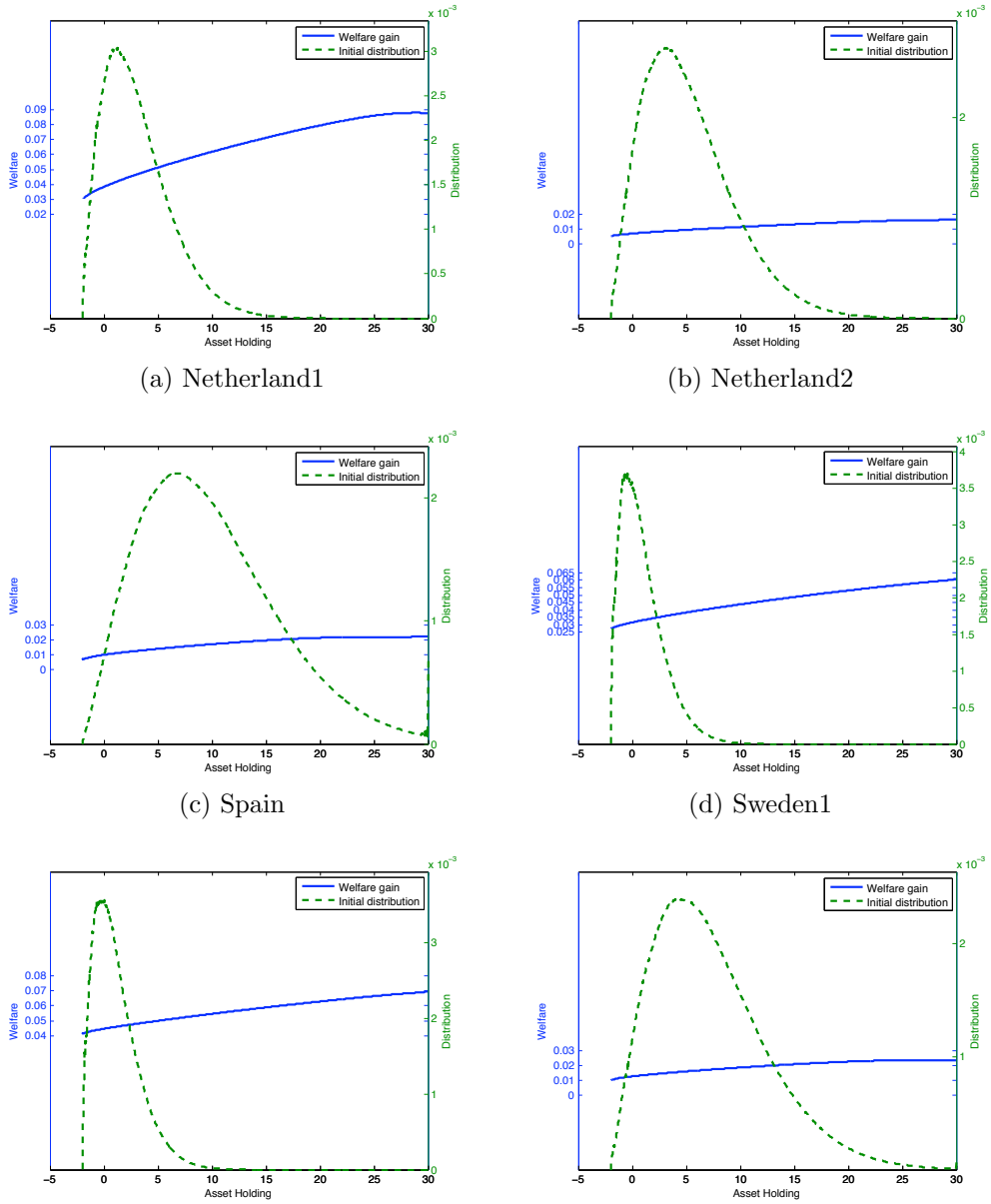


(a) Austria (b) Belgium

(c) Denmark (d) Finland1

(e) Finland2 (f) Ireland

Figure 6.6: Welfare gain and wealth distribution following debt consolidations (continued)



(a) Netherland1

(b) Netherland2

(c) Spain

(d) Sweden1

(e) Sweden2

(f) UK

Figure 6.7: Welfare gain and wealth distribution following debt consolidations

Considering the distribution of the meaningful variables to compute welfare, namely wealth, disposable income, consumption and leisure Gini indexes, we cannot deduce any tendency from the different strategies as fiscal instruments have distinct and sometimes opposite effects on the several Gini

coefficients (see Table 1 of Chapter 4). As regarded in Chapter 5, all inequality measures present the same path[1] as the one observed in Figure 6.4, rising first sharply during the debt reduction period, and decreasing smoothly afterwards. Different from the closed economy framework[2], wealth and disposable income Gini index end at a lower level relative to the initial steady sate level (see Table 6.6) due, essentially, to the capital flows across borders. All consolidation processes lead to an excess of asset demand supplied with foreign assets bought essentially by the lower wealth classes whose marginal propensity to save is higher. The disposable income Gini index follows.

The distribution of wealth or income reflects the dynamic of multiple variables, most of which are missing from our model. We do not expect the model to fully reproduce the reality occurred during the consolidation episodes concerning the distribution issues, namely the Gini coefficient available in international databases. Our model pretends to assess the effects of some policy options in a *ceteris paribus* logic. Table 6.7 shows the effective Gini coefficient observed during the period of consolidation processes. Looking at the different consolidation processes in each country, we can see that, amongst the twelve consolidation processes, in eight of them the income Gini index increases during the debt-reduction period (Denmark, Finland 1997-2001, Finland 2003-2008, Ireland, Netherlands 2005-2007, Spain, Sweden 1996-2002 and UK) showing an inequality cost during the austerity period of debt reduction, as predicted by our model. Thus, actual evolution of Gini coefficients may by partially explained by dominant effects of debt consolidation processes. The long run tendency towards the new (lower) steady state value is, obviously, much more difficult to observe.

[1]We only plot Swedish second episode but the regularity is common to all Gini indexes and for all the other consolidation processes.

[2]In the closed economy framework, the labour market effect on inequality dominates.

	Initial S. State		Final S. State	
Country	WG	IG	WG	IG
Austria	0.3804	0.3657	0.3708	0.3577
Belgium	0.3812	0.3657	0.3782	0.3634
Denmark	0.4170	0.3943	0.3844	0.3681
Finland 1	0.4320	0.4063	0.3725	0.3587
Finland 2	0.3874	0.3709	0.3749	0.3606
Ireland	0.3019	0.2959	0.1226	0.1223
Netherlands 1	0.3925	0.3748	0.3545	0.3433
Netherlands 2	0.3643	0.3514	0.3572	0.3454
Spain	0.3414	0.3324	0.3172	0.3102
Sweden1	0.4332	0.4065	0.4093	0.3879
Sweden 2	0.4243	0.3995	0.3992	0.3798
United Kingdom	0.3588	0.3474	0.3487	0.3386

Table 6.6: Inequality measures under consolidation episodes
Notes: WG = Wealth Gini index - IG = Income Gini index

Country	1990	1995	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Austria		0,24	0,25	0,24	0,26	0,25	0,24		0,27	0,26	0,26	0,25	0,26	0,26
Belgium		0,29	0,27	0,27	0,29	0,29	0,28		0,28	0,26	0,28	0,28	0,26	0,28
Denmark	0,23	0,21	0,20		0,21	0,23	0,22		0,25	0,24	0,24	0,24	0,25	0,25
Finland		0,23	0,22	0,22	0,24	0,26	0,27	0,26	0,26	0,25	0,26	0,26	0,26	0,26
Ireland		0,32	0,33	0,34	0,32	0,30	0,29		0,31	0,32	0,32	0,32	0,31	0,30
Netherlands	0,28	0,28	0,26	0,25	0,26	0,28	0,27	0,27	0,27		0,27	0,26	0,28	0,28
Spain	0,34	0,34	0,35	0,34	0,33	0,34	0,33	0,31	0,31	0,31	0,32	0,31	0,31	0,31
Sweden	0,21	0,21	0,21		0,22	0,24	0,24	0,23		0,23	0,23	0,24	0,23	0,24
United Kingdom	0,37	0,35	0,30	0,32	0,32	0,37	0,35	0,35	0,34		0,34	0,32	0,33	0,34

Table 6.7: Effective Gini Coefficient for disposable income during consolidation processes (grey cells) (data extracted from OECD.Stat: blank cells correspond to years for which there is no data)

In the open economy framework, capital flows freely across borders, and the financial account depends on the international level of interest rate in relation to the autarky level. If the equilibrium interest rate defined on the international market exceeds the autarky level [3], there is an excess of

[3]The one that would prevail in the domestic country in a closed economy simulation.

asset demand in the domestic country. Residents will buy foreign assets. Capital flows outwards creating a deficit in the financial account and the domestic country ends with a positive foreign asset position. Conversely, if the equilibrium interest rate is set under the domestic autarky level, the asset supply surpasses the asset demand. The excess of domestic assets will be acquired by foreign households. Capital flows inwards, the financial account presents a surplus, meaning that the domestic country ends with a negative foreign asset position.

During the consolidation processes, two principal phenomena occur in the capital market (see Figure 6.8). First, the asset supply (government plus private sector) curve moves to the left as the government reduces public debt. Second the asset demand curve moves to the right because of the income effect. In the presence of an initial deficit of the domestic financial account (the equilibrium interest rate is above the autarky level) the excess of asset demand increases. Residents will buy more foreign asset and capital will flow out increasing the deficit of the financial account. In the presence of an initial surplus of the domestic financial account (the equilibrium interest rate is under the autarky level) the excess of asset supply contracts. Some foreign capital moves back to its origin. The financial account surplus decreases, or even turns to deficit when the autarky interest rate moves below the international interest rate [4]. Regardless the initial position, in all consolidation processes, capital flows out depressing the financial account. Only in four cases (Belgium, Ireland, Spain and UK)[5], and temporarily during the first years of transition, the asset demand curve retreat dominates over the asset supply curve and lightly increases the capital account.

[4]This is the case for Austria and Netherlands 1994-2002.

[5]Precisely those countries exhibiting the higher fiscal efforts (figure 6.5).

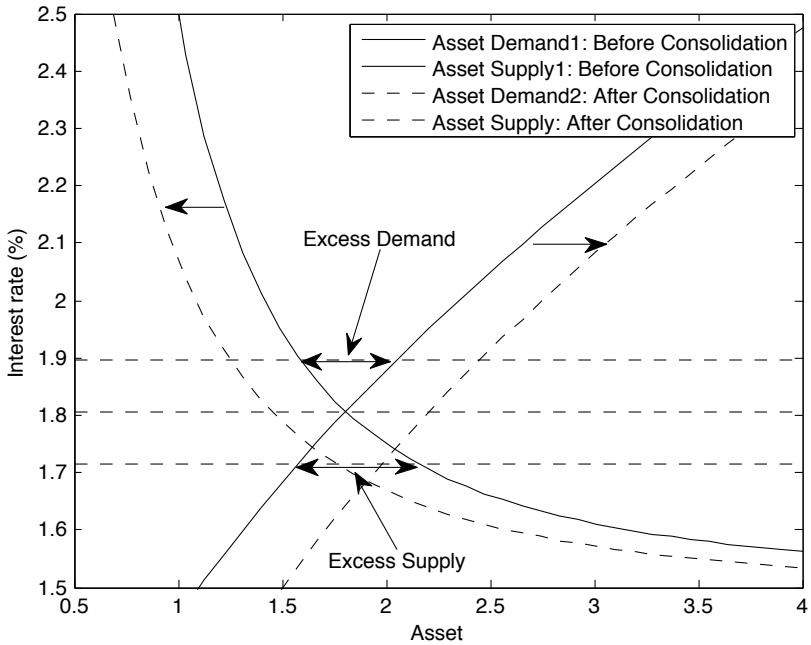


Figure 6.8: International Asset Market: Open economy Simulation

Table 6.8 presents the net capital transactions with the rest of the world for the EU15 countries during consolidation periods (source: AMECO) [6]. As we have mentioned before, when we've presented actual Gini indexes, capital flows depends on many other factors and the model is unable to reproduce completely the data. The net capital transaction is a flow measure contrary to the net asset position used in our model. However, a increasing in net foreign asset position (when capital flows out of the country) between two different moments must be linked to a negative net capital transition during the period that separates the two moments. As it can be seen through the table, during the 12 successful consolidation processes, capital flows out of domestic borders in eight cases (Austria, Belgium, Finland 1995-2001, Finland 2003-2008, Netherlands 1994-2002, Netherlands 2004-2007, Sweden 1996-2002 and Sweden 2003-2002). During the Danish consolidation episode, the net capital transition varies from negative to positive. For the remaining consolidation processes (Ireland, Spain and UK), foreign capital flows in

[6]Net capital transactions = capital received from the rest of the world minus capital transfered to the rest of the world.

during the consolidation period. A possible explanation for the last case may have to do with the stronger consolidation effect on international interest rate cause by a pure scale effect in the case of Spain and UK and by the specific strategy based on productive expenditure in the case of Ireland. Note that the capital flow levels depend strongly on the difference between the autarky interest rate level and the one fixed in international market.

Country	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Austria	NA	NA	NA	NA	NA	-0,21	-0,08	-0,11	-0,31	-0,25	-0,47	-0,59	-0,39	0,01	-0,28	-0,19	-0,80	-0,06	-0,08
Belgium	-0,30	-0,25	-0,28	-0,29	-0,23	-0,32	-0,16	0,27	-0,23	-0,08	-0,33	-0,47	-0,46	-0,18	-0,16	-0,32	-0,01	-1,15	-1,51
Denmark	0,06	-0,02	0,01	0,03	-0,01	-0,05	0,02	0,09	-0,06	1,08	0,03	0,01	0,15	-0,01	0,03	0,39	0,01	0,03	0,05
Finland	0,30	-0,41	-0,31	-0,09	-0,33	-0,51	-0,74	-0,28	-0,58	-0,15	0,13	0,12	0,13	0,13	0,15	0,26	0,17	-0,47	-1,69
France	-1,95	0,74	0,90	1,00	-2,90	0,49	0,65	1,24	1,02	-0,74	1,44	-0,71	0,03	-7,83	1,19	-0,01	0,42	1,53	0,49
Germany	NA	-2,20	-0,96	-0,96	-1,32	-2,01	-1,69	0,09	0,70	-0,13	6,87	-0,31	-0,21	0,31	-0,03	-0,49	0,20	0,59	-0,21
Greece	NA	NA	NA	NA	NA	0,75	1,37	1,89	2,31	2,07	3,37	1,88	1,57	2,63	2,70	2,57	4,79	5,04	3,40
Ireland	0,30	0,49	0,61	0,64	0,32	0,63	0,62	0,77	0,84	0,56	1,18	0,70	0,51	0,09	0,28	0,26	0,22	0,04	0,07
Italy	0,60	0,48	0,60	1,41	0,92	1,27	0,06	2,93	2,24	2,79	3,20	0,94	-0,07	2,25	1,70	1,35	1,83	2,26	0,83
Luxembourg	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	-0,10	-0,13	-0,62	0,88	-0,29	-0,15	-0,23
Netherlands	-0,61	-0,59	-0,95	-1,14	-1,07	-1,16	-1,85	-1,00	-0,68	-0,54	-1,21	-0,79	-0,97	-1,02	-1,32	-1,75	-1,89	-2,25	-2,00
Portugal	0,88	1,37	1,72	1,97	1,65	2,34	2,25	2,92	2,65	2,87	2,02	2,27	2,46	3,28	2,57	2,29	1,86	2,26	3,02
Spain	0,79	2,18	2,64	2,27	1,86	4,52	5,09	5,55	5,78	6,22	5,24	5,66	7,95	8,51	8,77	8,28	6,33	4,81	4,97
Sweden	NA	NA	NA	-0,58	-0,82	-0,48	-1,21	-0,78	-0,09	-2,86	-0,39	-0,16	-0,16	0,01	0,04	0,27	-2,11	-0,30	-0,55
United Kingdom	0,70	0,41	0,57	0,40	0,04	0,64	1,55	1,38	0,72	1,13	2,79	2,12	1,48	2,12	3,04	2,20	1,43	3,75	4,07

Table 6.8: Net capital transactions with the rest of the world (source: AMECO)

6.3 Summing up

Throughout this chapter our model is used with the open economy framework to simulate the twelve selected consolidation episodes occurred in UE15 between 1990 and 2008 (one pure revenue, three pure expenditure and eight mixed strategies based on taxes and expenditure cuts). In order to compare debt consolidation welfare gains across countries when consolidation efforts are of different magnitude, we use a welfare gain intensity measure (WGI) that gives the welfare gain per percentage point of debt reduction, and the total spending cuts (TSC), which refer to the combined reduction in social transfers and unproductive expenditures involved per each percentage point of debt reduction.

With the exception of the Belgium case, all consolidation strategies entail positive welfare gains. The transition costs affect all episodes and are determinant in sorting the best welfare enhancing strategies. Our results confirm the superiority of fiscal adjustments based on unproductive expenditures

over those based on tax or social transfer reductions. In mixed strategies, welfare is further enhanced with lower tax effort and higher TSCs. Meanwhile, switching unprodutive expenditure for public investment also results in significant welfare improvement (Ireland).

Finally, all strategies involve lower welfare inequality costs. Concerning wealth and income inequality, all episodes replicate both Gini index paths, namely the initial hump shaped curve and the lower final values corresponding to more compressed distributions.This improvement on asset and disposable income distribution is closely related to the financial account movements (capital flows out the consolidation country) that characterize consolidation episodes in an open economy framework.

Chapter 7

Conclusion

The present thesis aims at studying the welfare impacts of debt and public expenditure in a heterogeneous-agents framework. Fiscal policy stance has direct and indirect effects on welfare and, in particular, in welfare inequality. In this case, the use of heterogeneous-agents models is a requirement for the research approach. Moreover, the proposed model has to conform standard theoretical and methodological robustness and thus, relies on micro-founded decision-making, while capturing, at the aggregate level, the mechanisms through which fiscal instruments operate. In this context we proceed to analyse the impacts on welfare (and inequality) of several dimensions of public sector intervention, using a comparative static analysis and also following a dynamic approach to mimic debt consolidation episodes. In particular, these two stages of simulation aim to contribute to the debate by providing insights on optimal size of government as well, on the welfare-enhancing ability of several fiscal instruments, as well as on the optimal composition of public expenditure. We also assess optimal debt thresholds and compute welfare and inequality effects of different debt consolidation strategies.

From the comparative static analysis, we find that a rise in unproductive expenditure and in transfers improve utility up until certain levels, despite negative impacts arising from tax effects. Larger debts bring positive insurance effects through interest rate incentives on savings, but impinge negatively on welfare inequality. Welfare level effect is also negative due to side

effects of taxes on labor supply. Using a calibration mimicking average unproductive and productive spending of the EU countries, optimal combination of debt and social transfer levels produced by the model are smaller than thoseobserved in the EU countries during the last decades and, in the case of debt, optimal values are below the limit established by the Stability Growth Pact. The larger the size of government (as measured by the expenditures-to-output ratio) the larger the optimal debt level is and, consequently, the larger welfare inequality is. Finally if we consider a sovereign risk in the model the optimal debt levels are substantially lower.

By including the utility flow from in-kind government spending (unproductive expenditure) in the household's utility function, the optimal levels of debt and transfers decrease significantly. Concerning the spending composition (intra-temporal) we find that: (i) substituting unproductive spending by transfers is welfare enhancing and improves inequality but only up to a lower bound of unproductive spending, rather inelastic (the smaller government size, the costs attached to unproductive expenditure cuts sooner dominate transfer welfare- and inequality-enhancing effects); (ii) substituting unproductive by productive spending is always welfare enhancing and has no impacts on any inequality measure; and (iii), shifting transfers towards productive expenditure is always welfare enhancing for a sufficiently high output elasticity of public investment.

In what regards the dynamic analysis, we conclude that, in a closed economy, only the consolidations based on the reduction of transfers and unproductive spending are welfare enhancing, with superiority of the latter. However, both strategies involve transition costs, mostly due to a recession with increased inequality observed during the first phase of transition. In an open economy framework the results qualitatively replicate those of the closed economy, only with smaller magnitude due to the dilution effect operating through interest rate. The best strategy continues to be the unproductive expenditure based one. For the country that passively adjusts when the other consolidates we found positive free rider effects caused mainly by the interest rate reduction implied by the foreign consolidation process. Moreover, capital flows across boards have significant impacts on the distribution of

wealth and disposable income in the small country. With the exception of the revenue-based strategy, when the small economy acts passively, capital flows out and both wealth and disposable Gini indexes rise, increasing wealth and disposable income inequality. Differently, when the small country consolidates, capital flows in and both wealth and disposable Gini indexes fall, decreasing wealth and disposable income inequality.

Including sovereign risk improves the welfare gain of fiscal adjustments episodes by inducing a positive level and inequality effects on welfare. In the same way, "cold shower" strategies, by inducing an accelerated transition process, also enhance welfare gains relative to gradual ones.

By mimicking twelve consolidation episodes that have occurred in EU15 countries during the last two decades, we confirm that fiscal adjustments based on unproductive expenditures are welfare-superior. Moreover, welfare is further enhanced the lower tax effort is, the higher global spending cuts (either on social transfers or on unproductive expenditures) and the more public expenditure is biased towards investment. Finally, all strategies involve lower welfare inequality costs despite the hump shape forms of wealth and income Gini indexes paths.

Heterogeneous-agents models have evolved in many directions and have been improved with several extensions over the last decades. As so, our thesis presents many possible future lines of research in order to explore other insights on fiscal consolidation. One first possibility consists of incorporating additional sources of heterogeneity in line with Krusell and Smith (1998) who, by introducing an idiosyncratic shock on individual discount rates manage to generate a more realistic wealth distribution or following Rios-Rull and Quadrini (1997) who extended the model as to introduce a social security system and the bequest motive. Another source of heterogeneity can be found in Floden (2001) where social transfers are conditioned on agent's income and wealth (means-tested). A second major issue consists of extending our model with time-varying stochastic aggregate variables in order to explore potential effect of aggregate shocks (Ljungqvist and Sargent (2004) and Krusell and Smith (1998)).

Another possible line of investigation consists of incorporating a different

model of growth, possibly one using endogenous growth theories. In the literature, several authors use models of endogenous growth to estimate optimal level of debt and taxes but with a representative agent approach (Jones and Manuelli (2005), Jones et al. (1993) among others). We could incorporate the theory of endogenous growth in the heterogeneous-agents framework and evaluate the consequences of using such model on the results obtained so far. Finally, one could also include public expenditure, namely supply-side public policies, aimed at affecting the duration of transitions in the labour market, i.e., an endogenous transition matrix evolving in accordance to different fiscal policy instruments.

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