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Asset Liquidity and Fiscal Consolidation Programs

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Abstract

We argue that the relationship between wealth inequality and fiscal multipliers depends crucially on the type of fiscal experiment used as well as on the measure of the wealth distribution. We calibrate an incomplete-markets, overlapping generations model to different European economies and use Household Finance and Consumption Survey (HFCS) data to compare fiscal multipliers when models are calibrated to match the distribution of *liquid* vs. *net* wealth. We find a *negative* relationship between fiscal multipliers and wealth inequality when considering fiscal consolidation programs, in contrast to fiscal expansions experiments which are standard in the literature. The underlying mechanism relies on the relationship between the distribution of wealth and the share of credit constrained agents. We examine the role of households' balance sheet compositions regarding asset liquidity and find that when calibrating the model to match liquid wealth, the relationship between wealth inequality and fiscal multipliers is much stronger.

Keywords: Fiscal Consolidation, Wealth Inequality, Fiscal Multipliers, Consumption Smoothing

Hypothesis

JEL Classification: E21; E62; H31; H63

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1 Introduction

The 2008 financial crisis brought a renewed interest in fiscal policy. Until 2008, the debate around monetary policy effects dominated over fiscal policy. One of the reasons, according to [Ramey \(2011\)](#) was the belief that fiscal policy typically has a more substantial implementation lag than monetary policy. When the effects of fiscal policy materialize, the economy can be in a different state of the economic cycle, and the consequences can be opposite to what was intended. However, historically low nominal interest rates limited the role for conventional monetary policy, and fiscal policy was brought back to the center of the policy agenda. At the same time, European economies also faced historically high sovereign debt levels which, combined with the fall in output and the rescue of the financial system in the aftermath of the Great Recession of 2008, threatened the sustainability of public finances and led to a series of austerity packages which had impacts that were mostly unanticipated and different across countries (see [Blanchard and Leigh \(2013\)](#)).

Alongside the renewed interest in fiscal policy, the topic of inequality has recently raised interest among scholars and the general public. [Piketty \(2014\)](#) in the book *Capital in the Twenty-First Century* presented a historical perspective of income and wealth distribution and its determinants.¹ In fact, wealth inequality has been rising over the past decades. On top of that, there have been significant differences in the increase in income and wealth inequality across countries (see [Atkinson and Morelli \(2012\)](#)).

Recent contributions highlighted the relevance of income and wealth inequality for fiscal policy. [Brinca et al. \(2016\)](#) show that observable differences in income and wealth distributions across countries can lead to economically meaningful differences regarding the impact of a one-time increase in government expenditures financed by a one-time decrease in lump-sum transfers. Higher wealth inequality leads to a distribution with fatter tails and consequently more credit constrained agents, which have a larger labor supply elasticity w.r.t. a current negative income shock. [Röhrs and Winter \(2017\)](#) focus on the welfare implications of reducing government and also find that

¹Although this subject has gained importance in the last years, it is not a new topic. Plutarch, an ancient Greek historian (46-120 AD) said that "An imbalance between rich and poor is the oldest and most fatal ailment of all republics."

the optimal path of debt reductions depend on the wealth distribution and the corresponding share of credit constrained agents. [Brinca et al. \(2017\)](#) show that cross-country differences in income inequality can account for significant differences in the observed impacts of fiscal consolidation programs. This same mechanism is behind other theories that have been brought forth in accounting for the observed heterogeneity of output responses to fiscal shocks - [Basso and Rachedi \(2018\)](#) show that differences in population age structures across U.S. states explain differences in fiscal multipliers, precisely because younger agents are more likely to be credit constrained.

However, studies that took into account the nature of the asset composition are limited to the U.S. For European countries, studies have been relying on net wealth distribution,² instead of liquid wealth distribution.³ The relevance of such distinction arises from the fact that only liquid wealth can be used for consumption smoothing purposes and given the focus of the literature on short-run fiscal multipliers, highly illiquid assets such as pension funds for example, cannot be used to such purposes. Hence, models that are calibrated to match the net wealth distribution will produce aggregate marginal propensities to work and consume in response to the fiscal shocks that are likely to be biased, and therefore affect the size of the output response (see [Domeij and Floden \(2006\)](#)). This difference can now be correctly analyzed since the ECB brought a new dataset, the *Household Finance and Consumption Survey*, that can be used to perform cross-country studies taking into account the asset composition of the wealth distribution.

[Carroll et al. \(2017\)](#) show that marginal propensities to consume in response to a positive income shock can be substantially larger if models are calibrated to match the moments of liquid (as opposed to net) wealth distributions. [Kaplan and Violante \(2014\)](#) and [Kaplan et al. \(2014\)](#) show that the difference in asset liquidity can explain the difference between empirical results regarding the marginal propensity to consume and the ones stemming from standard macroeconomic models.

The second reason for using liquid wealth rather than net wealth is that the liquid wealth

²According to the Household Finance and Consumption Survey of the ECB, net wealth is the "total household assets including pension wealth from defined contribution plans minus total outstanding household's liabilities."

³According to the Household Finance and Consumption Survey of the ECB, liquid wealth comprises non-self employment private businesses, sight accounts, savings accounts, mutual funds, bonds, shares, managed accounts, 'other' assets, private lending, voluntary pension plans or whole life insurance contracts plus the current account balances of any defined contribution public or occupational plans the household members own.

distribution tends to be, for most of the countries, more uneven distributed than the net wealth distribution (see Figure 1), which can lead to a higher share of credit-constrained individuals than what otherwise would be inferred (see Kaplan et al. (2014)). The relevance of this idea is because the share of credit-constrained individuals is the data moment that is at the heart of many fiscal policy transmission mechanisms proposed in the literature. Using liquid wealth can help to bridge the gap between empirical estimates of the share of credit-constrained agents (see Grant (2007)) and that same share in standard incomplete markets models.

Third and lastly, as we show in Figure 1 for a sample of 15 European countries,⁴ liquid wealth and net wealth are not closely associated: the correlation is small (albeit positive) and not statistically significant. These numbers reinforce the idea that targeting liquid wealth instead of net wealth can be very important.

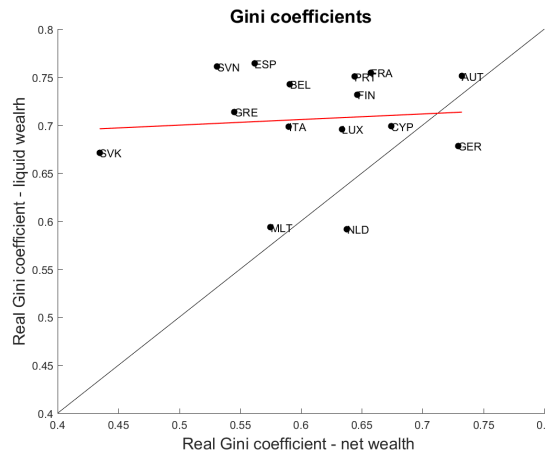


Figure 1: Gini coefficient of the liquid wealth distribution the x-axis and Gini coefficient of the net wealth distribution in the y-axis. Correlation coefficient 0.0820; p-value 0.7715.

In this paper, we focus on output responses to fiscal consolidation programs and the quantitative relevance of taking into account the distribution of liquid vs. net wealth for the size of fiscal multipliers. We use a novel micro-dataset, the Household Finance and Consumption Survey which has detailed household balance sheet data, and analyzes the effects of the same fiscal consolidation shock in a model calibrated to 9 different European countries, comparing fiscal multipliers when

⁴The 15 European countries used are Austria (AUT), Belgium (BEL), Cyprus (CYP), Finland (FIN), France (FRA), Germany (GER), Greece (GRE), Italy (ITA), Luxembourg (LUX), Malta (MLT), the Netherlands (NLD), Portugal (PRT), Slovakia (SVK), Slovenia (SVN) and Spain (ESP).

calibrating these models using moments of the liquid and net wealth distributions. We use the model proposed in [Brinca et al. \(2017\)](#), which contains overlapping generations with heterogeneous agents, incomplete markets, exogenous credit constraints, uninsurable idiosyncratic risk and a bequest motive.

We find that output falls in the short-run, as a consequence of the debt reduction policy, despite converging to a higher level at the end of the consolidation program. The mechanism is similar to the one proposed in [Brinca et al. \(2016\)](#): differences in wealth inequality translate to differences in the share of agents that are credit constrained which, in turn, will lead to different aggregate labor supply elasticities for the fiscal shock. The difference to [Brinca et al. \(2016\)](#) is that, for fiscal consolidation shocks, higher wealth inequality implies *lower* multipliers: as debt-over-GDP decreases, there is a crowd-in effect of assets into productive capital, which increases the marginal product of labor and the net present value of agents' lifetime income. In the short run output falls due to inter-temporal income and substitution effects: agents substitute leisure in the future for leisure today as wages are increasing over the transition to the lower debt-to-GDP steady state; and agents can now afford a higher level of leisure due to the increase in the net present value of lifetime income, reinforced by a lower interest rate which discounts less future income. These effects lead labor supply to fall in the short run, but by more in countries with less wealth inequality and smaller share of credit-constrained agents, as their labor supply elasticity to future shocks is much smaller. This generates the inverse relationship between wealth inequality and fiscal multipliers.

We also find that calibrating the models to match moments of the net or liquid wealth distributions has no qualitative implications for the results, but the differences are quantitatively relevant. We find multipliers to be on average 14% higher, in absolute terms, when calibrating the models to match the moments of the liquid wealth distribution. This difference is roughly the same regardless of the consolidation program being financed by a decrease in government expenditures or an increase in labor taxes. Despite the small sample size, the differences are also statistically significant.

To the extent of our knowledge, our paper is the only one that explores the policy implications of a fiscal consolidation shock either financed by austerity or by labor income taxes for Europe in

the context of a general equilibrium model using liquid wealth. The rest of the article is organized as follows. In section 2 we characterize our OLG economy with heterogeneous agents, present the households' problem and define the competitive equilibrium. Section 3 explains the calibration done for each country. Section 4 presents the results using cross-country analysis. Section 5 concludes. The appendix shows some model properties and calibration details.

2 Model

In this section, we describe the model we will use to assess the response to fiscal consolidation shocks in different countries. The model is similar to the one that Brinca et al. (2016) uses, an overlapping generation model with heterogeneous agents and incomplete markets, but with a bequest motive as introduced by Brinca et al. (2017).

2.1 Technology

There is a representative firm that produces one good, output, according to a Cobb-Douglas production function:

$$Y_t(K_t, L_t) = K_t^\alpha L_t^{1-\alpha} \quad (1)$$

with K_t being the capital input in period t and L_t the number of efficient units of labor force used in production in period t . Capital evolves according to:

$$K_{t+1} = (1 - \delta)K_t + I_t \quad (2)$$

where δ is the annual depreciation rate of capital stock and I_t is the gross investment in period t . Each period, the firm chooses L_t and K_t in order to maximize their profits:

$$\max_{L_t, K_t} \Pi_t = Y_t - [w_t L_t + (r_t + \delta)K_t] \quad (3)$$

In a competitive equilibrium, the factor prices, w_t and r_t will be equal to the marginal product of labor and capital, respectively:

$$w_t = \frac{\partial Y_t}{\partial L_t} = (1 - \alpha) \left(\frac{K_t}{L_t} \right)^\alpha \quad (4)$$

$$r_t = \frac{\partial Y_t}{\partial K_t} = \alpha \left(\frac{L_t}{K_t} \right)^{1-\alpha} - \delta \quad (5)$$

2.2 Demographics

The economy is populated by J overlapping generations of households that live for a finite amount of time. Households enter the labor market at age 20 and retire at age 65. Let j stand for the household's age. Retired households face an age-dependent probability of dying, $\pi(j)$, and at the age of 100, they die for certain.⁵ In the model, periods are one year, so each agent has 45 periods of active work life. Furthermore, there is no population growth *i.e.* population size is fixed. We normalize the size of each cohort to 1. Using $\omega(j) = 1 - \pi(j)$ to refer the age-dependent probability of survive, applying the law of large numbers, the mass of retired agents of age $j \geq 65$ still alive at period t is equal to $\Omega_j = \prod_{q=65}^{j-1} \omega(q)$.

Households are heterogeneous not only in respect to age but also to asset holdings, to idiosyncratic productivity, to the subjective discount factor, and the permanent ability. The subjective discount factor can be, with equal probability, one out of the three values $\beta \in \{\beta_1, \beta_2, \beta_3\}$ and it is constant for each household during their lifetime. The permanent ability component is realized at birth, so when households enter the labor market at age 20, they already have a certain level of productivity.

There are no annuity markets, so a fraction of households leave unintended bequests that are equally redistributed across the living households, via lump-sum transfers. We use Γ to denote the per-household bequest. Moreover, we assume that retired households' utility is increasing in the bequest they leave when they die.⁶

⁵This means that $J=81$.

⁶The usage of bequests is useful in the model calibration of asset holdings of elderly households.

2.3 Labor Income

The wage of an individual, w_i is given by:

$$w_i(j, a, u) = we^{\gamma_1 j + \gamma_2 j^2 + \gamma_3 j^3 + a + u} \quad (6)$$

where w is the wage per efficient unit of labor determined in the competitive market, γ_1 , γ_2 and γ_3 capture the age profile of wage, $a \sim N(0, \sigma_a^2)$ is the permanent ability and u the (persistent) idiosyncratic productivity shock that is realized every period. This idiosyncratic shock follows the AR(1) process:

$$u_{t+1} = \rho u_t + \epsilon_{t+1}, \epsilon \sim N(0, \sigma_\epsilon^2) \quad (7)$$

where ρ is the persistence of the idiosyncratic shock.

2.4 Preferences

The momentary utility function of a household, $U(c, n)$, depends positively on consumption, c and negatively on hours of work, $n \in]0, 1]$, and takes the following form:

$$U(c, n) = \frac{c^{1-\sigma}}{1-\sigma} - \chi \frac{n^{1+\eta}}{1+\eta} \quad (8)$$

where σ is the risk-aversion parameter, χ the disutility of working factor and η the inverse Frisch elasticity. Retired households have an additional term that comes from the bequest they leave when they die:⁷

$$D(k) = \phi \log(k) \quad (9)$$

Every period of active work-life they decide how many hours to work, n , how much to consume, c , and how much to save, k' . Retired households do not supply labor but receive a social security payment, Ψ_t , constant over time and across households.⁸

⁷Barro (1974) was the first to introduce bequests in macroeconomic models to show that under certain circumstances the Ricardian Equivalence would hold.

⁸Even if Ψ_t was a function of the income received during the active life, the results would not be different.

2.5 Government

The Government action can be subdivided into two parts: social security and policy actions. The social security system works by taxing employees and the employer (the representative firm) at the rate τ_{SS} and $\tilde{\tau}_{SS}$, respectively, and pays benefits Ψ_t to retirees. The Government also intervenes in the economy consuming pure public goods, G_t , with a lump-sum redistribution, g_t , and paying interests on the national debt to the debt-owners, the households, $r B_t$. To finance these expenditures, it taxes consumption, capital, and labor. Consumption and capital are taxed at flat rates, τ_c and τ_k . Labor income is taxed in a non-linear way using the functional form proposed in [Benabou \(2002\)](#):

$$\tau(y) = 1 - \theta_0 y^{-\theta_1} \quad (10)$$

where y stands for the pre-tax labor income and $\tau(y)$ is the average tax rate given the pre-tax income of y . The parameters θ_0 and θ_1 determine the level and the progressivity of the tax code, respectively.⁹ [Heathcote et al. \(2017\)](#) showed this function fits the U.S. data well.

We assume that there is some outstanding Government debt but that Government debt-to-output ratio, $B_y = \frac{B_t}{Y_t}$, does not change over time. Furthermore, in a steady-state, the ratios of Government revenue-to-output and expenditure-to-output remain constant, which imply no new debt being created. Denoting R_t as the Government's revenue from the taxes collected on labor, capital and consumption and R_t^{SS} as the Government's revenues from social security taxes, the Government budget constraints take the following form:

$$g \left(45 + \sum_{j \geq 65} \Omega_j \right) = R - G - rB \quad (11)$$

$$\psi \left(\sum_{j \geq 65} \Omega_j \right) = R^{SS} \quad (12)$$

⁹In the appendix [6.1](#) a further discussion of the properties of this tax function is provided.

2.6 Recursive Formulation of the Household Problem

At any given time a household is characterized by the vector (k, β, a, u, j) , where k is the household's savings, $\beta \in \{\beta_1, \beta_2, \beta_3\}$ is the time discount factor, a the permanent ability, u is the idiosyncratic shock, and j is the age of the household. Households will choose how much to consume, c , how many hours to work, n , and how much to save, k' , such that they maximize their utility and the discounted continuation value:

$$\begin{aligned}
 V(k, \beta, a, u, j) &= \max_{c, k', n} \left[U(c, n) + \beta E_{u'} [V(k', \beta, a, u, j + 1)] \right] \\
 \text{s.t. } c(1 + \tau_c) + k' &= (k + \Gamma)(1 + r(1 - \tau_k)) + g + Y^L \\
 Y^L &= \frac{nw(j, a, u)}{1 + \tilde{\tau}_{SS}} \left(1 - \tau_{SS} - \tau_l \left(\frac{nw(j, a, u)}{1 + \tilde{\tau}_{SS}} \right) \right) \\
 n \in]0, 1], \quad k' &\geq -b, \quad c > 0
 \end{aligned} \tag{13}$$

Here, Y^L is the labor income after social security taxes and labor income taxes. $\tilde{\tau}_{SS}$ and τ_{SS} are the social security taxes paid by the employee and by the employer, respectively. The problem of a retired household is similar to an active agents, except that it does not supply labor, it has an age-dependent probability of dying $\pi(j)$ and it gains utility, $D(k)$, from leaving a bequest, is:

$$\begin{aligned}
 V(k, \beta, j) &= \max_{c, k'} \left[U(c, n) + \beta(1 - \pi(j))V(k', \beta, j + 1) + \pi(j)D(k) \right] \\
 \text{s.t. } c(1 + \tau_c) + k' &= (k + \Gamma)(1 + r(1 - \tau_k)) + g + \psi \\
 k' &\geq 0, \quad c > 0
 \end{aligned} \tag{14}$$

2.7 Stationary Recursive Competitive Equilibrium

Let $\Phi(k, \beta, a, u, j)$ be the measure of households with the corresponding characteristics. The stationary recursive competitive equilibrium is defined as follows:

1. Given the factor prices and the initial conditions the consumers' optimization problem is solved by the value function $V(k, \beta, a, u, j)$ and the policy functions, $c(k, \beta, a, u, j)$,

$k'(k, \beta, a, u, j)$, and $n(k, \beta, a, u, j)$.

2. Markets clear:

$$\begin{aligned} K + B &= \int k d\Phi \\ L &= \int n(k, \beta, a, u, j) d\Phi \\ \int c d\Phi + \delta K + G &= K^\alpha L^{1-\alpha} \end{aligned}$$

3. The factor prices satisfy:

$$\begin{aligned} w &= (1 - \alpha) \left(\frac{K}{L} \right)^\alpha \\ r &= \alpha \left(\frac{L}{K} \right)^{1-\alpha} - \delta \end{aligned}$$

4. The Government budget balances:

$$g \int d\Phi + G + rB = \int \left(\tau_k r(k + \Gamma) + \tau_c c + n\tau_l \left(\frac{nw(a, u, j)}{1 + \tilde{\tau}_{SS}} \right) \right) d\Phi$$

5. The social security system balances:

$$\psi \int_{j \geq 65} d\Phi = \frac{\tilde{\tau}_{SS} + \tau_{SS}}{1 + \tilde{\tau}_{SS}} \left(\int_{j \geq 65} nwd\Phi \right)$$

6. The assets of the deceased are uniformly distributed among the living:

$$\Gamma \int \omega(j) d\Phi = \int (1 - \omega(j)) k d\Phi$$

2.8 Fiscal Experiment and Transition

The fiscal experiments analyzed are the same as in [Brinca et al. \(2017\)](#). The Economy starts in the steady-state and without any previous announcement, Government reduces public debt, B by 10% of GDP, during 50 periods. We used two different policies to achieve this reduction: either

the reduction is financed by a decrease in Government spending, G , of 0.2% of the steady-state GDP every period, or it is financed by an increase in the labor income tax, τ_l of 0.1% of the steady-state GDP every period, for all agents. After the 50 periods of consolidation, either the Government spending or the labor tax return to the initial level. We assume that the economy takes an additional 50 periods to converge to the new steady-state equilibrium with the lower debt-to-GDP ratio. Furthermore, the lump-sum transfer, g , is set to clear the Government budget.

The definition of a transition equilibrium after the fiscal experiment is in appendix 6.2. The main difference comparing to the steady-state is that the dynamic-programming problem of households requires another state variable: time, t , capturing all the changes in policy and price variables relevant in this maximization problem along the transition to the lower debt-to-GDP steady state. The method to achieve the numerical solution of the model is similar to the one used in [Krusell and Smith \(1998\)](#) which guesses paths for all the variables that will depend on time and then solves the problem backward after the guess is updated.

2.9 Definition of the Fiscal Multiplier

We define the impact and cumulative multipliers as in [Brinca et al. \(2017\)](#):

$$\text{impact multiplier} = \frac{\Delta Y_0}{\Delta I_0}, \text{ with } I = \{G, R\} \quad (15)$$

where ΔY_0 is the change of output from period 0 to period 1 and ΔI_0 can be the change in Government spending from period 0 to period 1 if $I = G$ or the change in Government revenue from period 0 to period 1 if $I = R$. During a consolidation via G , τ_l and g are kept unchanged and during a consolidation via τ_l , G and g are kept unchanged.

$$\text{cumulative multiplier } I(T) = \frac{\sum_{t=0}^{t=T} \left(\prod_{s=0}^{s=T} \frac{1}{1+r_s} \right) \Delta Y_t}{\sum_{t=0}^{t=T} \left(\prod_{s=0}^{s=T} \frac{1}{1+r_s} \right) \Delta I_t}, \text{ with } I = \{G, R\} \quad (16)$$

where ΔY_t is the change in output from period 0 to period t and ΔI_t can be the change in Government spending from period 0 to period t , if $I = G$ or the change in Government revenue from period 0 to period t , if $I = R$.

3 Calibration

The model described in Section 2 is calibrated following the same methodology of Brinca et al. (2016) and Brinca et al. (2017) to match moments of 9 economies: Austria, France, Germany, Greece, Italy, the Netherlands, Portugal, Slovakia, and Spain.¹⁰ Certain parameters have direct empirical counterparts, and they were calibrated outside of the model. Other parameters are not observable, and so they are calibrated using a Simulated Method of Moments (SMM) approach. Appendix 6.3 presents all the calibration values.

3.1 Wages

To estimate the life cycle profile of wages, equation 6, we use data from the Luxembourg Income Study (LIS) and run for the below regression separately for each of the nine countries:

$$\ln(w_i) = \ln(w) + \gamma_1 j + \gamma_2 j^2 + \gamma_3 j^3 + \epsilon_i \quad (17)$$

where w is the wage rate from equation 4 and j is the age of individual i . This equation was estimated in efficient units and the estimated values of γ_1 , γ_2 and γ_3 are in table 2.

The parameter for the variance of the ability, σ_a , is assumed to be unchanged across countries and set equal to the average of the European countries in Brinca et al. (2016). The parameter for the persistence of idiosyncratic shock, ρ , was also set to be unchanged across countries and equal to the value used in Brinca et al. (2016), who use U.S. data from the Panel Study of Income Dynamics (PSID).¹¹ The variance of the idiosyncratic risk, σ_ϵ is then endogenously calibrated, as we will describe below.

3.2 Preferences and the Borrowing Limit

There is a large debate about the value of the Frisch elasticity of labor supply, η , in the literature.¹² We set it equal to 1.0, which is similar to a number of recent studies (Guner et al. (2014) or Trabandt

¹⁰Sample determined by data availability.

¹¹The value of ρ was set equal to the U.S. because European countries do not have data to perform a consistent estimation.

¹²For a complete literature review, see Reichling and Whalen (2012).

and Uhlig (2012)). The parameter that determines the disutility of hours worked, χ , the discount factors, $\beta_1, \beta_2, \beta_3$, and the borrowing limit, b , are calibrated so that selected model moments match the respective data moments, as we will describe below. In order to ensure that the age-profile of wealth is empirically plausible, we include a bequest motive as in Brinca et al. (2017) and Brinca et al. (2019) and choose φ accordingly.

3.3 Taxes and Social Security

We apply the labor income tax function of equation (10), proposed by Benabou (2002). We use U.S. labor income tax data provided by the OECD to estimate θ_0 and θ_1 for different family types. To obtain a tax function for the single individual households in our model, we take a weighted average of θ_0 and θ_1 , where the weights are each family type's share of the population.¹³

The employer social security rate, $\tilde{\tau}_{SS}$, and the employee social security rate, τ_{SS} were set equal to the average tax rates between 2001 and 2007 for each country. The consumption tax rate, τ_c , and the capital tax rate, τ_k , were taken from Trabandt and Uhlig (2012), for each of the analysed countries. Table 2 summarizes the tax rates values for the entire sample.

3.4 Parameters Calibrated Endogenously

There are 7 parameters that do not have any direct empirical counterpart: $\varphi, \beta_1, \beta_2, \beta_3, b, \chi$ and σ_ϵ . To calibrate them, we use the simulated method of moments. We minimize the following loss function:

$$L(\varphi, \beta_1, \beta_2, \beta_3, b, \chi, \sigma_\epsilon) = ||M_m - M_d|| \quad (18)$$

where M_m and M_d are model moments and data moments chosen. As there are seven parameters to calibrate, in order to have a precisely identified system we need 7 data moments. The data moments chose are the same as in Brinca et al. (2017):¹⁴ average yearly hours, taken from the OECD Economic Outlook, the ratio of capital-to-output, $\frac{K}{Y}$, taken from the Penn World Table 8.0, the variance of log wages, taken from the Luxembourg Income Study (LIS) and the three quartiles of the cumulative liquid wealth distribution (the wealth held by those between the 1st and the 25th

¹³The weights used were based in US data as some countries do not have detailed demographic data.

¹⁴In table 4 we summarize the calibration targets.

percentile, between the 1st and the 50th percentile, and between the 1st and the 75th percentile) taken from the Household Finance and Consumption Survey (HFCS), and the mean asset position held by the households with 75 to 80-years old relative to the mean wealth in the economy, from the Luxembourg Wealth Study (LWS).¹⁵ The target moments are calibrated with an average error margin of 1.93%. Table 4 exhibits the target moments and table 5 displays the endogenous calibrated parameters and the calibration error for the nine countries.

Figure 2 compares the Gini coefficient of the liquid wealth distribution in the data with the wealth distribution in the model for the nine economies considered. It ensures that the calibration done mimics the real data since the Pearson correlation coefficient is very close to 1.

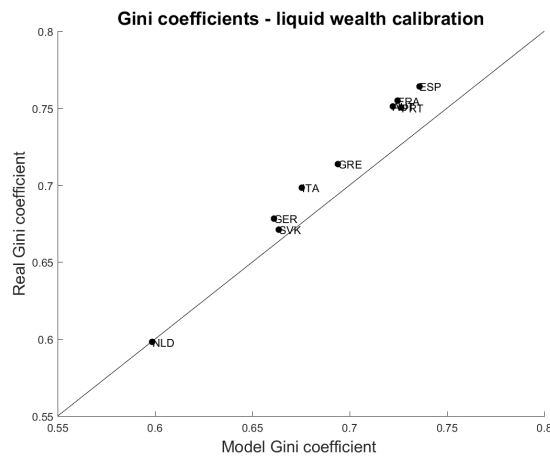


Figure 2: Comparison of Gini coefficient: The Gini from the data (Real Gini coefficient) is on the y-axis and the Gini obtained from the model calibration (Model Gini coefficient) is on the x-axis. It is also represented the 45-degrees line. The Pearson correlation coefficient is 0.9973 with a p-value < 0.01

4 Results

Our premise is that not only the households' balance sheet composition matters for the effects of a fiscal consolidation policy but also the type of fiscal experiment carried out. This section describes the simulations undertaken, the resultant patterns from these simulations, the implied cross-country relationship regarding fiscal consequences and inequality, the importance of liquid wealth in the

¹⁵As we do not have detailed data for the population share of each family for European countries, we use U.S. family shares, as in Holter et al. (2017).

context of this policy and tests the robustness of the relationship for other inequality measures.

4.1 Experiment

The results from the calibration for the 9 European countries constitute the steady-state or the benchmark point. Contrary to what is standard in most of the literature, we implement a fiscal consolidation policy similar to the one in [Brinca et al. \(2017\)](#). We depart from the steady-state point and implement the fiscal consolidation policy for 50 years, where countries reduce the debt-to-output ratio. We implement two different kinds of experiments for each country: a fiscal consolidation via austerity, *i.e.* decreases in Government expenditure, G ; or a fiscal consolidation via taxation, with increases in the labor tax rate, τ_l

For a fiscal consolidation financed through a decrease in public expenditure, G , Government cuts G by 0.2% of the steady-state GDP. Alternatively, the Government can implement a fiscal consolidation by increasing labor taxes, τ_l . In this case, the public authority increases the tax rate by 0.1% of the steady-state GDP. Either way, the policy creates enough revenue after 50 years to decrease the debt-to-output ratio by ten percentage points.

4.2 Mechanisms

The mechanisms behind the two types of fiscal consolidation policies are distinct and it is important to characterize them separately. It is also relevant to describe how wealth inequality affects the chain of events. As described in section 2, the model has four sources of heterogeneity: the households' age, j , their permanent ability, a , the discount factor, β and the idiosyncratic productivity shock, u . These four factors influence the households' wealth accumulation and consequently the aggregate response to the fiscal consolidation shocks.

While the Government pays its debt, the number of Government bonds in the economy decreases which makes households to change how they save. Households gradually shift savings to physical capital, which drives up the capital-to-labor ratio. An economy with more capital per worker is an economy with higher marginal productivity of labor, in other words, more capital in the economy allows workers to be more productive. Due to the market clearing conditions, the marginal productivity of labor equals the wage rate (equation 4). Hence, it also rises. Due to inter-temporal

and income effects, households will prefer to have more leisure, as wages are increasing over the 50-years transition. With higher wages and lower interest rates, the net present value of lifetime income is higher, which leads labor supply to fall in the short-run and, consequently output also drops.

However, a country with more wealth inequality has more hand-to-mouth agents, which are financially constrained agents. These agents do not have the chance of smoothing consumption as much as they would like. A country with a higher share of financially constrained agents has a more rigid labor supply, meaning that the labor input does not react as much to negative policy shocks which ultimately gives lower drops in output.

In the case of a consolidation via labor income taxes, τ_l , we have that an increase in the tax rate also originates intra-temporal substitution effects on the labor supply. In fact, a higher tax rate leads to a lower after-tax income which reduces the opportunity cost of leisure. As a result, labor supply will decrease, reducing the labor input and causing the output to fall.

Following the same reasoning, economies with a higher wealth inequality display a more substantial fraction of financially constrained households. These agents will have a relatively modest reaction to the tax rate increase as they are needy agents. These agents would like to reduce the labor supply, but they cannot reduce it. Therefore, countries with higher shares of constrained agents will have less severe reactions to the fiscal consolidation policy, *i.e.* output drops will be smaller.

4.3 Cross-country analysis

In [Brinca et al. \(2016\)](#), the authors conclude that the wealth distribution is relevant for fiscal policy. They perform the classical fiscal expansion experiment in the literature where current Government consumption, G , increases financed by a reduction in current Government transfers, g . They conclude that wealth inequality and fiscal multipliers are positively related with a correlation coefficient of 0.623.

As described previously, for a fiscal consolidation shock, countries with higher wealth inequality, have a larger share of financially constrained agents and a more rigid labor supply causing smaller

drops in output. In other words, countries with more uneven distribution have smaller fiscal multipliers in absolute values.

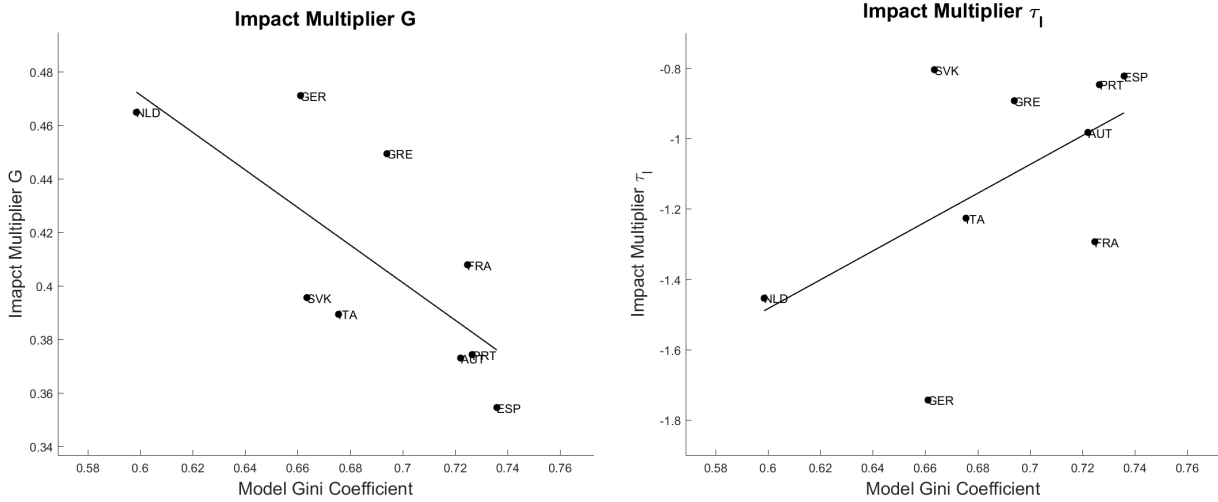


Figure 3: Impact multiplier and Gini coefficient. On the left panel we have the cross-country relation for a consolidation via G (correlation coefficient -0.73 ; p -value 0.026), while on the right panel we have the cross-country data for a consolidation via τ_l (correlation coefficient 0.55 ; p -value 0.124).

In Figure 3 we plot the impact multipliers for a fiscal consolidation policy either financed by austerity or by taxation and the wealth Gini coefficients across the 9 European countries considered, in the context of a model calibrated for liquid wealth. As countries have more wealth inequality, the impact multipliers are less sizable.

Furthermore, and in accordance to what is standard in the literature, the effects from a fiscal consolidation experiment financed by labor income taxes, τ_l are more severe than the effects from a fiscal consolidation experiment financed by Government expenditure, G .¹⁶ This phenomenon is observable by looking at the absolute value of the fiscal multipliers. For our nine country sample, the fiscal multiplier of τ_l is, on average, 2.7 times larger than the fiscal multipliers of G , in absolute terms.¹⁷

¹⁶This is a result that comes from the fact that the consequences of taxation have more direct effects on the economy than austerity. Blanchard and Perotti (2002) estimated different fiscal multipliers for the period 1947-1997 and shows that the multiplier of τ_l tend to be larger than the multiplier of G .

¹⁷Table 1 has the multipliers' values and the ratio between the τ_l multiplier and the G multiplier of each country.

4.4 Net Wealth vs. Liquid Wealth

The central economic concept behind the mechanisms is the consumption smoothing hypothesis. This hypothesis states that households prefer to consume similar amounts in each period, instead of having a considerable variance in consumption. To keep this behavior during low-income periods, households can resort to their accumulated wealth, convert it into cash and use it to consume. Yet, not all sorts of assets are right away convertible to cash. Real estate, for instance, is not immediately sold and so households cannot use this particular asset to smooth consumption, in the short-run.

According to [OECD \(2015\)](#), liquid wealth only represents 25.9% of the total wealth for 18 OECD countries. Additionally, the same book shows that net wealth and liquid wealth are not linearly related and that liquid wealth has a more uneven distribution. Therefore, one should use a model calibrated for liquid wealth distribution to explain how an economy responds to a fiscal consolidation shock. To demonstrate this argument, we perform a cross-country analysis for the 9 European economies considered in this paper that illustrate the mechanism of how wealth inequality affects a fiscal consolidation shock. The results show that the mechanism is much stronger for liquid wealth than for net wealth.

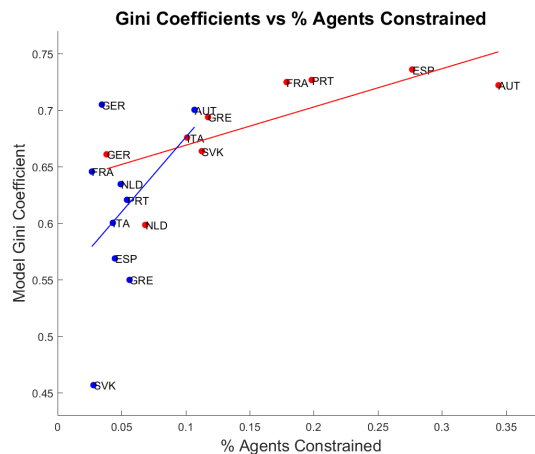


Figure 4: Percentage of agents constrained on the x-axis and Gini coefficient on the y-axis. Red points and lines represent the liquid wealth model and the blue points and lines represent the net wealth calibration (correlation coefficient of liquid wealth 0.76, p-value 0.017; and correlation coefficient of net wealth 0.41, p-value 0.27)

Figure 4 illustrates the relationship between the Gini coefficient and the percentage of agents financially constrained, in a model calibrated for net wealth and liquid wealth. Although the relation

for net wealth is steeper than the relation for liquid wealth, due to the tremendous point-dispersion, there is no statistical significance for the correlation coefficient of net wealth (blue points). In other words, this first step of the mechanism only has statistical power in the model calibrated with liquid wealth (red points).

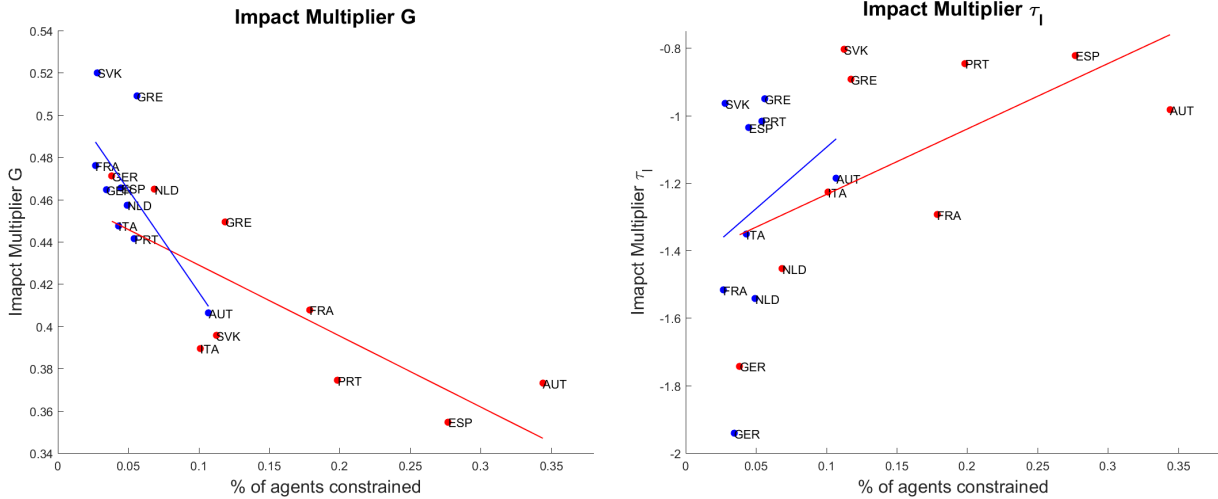


Figure 5: Impact multiplier and Percentage of agents constrained. Red points and lines represent the liquid wealth model and the blue points and lines represent the net wealth calibration. On the left panel we have the cross-country data for a consolidation via G (correlation coefficient of liquid wealth -0.79 , p -value 0.012 ; and net wealth -0.68 , p -value 0.044), while on the right panel we have the cross-country data for a consolidation via τ_1 (correlation coefficient of liquid wealth 0.59 , p -value 0.097 ; and correlation coefficient of net wealth 0.26 , p -value 0.502).

Figure 5 shows the other step of the mechanism which states that economies with more financially constrained agents react less to fiscal consolidation policies and so the fiscal multipliers are closer to zero. Indeed, this relation happens independently of the type of wealth used. However, once again, the results have more statistical significance for the model calibrated with liquid wealth. This fact indicates that liquid wealth is, *de facto* the vital measure in what concerns consumption smoothing.

Looking at Figures 4 and 5, one can see that the liquid wealth calibration allowed for higher percentages of credit constrained or hand-to-mouth agents. This is congruent with liquid wealth distribution having a higher Gini coefficient. Several articles estimated the percentage of hand-to-mouth agents for the U.S.¹⁸ (see Kaplan et al. (2014) or Grant (2007)) and it is significantly larger than the net wealth models exhibit. Liquid wealth models allow achieving a more realistic value of hand-to-mouth agents.

¹⁸There is no estimation for European countries, to the extent of our knowledge.

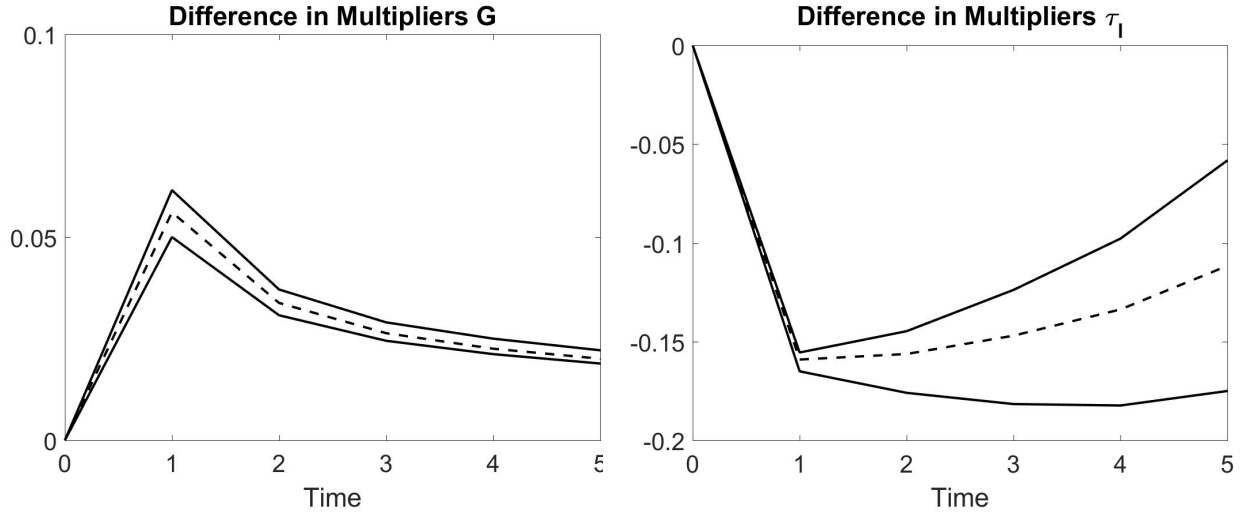


Figure 6: Difference of net wealth cumulative multiplier and liquid wealth cumulative multipliers for a government spending consolidation (left panel) and labor tax consolidation (right panel) in the first five periods. The area between the two solid lines is the 95% confidence interval obtained with sample bootstrapping.

The difference in liquid wealth and net wealth influence not only impact multipliers, but also cumulative multipliers. Figure 6 shows the difference in the cumulative multipliers between net wealth and liquid wealth for the five periods immediately after the shock, computed according to equation 16. It reinforces the idea that net wealth multipliers are larger, in absolute value than liquid wealth multipliers but overtime. This occurs precisely because of the mechanism described above where liquid wealth distribution is more unevenly distributed than net wealth which leads to a more significant share of constrained agents and consequently to lower labor supply and output responses to the shocks.

4.5 Robustness of the Mechanism

One possible issue that can arise is the type of measure used to wealth inequality. Allison (1978) presents several measures of income and wealth inequality, including the Gini coefficient. Although Leigh (2007) shows that there is a reliable and statistically significant relationship between top income shares and broader inequality measures, as the Gini coefficient, in this subsection we shall present the relationship of wealth inequality and fiscal multipliers, using the wealth ratios to measure inequality.

Independently of the ratio used, the measure on the numerator corresponds to the share of wealth

held by the wealthier households. On the other hand, the denominator corresponds to the share of wealth held by the poorer households. This means that a larger ratio implies a more uneven wealth distribution. In this subsection, we use the wealth ratio B90/B40 - Bottom 90 over Bottom 40. It corresponds to the wealth held by the poorest 90% over the wealth held by the poorest 40%.

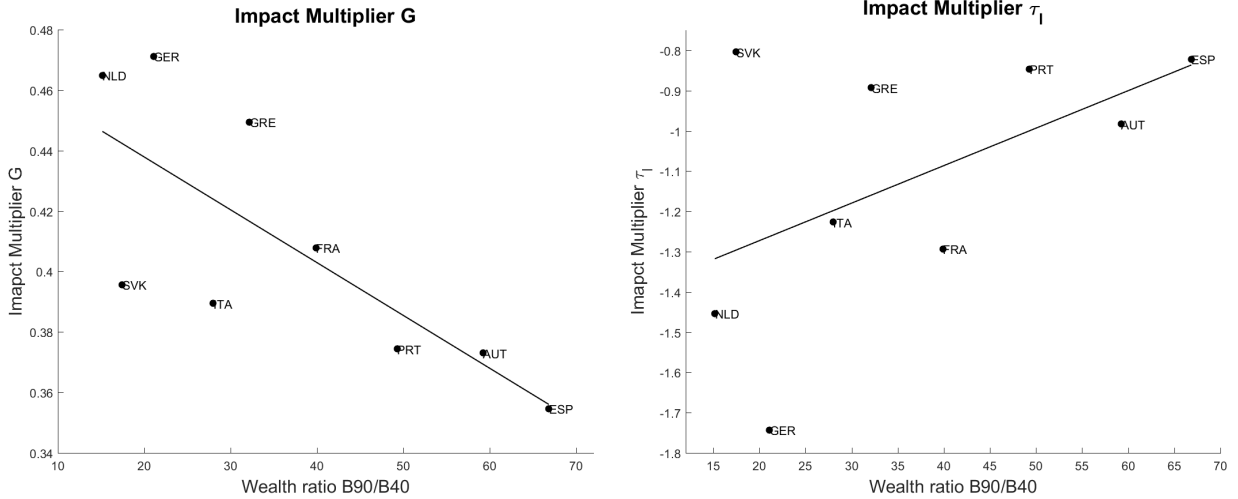


Figure 7: Impact multiplier and the B90-B40 ratio (B90 is the wealth held by the poorer 90% and B40 is the wealth held by the poorer 40%). On the left panel we have the cross-country data for a consolidation via G (correlation coefficient of -0.76, p-value 0.018), while on the right panel we have the cross-country data for a consolidation via τ_l (correlation coefficient of 0.52, p-value 0.149).

Figure 7 corroborates the same relation described above between fiscal multipliers and wealth inequality. For a fiscal consolidation financed by G , more inequality leads to lower multipliers, and for a consolidation financed by τ_l , more inequality leads to higher multipliers. We also have that the relationship in the case of the experiment financed with taxation is not statistically significant. In the appendix 6.3, we include other figures that test the same relation for different wealth ratios.

5 Conclusion

This paper analyzes the impacts of wealth inequality on a fiscal consolidation program financed either by austerity or by taxation. In particular, we assessed the impact of liquid wealth distribution, which is a measure more readily convertible to cash, in a fiscal contraction. We started by documenting that the Gini coefficient of net wealth distribution and liquid wealth distribution have a minimal relation and that the distribution of liquid wealth is more uneven than the one of net wealth.

To explain how wealth inequality affects the recessive impacts of the policy we calibrated an incomplete-markets, overlapping generations model to 9 European economies using the Household Finance and Consumption Survey (HFCS). We calibrated the model for both liquid wealth and net wealth, with the aim of testing the robustness of the mechanism.

We find that the relationship between wealth inequality and fiscal multipliers depend crucially on the fiscal instrument. In a case of fiscal expansion as in [Brinca et al. \(2016\)](#), the relationship is positive. In a case of fiscal consolidation the relationship is inverted, *i.e.* higher wealth inequality leads to smaller fiscal multipliers in absolute value. This result comes from the share of financially constrained agents in each country. In fact, more wealth inequality is associated with more financially constrained agents and consequently with a more rigid labor supply. Therefore, the output drops will be smaller for a country with higher inequality comparing to a country with lower inequality.

The economic concept behind this mechanism is the permanent-income / consumption-smoothing hypothesis. For this reason, liquid wealth should be preferred over net wealth when analyzing the impacts of fiscal policy, as the possibility of liquidating assets for consumption smoothing is central to the mechanism being used. Furthermore, when calibrating the model to match liquid wealth, the relationship between wealth inequality and fiscal multipliers for calibrated models to different countries is stronger, both in terms of correlation and statistical significance. This means that cross-country differences in these economies along other dimensions (such as tax structures, age profiles of income, etc.) become comparably less important.

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6 Appendix

6.1 Tax Function

¹⁹ Given the tax function

$$ya = \theta_0 y^{1-\theta_1}$$

which we employ, the average tax rate is defined as

$$ya = [1 - \tau(y)]y$$

and thus

$$\theta_0 y^{1-\theta_1} = [1 - \tau(y)]y$$

and thus

$$1 - \tau(y) = \theta_0 y^{-\theta_1}$$

$$\tau(y) = 1 - \theta_0 y^{-\theta_1}$$

$$T(y) = \tau(y) \cdot y = y - \theta_0 y^{1-\theta_1}$$

$$T'(y) = 1 - (1 - \theta_1)\theta_0 y^{-\theta_1}$$

Thus the tax wedge for any two incomes (y_1, y_2) is given by:

$$1 - \frac{1 - \tau(y_2)}{1 - \tau(y_1)} = 1 - \left(\frac{y_2}{y_1}\right)^{-\theta_1} \quad (19)$$

and therefore independently of the scaling parameter θ_0 . Thus by construction one can raise average taxes by lowering θ_0 and not change the progressivity of the tax code, since (as long as tax

¹⁹This appendix is borrowed from [Holter et al. \(2017\)](#)

progressivity is defined by the tax wedges) the progressivity of the tax code²⁰ is uniquely determined by the parameter θ_1

6.2 Definition of a Transition Equilibrium after the Unanticipated Fiscal Consolidation Shock

²¹We define a recursive competitive equilibrium along the transition between steady states as follows:

Given the initial capital stock, the initial distribution of households and initial taxes, respectively K_0, ϕ_0 and $\{\tau_l, \tau_c, \tau_k, \tau_{SS}, \tilde{\tau}_{SS}\}_{t=1}^{t=\infty}$, a competitive equilibrium is a sequence of individual functions for the household, $\{V_t, c_t, k'_t, n_t\}_{t=1}^{t=\infty}$, of production plans for the firm, $\{K_t, L_t\}_{t=1}^{t=\infty}$, factor prices, $\{r_t, w_t\}$, government transfer $\{g_t, \Psi_t, G_t\}_{t=1}^{t=\infty}$, government debt, $\{B_t\}_{t=1}^{t=\infty}$, inheritance from the dead, $\{\Gamma_t\}_{t=1}^{t=\infty}$, and of measures, $\{\Phi_t\}_{t=1}^{t=\infty}$, such that for all t :

1. Given the factor prices and the initial conditions the consumers' optimization problem is solved by the value function $V(k, \beta, a, u, j)$ and the policy functions $c(k, \beta, a, u, j)$, $k'(k, \beta, a, u, j)$, and $n(k, \beta, a, u, j)$

2. Markets clear:

$$K_{t+1} + B_t = \int k_t d\Phi_t$$

$$L_t = \int n_t(k_t, \beta, a, u, j) d\Phi_t$$

$$\int c_t d\Phi_t + K_{t+1} + G_t = (1 - \delta)K_t + K^\alpha L^{1-\alpha}$$

3. The factor prices satisfy:

$$w_t = (1 - \alpha) \left(\frac{K_t}{L_t} \right)^\alpha$$

$$r_t = \alpha \left(\frac{L_t}{K_t} \right)^{1-\alpha} - \delta$$

²⁰Note that

$$1 - \tau(y) = \frac{1 - T'(y)}{1 - \theta_1} > 1 - T'(y)$$

and thus as long as $\theta_1 \in]0, 1[$ we have that

$$T'(y) > \tau(y)$$

and thus marginal tax rates are higher than average tax rates for all incomes.

²¹This appendix is borrowed from [Brinca et al. \(2017\)](#)

4. The Government budget balances:

$$g_t \int d\Phi_t + G_t + r_t B_t = \int \left(\tau_k r_t (k_t + \Gamma_t) + \tau_c c_t + n_t \tau_l \left(\frac{n_t w_t (a, u, j)}{1 + \tilde{\tau}_{SS}} \right) \right) d\Phi_t + (B_{t+1} - B_t)$$

5. The social security system balances:

$$\psi_t \int_{j \geq 65} d\Phi_t = \frac{\tilde{\tau}_{SS} + \tau_{SS}}{1 + \tilde{\tau}_{SS}} \left(\int_{j \geq 65} n_t w_t d\Phi_t \right)$$

6. The assets of the dead are uniformly distributed among the living:

$$\Gamma_t \int \omega(j)_t d\Phi_t = \int (1 - \omega(j)) k_t d\Phi_t$$

7. Aggregate law of motion:

$$\phi_{t+1} = \gamma_t(\phi_t)$$

6.3 Additional Figures and Tables

Table 1: Impact Multipliers for the model calibrated with liquid wealth

Country	Multiplier G	Multiplier τ_l	Mult τ_l / Mult G
Austria	0.3731	-0.9829	2.634
France	0.4078	-1.2936	3.172
Germany	0.4711	-1.7431	3.700
Greece	0.4495	-0.8931	1.987
Italy	0.3895	-1.2267	3.149
Netherlands	0.4649	-1.4536	3.127
Portugal	0.3743	-0.8460	2.260
Slovakia	0.3956	-0.8042	2.033
Spain	0.3546	-0.8223	2.319

Table 2: Parameters calibrated exogenously

Country	Age profile parameters			Taxes					
	γ_1	γ_2	γ_3	θ_0	θ_1	$\tilde{\tau}_{SS}$	τ_{SS}	τ_c	τ_k
Austria	0.155	-0.004	3.0e-05	0.939	0.187	0.217	0.181	0.196	0.240
France	0.384	-0.008	6.0e-05	0.915	0.142	0.434	0.135	0.183	0.355
Germany	0.176	-0.003	2.3e-05	0.881	0.221	0.206	0.210	0.155	0.233
Greece	0.120	-0.002	1.3e-05	1.062	0.201	0.280	0.160	0.154	0.160
Italy	0.114	-0.002	1.4e-05	0.897	0.180	0.329	0.092	0.145	0.340
Netherlands	0.307	-0.007	4.9e-05	0.938	0.254	0.102	0.200	0.194	0.293
Portugal	0.172	-0.004	2.6e-05	0.937	0.136	0.238	0.110	0.194	0.293
Slovakia	0.096	-0.002	1.7e-05	0.974	0.105	0.326	0.131	0.181	0.151
Spain	0.114	-0.002	1.4e-05	0.904	0.148	0.305	0.064	0.144	0.296

¹ $\gamma_1, \gamma_2, \gamma_3$ are estimated according to equation (17), using the most recent LIS survey available before 2008. Data for Portugal comes from Quadros de Pessoal 2009 database;

² θ_0, θ_1 are estimated according to equation 10;

³ $\tilde{\tau}_{SS}, \tau_{SS}$ are the average social security taxes paid by the employer and by the employee, respectively, using OECD data of 2001-2007;

⁴ τ_c and τ_k come from [Trabandt and Uhlig \(2012\)](#) or calculated using their approach. They represent the average effective tax rate from 1995-2007.

Table 3: Parameters held constant across countries

Parameter	Value	Description	Source
α	0.33	Capital share of output	Literature
δ	0.06	Depreciation rate of capital	Literature
ρ	0.335	Persistence in equation 7	Estimated with PSID 1968-1997
σ_a	0.423	Variance of the ability	Brinca et al. (2016)
σ	1.2	Risk-aversion factor	Literature
η	1	Inverse Frisch Elasticity	Trabandt and Uhlig (2012)

Table 4: Calibration Targets - M_d

Country	Q1	Q2	Q3	K/Y	\bar{n}	Var $\ln(w)$
Austria	0.0056	0.0395	0.1480	3.359	0.226	0.199
France	0.0045	0.0328	0.1418	3.392	0.184	0.478
Germany	0.0063	0.0544	0.2234	3.013	0.189	0.354
Greece	0.0069	0.0462	0.1831	3.262	0.230	0.220
Italy	0.0087	0.0595	0.2012	3.943	0.200	0.225
Netherlands	0.0106	0.0812	0.3119	2.830	0.200	0.282
Portugal	0.0039	0.0283	0.1399	3.229	0.249	0.298
Slovakia	0.0131	0.0631	0.1399	3.799	0.204	0.250
Spain	0.0041	0.0275	0.1314	3.378	0.183	0.225

¹ The average share of wealth held by the households in the cohort of 75-80 years old relative to the total population mean is the 7th target. It was used the U.S. measure which is equal to 1.5134;

² Q1, Q2 and Q3 are the three quartiles of the cumulative distribution of liquid wealth derived from LWS;

³ K/Y is derived from PWT 8.0, average from 1990-2011;

⁴ \bar{n} is average hours worked per capita derived from OECD data 1990-2011;

⁵ Var $\ln(w)$ is the variance of log wages from the most recent LIS survey available before 2008. Data for Portugal comes from Quadros de Pessoa 2009 database.

Table 5: Parameter Values calibrated endogenously and respective error
Estimated by SMM

Country	β_1	β_2	β_3	b	χ	φ	σ_ϵ	Error (%)
Austria	0.9165	1.0008	0.8837	-0.040	14.47	5.99	0.1757	2.55
France	0.9030	1.0145	0.9170	-0.060	18.43	4.19	0.5060	0.59
Germany	0.9560	0.9953	0.9560	0.003	14.42	3.81	0.5386	0.01
Greece	0.9650	1.0045	0.9665	-0.070	16.77	3.35	0.1206	1.58
Italy	0.9750	1.0200	0.9755	-0.078	20.75	5.90	0.2144	5.20
Netherlands	0.9680	0.9856	0.9579	-0.022	14.72	2.99	0.2625	0.23
Portugal	0.8965	0.9921	0.8900	-0.030	11.62	6.70	0.3810	0.73
Slovakia	0.9410	1.0016	0.9410	-0.091	21.15	7.92	0.3269	3.28
Spain	0.8950	1.0005	0.8920	-0.027	25.15	7.05	0.2372	1.92

¹ The error corresponds to the value of the Loss function in equation (18).

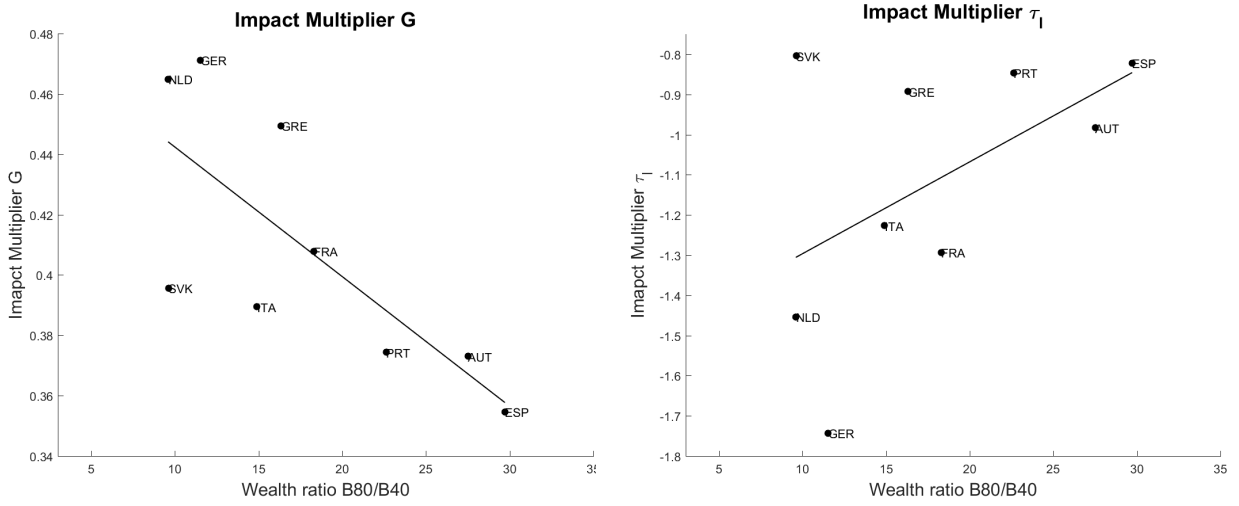


Figure 8: Impact multiplier and the B80-B40 ratio (B80 is the wealth held by the poorer 80% and B40 is the wealth held by the poorer 40%). On the left panel we have the cross-country data for a consolidation via G (correlation coefficient of -0.748, p-value 0.021), while on the right panel we have the cross-country data for a consolidation via τ_I (correlation coefficient of 0.515, p-value 0.156).

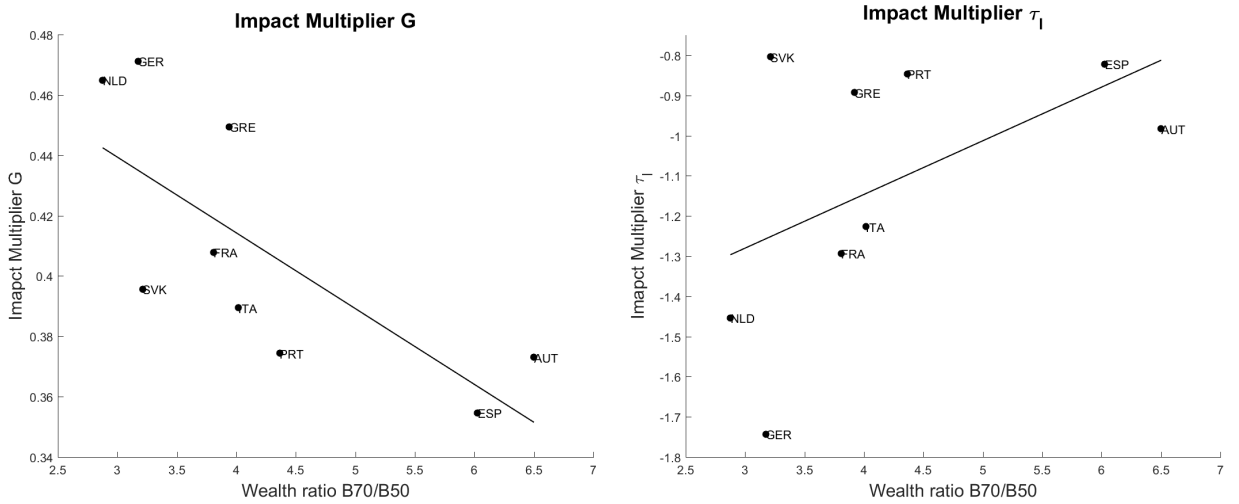


Figure 9: Impact multiplier and the B70-B50 ratio (B70 is the wealth held by the poorer 70% and B50 is the wealth held by the poorer 50%). On the left panel we have the cross-country data for a consolidation via G (correlation coefficient of -0.739, p-value 0.023), while on the right panel we have the cross-country data for a consolidation via τ_I (correlation coefficient of 0.509, p-value 0.162).