Liquidity constraints and fiscal multipliers

Sá, Diogo

Nova School of Business and Economics

January 2022

Liquidity Constraints and Fiscal Multipliers

Diogo Larangeira de Sá *

January, 2022

Abstract

Although recent studies identified the percentage of constrained agents as the crucial force driving many fiscal policy mechanisms, the values attained were purely the result of model calibrations. We make use of household-level data to estimate the fraction of hand-to-mouth households for several European countries. We calibrate an overlapping generations model with heterogeneous agents to match the net liquid wealth distribution and study the impact of credit constraints on the effectiveness of fiscal consolidation policies. Our findings suggest that the share of hand-to-mouth agents is no longer quantitatively relevant to explain the cross-country heterogeneity in fiscal multipliers when we calibrate the model to match empirically plausible estimates of that share. These results may be driven by the characteristics of the model we employ, which excludes the wealthy hand-to-mouth.

Keywords: Fiscal Multipliers, Liquidity Constraints, Fiscal Consolidation, Hand-to-Mouth

JEL Classification: D31, E21, E62, H31

*Nova School of Business and Economics, Universidade Nova de Lisboa. Email: diogo.sa@novasbe.pt

1 Introduction

The Global Financial Crisis stressed the importance of both liquidity constraints and fiscal policy. On the one hand, the crisis that emerged in the housing and credit markets (Constâncio, 2020) was greatly exacerbated due to the default on the loans of households with small holdings of liquid wealth, or liquidity-constrained households. On the other hand, to respond to the Great Recession, many European countries used expansionary fiscal policies, which contributed to historically large government debt levels. Consequently, economies faced the need to adopt measures to reduce their sovereign deficits, either by raising taxes, cutting spending, or both (Alesina et al., 2015). Thenceforth, several authors have been interested in understanding the effects of fiscal consolidations on the economy. Ramey (2019), for instance, provides an overview of how are research methods and empirical estimates of multipliers changing since the 2008 financial crisis.

This paper contributes to the literature by understanding how country-specific estimated fractions of constrained agents affect the country heterogeneity of multipliers from fiscal consolidation shocks. We start by estimating the proportion of credit-constrained households in 9 European countries making use of household-level survey data from the Household Finance and Consumption Survey (HFCS) and applying the methodology of Kaplan et al. (2014). Then, we calibrate the overlapping generations model with heterogeneous agents and incomplete markets constructed by Brinca et al. (2021) to match the net liquid wealth distribution – rather than the net wealth or financial assets ones used in Brinca et al. (2021) and Bernardino (2020), respectively – across those 9 economies. This allows us to analyze the extent to which output responses to fiscal consolidation shocks vary among countries with more or less constrained agents.

We find that the share of the population that is liquidity-constrained has no longer a quantitative relevance to explain the cross-country heterogeneity in fiscal multipliers when we account for empirically plausible estimates of that share. This conclusion may be driven by the characteristics of the model we employ, which excludes from the constrained households the wealthy hand-to-mouth, which are both the predominant group of hand-to-mouth and the ones whose labor supply responds more to future income shocks. To the best of our knowledge, our paper is the first one to empirically estimate the percentage of financially constrained agents to study the impact of fiscal consolidation shocks by calibrating a macroeconomic model using net liquid wealth.

Related literature. Recent papers have worked on decomposing the transmission channels and the magnitude whereby fiscal consolidation occurs. Barrell et al. (2012) perform a set of simulations using the National Institute Global Econometric Model (NiGEM), and identify three main factors that may justify cross-country heterogeneity in fiscal multipliers: country size, the openness of the economy, and income elasticity of consumption. The authors document higher multipliers in larger and closed-to-trade economies, and in economies whose demand is more responsive to changes in income. In addition, they find multipliers to be moderately correlated with income elasticity only in the case of consolidations via taxes (rather than via government spending). They also suggest that the mechanism occurs through liquidity constraints, in the sense that economic agents from less financially-liberalized economies tend to have larger demand responses to income shocks precisely because they are more liquidity-constrained. Using quarterly data of 44 countries, Ilzetzki et al. (2013) state that the size of fiscal multipliers is determined by idiosyncratic country characteristics, including its development level, exchange rate system, and trade openness. They contend that the government spending shock has larger output responses in developed countries, under fixed exchange rate regimes, and in relatively closed economies. Alesina et al. (2017) conclude that recessions originated by consolidation policies are deeper and longer in the case of tax increases. Furthermore, Brinca et al. (2020) document that the labor share of income is a significant determinant of fiscal multipliers. They argue that larger labor shares originate lower opportunity costs of leisure, thus leading to higher labor supply decreases after a shock.

Incomplete markets models have been used thoroughly for fiscal policy, from the size of multipliers to the optimal design of tax structures, either in terms of progressivity (Brinca et al., 2019) or even optimal carbon mitigation policies (Malafry and Brinca, 2022). Brinca (2020) reviews recent contributions in the context of heterogeneous-agents macroeconomic models and states the role of microeconomic heterogeneity in affecting aggregate variables such as output. Also, Brinca et al. (2019) show that the larger the size of the government spending shock, the lower the fiscal multiplier, revealing a nonlinear effect of spending which is contrary to recent contributions. Brinca et al. (2016) stress the role of the share of households with binding credit constraints as a fundamental determinant of differences in multipliers across 15 OECD countries. In their model, increases in government expenditures in countries with higher wealth inequality give rise to stronger labor-supply hikes and thus larger output responses. The reason behind this conclusion is that more inequality is associated with more liquidity-constrained agents.

The interplay between inequality and fiscal consolidations is also at the center of recent research. Brinca et al. (2021) study the relationship between income inequality and the effects of fiscal consolidation programs using net wealth to calibrate a macroeconomic model. If income inequality is driven by idiosyncratic productivity risk, agents decide to have precautionary savings, leading to a lower percentage of constrained agents (a reversed relation). Therefore, in an economy with fewer liquidity-constrained agents – low-wealth agents whose supply of labor responds less to future income shocks –, the drop in output will be stronger. Bernardino (2020) uses the distribution of total financial assets (instead of net wealth) among households from 9 European economies to evaluate the impact of fiscal consolidation policies and finds that countries with higher inequality have lower multipliers. More inequality leads to more financially constrained agents, who are not able to shrink their labor supply as they would like in response to the shock, thus causing smaller declines in output. In fact, the percentage of financially constrained agents in the economy is the crucial force driving many of these fiscal policy mechanisms.

Nevertheless, in these studies, the share of credit-constrained agents is purely generated by the calibration of the model – which is intended to reproduce, among others, the wealth distribution –, and thus not based on empirical data. Accounting for empirical estimates of the proportion of financially constrained consumers can lead to distinct results when compared with those from standard incomplete-markets models. Hence, it is crucial to use the result of this estimation to ensure more accurate empirical studies about the size of fiscal multipliers.

Previous works have estimated the percentage of credit-constrained agents both in the U.S. and in Europe. Since credit constraints are difficult to observe, authors have been using proxies to identify constrained consumers (Grant, 2007). One of the earliest approaches to address this question was by Zeldes (1989), who defined as constrained individuals with net worth (or total wealth) holdings of no more than two months of their labor earnings. Moreover, Jappelli (1990) makes use of direct questions regarding credit refusal (or not applying for credit fearing a credit refusal) from the 1983 Survey of Consumer Finances (SCF). Using also U.S. survey data, Grant (2007) splits households based on their demand for and the supply of credit by lenders. Credit-constrained households are the ones who borrow but not as much as they would like.

Alternatively, a more recent approach suggested dividing households according to their liquidity rather than net worth. Kaplan and Violante (2014) and Kaplan et al. (2014) distinguish between *Hand-to-Mouth* households – consumers that hold virtually no liquid wealth (as cash, for instance) –, and non-constrained ones. The authors also separate constrained households between *wealthy hand-to-mouth* and *poor hand-to-mouth*. While the former possess large amounts of illiquid wealth, the latter have zero or negative illiquid wealth. This classification is important because a perspective based on the total wealth does not consider the *wealthy hand-to-mouth*, which they find to be the most relevant portion of hand-to-mouth households. Based on the household classification of Kaplan et al. (2014), several papers estimated the percentage of hand-to-mouth either for the United States (Aguiar et al., 2020) or the Euro Area (Ampudia et al., 2018; Slacalek et al., 2020; European Central Bank, 2021). Although they define liquid wealth in a substantially distinct way, their conclusions are in line with the ones of Kaplan et al. (2014), who show that the share of hand-to-mouth agents is smaller in the four biggest Euro Area economies when compared to the U.S. Additionally, they argue that liquidity-constrained households are the group whose consumption reacts more to monetary policy shocks. However, these studies have been focusing only on household heterogeneity in the context of monetary policy, rather than fiscal policy, which is precisely what we intend to do in this paper.

Another major reason for taking the result of estimating the proportion of financially constrained agents to assess the effect of fiscal policies is that these consumers tend to have larger marginal propensities to consume following income changes than non-hand-to-mouth ones (Kaplan and Violante, 2018), which is argued to be a key factor in determining the impact of several fiscal policies on output (Brinca et al., 2016; Kaplan et al., 2014). What is more, Carroll et al. (2017) analyze the relationship between the distribution of wealth among households and their marginal propensities to consume calibrating a model to the net worth and liquid financial assets distributions. The authors predict that an economy with a larger percentage of hand-to-mouth agents will tend to have a bigger consumption multiplier since these agents consume relatively more following a temporary and positive income shock, a conclusion that is aligned with those from macro models with liquidity constraints and precautionary savings (Ampudia et al., 2018). Christelis et al. (2019) measure the marginal propensity to consume with respect to negative income shocks using household-level survey data from the Netherlands. Their estimates are based on survey answers to questions that ask how much agents would consume either if they would face an unexpected and temporary increase or decrease in income. As reported by Christelis et al. (2019), on average, consumption reacts more to negative rather than positive income changes.

Roadmap. The remainder of the paper is structured as follows. In section 2, we define hand-to-mouth households, describe the empirical strategy to identify them in the data, and provide estimates of the share of constrained agents following the approach in Kaplan et al. (2014). Section 3 presents the macroeconomic model with heterogeneous agents and the fiscal consolidation experiments employed. Section 4 details the calibration of the model. Section 5 analyzes the relevance of estimating the share of constrained agents to determine the multipliers stemming from fiscal consolidation policies. Section 6 concludes.

2 Hand-to-Mouth Households

2.1 Hand-to-Mouth status

We categorize households according to the average net liquid and illiquid wealth they hold using the model of Kaplan and Violante (2014) and Kaplan et al. (2014). Firstly, households are split between hand-to-mouth and non-hand-to-mouth. Hand-to-mouth households (hereafter, HtM) are consumers that spend their entire income and thus hold virtually no net liquid wealth, defined as the difference between liquid assets and liquid liabilities. Subsequently, these are subdivided into wealthy hand-to-mouth (W-HtM), which possess positive amounts of illiquid wealth, and poor hand-to-mouth households (P-HtM), who have zero or negative illiquid wealth.[1] The remaining group of households is composed of non-financially-constrained, or non-hand-to-mouth (N-HtM), economic agents.

According to Kaplan and Violante (2014), HtM are at one of two kinks of their intertemporal budget constraint at the end of the pay period: (i) the zero net liquid wealth or (ii) the credit limit. Households in the first kink do not borrow, whereas the ones in the second kink borrow and consume all the requested amount of credit. Empirically, measuring HtM in these kinks is complex due to the mismatch between the discrete moment in which households receive their labor income and the moment in which they actually consume it (over the period). To solve this problem, the authors include households with positive holdings of net liquid wealth as HtM. In practice, to identify the HtM in the first kink, the authors compute the share of households who own a zero or positive, but no more than half of their bi-weekly labor income, net liquid wealth.[2] The remaining share of HtM is constituted by agents whose net liquid wealth is negative and up to half of their bi-weekly labor income minus their credit limit. We assume that households can borrow up to one month of their labor income as in the baseline specification of Kaplan et al. (2014). Appendix A presents a more detailed definition of the household classification and the variables used.

2.2 Data

The household-level survey data that we use comes from the first wave of the Household Finance and Consumption Survey (HFCS) conducted by the European Central Bank.[3] We extend the cross-country analysis of the four biggest countries of the Euro Area from Kaplan et al. (2014) to 9 euro area economies: Austria (AT), France (FR), Germany (DE), Greece (GR), Italy (IT), the Netherlands (NL), Portugal (PT), Slovakia (SK), and Spain (ES).

Similar to Kaplan et al. (2014), our analysis excludes households whose representative

[1]Negative illiquid wealth refers to the cases when the value of real estate property drops below the amount still owed on those properties. As described in Kaplan et al. (2014), we consider households with negative home equity as poor hand-to-mouth since they are not able to use the illiquid assets they hold to smooth consumption.

[2]We assume the pay period is two weeks based on U.S. data between 1990 and 2010 from the CEX.

[3]Appendix B provides a more extensive description of the HFCS.

member is not between 22 and 79 years old, whose labor income is negative, and whose income comes only from self-employment. Regarding data analysis, three main issues arise. Firstly, the HFCS uses a multiple imputation procedure with five implicates, which means that the dataset is composed of five different imputed values for every missing value of income and wealth variables. To estimate a single percentage of HtM households for each country, we first determine the share of HtM for each of the implicates, and then compute an average of those values. Secondly, since the date of the interview is not reported for some households, we substitute those missing dates by the midpoint date between the beginning and the end of the fieldwork period for each country. Lastly, the values collected for the household's balance sheet do not refer to the same period as the income variables and they also differ from the period in which the interview took place. Therefore, to have the same reference period among countries and allow comparable results, we adjust the values of those variables using the Harmonized Index of Consumer Prices (HICP) of the year and quarter of each observation. The reference periods come from Eurosystem Household Finance and Consumption Network, HFCN (2013) and the HICP data is obtained from the ECB Statistical Data Warehouse.

2.3 Results

Figure 1 shows the proportion of hand-to-mouth households in each of the 9 European countries considered. According to our estimation, between 20 and 37 percent of the households in each of the 9 European countries are HtM, and more than 2/3 of them are wealthy HtM, except for Italy. Our findings are in accordance with the recent literature, which finds that between 22 and 24 percent of Euro Area households are financially constrained, predominating the group of wealthy HtM (Ampudia et al., 2018; Slacalek et al., 2020).[4]

Two important features stand out from our empirical analysis. The first one is that it is crucial to account for empirical shares of HtM agents when evaluating the impact of fiscal shocks. The reason is that our estimates differ considerably from the values that the recent literature has been using. Figure 2 compares the estimated share of HtM with the one obtained from the calibration of a standard macroeconomic model using net wealth, as in Brinca

[4]Besides using data from the second rather than the first wave of the HFCS, these authors define liquid and illiquid assets differently, which can explain the variability in the results.

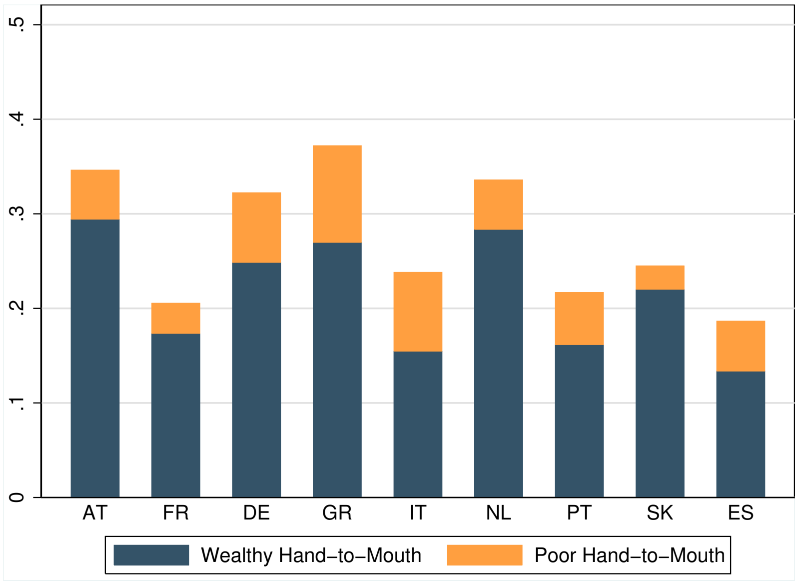

Figure 1. Share of total, wealthy, and poor HtM in 9 European countries

et al. (2021). Although there exists a moderate correlation between the two measurements of constrained agents, it is not statistically significant. Besides, it clearly shows that our estimates are much higher than the traditional measurements of HtM in heterogeneous-agents models.

One possible reason driving this result is that a perspective based on net wealth does not consider as constrained the wealthy hand-to-mouth households (Kaplan et al., 2014), generating an underestimation of the real proportion of liquidity-constrained agents in the economy. Additionally, the range of percentages from our empirical estimates diverges substantially from the one produced by the net wealth calibration. While the latter achieves shares of constrained agents roughly between 2.6 and 10.7, our estimates range from around 20 to 37 percent. This reinforces the importance of using the result of this estimation to ensure a more profound knowledge and more accurate empirical studies about the size of fiscal multipliers across countries with various shares of constrained households.

Lastly, the identification of constrained households according to a perspective based on their net liquid wealth is a more precise way to assess their ability to smooth consumption in response to fiscal consolidation shocks. Brinca et al. (2021) calibrated a model to reproduce the distribution of net wealth, thus not accounting for household liquidity. As a result, they implicitly assumed that agents could convert their illiquid assets (such as real estate) to cash to avoid huge consumption decreases after a tax increase, for instance. Bernardino (2020) stressed the importance of looking at liquid rather than total distributions of wealth. However, the author uses a model calibration that matches the distribution of total financial assets, which includes illiquid assets such as saving deposits – bank deposits that holders are not allowed to convert immediately into money – and excludes liquid assets like cash, also not accurately considering liquidity. An alternative approach would be to account for the distribution of liquid wealth. Nonetheless, it would still not be the most appropriate measure, since we would be ignoring the possibility of households having liquid debts to pay. Thus, we address the issue by examining the net liquid wealth distribution, a definition that excludes liquid liabilities (such as credit card debts) from the liquid assets. Hence, our calibration using net liquid wealth intends to provide a deeper understanding of how the behavior of constrained households after a negative income shock affects fiscal multipliers.

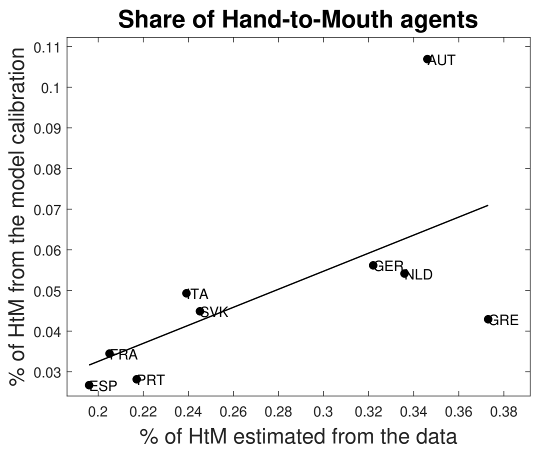

Figure 2. Comparison of the share of hand-to-mouth agents: the share of HtM agents obtained from the model calibration using net wealth is on the y-axis and the fraction of HtM households estimated from the data is on the x-axis. The Pearson correlation coefficient is 0.5011 and the p-value is 0.1694.

3 Model

This section details the model employed to study the relevance of liquidity constraints on the effects of fiscal consolidation programs. We use the overlapping generations model with heterogeneous agents and incomplete markets proposed by Brinca et al. (2021) since it captures household heterogeneity with respect to asset holdings, a crucial element to identify constrained households.

3.1 Technology

In this economy, the representative firm produces output according to a Cobb–Douglas production function:

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

where K_t is the capital input in period t and L_t is the number of efficient units of labor input in period t. Capital evolves over time as follows:

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

where δ is the annual depreciation rate of the capital stock and I_t is the gross investment in period t. The firm chooses in each period how much of each input to use so as to maximize its profits:

$$\max_{L_t, K_t} \Pi_t = Y_t - w_t L_t - (r_t + \delta)K_t. \tag{3}$$

In a competitive equilibrium, the wage per efficient unit of labor, w_t, will be equal to the marginal product of labor, and the rental price of capital, r_t, will be equal to the marginal product of capital deducted by the capital depreciation rate:

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

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

3.2 Demographics

The economy is composed of J overlapping generations of finitely-lived households. The latter enter the labor market at age 20 and retire at 65. Since a model period lasts one year, agents are actively working for 45 years. We assume that j is the age of a household. Retired households face an age-dependent probability of dying, $\pi(j)$, and they die at age 100 for certain.[5] Also, there is no population growth, so the size of the population is fixed. The size of each new cohort is normalized to 1. Using $\omega(j) = 1 - \pi(j)$ to denote the age-dependent probability of survival,

[5] This means that $J = 81$.

according to the law of large numbers, the mass of retired agents with age $j \geq 65$ still alive in each period is equal to $\Omega_j = \prod_{q=65}^{q=J-1} w(q)$.

Households are heterogeneous not only concerning age, but also to asset holdings, idiosyncratic productivity, the subjective discount factor, and their permanent ability. The subjective discount factor is constant over time for each household and takes one out of three values $\beta \in \{\beta_1, \beta_2, \beta_3\}$ with equal probability. The permanent ability component is determined by the productivity level that each household has at birth.

Finally, there are no annuity markets. As a result, a proportion of households leave unintended bequests that are redistributed to the living ones via lump-sum transfers. We denote Γ as the per-household bequest and we assume that the utility of retired households increases according to the value of the bequest they leave when they die.[6]

3.3 Labor Income

The wage of an individual i in period t is given by:

$$w_{i,t}(j, a, u) = w_t e^{\gamma_1 j_i + \gamma_2 j_i^2 + \gamma_3 j_i^3 + a_i + u_{i,t}}, \tag{6}$$

where w_t 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 wages, $a \sim N(0, \sigma_a^2)$ is the permanent ability and u corresponds to the idiosyncratic productivity shock that is realized in each period. This idiosyncratic shock follows an AR(1) process, where ρ is the persistence of the shock:

$$u_{i,t} = \rho u_{i,t-1} + \epsilon_{i,t}, \epsilon \sim N(0, \sigma_\epsilon^2). \tag{7}$$

3.4 Preferences

The preferences of households are described by a momentary constant relative risk aversion (CRRA) utility function, $U(c, n)$. Utility varies positively with increases in consumption, c,

[6]Introducing bequests in the model is helpful to calibrate the asset holdings of retired households.

and negatively with more hours of work, $n \in]0,1]$. It is defined as follows:

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

where σ is the parameter that represents the risk aversion of households, χ the disutility of working an additional hour, and η the inverse Frisch elasticity. Retired households have an additional component in their utility function, $D(k)$, to account for the bequest they leave when they die:

$$D(k) = \varphi \log(k). \tag{9}$$

In the course of their work-life period, households need to choose how many hours to work, n, how much to consume, c, and how much to save, $k^{'}$. After their retirement, agents do not supply labor, but they get a social security payment, Ψ_t.

3.5 Government

The role of the government in this economy comprises two main intervention areas: social security and policy actions. On the one hand, the government maintains a balanced social security system by taxing employees and the representative firm at different rates, τ_{SS} and $\tilde{\tau}_{SS}$, respectively, to pay pensions, Ψ_t, to retirees.

On the other hand, the government also consumes pure public goods, G_t, pays interest on its debt to debt owners, rB_t, and pays out lump-sum redistributions, g_t. To be able to fund these expenditures, it taxes consumption, capital, and labor. Consumption and capital income are taxed at flat rates, τ_c and τ_k, respectively. On the contrary, labor income is taxed using a non-linear method as suggested in Bénabou (2002):

$$\tau_l(y) = 1 - \theta_0 y^{-\theta_1} = \tau_l, \tag{10}$$

where y denotes the labor income before taxes and $\tau_l(y)$ the average tax rate considering the initial income, y. The parameters θ_0 and θ_1 indicate the level and the progressivity of the tax code, respectively.[7]

Furthermore, we assume that the government has some outstanding public debt and that its debt-to-output ratio, $B_Y = \frac{B_t}{Y_t}$, is constant over time. In the steady state of the economy, the ratios of government revenues to output and expenditures to output are constant, implying that there is no creation of new debt. Defining R_t as the total revenues of the government from the taxation of labor, capital, and consumption income, and R_t^{SS} as the total revenues of the government originated by social security taxes, one can state the government budget constraint in the steady state as follows:

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

$$\Psi\left(\sum_{j \geq 65} \Omega_j\right) = R^{SS}. \tag{12}$$

3.6 Recursive Formulation of the Household Problem

In any given period, each 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 is the permanent ability, u is the idiosyncratic shock and j is the age of the household. We can formulate the optimization problem of working-age households as follows:

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

where Y^L is the labor income after social security and labor income taxes, τ_{SS} and $\tilde{\tau}_{SS}$ are the social security taxes paid by the employee and by the employer, respectively, and b is the borrowing limit. The problem of a retired household is similar to that of an economically active household, except that: it does not supply labor; it has an age-dependent probability of dying,

[7] Appendix C.1 presents a supplementary analysis of the properties of this tax function.

$\pi(j)$; and it gains utility $D(k')$ from leaving a bequest. The retired household's optimization problem can be formulated as follows:

$$V(k,\beta,j) = \max_{c,k'} \Big[U(c,n) + \beta(1-\pi(j))V(k',\beta,j+1) + \pi(j)D(k')\Big]$$

$$\textbf{s.t.:}\ c\,(1+\tau_c) + k' = (k+\Gamma)(1+r(1-\tau_k)) + g + \Psi,$$

$$k' \geq 0, \quad c > 0. \tag{14}$$

3.7 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:

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

3. The factor prices satisfy:

$$w = (1-\alpha)\left(\frac{K}{L}\right)^\alpha,$$
$$r = \alpha\left(\frac{K}{L}\right)^{\alpha-1} - \delta.$$

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:

$$\Psi \int_{j \geq 65} d\Phi = \frac{\tilde{\tau}_{SS} + \tau_{SS}}{1 + \tilde{\tau}_{SS}} \left(\int_{j<65} nw \, d\Phi \right).$$

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

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

3.8 Fiscal Experiment and Transition

The economy is initially in a steady state and, without any announcement, the government reduces its debt, B, by 10% of GDP during 50 periods. To achieve this reduction, the government can either cut government spending, G, by 0.2% of the steady-state GDP every period or increase the labor income tax, τ_l, by 0.1% of the steady-state GDP every period and for all economic agents. Following the consolidation period, either the government spending or the labor income tax return to its initial level. We assume that the economy further takes 50 years to converge to the new steady state with a lower debt-to-output ratio. The fiscal consolidation experiments performed are equivalent to the ones in Brinca et al. (2021).

Appendix C.2 details the definition of the transition equilibrium which occurs after the fiscal experiment. When compared to the stationary equilibrium, the distinction is that the dynamic-programming problem of households needs an additional state variable, time t, to capture all the relevant changes in policy and price variables in this maximization problem. To achieve the numerical solution of the model, we employ a similar method to that used in Brinca et al. (2016) and Krusell and Smith Jr. (1999), which guesses paths for all the time-dependent variables and solves the problem by working backward, updating the guess thereupon.

3.9 Definition of the Fiscal Multiplier

The impact and cumulative multipliers are defined as in Brinca et al. (2021):

$$Impact\ multiplier = \frac{\Delta Y_0}{\Delta I_0}, with\ I = \{G, R\} \tag{15}$$

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 fiscal consolidation financed by a reduction in government spending, G, the labor income tax, τ_l, and the lump-sum redistribution, g, are kept constant. Similarly, during a consolidation financed through an increase in τ_l, G and g are kept unchanged.

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

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 $I = R$.

4 Calibration

The model detailed in the previous section is calibrated using the same methodology of Brinca et al. (2016), Bernardino (2020) and Brinca et al. (2021) to match moments of the 9 countries for which we have estimated the percentage of credit-constrained agents. Certain parameters, listed in tables 1 and 2, are calibrated outside the model since they have direct empirical counterparts. The remaining parameters are not directly observed; hence, these are endogenously calibrated using an exactly identified Simulated Method of Moments (SMM) approach.

4.1 Wages

To estimate the life-cycle profile of wages, γ_1, γ_2 and γ_3, introduced in equation (6), we use data from the Luxembourg Income Study (LIS) and run the below regression for each country:

$$ln(w_i) = ln(w) + \gamma_1 j + \gamma_2 j^2 + \gamma_3 j^3 + \epsilon_i, \tag{17}$$

where w is the wage rate from equation (4) and j is the age of an individual i. The variance of the permanent ability, σ_a, is assumed to be invariable across countries and set equal to the average of σ_a for the European economies as considered in Brinca et al. (2016). The persistence of the idiosyncratic shock, ρ, is 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).[8] The variance of the idiosyncratic income risk, σ_ϵ, is endogenously calibrated, as detailed in subsection 4.4.

4.2 Preferences and Borrowing Limit

Following Trabandt and Uhlig (2011) and Guner et al. (2016), the inverse of the Frisch labor supply elasticity, η, is set constant and equal to 1. In addition, and according to the literature, we assume that the risk aversion parameter, σ, is equal to 1.2. Apart from σ_ϵ, the bequest utility parameter, φ, the heterogeneous discount factors, $\beta_1, \beta_2, \beta_3$, the borrowing limit, b, and the disutility of working an additional hour, χ, are also endogenously calibrated, i.e., calibrated to match model moments with the corresponding data moments.

4.3 Taxes and Social Security

The labor income tax function we employ is the one suggested by Bénabou (2002) and described in equation (10). We use U.S. data on labor income taxes from the OECD to estimate θ_0 and θ_1 for various types of households. To obtain a tax function for the single individual households in our model, we then take a weighted average of θ_0 and θ_1, where the weights correspond to the share of each family type in the total population.[9]

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 (2011). Table 1 summarizes the tax parameters for the entire sample.

[8] The persistence of the idiosyncratic shock is estimated based on the U.S. considering that there is not sufficient panel data for European countries to allow a consistent estimation.

[9] The weights used were based on U.S. data since we do not have detailed data for European countries.

4.4 Parameters Calibrated Endogenously

To calibrate the parameters which do not have any direct empirical counterpart, φ, β_1, β_2, β_3, b, χ and σ_ϵ, we use the simulated method of moments (SMM). We minimize the following loss function:

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

where M_m and M_d are the model moments and the corresponding moments in the data.

As we are endogenously calibrating 7 parameters, we need 7 data moments to have an exactly identified system. We choose similar data moments as the ones in Brinca et al. (2021): the mean net asset position of households between 75 and 80 years relative to the average asset holdings in the economy, $\bar{k}_{75-80}/\bar{k}$; the capital-to-output ratio, K/Y; the variance of the natural logarithm of wages, Var(ln w); the average yearly hours worked per capita, $\bar{n}$; the first and the second quartiles of the cumulative net liquid wealth distribution, Q_1 and Q_2; and the percentage of credit-constrained agents, $\%$ HtM.[10] The difference between our calibration and others such as the ones from Brinca et al. (2021) and Bernardino (2020) is that, instead of using the top quartile of the cumulative net liquid wealth distribution, Q_3, we include the estimated share of hand-to-mouth households for each country as a new data moment. Moreover, we make use of the cumulative net liquid wealth distribution rather than the total financial assets one used by Bernardino (2020).[11] The targeted data moments for each country are displayed in table 3. Table 4 exhibits the respective model values obtained for each target and the calibration errors. We fit the targeted data moments with an average error margin of 1.94%. The endogenously calibrated parameters are presented in table 5.

[10] The shares of mean wealth of the old agents were based in U.S. data as we have few observations per cohort for European countries.

[11] The wealth quartiles were computed according to the definition of net liquid wealth from Kaplan et al. (2014) to ensure consistency between our estimation and calibration.

5 Results

5.1 Inspecting the mechanisms

As described above in subsection 3.8, we study two fiscal experiments in which the government reduces its debt-to-output ratio by 10 percentage points during 50 periods: either the government cuts its spending or raises the labor income tax.

As the government shrinks its debt, households start to invest relatively more in physical capital than in bonds, which are more scarce. The capital-to-labor ratio increases, which leads workers to be more productive over time. In a competitive equilibrium, the marginal product of labor corresponds to the wage per efficient unit of labor, so future wages also grow progressively. Therefore, expecting a higher lifetime income, households prefer to reduce their supply of labor in the short run. As output is supply-determined, it further decreases.

Regarding the tax consolidation, rises in labor income taxes originate lower after-tax incomes for all agents, which ultimately discourages them to supply as many hours of work as they would without the shock. Thus, output also goes down.

Nevertheless, the output response to a negative fiscal shock will be smaller if the economy has more liquidity-constrained households. Since households who spend virtually all their income cannot borrow to hamper a fall in consumption, they will have to continue working relatively more in the present. As a result of their smaller elasticity of labor supply, the decline in output is less marked.

5.2 Fiscal Multipliers and Hand-to-Mouth

Following the mechanism which has been proposed in the literature for fiscal consolidations and described in the previous subsection, one would expect that countries with more hand-to-mouth agents – who have smaller labor supply responses to income shocks – would thereby have lower fiscal multipliers (in absolute terms).

To evaluate the importance of liquidity-constrained agents in determining fiscal multipliers, we allow the share of HtM households in the benchmark economy calibrated to Germany to vary. We do this by changing the borrowing limit, b, such that it reproduces percentages of constrained agents that range from the lowest to the highest estimated value we get for our sample of countries. Consequently, we are able to isolate the effect of the proportion of hand-to-mouth in the economy. For each value of b, we repeat the two fiscal consolidation experiments.

Figure 3 plots the relationship between the percentage of hand-to-mouth agents and the impact multiplier for the consolidation via decreases in G and the one via increases in τ_l when we decrease the borrowing limit. As one can see in both panels, there is a positive relationship between the share of HtM households and multipliers in absolute values. In a consolidation via spending, increasing the portion of HtM in the economy from 21.8% to 35.0% originates a rise in the impact multiplier from roughly 0.385 to 0.400. Concerning the tax-based consolidation, allowing for higher HtM shares leads the impact multiplier to go from -1.295 to -1.422.

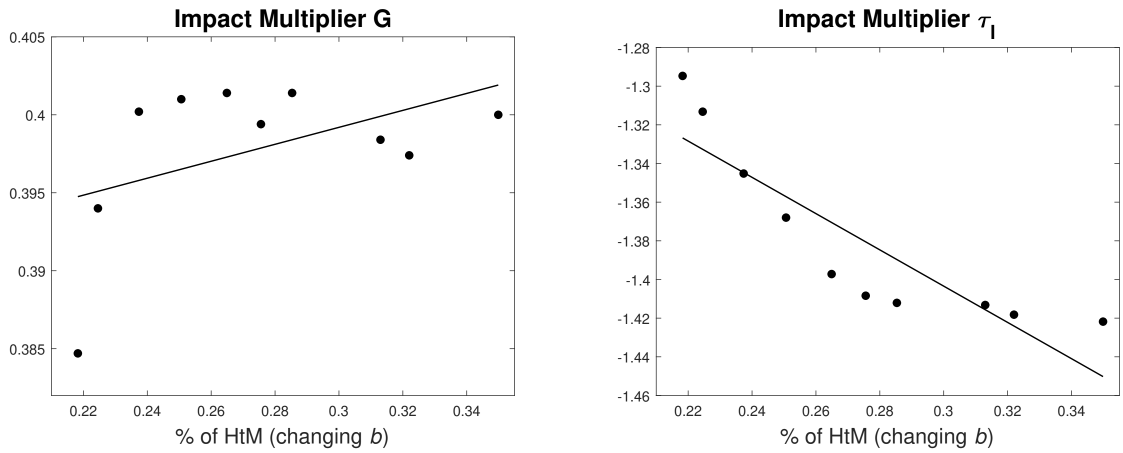

Figure 3. Impact Multiplier and the Percentage of Hand-to-Mouth Agents when decreasing the borrowing limit. Impact multiplier for a consolidation via decreases in G (left panel) and for a consolidation via increases in τ_l (right panel) plotted against the share of hand-to-mouth agents in the German benchmark economy, when decreasing the borrowing limit. Left panel: correlation coefficient 0.4648, p-value = 0.1759. Right panel: correlation coefficient -0.8812, p-value = 0.0008.

In fact, our results suggest that the mechanism proposed by the recent literature has no longer a quantitative relevance when we account for empirically plausible estimates of the proportion of credit-constrained households. One of the main drivers of these empirical results may be the characteristics of the households in the model proposed by Brinca et al. (2021) and which we employ in this paper. Considering an economy with one asset, the authors implicitly treat financially constrained households as if they were all poor, with low liquid and negative illiquid wealth. Crucially, this group of consumers is associated with low productivity levels. However, in reality, among the constrained agents, we find a large share of wealthy households, who are associated with larger levels of productivity. Thus, a more precise way to assess the impact of fiscal policy would require to account for the presence of two assets, as suggested by Kaplan et al. (2014).

In a two-asset model, a liquid and an illiquid one, it would be possible to generate a distribution of hand-to-mouth agents not only based on the mass corresponding to lower levels of total wealth, but also at the upper tail, where the concentration of wealthy hand-to-mouth or high-productivity households is larger. If, at a particular moment in time, a rich and constrained household would no longer be constrained, the decrease in its labor supply after a fiscal consolidation shock would be relatively more important to output drops than that of a poor HtM household. This would happen precisely because the group constituted by rich and constrained households is also the most productive one. Consequently, lower proportions of constrained households would lead to larger multipliers in absolute values, arguably validating the above-mentioned transmission mechanism for fiscal consolidations.

5.3 Cross-country analysis

In this subsection, we expand our analysis to the group of nine economies for which we have calibrated the model previously described. The conclusions of the preceding subsection indicate that larger percentages of financially constrained agents are associated with higher, rather than lower, absolute values of fiscal multipliers. Since these findings do not corroborate the mechanism of subsection 5.1, we do not expect to encounter a negative cross-country correlation between the proportion of constrained agents and multipliers as the mechanism predicts.

Figure 4 depicts the correlation between the estimated share of HtM in each of the considered countries and the impact multiplier stemming either from a consolidation via G or τ_l. As expected, the main results we find suggest that there is no statistically significant evidence of a relationship between the share of constrained agents and impact multipliers when we calibrate the model to match empirical estimates of HtM. However, the mechanism appears to still be present, although weaker, in a consolidation financed through austerity, in which more HtM agents are associated with smaller multipliers.

Besides the model characteristics, the dissimilarity among the range of percentage values for constrained agents when compared to the ones produced by model calibrations using net wealth

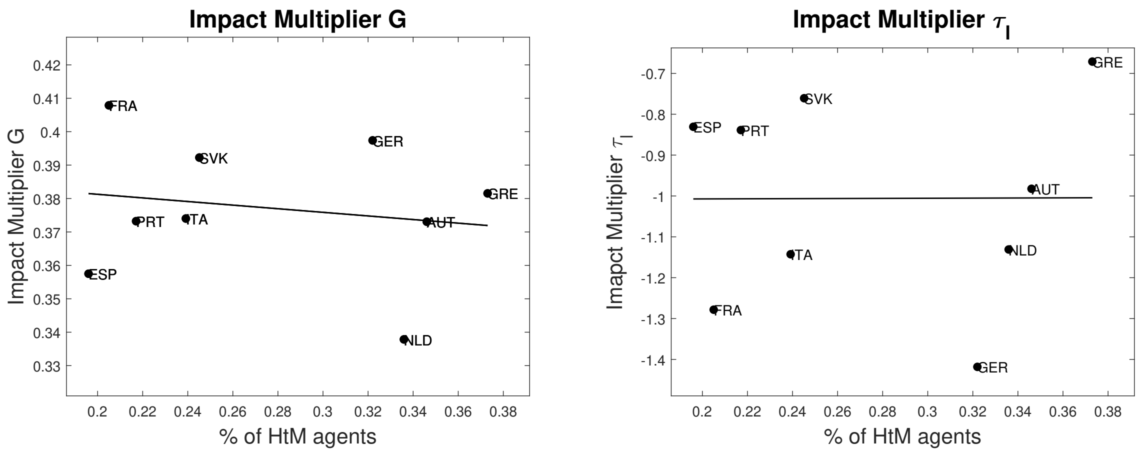

Figure 4. Impact Multiplier and the Estimated Percentage of Hand-to-Mouth Agents. On the left panel, we have the cross-country relation for the consolidation via government spending (correlation coefficient of -0.1742 and p-value of 0.6540), whereas on the right panel we have the cross-country relation for the consolidation via labor income taxes (correlation coefficient of 0.0044 and p-value of 0.9911).

as in Brinca et al. (2021) may also justify a weaker mechanism. As displayed in subsection 2.3, the minimum value from our sample of countries is more than 7 times higher than what is attained by standard models, and the maximum one is more than 3 times bigger. What is more, we find that countries which we identify as being the ones with larger fractions of hand-to-mouth households are not the same as those from the literature. As an illustration, our estimate for the proportion of HtM agents in Germany is more than 9 times greater than the corresponding one in a model calibrated for net wealth.

In line with the findings of the recent literature, namely Alesina et al. (2017) and Bernardino (2020), the recessive impacts of fiscal consolidation shocks are stronger in the case of labor income tax increases. Using a calibration with net liquid wealth, we achieve multipliers which are, on average and in absolute values, 2.7 times higher for consolidations via τ_l rather than via G, similar results to the calibration with financial assets of Bernardino (2020). Table 6 presents the impact multipliers obtained with our calibration.

6 Conclusion

This paper studies how country-specific estimated fractions of constrained agents affect the country heterogeneity of multipliers from fiscal consolidation shocks. Recent studies identified the percentage of constrained agents in the economy as being the crucial force driving many fiscal policy mechanisms. Nevertheless, the values used for those percentages were the result of calibration processes, and thus not based on empirical evidence.

We start by estimating the proportion of hand-to-mouth households in 9 European countries making use of household-level survey data from the Household Finance and Consumption Survey (HFCS). Then, we extend the analysis of Bernardino (2020) and calibrate an overlapping generations model with heterogeneous agents to match the net liquid wealth distribution. Compared to the total financial assets wealth one, this is a more accurate way to identify constrained households and evaluate their consumption smoothing behavior to an unanticipated fiscal consolidation shock.

Our results suggest that, assuming the mechanism proposed by Brinca et al. (2021) exists, the share of hand-to-mouth agents is no longer quantitatively relevant to explain the cross-country heterogeneity in fiscal multipliers when we calibrate the model to match empirically plausible estimates of that share. These findings may be driven by the characteristics of the households in the model we employ, which is an economy with only one asset that implicitly considers financially constrained households as if they were all poor, with low liquid and negative illiquid wealth. As a result, even though the total percentage of credit-constrained households in each country is one of the calibration targets we intend to reproduce with our model, the wealthy hand-to-mouth are not separately considered. Since, as we show, these are the majority of hand-to-mouth, and also the ones whose labor supply responds more to future income shocks, not accounting for them in the model may dampen the relationship between hand-to-mouth and impact multipliers. Hence, it would be important to consider a model with two assets, a liquid and an illiquid one, to better assess the role of liquidity constraints on fiscal multipliers.

We also find that fiscal shocks have stronger effects on output in tax-based consolidations, a coherent result with the literature. Although our findings are not statistically significant, our paper underpins the importance of considering empirical values for the proportion of liquidity-constrained households rather than the product of a model calibration when assessing the consequences of fiscal policy.

Policymakers should draw their attention to this type of household for two reasons. On the one hand, credit-constrained households are not able to borrow to smooth consumption after a transitory shock in income, which can be, for example, a fiscal consolidation measure. On the other hand, we find that a large proportion of European households consume virtually all of their entire income, and that two-thirds of those are wealthy hand-to-mouth or high-productivity households. Since liquidity-constrained households tend to have larger marginal propensities to consume following temporary income changes, the effectiveness of fiscal policy can be severely affected by the reaction of these households. In a model with a liquid and an illiquid asset, the predominance of high-productivity constrained households – a group of hand-to-mouth households whose post-shock decreases in labor supply are relatively more important to output drops – can help explain why countries with lower proportions of constrained households may react more to fiscal consolidation shocks.

References

Aguiar, M. A., M. Bils, and C. Boar (2020). Who are the hand-to-mouth? Working Paper 26643, National Bureau of Economic Research.

Alesina, A., O. Barbiero, C. Favero, F. Giavazzi, and M. Paradisi (2015). Austerity in 2009-2013. Working Paper 20827, National Bureau of Economic Research.

Alesina, A., O. Barbiero, C. Favero, F. Giavazzi, and M. Paradisi (2017). The effects of fiscal consolidations: Theory and evidence. Working Paper 23385, National Bureau of Economic Research.

Ampudia, M., D. Georgarakos, J. Slacalek, O. Tristani, P. Vermeulen, and G. Violante (2018). Monetary policy and household inequality.

Barrell, R., D. Holland, and I. Hurst (2012). Fiscal multipliers and prospects for consolidation.

Bernardino, T. (2020). Asset liquidity and fiscal consolidation programs. *Notas Económicas*, 69–89.

Bénabou, R. (2002). Tax and education policy in a heterogeneous-agent economy: What levels of redistribution maximize growth and efficiency? *Econometrica 70*(2), 481–517.

Brinca, P. (2020). Modern macroeconomics and heterogeneity. *Notas económicas* (51), 7–20.

Brinca, P., M. F. e Castro, M. H. Ferreira, and H. Holter (2019). The Nonlinear Effects of Fiscal Policy. Working Papers 2019-015, Federal Reserve Bank of St. Louis.

Brinca, P., M. H. Ferreira, F. Franco, H. A. Holter, and L. Malafry (2021). Fiscal consolidation programs and income inequality. *International Economic Review 62*(1), 405–460.

Brinca, P., B. Freitas, and M. Mano (2020). Labor Share Heterogeneity and Fiscal Consolidation Programs. CeBER Working Papers 2020-04, Centre for Business and Economics Research (CeBER), University of Coimbra.

Brinca, P., H. A. Holter, P. Krusell, and L. Malafry (2016). Fiscal multipliers in the 21st century. *Journal of Monetary Economics 77*, 53–69.

Brinca, P., J. Oliveira, and J. Duarte (2019). Investment-specific technological change, taxation and inequality in the us.

Carroll, C., J. Slacalek, K. Tokuoka, and M. N. White (2017). The distribution of wealth and the marginal propensity to consume. *Quantitative Economics 8*(3), 977–1020.

Christelis, D., D. Georgarakos, T. Jappelli, L. Pistaferri, and M. van Rooij (2019). Asymmetric Consumption Effects of Transitory Income Shocks*. *The Economic Journal 129*(622), 2322–2341.

Constâncio, V. (2020). The return of fiscal policy and the euro area fiscal rule. Working Papers REM 2020/0127, ISEG - Lisbon School of Economics and Management, REM, Universidade de Lisboa.

European Central Bank, E. (2020). Doc. UDB2 - HFCS Core Variables Catalogue, Wave 1.

European Central Bank, E. (2021). Monetary policy and inequality. *ECB Economic Bulletin Issue 2*.

Eurosystem Household Finance and Consumption Network, HFCN (2013). The eurosystem finance and consumption survey: Methodological report for the first wave. Statistics Paper Series 1, European Central Bank.

Grant, C. (2007). Estimating credit constraints among US households. *Oxford Economic Papers 59*(4), 583–605.

Guner, N., M. Lopez-Daneri, and G. Ventura (2016). Heterogeneity and government revenues: Higher taxes at the top? *Journal of Monetary Economics 80*, 69–85.

Holter, H. A., D. Krueger, and S. Stepanchuk (2019). How do tax progressivity and household heterogeneity affect laffer curves? *Quantitative Economics 10*(4), 1317–1356.

Ilzetzki, E., E. G. Mendoza, and C. A. Végh (2013). How big (small?) are fiscal multipliers? *Journal of Monetary Economics 60*(2), 239–254.

Jappelli, T. (1990). Who is Credit Constrained in the U. S. Economy? *The Quarterly Journal of Economics 105*(1), 219–234.

Kaplan, G. and G. L. Violante (2014). A model of the consumption response to fiscal stimulus payments. *Econometrica 82*(4), 1199–1239.

Kaplan, G. and G. L. Violante (2018). Microeconomic heterogeneity and macroeconomic shocks. *Journal of Economic Perspectives 32*(3), 167–94.

Kaplan, G., G. L. Violante, and J. Weidner (2014). The wealthy hand-to-mouth. Working Paper 20073, National Bureau of Economic Research.

Krusell, P. and A. A. Smith Jr. (1999). On the Welfare Effects of Eliminating Business Cycles. *Review of Economic Dynamics 2*(1), 245–272.

Malafry, L. and P. Brinca (2022). Climate policy in an unequal world: Assessing the cost of risk on vulnerable households. *Ecological Economics 194*, 107309.

Ramey, V. A. (2019). Ten years after the financial crisis: What have we learned from the renaissance in fiscal research? *Journal of Economic Perspectives 33*(2), 89–114.

Slacalek, J., O. Tristani, and G. L. Violante (2020). Household balance sheet channels of monetary policy: A back of the envelope calculation for the euro area. *Journal of Economic Dynamics and Control 115*, 103879.

Trabandt, M. and H. Uhlig (2011). The laffer curve revisited. *Journal of Monetary Economics 58*(4), 305–327.

Zeldes, S. P. (1989). Consumption and liquidity constraints: An empirical investigation. *Journal of Political Economy 97*(2), 305–346.

Appendix

A Measurement of Variables

[12] Following Kaplan et al. (2014), a household is defined as **Hand-to-Mouth (HtM)** if:

- Net liquid wealth ≥ 0 AND net liquid wealth $\leq$ biweekly (net) income$/2$ OR
- Net liquid wealth < 0 AND net liquid wealth $\leq$ biweekly (net) income$/2$ $-$ credit limit.

A household is:

1. **Poor Hand-to-Mouth (P-HtM)** if it is Hand-to-Mouth AND net illiquid wealth ≤ 0,
2. **Wealthy Hand-to-Mouth (W-HtM)** if it is Hand-to-Mouth AND net illiquid wealth > 0,
3. **Non-Hand-to-Mouth (N-HtM)** if it is not Hand-to-Mouth.

According to European Central Bank (2020), the variables above are defined as follows:[13]

- **Net liquid wealth** $=$ liquid assets $-$ liquid liabilities
- **Liquid assets** $=$ cash $+$ sight (or checking) accounts $+$ directly held mutual funds $+$ stocks $+$ bonds $=$ checking accounts * $(1 +$ cash ratio$)$ $+$ directly held mutual funds $+$ stocks $+$ bonds $=$ hd1110 $\left(1 + \frac{139}{2500}\right)$ $+$ da2102 $+$ da2105 $+$ da2103
- **Liquid liabilities** $=$ overdraft debt $+$ credit card debt $=$ dl1210 $+$ dl1220 $=$ hc0220 $+$ hc0320
- **Net illiquid wealth** $=$ illiquid assets $-$ illiquid liabilities
- **Illiquid assets** $=$ value of the household's main residence and other properties $+$ occupational pension plans $+$ voluntary pension plans and cash value of life insurance policies $+$ saving accounts, time deposits, certificate of deposits or other deposits (saving

[12] This appendix is borrowed from Slacalek et al. (2020) Appendix A1, although there are significant differences in some definitions.

[13] Since the HFCS does not provide data on household holdings of cash except for Spain, Kaplan et al. (2014) use an imputation method according to the 2010 Survey of Consumer Payment Choice from the U.S. to obtain a measure of cash and include it in the definition of liquid assets. The cash ratio corresponds to the proportion of average cash balances out of the median value of checking accounts.

and time deposits) = (hb0900 + hb2801 + hb2802 + hb2803 + hb2900) + total(pf0710) + da2109 + hd1210

- **Illiquid liabilities** = amount of mortgages and non-collateralized (unsecured) loans for the household's main residence and other properties

- **Income** = employee income + (unemployment benefits + gross income from regular social transfers) + regular private transfers + public pensions income = di1100 + di1600 + hg0210 + di1510

B Data

The household-level data we use for Austria, France, Germany, Greece, Italy, the Netherlands, Portugal, Slovakia, and Spain is obtained from the first wave of the Eurosystem Household Finance and Consumption Survey (HFCS). The HFCS is a project jointly coordinated by the ECB, all national central banks of the Eurosystem, and three national statistical institutes. It offers country-representative microdata on the assets, liabilities, income, and consumption of euro area households.

The data from the first wave of the ECB's HFCS comprises 62 521 households. Our sample is composed of 45 832 households, which corresponds to more than 70% of the total sample size of the HFCS. For the majority of the 15 euro area countries where the survey was conducted, the fieldwork occurred between 2010 and 2011. For the 9 countries in our sample, interviews and data collection were made between November 2008 and August 2011.

C Additional Model Details

C.1 Tax Function

[14] Given the tax function

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

[14]This appendix is borrowed from Holter et al. (2019).

which we employ, the after-tax labor income is defined as

$$ya = [1 - \tau_l(y)]y,$$

and, thus,

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

and, thus,

$$\begin{aligned}
1 - \tau_l(y) &= \theta_0 y^{-\theta_1} \\
\tau_l(y) &= 1 - \theta_0 y^{-\theta_1} \\
T_l(y) &= \tau_l(y)y = y - \theta_0 y^{1-\theta_1} \\
T_l'(y) &= 1 - (1 - \theta_1)\theta_0 y^{-\theta_1}.
\end{aligned}$$

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

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

and, therefore, determined only by the parameter θ_1 and independent of the scale parameter θ_0. Thus, by construction, one can raise average taxes by lowering θ_0 and not change tax progressivity, since (as long as tax progressivity is defined by the tax wedges) the progressivity of the tax code is uniquely determined by the parameter θ_1.[15]

[15]Note that

$$1 - \tau_l(y) = \frac{1 - T_l'(y)}{1 - \theta_1} > 1 - T_l'(y),$$

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

$$T_l'(y) > \tau_l(y).$$

Hence, marginal tax rates are higher than average tax rates for all income levels.

C.2 Definition of a Transition Equilibrium After the Unanticipated Fiscal Consolidation Shock

[16] We 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, $\{r_t, w_t\}_{t=1}^{t=\infty}$, government transfers $\{g_t, \Psi_t, G_t\}_{t=1}^{t=\infty}$, 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:

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

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

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

3. The factor prices satisfy:

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

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

4. The government budget balances:

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

[16] This appendix is borrowed from Brinca et al. (2021).

5. The social security system balances:

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

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

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

7. Aggregate law of motion:

$$\Phi_{t+1} = \Upsilon_t(\Phi_t).$$

D Additional Tables

Table 1. Parameters calibrated exogenously

Country	Age profile			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

Notes: The age profile of wages, γ_1, γ_2 and γ_3 are estimated according to equation (17) and using the most recent LIS survey available before 2008. Data for Portugal comes from Quadros de Pessoal 2009 database. θ_0 and θ_1 are estimated according to equation (10). $\tilde{\tau}_{SS}$ and τ_{SS} are the average social security taxes paid by the employer and by the employee, respectively, using OECD data from 2001 to 2007. τ_k and τ_c are taken from Trabandt and Uhlig (2011) or computed using their approach, and represent average effective tax rates from 1995 to 2007.

Table 2. 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 parameter	Literature
η	1	Inverse Frisch Elasticity	Trabandt and Uhlig (2011)

Table 3. Calibration Targets $-M_d$

Country	Q_1	Q_2	% HtM	K/Y	$\bar{n}$	Var(ln w)
Austria	-0.0155	-0.0050	0.346	3.359	0.226	0.199
France	-0.0094	0.0091	0.205	3.392	0.184	0.478
Germany	0.0110	0.0242	0.322	3.013	0.189	0.354
Greece	-0.1016	-0.0896	0.373	3.262	0.230	0.220
Italy	-0.0030	0.0359	0.239	3.943	0.200	0.225
Netherlands	-0.1017	-0.0875	0.336	2.830	0.200	0.282
Portugal	-0.0210	0.0147	0.217	3.229	0.249	0.298
Slovakia	-0.0100	0.0366	0.245	3.799	0.204	0.250
Spain	-0.0091	0.0180	0.196	3.378	0.183	0.225

Notes: The average share of wealth held by the households aged 75-80 relative to the whole population mean wealth is the 7^{th} calibration target. It was used the U.S. measure, which is equal to 1.5134. Q_1 and Q_2 are the first and the second quartiles of the cumulative distribution of net liquid wealth derived from the 1^{st} wave of the ECB's Household Finance and Consumption Survey (HFCS). Units: share of total net liquid wealth. The $\%$ HtM was estimated using data on the 1^{st} wave of the HFCS. K/Y was taken from the Penn World Table 8.0 (PWT 8.0), average from 1990-2011. $\bar{n}$ is average yearly hours worked per capita derived from OECD data, average from 1990-2011. Var ln(w) is the variance of the natural logarithm of wages from the most recent Luxembourg Income Study (LIS) survey available before 2008. Data for Portugal comes from Quadros de Pessoal 2009 database.

Table 4. Calibration Fit

Country	Q_1		Q_2		**% HtM**		K/Y		$\bar{n}$		**Var(ln$w$)**		**Error (%)**
	M_d	M_m	M_d	M_m	M_d	M_m	M_d	M_m	M_d	M_m	M_d	M_m	
Austria	-0.0155	0.0054	-0.0050	0.0140	0.346	0.34605	3.359	3.357	0.226	0.226	0.199	0.199	1.4131
France	-0.0094	0.0043	0.0091	0.0223	0.205	0.20520	3.392	3.381	0.184	0.184	0.478	0.478	1.3691
Germany	0.0110	0.0085	0.0242	0.0206	0.322	0.32202	3.013	3.095	0.189	0.189	0.354	0.354	1.9408
Greece	-0.1016	-0.0310	-0.0896	-0.0547	0.373	0.37303	3.262	3.177	0.230	0.230	0.220	0.220	2.4449
Italy	-0.0030	0.0085	0.0359	0.0277	0.239	0.23915	3.943	3.928	0.200	0.200	0.225	0.225	1.5600
Netherlands	-0.1017	-0.0390	-0.0875	-0.0675	0.336	0.33590	2.830	3.062	0.200	0.182	0.282	0.282	3.0597
Portugal	-0.0210	0.0035	0.0147	0.0206	0.217	0.21708	3.229	3.223	0.249	0.249	0.298	0.298	1.4715
Slovakia	-0.0100	0.0036	0.0366	0.0191	0.245	0.24515	3.799	3.744	0.204	0.206	0.250	0.250	2.0321
Spain	-0.0091	-0.0178	0.0180	-0.0238	0.196	0.19599	3.378	3.349	0.183	0.180	0.225	0.225	2.1834

Notes: M_d and M_m are the data values and the respective model values obtained for each target according to our calibration. The error represents the value of the loss function L in equation (18).

Table 5. Parameters calibrated endogenously

Country	β_1	β_2	β_3	b	χ	φ	σ_ϵ
Austria	0.9156	1.0008	0.8837	-0.040	14.47	5.99	0.1757
France	0.8645	1.0147	0.9170	-0.060	18.55	4.19	0.5060
Germany	0.8300	0.9953	0.8050	-0.068	16.86	4.40	0.4386
Greece	0.9100	1.0045	0.5880	0.295	17.00	4.20	0.1206
Italy	0.8878	1.0201	0.9755	-0.090	21.02	6.40	0.2144
Netherlands	0.8680	0.9960	0.8398	0.285	18.55	5.25	0.2625
Portugal	0.8843	0.9921	0.8833	-0.032	11.62	6.70	0.3810
Slovakia	0.9355	1.0016	0.7942	-0.025	21.15	8.44	0.3269
Spain	0.9048	1.0005	0.9098	0.107	26.15	7.05	0.2372

Table 6. Cross-country impact multipliers using our estimates for the share of HtM agents

Country	Multiplier G	Multiplier τ_l	$\mid$ Multiplier $\tau_l \mid / \mid$ Multiplier $G \mid$
Austria	0.3731	-0.9824	2.633
France	0.4079	-1.2783	3.134
Germany	0.3974	-1.4182	3.569
Greece	0.3815	-0.6712	1.759
Italy	0.3740	-1.1426	3.055
Netherlands	0.3379	-1.1310	3.347
Portugal	0.3732	-0.8388	2.248
Slovakia	0.3923	-0.7608	1.939
Spain	0.3575	-0.8307	2.324