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Labour Share Heterogeneity and Fiscal Consolidation Programs

Bruno Miguel Esteves Freitas

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Bruno Freitas †

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Abstract

We show that the labour share of income is an important factor affecting the mechanisms behind fiscal consolidation programs, thus requiring consideration when evaluating fiscal multipliers across countries. We calibrate a life-cycle, overlapping generations model to match key characteristics of different European economies and evaluate the recessive impacts of fiscal consolidation programs. We find a positive relationship between the labour share and the impact fiscal multipliers generated by our model. This result directly follows from the higher weight of labour on production and the lower opportunity cost of leisure present in economies with a higher labour share. Following the impact period, the relationship between the labour share and the fiscal multipliers is dependant on the type of fiscal instrument employed in the consolidation.

Keywords: Fiscal Consolidation, Labour Share, Fiscal Multipliers, Public Debt

JEL Classification: D33, E21, E62, H31

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†Nova School of Business and Economics, Universidade Nova de Lisboa. Email: brunoestevesfreitas@gmail.com

1 Introduction

Following the 2008 financial crisis, several European economies were faced with historically high sovereign debt levels. Consequently, many of these countries began developing plans to reduce their indebtedness, either through reductions in government spending, tax increases or a combination of both. This episode brought a renewed interest in fiscal policy, in particular the impacts of fiscal consolidation programs and the fiscal multipliers (see Blanchard and Leigh (2013) and Alesina et al. (2015a)). As standard in the literature, fiscal multipliers are not homogeneous across economies and time, but rather dependant on country characteristics, the state of the economy and the type of fiscal instruments employed. Recent studies have thus focused on trying to pinpoint the sensibility of the fiscal multiplier for each of the aforementioned factors.

A common feature among the literature, namely when performing model calibrations, is the assumption that the labour income share revolves around two-thirds of the overall economy's income. As the labour share measures the fraction of national income accruing to labour (see Krueger (1999)), the assumption that such variable is equal across countries and time is quite strong. Indeed, as we show in Figure 1, there is a pronounced cross-country labour share heterogeneity for a sample of 15 European countries, with values rather different from 66%.

In this paper, we study how the labour share affects the mechanisms behind fiscal consolidation programs. We use the model proposed in Brinca et al. (2016), which is an overlapping generations model with heterogeneous agents, incomplete markets, exogenous credit constraints, uninsurable idiosyncratic risk and a bequest motive as introduced in Brinca et al. (2019b). We begin by calibrating the model to a benchmark economy (Germany) under different labour share values. We then analyze how each of these differently calibrated economies respond to a gradual reduction in government debt, either through a cut in government spending or an increase in labour income taxation. To study whether the relationship between the labour share and the fiscal multiplier is strong enough to hold when taking into account different country characteristics, we perform a multi-country exercise where we calibrate our model to match a wide range of country-specific data moments from a sample of 9 European economies and perform the same fiscal shock.

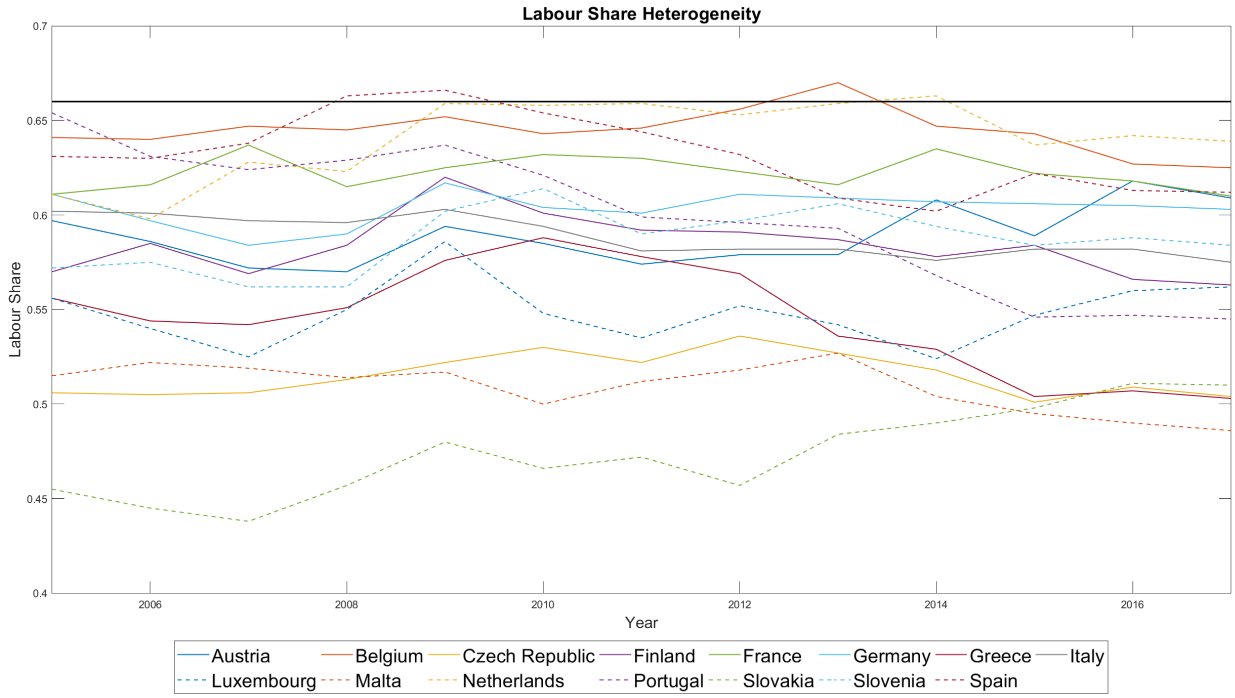

Figure 1: Labour share heterogeneity. The reference line corresponds to a labour share value of 66%.

We find that output falls in the short-run due to the fiscal consolidation shock, but gradually converges to a higher level at the end of the debt reduction program. The mechanism is similar to the one proposed in Brinca et al. (2019b): As the government pays its debt, the number of sovereign bonds in the economy decreases, leading households to gradually shift their savings towards physical capital. The consequent increase in the capital-to-labour ratio boosts the marginal productivity of labour, which increases total production. Market clearing conditions imply that the wage rate must equal the marginal productivity of labour, so the wage rate also rises. With gradually increasing wages, the expected life-time income of workers increases. Thus, the labour supply, and consequently output, drop in the short-run.

As is standard in the literature (see Blanchard and Perotti (2002) and Alesina et al. (2015b)), we find that increases in labour taxation have more severe effects than reductions in government spending. Since the disposable income of workers is particularly affected with the tax increase, the short-run labour supply drops considerably more. Such drop is strong enough to make workers consume their savings. Hence, and opposite to the spending reduction scenario, we find that capital actually decreases following the labour tax shock. As such, output drops even further.

We also find a positive relationship between the labour share and the impact fiscal multipliers generated by our model, either through a fiscal consolidation via spending or via labour taxation. As the weight of labour on production is higher, an economy with a higher labour share has a lower capital-to-labour ratio. Subsequently, the marginal productivity of labour is lower, in turn leading to lower total production and lower wage rates. Due to the negative relation between wages and the labour share, the opportunity cost of leisure is lower in economies with a higher labour share, allowing for a higher short-run drop in the labour supply and, consequently, on output. Moreover, as an economy with a higher labour share has a higher weight of labour on production, the same decrease in the labour supply leads to a more pronounced decrease in output. These two distinct effects generate the positive relationship between the labour share and the impact fiscal multipliers.

Regarding the cumulative fiscal multipliers, we find different results dependant on the type of the fiscal consolidation program employed. Under the consolidation via spending, the relationship between the labour share and the fiscal multiplier remains positive throughout all periods. Under the consolidation via taxation, the relationship becomes negative following the first period after the fiscal shock, as the aforementioned drop in capital will have more severe consequences for a higher weight of capital on total production.

In the multi-country exercise, we get that the Spearman correlation between the fiscal multipliers generated by our model and the labour shares is 70.3% when considering a consolidation via spending and -41.0% when considering a consolidation via taxation. These results show that the positive relationship between the labour share and the impact fiscal multiplier holds even when taking into account country-specific data moments.

The remainder of the paper is organized as follows. In section 2 we discuss some of the recent relevant literature. In section 3 we describe the overlapping generations model employed and present the fiscal consolidation experiments. Section 4 details the model calibration. Section 5 describes the mechanisms behind the two types of fiscal consolidation policies and how the labour share affects the chain of events, along with the cross-country exercise. Section 6 concludes.

2 Related Literature

The literature assessing which factors affect the fiscal multiplier is vast and diverse. Blanchard and Leigh (2013) and Blanchard and Leigh (2014) find that the International Monetary Fund (IMF) severely underestimated the impacts of fiscal consolidation programs across European countries following the Great Recession, thus showing that not all factors affecting the fiscal multipliers were taken into consideration.

Alesina et al. (2015b) study the differences between tax-based consolidations and spending-based ones. The authors' main finding is that tax-based consolidations are much more costly in terms of output losses, as this type of programs produce deeper and longer recessions. Ilzetzki et al. (2013) show that the fiscal multiplier depends crucially on key country characteristics, such as the level of development, exchange rate regime and openness to trade. They conclude that the fiscal effect is larger in developed countries, operating under predetermined exchange rate and closed to trade. Anderson et al. (2016) find that unexpected government spending shocks have different effects on consumers depending on their income and age levels. Following an unexpected increase in the government spending, consumption levels drop significantly for the wealthiest and working-age individuals, whereas consumption of the poorest increases the most. Pappa et al. (2015) study how corruption and tax evasion relate to the recessive impacts of fiscal consolidation shocks, and find that the increase in taxation motivates production in the shadow economy. As this economy is characterized by considerable lower productivity levels, output drops even further.

Carroll et al. (2014) find that the higher the proportion of financially constrained agents in an economy, the higher the consumption multiplier. This result is a direct consequence of credit-constrained agents exhibiting a higher marginal propensity to consume. Relatedly, Brinca et al. (2016) show that higher wealth inequality is associated with stronger expansionary impacts of increases in government expenditures, precisely because higher wealth inequality is associated with a higher number of credit constrained agents. Brinca et al. (2019b) document a strong positive relationship between income inequality and the output losses deriving from a fiscal consolidation shock. As income inequality induces a precautionary savings behaviour, the share of credit constrained agents decreases. Given that credit constrained agents do not respond to future income changes, the lower the share of these agents in the economy, the higher the output losses. Brinca et al. (2019a) address the non-linear effects of both expansionary and contractionary fiscal policies, showing that the fiscal multipliers are increasing in the shock.

With regards to the labour share, several studies have attempted to pinpoint the causes of its heterogeneity across countries and time. Technological differences are often presented as one of the main causes (see OECD (2012), Bentolila and Saint-Paul (2003), Arpaia et al. (2009)), since the diffusion of information and communication technologies allows for cheaper capital goods and better production processes, leading to automation and capital deepening. Institutional factors such as the minimum wage, the unemployment rate and benefits, and the bargaining power of workers are also recurrent in the literature. The workers' bargaining power puts upward pressure on the wage rate and, subsequently, on the labour share. Oppositely, high unemployment leads to a decrease in the labour share, since the wage demands of workers are lower. Unemployment benefits put upward pressure on the labour share, as the reservation wages of workers are higher (see OECD (2012), ILO (2013), IMF (2007)).

3 Model

In this section, we detail the model used to study the fiscal consolidation episodes. The model is similar to the one proposed in Brinca et al. (2016), which is an overlapping generations model with heterogeneous agents, incomplete markets, exogenous credit constraints, uninsurable idiosyncratic risk and a bequest motive as introduced in Brinca et al. (2019b)

3.1 Technology

A 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 labour input in efficiency units, in period t.

The evolution of capital is given by:

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

where I_t is the gross investment in period t and δ is the annual capital depreciation rate. Every period, the firm maximizes its profits by efficiently choosing L_t and K_t:

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

In a competitive equilibrium, the wage per efficient unit of labour, w_t, will be equal to the marginal product of labour, and the rental price of capital, r_t, is equal to the marginal product of capital:

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

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

3.2 Demographics

The economy is populated by J overlapping generations of households, which have a finite lifespan. Households start life at age 20 and retire at age 65. Each period in the model accounts for 1 year, meaning there are 45 periods of active work life. The age of a household is denoted by j. Retired households face an age-dependent probability of dying, $\pi(j)$, and die for certain when reaching the age of 100. Letting $\omega(j) = 1 - \pi(j)$ denote the age-dependent probability of survival, it follows from the law of large numbers that the probability mass of retired agents with age $j \geq 65$ still alive in each period is given by $\Omega_j = \prod_{i=65}^{i=j} \omega(i)$. Upon death, retired households leave unintended bequests which are redistributed to living households in a lump-sum manner. We denote Γ as the per-household bequest. There is no population growth, so the size of the total population is fixed. The size of each new cohort is normalized to 1.

Households are heterogeneous not only with respects to their age but also regarding their subjective discount factor, β, their permanent ability, a, and their idiosyncratic productivity. A household's subjective discount factor can take one of three values with equal probability, $\beta \in \{\beta_1, \beta_2, \beta_3\}$, taken as constant over time. The permanent ability of each household is realized at birth and follows a normal distribution with zero mean, $a \sim N(0, \sigma_a^2)$.

3.3 Labour Income

The wage of a given worker i, in period t, is given by:

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

where w_t is the wage per efficient unit of labour resulting from equation 4, γ_1, γ_2 and γ_3 capture the age profile of the worker, $a \sim N(0, \sigma_a^2)$ is the worker's permanent ability and u is the idiosyncratic productivity shock that is realized in each period. This shock follows an AR(1) process:

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

where ρ is the persistence of the shock.

3.4 Preferences

We employ a momentary constant relative risk aversion (CRRA) utility function for each household, $U(c, n)$, which depends positively on consumption, c, and negatively on hours worked, $n \in]0, 1]$. The utility function takes the following functional form:

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

where σ is the risk-aversion parameter and η is the inverse Frisch elasticity. Every period of their active work-life, households decide how many hours to work, n, how much to consume, c, and how much to save, k'. Retired households do not supply any labour, but receive a social security payment, Ψ_t.

The utility of retired households has an additional term, $D(\Gamma)$, which positively relates to the bequest these households leave when they die:

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

3.5 Government

The government runs a balanced social security system, in which the retirees receive annual pensions, Ψ_t, and employees and the employer (the representative firm) are taxed at rates τ_{SS} and $\tilde{\tau}_{SS}$, respectively.

The government also takes policy actions, where it taxes consumption and capital and labour income in order to finance expenditures on pure public consumption goods, G_t, interest payments on the sovereign debt, rB_t, and lump-sum redistributions, g_t. We take the sovereign debt-to-output ratio, $B_y = \frac{B_t}{Y_t}$, as constant over time. We employ the functional form proposed in Benabou (2002) to model the non-linear taxation on labour income.[1]

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

where y stands for the pre-tax labour income and $\tau(y)$ is the average tax rate given the pre-tax income y. The parameters θ_0 and θ_1 account for the level and the progressivity of the tax code, respectively.

Denoting R_t as the government's revenue from taxation on labour, capital and consumption, and R_t^{SS} as the government's revenue from social security taxes, the government budget constraints in the steady-state take the following form:

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

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

[1] A further discussion of the properties of this tax function is provided in Appendix A.1.

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 household's age. We can formulate the working-age household's optimization problem as follows:

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

where Y^L is the labour income after taxes, b is the borrowing limit, and τ_{SS} and $\tilde{\tau}_{SS}$ are the social security taxes paid by the employee and by the employer, respectively.

The optimization problem of a retired household is similar to that of an active household, with the exception of not supplying any labour, receiving annual retiree benefits, having an age-dependent probability of dying $\pi(j)$, and gaining utility, $D(\Gamma)$, from leaving a bequest. Hence, we can formulate the retired household's optimization problem as follows:

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

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:

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

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

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:

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

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 fiscal consolidation experiment we employ is similar to the one in Brinca et al. (2019b). The economy is initially in the steady-state and the government unexpectedly announces a reduction of the sovereign debt-to-output ratio, B_y, by 10p.p., during the course of 50 periods. Two different policies can be employed in order to achieve this result: either the government spending, G, decreases by 0.2% of the steady-state GDP every period, or the labour income tax, τ_l, increases by 0.1% of the steady-state GDP every period, for all agents. After the 50 periods of consolidation, either the government spending or the labour tax return to the initial level. The economy takes an additional 50 periods to converge to the new steady-state equilibrium, now with the lower debt-to-GDP ratio.

The definition of a transition equilibrium after the fiscal experiment is detailed in appendix A.2. The difference to the stationary equilibrium is an added time variable, t, which captures all the changes in policy and price variables relevant in this maximization problem along the transition to the lower debt-to-GDP steady state.

3.9 Definition of the Fiscal Multiplier

The impact and cumulative multiplier are defined as in Brinca et al. (2019b). Considering the fiscal consolidation episode via government spending, we define the impact multiplier as:

$$Impact\ multiplier\ G = \frac{\Delta Y_1}{\Delta G_1} \tag{15}$$

where ΔY_1 is the change of output from period 0 to period 1 and ΔG_1 is the change in government *spending* from period 0 to period 1. The corresponding cumulative multiplier, at time T, is:

$$Cumulative\ multiplier\ G(T) = \frac{\sum_{t=1}^{t=T} \left(\prod_{s=0}^{s=T-1} \frac{1}{1+r_s} \right) \Delta Y_t}{\sum_{t=1}^{t=T} \left(\prod_{s=0}^{s=T-1} \frac{1}{1+r_s} \right) \Delta G_t} \tag{16}$$

Regarding the fiscal consolidation episode via taxation, we define the impact multiplier as:

$$Impact\ multiplier\ \tau_l = \frac{\Delta Y_1}{\Delta R_1} \tag{17}$$

where ΔY_1 is the change of output from period 0 to period 1 and ΔR_1 is the change in government *revenue* from period 0 to period 1. The corresponding cumulative multiplier, at time T, is:

$$Cumulative\ multiplier\ \tau_l(T) = \frac{\sum_{t=1}^{t=T} \left(\prod_{s=0}^{s=T-1} \frac{1}{1+r_s} \right) \Delta Y_t}{\sum_{t=1}^{t=T} \left(\prod_{s=0}^{s=T-1} \frac{1}{1+r_s} \right) \Delta R_t} \tag{18}$$

4 Calibration

The model described in Section 3 is calibrated to the German economy, following the same methodology of Brinca et al. (2016), Bernardino (2019), Brinca et al. (2019a) and Brinca et al. (2019b). Germany arises as a natural choice since it is the largest economy in Europe, and will serve as the benchmark scenario. Certain parameters are calibrated outside of the model, as they have direct empirical or theoretical counterparts. Tables 3 and 4 list the corresponding calibration results. The remaining parameters are calibrated endogenously, using a simulated method of moments (SMM) approach. Table 6 lists the corresponding calibration results. We follow the same calibration strategy for the cross-country exercise, holding the parameters listed in table 3 as constant.

4.1 Wages

To estimate the age profile of wages, γ_1, γ_2 and γ_3 (see equation 6), we use data from the Luxembourg Income Study (LIS) and run the following regression for each country:

$$ln(w_i) = ln(w) + \gamma_1 j + \gamma_2 j^2 + \gamma_3 j^3 + \epsilon_i \tag{19}$$

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

The variance of the ability, σ_a, is held constant across countries and set equal to the average of the European countries analyzed in Brinca et al. (2016). The persistence of the idiosyncratic shock, ρ, is also 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)[2]. The variance of the idiosyncratic risk, σ_ϵ, is endogenously calibrated, as detailed in section 4.5.

4.2 Preferences and the Borrowing Limit

The inverse of the Frisch elasticity of labour supply, η, is set to 1, following Trabandt and Uhlig (2011) and Guner et al. (2016), and held constant across countries. The disutility of hours worked,

[2]The persistence of the idiosyncratic shock is estimated based on the U.S. since most European countries do not have sufficient data to perform a consistent estimation.

χ, the subjective discount factors, $\beta_1, \beta_2, \beta_3$ and the bequest motive, φ, are endogenously calibrated. The borrowing limit, b, is also endogenously calibrated, as detailed in section 4.5.

4.3 Taxes and Social Security

We employ the labour income tax function detailed in equation (10), using U.S. labour income tax data provided by the OECD to estimate θ_0 and θ_1 for different family types.[3] To obtain the tax function for a single households, we compute a weighted average of θ_0 and θ_1, where the weights correspond to the share of each family type in the total population.

The employer social security rate, $\tilde{\tau}_{SS}$, and the employee social security rate, τ_{SS}, are set 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 4 summarizes the estimated tax rates for each country.

4.4 Labour Share

The unadjusted labour share is commonly computed as the ratio of total compensation of employees – wages and salaries before taxes, plus employers' social contributions - over the national income aggregate (see Guerriero (2019)). However, this method excludes the income from the self-employed, leading to an underestimation of the true share of labour income. To overcome this issue, we employ the novel microdata-adjusted labour-share estimations put forward by the International Labour Organization (ILO). The proposed adjustment takes into account the heterogeneity of workers within the self-employed by dividing these workers into three different subgroups: own-account workers (OAW), contributing family workers (CFW), and employers (ERS). The resulting adjusted labour income share is thus given by:

$$LS = \frac{CE}{Y} \cdot \frac{\%Employees + \gamma_{OAW} \cdot \%OAW + \gamma_{CFW} \cdot \%CFW + \gamma_{ERS} \cdot \%ERS}{\%Employees} \tag{20}$$

where CE is the total compensation of employees, Y is the national income aggregate and γ_{OAW}, γ_{CFW}, γ_{ERS} are the relative wages of each group of the self-employed workers. The methodological

[3] The level and progressivity of the tax code are estimated based on the U.S. since most European countries do not have sufficient data to perform a consistent estimation.

description of the relative wages' estimation can be found in ILO (2019).

4.5 Parameters Calibrated Endogenously

We use the simulated method of moments (SMM) approach to calibrate the parameters which do not have any direct empirical counterpart: $\varphi, \beta_1, \beta_2, \beta_3, b, \chi, \sigma_\epsilon$. We minimize the following loss function:

$$L(\varphi, \beta_1, \beta_2, \beta_3, b, \chi, \sigma_\epsilon) = ||M_m - M_d|| \tag{21}$$

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

Since we are endogenously calibrating seven parameters, we require seven target data moments in order to have an exactly identified system. The chosen data moments, listed in table 5, are the same as in Brinca et al. (2019b): the average fraction of yearly hours worked, $\bar{n}$, the capital-to-output ratio, K/Y, the variance of the natural logarithm of wages, $\text{Var}(\ln w)$, the three quartiles of the cumulative net wealth distribution, Q_{25}, Q_{50}, Q_{75}, and the average net asset position of households with 75 to 80 years-old relative to the mean net wealth in the economy, $\bar{k}_{75-80}/\bar{k}$.

Table 6 displays the endogenously calibrated parameters and the corresponding calibration errors for the 9 European countries analyzed in the cross-country exercise, including the benchmark economy. The average value of the loss function across countries is 1.22. Table 1 displays the values of the data moments for the benchmark economy, along with the values produced by our model. As shown, we fit all the targeted data moments with very low error margins.

Data Moment	Description	Source	Data Value	Model Value
$\bar{k}_{75-80}/\bar{k}$	Mean wealth age 75-80 / mean wealth	LWS	1.513	1.513
K/Y	Capital-output ratio	PWT	3.013	3.013
$\text{Var}(\ln w)$	Variance of log wages	LIS	0.354	0.354
$\bar{n}$	Fraction of hours worked	OECD	0.190	0.190
Q_{25}, Q_{50}, Q_{75}	Wealth Quartiles	LWS	-0.004, 0.027, 0.179	-0.004, 0.030, 0.175

Table 1: Calibration fit of the benchmark economy.

5 Results

In this section, we describe the simulations undertaken, the findings resultant from each experiment and the implied relationship between the labour share and the recessive impacts of fiscal consolidation programs. We assess whether such relation is strong enough to hold even when taking into account different country characteristics by performing a multi-country exercise, along with a robustness analysis.

5.1 Mechanisms behind the Fiscal Consolidation Programs

We employ the fiscal experiment described in section 3.8. The economy departs from the steady-state and the government unexpectedly announces a reduction of the sovereign debt-to-output ratio by 10p.p., during the course of 50 periods. The debt reduction program can be financed either through a reduction in government spending or an increase in the labour income tax rate.

As the government pays its debt, the number of government bonds available in the economy decrease, which leads households to gradually shift their savings towards physical capital. This shift in savings drives up the capital-to-labour ratio. With more capital per worker, the marginal productivity of labour rises. Since market clearing conditions imply that the marginal productivity of labour is equal to the wage rate (see equation 4), wages and output gradually increase to a higher level in the long-run. With gradually increasing wages, the expected life-time income of workers rises, so the total labour supply drops in the short-run. Consequently, output falls in the short-run.

In the case of a consolidation via labour income taxes, τ_l, another mechanism is at play. The increase in the tax rate leads to a drop in the workers' after-tax income, which reduces the opportunity cost of leisure. As such, the labour supply, and consequently output, will decrease even further in the short-run.

5.2 Fiscal Multipliers and the Labour Share

To evaluate the sensibility of the fiscal multiplier to the labour share, we change the value of the labour share from low to high in the benchmark economy calibrated to Germany. In order to isolate the effect of the labour share, we re-calibrate the model in each experiment to match the initial data moments. Table 2 summarizes the main differences in the benchmark economy when the calibration is made taking into account different labour share values.

Labour Share	**48.1%**	**54.5%**	**60.2%**	**66.0%**	**73.2%**
Capital-Labour ratio	9.884	7.540	6.247	5.200	4.513
GDP per capita	1.000	0.761	0.629	0.520	0.453
Wage rate	1.000	0.865	0.790	0.730	0.694

Table 2: The effects of the labour share. The values accruing to the GDP per capita and the wage rate were normalized so that the corresponding highest values are equal to 1.

Due to the higher weight of labour on production, an economy with a higher labour share has a lower capital-to-labour ratio.[4] As already noted, the marginal productivity of labour, and consequently GDP per capita, are positively related to the ratio between capital and labour. Hence, both these variables are lower under higher values of the labour share. Under market clearing conditions, the wage rate will also be lower (see equation 4).

5.2.1 Impact Multipliers and the Labour Share

Figure 2 shows a positive relationship between the labour share and the impact multiplier from a consolidation via spending. As we increase the labour share from 48.1% to 73.2%, the impact multiplier rises from 0.424 to 0.470. Two distinct effects generate this positive relationship: Firstly, given the negative relationship between wages and the labour share (see Table 2), the opportunity cost of leisure is lower for higher labour share values, implying a higher drop in the labour supply following the fiscal shock. Secondly, due to the higher weight of labour on production, an economy with a higher labour share has a more pronounced decrease in output for the same decrease in the labour supply.

With regards to the consolidation via labour income taxation, we similarly find that an economy with a higher labour share has a more pronounced impact multiplier. As we increase the labour share from 48.1% to 73.2%, the impact multiplier goes from -1.716 to -1.758. The two mechanisms at play are the same as in a consolidation via spending, but the effects from the fiscal shock are

[4]This result is standard in canonical Real Business Cycle (RBC) models. The steady-state capital-labor ratio in a standard de-centralized RBC model is $\frac{K}{L} = (\frac{\alpha A}{r+\delta})^{\frac{1}{1-\alpha}}$. For a formal derivation see King and Rebelo (1999).

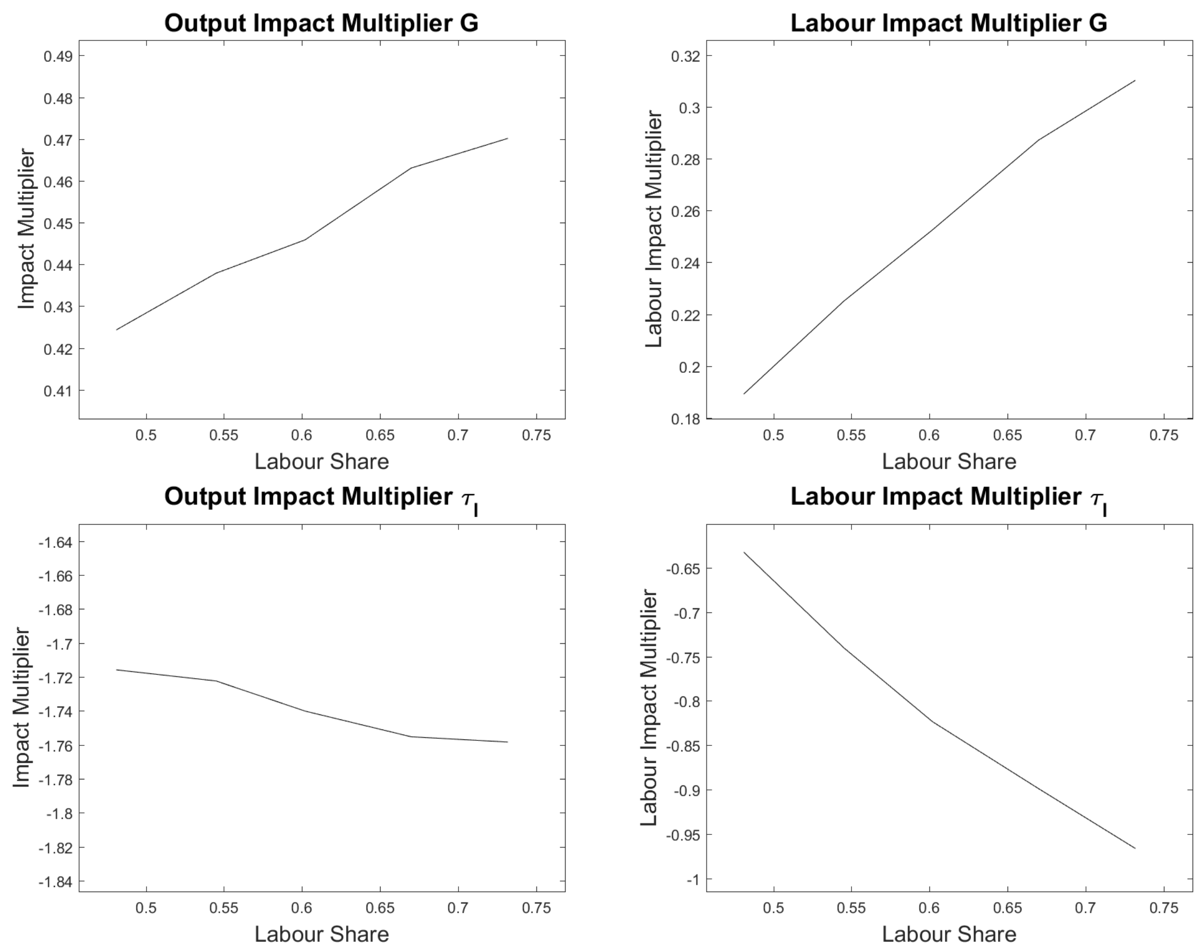

Figure 2: Impact multipliers for the consolidation via government spending (upper panels) and for the consolidation via labour taxation (lower panels). On the left panels we have the output impact multipliers, while on the right panels we have the labour impact multipliers.

more severe. Since the rise in the tax rate lowers the workers' after-tax income, the opportunity cost of leisure is lower. As such, the labour supply, and consequently output, decrease even further on impact. This result is in accordance to what is standard in the literature (see Blanchard and Perotti (2002) and Alesina et al. (2015b)).

5.2.2 Cumulative Multipliers and the Labour Share

The labour share influences not only the impact multipliers, but also the cumulative multipliers. Figure 3 shows the cumulative multipliers of the benchmark economy for the 5 periods during and immediately after the fiscal consolidation shock, under different labour share values.

Regarding the consolidation via spending reduction, both output and labour multipliers are

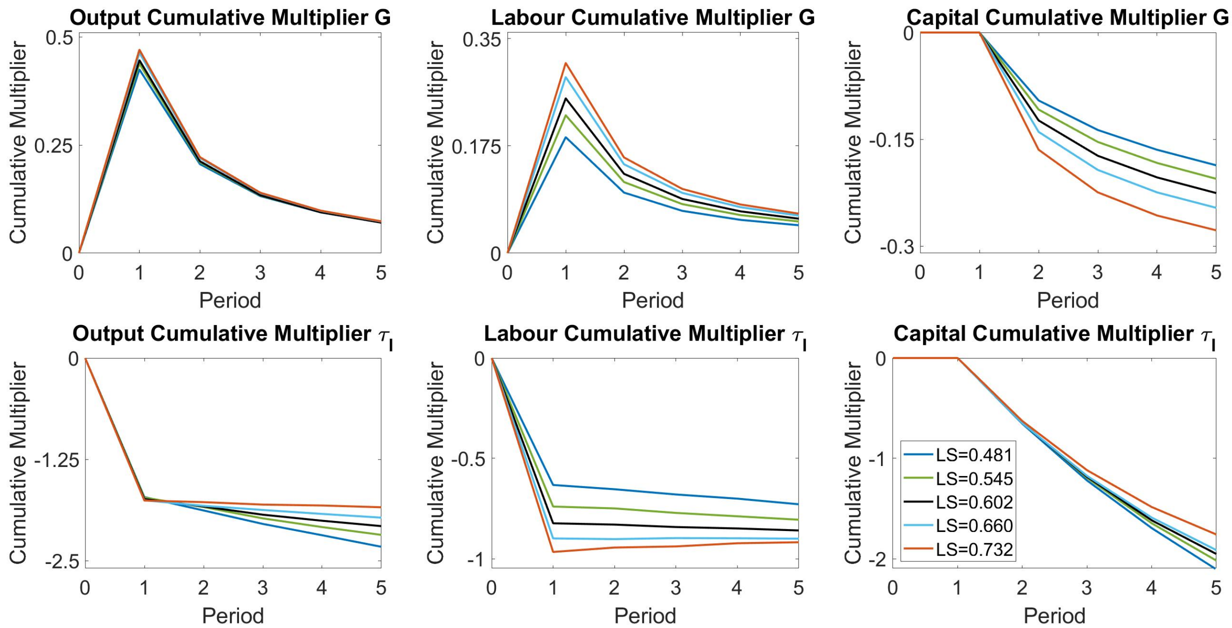

Figure 3: Cumulative multipliers for the consolidation via government spending (upper panels) and for the consolidation via labour taxation (lower panels). On the left panels we have the output cumulative multipliers, on the middle panels we have the labour cumulative multipliers and on the right panels we have the capital cumulative multipliers.

higher for economies with a higher labour share, even after the impact period. The drop in the labour supply is not strong enough for workers to consume their savings, so capital is not negatively affected in the following period. The gradual rise in capital arises from the crowding-in of savings from debt to capital, following the government debt repayment. This rise is more pronounced for higher values of the labour share, due to inter-temporal substitution effects: Given the lower weight of capital on production, the growth in the marginal productivity of workers will be lower for higher values of the labour share. Due to market clearing conditions, wage growth is also less pronounced. As such, total savings, and consequently total capital formation, are higher.

In the case of a consolidation via labour income taxes, the relationship between the labour share and the fiscal multiplier becomes negative after the first period. In this type of consolidation, the drop in the labour supply is strong enough to make workers consume their savings, implying a decrease in capital in the following periods. In turn, the marginal productivity of labour, wages and output, fall. As the drop in capital has stronger negative consequences for economies with a lower labour share, the relationship between the labour share and the fiscal multiplier inverts after the first period.

5.3 Cross-country analysis

In the previous section, we showed that our model produces a positive relationship between the labour share and impact fiscal multipliers when considering fiscal consolidation programs. In this section we perform a cross-country analysis to show that the mechanism is strong enough to hold even when taking into account a wide range of different country-specific data moments. The model is calibrated to 9 European countries: Austria (AUT), Czech Republic (CZR), France (FRA), Germany (GER), Italy (ITA), the Netherlands (NLD), Portugal (PRT), Slovakia (SVK) and Spain (ESP).[5] Table 5 describes the country-specific data moments for the countries in study. Table 6 displays the endogenously calibrated parameters and the corresponding calibration errors for each country. Parameters calibrated exogenously are listed in Table 4. Parameters held constant for all the countries are summarized in Table 3.

Figure 4 shows that countries with a higher share of labour income have, on average, more sizeable fiscal multipliers, in the context of the fiscal consolidation episode described in section 3.8. The Spearman correlations between the fiscal multipliers generated by our model and the labour shares are 70.3% when considering a consolidation via spending and -41.0% when considering a consolidation via taxation. As such, even when introducing substantial country heterogeneity, we find that our model reproduces a positive relationship between the labour share and the impact multiplier. Moreover, and in accordance to our findings in section 5.2.1, tax-based consolidations produce deeper recessions across countries than consolidations via spending. Table 8 shows that, for the 9 European countries in our sample, the fiscal multiplier is on average 2.8 times higher when the fiscal consolidation is done via labour taxation.

To test for the robustness of our findings, we employ a different cross-country labour share estimation. We now adopt the novel adjusted labour-share estimations provided the Organisation for Economic Co-operation and Development (OECD). This adjustment does not take into account the heterogeneity within the self-employed, and is based on total working hours, rather than the

[5]This sample was determined by data availability.

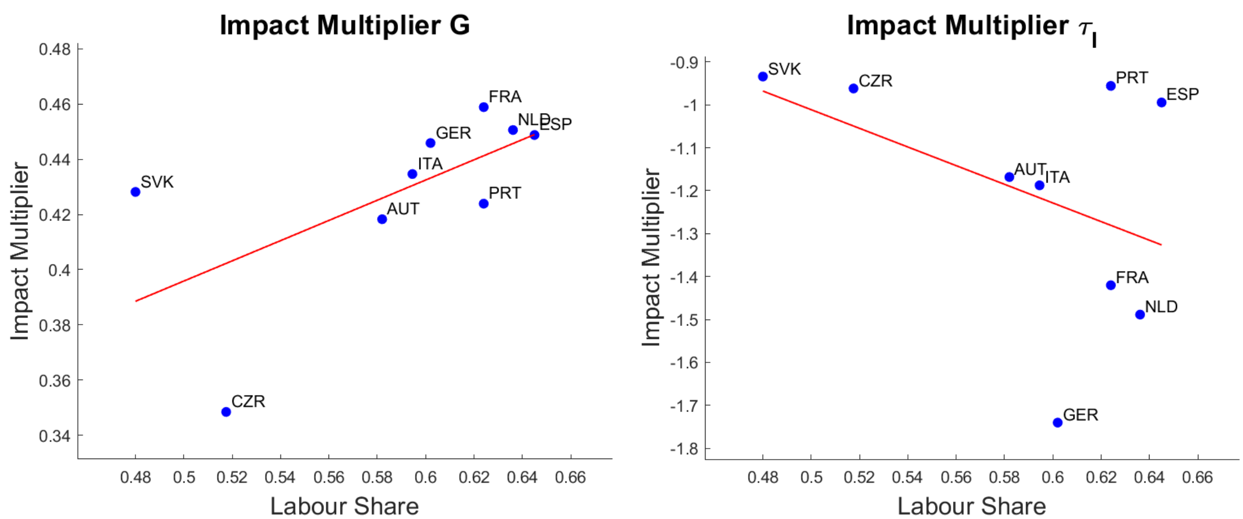

Figure 4: Impact multipliers and the labour share. On the left panel we have the cross-country relation for a consolidation via government spending (Spearman correlation coefficient 0.703), while on the right panel we have the cross-country relation for a consolidation via labour taxation (Spearman correlation coefficient -0.410).

total number of workers. The resulting adjusted labour income share is thus given by:

$$LS = \frac{CE}{Y} \cdot \frac{Total\ hours\ worked\ by\ persons\ employed}{Total\ hours\ worked\ by\ employees} \tag{22}$$

Figure 5 corroborates the cross-country relationship between the labour share and the fiscal multipliers detailed above. Countries with a higher labour share experience larger output drops on impact, both for tax and spending based consolidations. Using this different labour share estimation, the

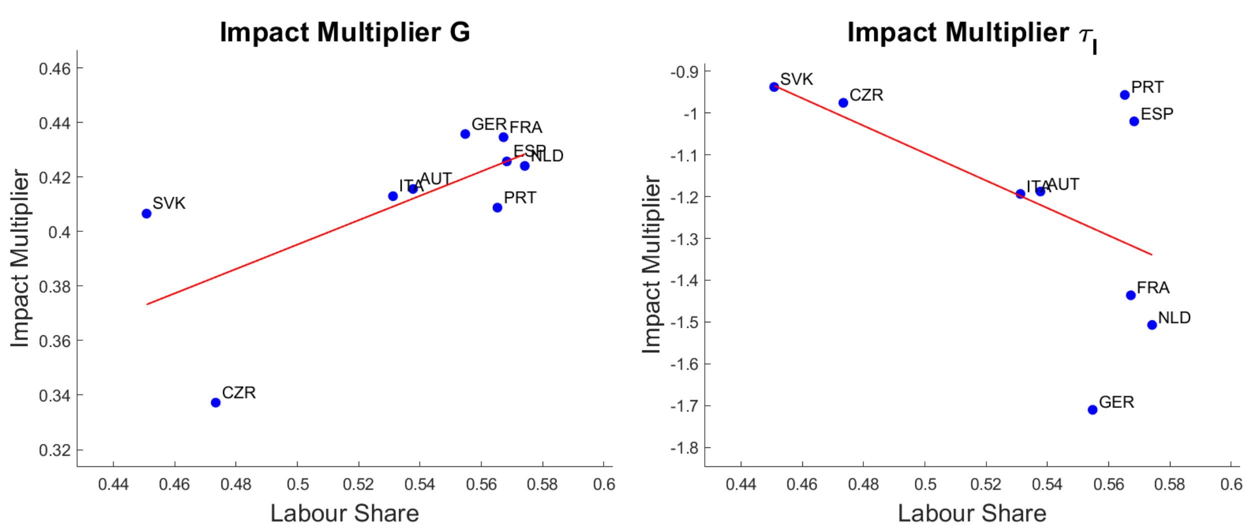

Figure 5: Impact multipliers and the labour share, using OECD estimations. On the left panel we have the cross-country relation for a consolidation via government spending (Spearman correlation coefficient 0.667), while on the right panel we have the cross-country relation for a consolidation via labour taxation (Spearman correlation coefficient -0.500).

Spearman correlations between the fiscal multipliers generated by our model and the labour shares are 66.7% when considering a consolidation via spending and -50.0% when considering a consolidation via taxation. We once again find that tax-based consolidations produce deeper recessions across countries than spending-based ones. As listed in Table 9, the fiscal multiplier is on average 2.9 times higher for a tax-based consolidation.

6 Conclusion

This paper assesses how the labour share of income affects the mechanisms behind fiscal consolidation programs. We motivate this study by showing a pronounced labour-share heterogeneity within a sample of 15 European countries, along with a renewed academic interest in the structural factors affecting the fiscal multipliers.

We calibrate a life-cycle, overlapping generations model to a benchmark economy (Germany), under different labour share values. We find that a higher share of labour income induces a lower capital-to-labour ratio, a lower wage rate and a lower GDP per capita.

We then study how each of the calibrated economies react to an unexpected debt reduction program, financed either through a decrease in government spending or an increase in labour income taxation. We find that a consolidation via labour taxation has more severe effects than reductions in government spending: As the disposable income of workers is particularly affected with the tax increase, the short-run labour supply drops considerably more. This drop is strong enough to make workers consume their savings, so capital actually decreases in the following period.

Our results also show a positive relationship between the labour share and the impact fiscal multipliers, regardless of the fiscal instrument employed. We find two mechanisms at play: Firstly, as the opportunity cost of leisure is lower for higher labour share values, the drop in the labour supply following the fiscal shock is larger. Secondly, due to the higher weight of labour on production, the decrease in output for the same decrease in the labour is also higher. Following the announcement period, we get different results dependant on fiscal instrument employed by the government. Under the consolidation via spending, the relationship between the labour share and the fiscal multiplier remains positive throughout all periods. Under the consolidation via taxation, the relationship becomes negative following the first period after the fiscal shock, as the aforementioned drop in capital will have more severe consequences for a higher weight of capital on total production.

The positive relationship between the labour share and the impact fiscal multiplier is strong enough to hold even when taking into account a wide range of country-specific data moments from a sample of 9 European economies. As such, it is important to consider the labour share of income when evaluating fiscal multipliers across countries.

Our calibrations do not take into consideration the causes of labour share disparities across the countries in study. As such, further research is needed towards assessing how each source affects the fiscal multipliers. Moreover, since we treat certain parameters as constant, future research should test for the validity of such assumptions. As our analysis only evaluates fiscal consolidation programs, further studies are required to assess expansionary policies.

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A Appendix

A.1 Tax Function

[6] 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

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

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

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

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

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

$$1 - \frac{1 - \tau(y_2)}{1 - \tau(y_1)} = 1 - \left(\frac{y_2}{y_1}\right)^{-\theta_1} \tag{23}$$

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 progressivity is defined by the tax wedges) the progressivity of the tax code is uniquely determined

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

by the parameter θ_1.[7]

A.2 Definition of a Transition Equilibrium after the Unanticipated Fiscal Consolidation Shock

[8] 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, $\{r_t, w_t\}$, 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:

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

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

[7]Note 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.

[8]This appendix is borrowed from Brinca et al. (2019b).

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:

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

A.3 *Additional Figures and Tables*

Parameter	Value	Description	Source
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 (2011)

Table 3: Parameters held constant across countries.

Country	Age profile			Taxes							Labour Shares	
	γ_1	γ_2	γ_3	θ_0	θ_1	$\tilde{\tau}_{SS}$	τ_{SS}	τ_c	τ_k		LS_{ILO}	LS_{OECD}
Austria	0.155	-0.004	3.0e-05	0.939	0.187	0.217	0.181	0.196	0.240		0.582	0.538
Czech R.	0.174	-0.004	3.0e-05	0.988	0.143	0.350	0.125	0.182	0.220		0.518	0.473
France	0.384	-0.008	6.0e-05	0.915	0.142	0.434	0.135	0.183	0.355		0.624	0.567
Germany	0.176	-0.003	2.3e-05	0.881	0.221	0.206	0.210	0.155	0.233		0.602	0.555
Italy	0.114	-0.002	1.4e-05	0.897	0.180	0.329	0.092	0.145	0.340		0.595	0.531
Netherlands	0.307	-0.007	4.9e-05	0.938	0.254	0.102	0.200	0.194	0.293		0.636	0.574
Portugal	0.172	-0.004	2.6e-05	0.937	0.136	0.238	0.110	0.194	0.293		0.624	0.565
Slovakia	0.096	-0.002	1.7e-05	0.974	0.105	0.326	0.131	0.181	0.151		0.459	0.431
Spain	0.114	-0.002	1.4e-05	0.904	0.148	0.305	0.064	0.144	0.296		0.645	0.568

Table 4: Parameters calibrated exogenously. *Notes:* The age profile of wages, γ_1, γ_2 and γ_3 are estimated according to equation (19), 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 of 2001-2007. τ_c and τ_k come from Trabandt and Uhlig (2011) or calculated using their approach. They represent the average effective tax rate from 1995-2007. LS_{ILO} is estimated according to equation 20. LS_{OECD} is estimated according to equation 22.

Country	Q1	Q2	Q3	K/Y	$\bar{n}$	Var ln(w)
Austria	-0.0097	0.0225	0.1858	3.359	0.226	0.199
Czech R.	0.0043	0.0612	0.2213	6.203	0.236	0.174
France	0.0010	0.0539	0.2616	3.392	0.184	0.478
Germany	-0.0036	0.0273	0.1788	3.013	0.189	0.354
Italy	0.0086	0.1025	0.3237	3.943	0.200	0.225
Netherlands	-0.0252	0.0499	0.3026	2.830	0.200	0.282
Portugal	0.0058	0.0821	0.2660	3.229	0.249	0.298
Slovakia	0.0546	0.2069	0.4495	3.799	0.204	0.250
Spain	0.0175	0.1289	0.3417	3.378	0.183	0.225

Table 5: Calibration Targets - M_d. *Notes:* 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 7^{th} target. It was used the U.S. measure which is equal to 1.5134. Q1, Q2 and Q3 are the three quartiles of the cumulative distribution of net wealth derived from LWS. K/Y is derived from PWT 8.0, average from 1990-2011. $\bar{n}$ is average hours worked per capita derived from OECD data 1990-2011. 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 Pessoal 2009 database.

Country	β_1	β_2	β_3	b	χ	φ	σ_ϵ	L
Austria	0.945	0.957	0.988	0.06	12.48	3.05	0.201	0.944
Czech R.	0.984	0.987	1.028	-0.02	14.33	7.60	0.136	1.694
France	0.951	0.982	1.006	0.20	16.43	2.96	0.506	0.586
Germany	0.922	0.950	0.984	0.10	14.91	2.77	0.439	0.452
Italy	0.974	0.984	1.006	-0.02	17.20	4.90	0.257	0.847
Netherlands	0.941	0.967	0.979	0.23	14.00	2.55	0.263	0.919
Portugal	0.948	0.953	0.983	0.00	10.65	4.70	0.380	1.041
Slovakia	0.949	0.950	0.960	-0.05	13.50	4.92	0.316	2.479
Spain	0.967	0.975	0.993	-0.10	23.71	5.05	0.258	2.036

Table 6: Parameters calibrated endogenously using ILO labour share estimations. L corresponds to the Loss function value in equation 21.

Country	β_1	β_2	β_3	b	χ	φ	σ_ϵ	L
Austria	0.942	0.950	0.980	0.10	11.38	2.45	0.201	1.429
Czech R.	0.981	0.983	1.024	0.02	12.43	6.30	0.136	1.200
France	0.943	0.974	0.997	0.18	14.43	2.56	0.506	0.853
Germany	0.912	0.943	0.974	0.12	13.71	2.13	0.436	1.150
Italy	0.966	0.976	0.998	-0.02	15.10	4.00	0.257	0.803
Netherlands	0.930	0.955	0.967	0.29	12.50	2.05	0.263	0.880
Portugal	0.940	0.943	0.973	0.00	9.55	3.80	0.380	0.601
Slovakia	0.944	0.945	0.956	-0.11	12.50	4.52	0.316	2.264
Spain	0.955	0.963	0.981	-0.11	20.31	4.05	0.258	1.653

Table 7: Parameters calibrated endogenously, using OECD labour share estimations. L corresponds to the Loss function value in equation 22.

Country	Multiplier G	Multiplier τ_l	$\mid$ Multiplier $\tau_l \mid / \mid$ Multiplier $G \mid$
Austria	0.418	-1.168	2.792
Czech R.	0.348	-0.962	2.761
France	0.459	-1.420	3.095
Germany	0.443	-1.735	3.915
Italy	0.435	-1.188	2.732
Netherlands	0.451	-1.489	3.303
Portugal	0.424	-0.956	2.255
Slovakia	0.428	-0.934	2.181
Spain	0.449	-0.994	2.216
Average	0.428	-1.205	2.806

Table 8: Cross-country impact multipliers, using ILO labour share estimations.

Country	Multiplier G	Multiplier τ_l	$\mid$ Multiplier $\tau_l \mid / \mid$ Multiplier $G \mid$
Austria	0.416	-1.188	2.858
Czech R.	0.337	-0.975	2.893
France	0.435	-1.436	3.305
Germany	0.436	-1.710	3.925
Italy	0.413	-1.194	2.890
Netherlands	0.424	-1.507	3.554
Portugal	0.409	-0.957	2.340
Slovakia	0.407	-0.938	2.306
Spain	0.426	-1.020	2.396
Average	0.411	-1.214	2.941

Table 9: Cross-country impact multipliers, using OECD labour share estimations.