Fiscal Consolidation Programs and Income Inequality*

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Abstract

Following the Great Recession, many European countries implemented fiscal consolidation policies, aimed at reducing government debt. In a recent paper, Blanchard and Leigh (2013) show that these policies had significant negative effects on output and argue that the effects were generally miscalculated by the IMF. Other than the size of the fiscal consolidation they can, however, not find any factor that helps reducing the forecast error. Using the same data, we document a strong positive empirical relationship between higher income inequality and stronger recessive impacts of austerity across European countries. To explain this finding, we develop a life-cycle, overlapping generations economy with uninsurable labor market risk. We calibrate our model to match key characteristics of a number of European economies, including the distribution of wages and wealth, social security, taxes and debt and study the effects of fiscal consolidation programs. We find that higher income risk induces precautionary savings behavior and decreases the proportion of credit-constrained agents in the economy. Credit constrained agents have a higher marginal propensity to consume goods and leisure and their labor supply respond less in response to increases in taxes or decreases in government expenditures. This explains the relation between income inequality and impact of fiscal consolidation programs. Our model produces a cross-country pattern between inequality and the fiscal multipliers, resulting from consolidation, which is quite similar to that in the data.

Keywords: Fiscal Consolidation, Income Inequality

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1 Introduction

The 2008 financial crisis lead several European economies to adopt counter-cyclical fiscal policies. As a result large government deficits ensued - exceeding 10% in several European countries. This created an urgency for fiscal consolidation policies in order to counteract the rising trend of debt to GDP ratios and reduce budget deficits. The process of fiscal consolidation across European countries contributed to the upsurge of several questions in recent literature on the effects of fiscal consolidation. Is fiscal consolidation ultimately contractionary or expansionary? Do long-run benefits outweigh the short-run discomfort? What is the optimal strategy of fiscal consolidation? We relate to this literature by presenting evidence on a dimension that explains the heterogeneous response to fiscal consolidation across countries: income inequality.

The fiscal impacts of these austerity policies were wrongly predicted by the International Monetary Fund (IMF). This fact is acknowledged by Blanchard and Leigh (2013), where the authors find evidence that the IMF underestimated the impacts of austerity across European countries, with stronger consolidation causing larger forecast errors. In Blanchard and Leigh (2014), the authors find that no significant alternative explanatory factors, such as pre-crisis debt levels or budget deficits, banking conditions, a country's external position, among others, help explain the forecast errors.

We start by replicating the exercise conducted by Blanchard and Leigh (2013) with a focus on the explanatory power of income inequality. We find that in countries with higher income inequality, the forecast errors were larger thus amplifying the unanticipated recessive impacts of fiscal consolidation. We then follow Ilzetzki et al. (2013), who study the impacts of different factors on fiscal multipliers and find that countries with higher income inequality are associated with stronger declines in output following decreases in government consumption. In conclusion, we show both that income inequality is an important dimension that the IMF failed to take into account when anticipating the recessive impacts of fiscal consolidation and that higher income inequality is associated with greater recessive responses to contractions in government consumption.

In order to explore this relationship, we use an overlapping generations economy with uninsurable idiosyncratic risk as in Brinca et al. (2016). We calibrate the model to match several moments of the German economy and then simulate a reduction of 10 percentage points in the debt over GDP ratio, over a period of 50 years, financed by either a temporary decrease in government expenditures or a temporary increase in labor income taxation.

The results from our simulations align with our empirical findings. Moreover, we find that it is the stochastic component of the income process that drives output's response to consolidation. To rationalize this result, start by noting that fiscal consolidation will shift resources from financing government debt to the productive side of the economy. The resulting increase in the capital stock will raise the marginal product of labor, wages and thus expected lifetime income. This will lead to a positive income effect leading agents to decrease their labor supply and output to fall in the short-run, despite the long run effects of consolidation on output being positive. An increase in income risk will lead to an increase in precautionary savings and a decrease in the share of agents with liquidity constraints. Since unconstrained agents have a more elastic labor supply response to the positive income effect from consolidation, labor supply will fall more when fewer agents are constrained.

We assess the transmission mechanism first by simulating our benchmark model calibrated to Germany and decreasing the variance of ability and idiosyncratic risk one at a time. While the fiscal multiplier is not sensitive to changes in the variance of ability, it does respond to the variance of risk. The reasoning for this is that variance of ability does not impact the percentage of agents constrained in the economy, whereas decreasing the variance of risk from the benchmark value 0.44 to 0.01 raises the percentage of agents constrained from 3.41 % to 34.87 %, which diminishes the value of the multiplier, as the labor supply is less responsive the larger the percentage of constrained agents.

In a multi-country exercise, we calibrate our model to 13 European economies, with different levels of variance of idiosyncratic risk. We find a positive correlation between income inequality and the fiscal multiplier. Moreover, we show that countries with higher variance of idiosyncratic risk have a smaller percentage of constrained agents and have larger multipliers, validating our mechanism.

The remainder of the paper is organized as follows: we begin by presenting some relevant literature in section 2. In Section 3 we assess the empirical relation between income inequality and fiscal multipliers. In Section 4 we describe the overlapping generation model, define the competitive equilibrium and explain the fiscal consolidation experiment. Section 5 describes the calibration of the model. In Section 6 we inspect the transmission mechanism, followed by the cross-country analysis in Section 7 and then concluding remarks.

2 Related literature

There has been a surge in the literature regarding the impacts of fiscal contractions. Guajardo et al. (2014) focus on short-term effects of fiscal consolidation on economic activity for a sample of OECD countries, using the narrative approach as in Romer and Romer (2010), finding that a 1% fiscal consolidation causes GDP to to decline 0.62%; Yang et al. (2015) build a sample of fiscal adjustment episodes for OECD countries in the period of 1970 to 2009 and find that somewhat smaller recessive impacts: a 1% increase in fiscal consolidation leads to a fall of 0.3% in output . Alesina et al. (2015) conclusions support previous findings, emphasizing that tax-based adjustments produce deeper and longer recessions than spending based ones. Pappa et al. (2015) study the impacts of fiscal consolidation in an environment with corruption and tax evasion and find evidence that fiscal consolidation causes large output and welfare losses and that much of the welfare loss is due to increases in taxes that create the incentives to produce in the less productive shadow sector.

Our paper also relates to the recent literature on the optimal composition of fiscal policy. Romei (2015) addresses the issue of the optimal speed and composition of a fiscal consolidation, evaluating the impact of different speeds of adjustment and of variations in several fiscal instruments on aggregate welfare. Romei (2015) concludes that a fiscal consolidation should be done quickly and by cutting public expenditure. Viegas and Ribeiro (2016) also find that the welfare impacts of spending-based to be smaller than tax-based consolidation.

There is also a growing literature regarding the relevance of wealth and income inequality for fiscal policy. Brinca et al. (2016) provide empirical evidence that higher wealth inequality is associated with stronger impacts of increases in government expenditures and show that an overlapping generations model with uninsurable income risk calibrated to match key characteristics of a number of OECD countries, can replicate this empirical pattern. Ferriere and Navarro (2014) provide empirical evidence that in the post-war U.S., fiscal expansions are only expansionary when financed by increases in tax progressivity. As in Brinca et al. (2016), Ferriere and Navarro (2014) are also able to match this empirical result using a similar framework. Winter et al. (2014) suggest that even though there are long-term welfare benefits of fiscal consolidation in the US, they do not outweigh the welfare costs of the transition to the new steady state. The authors also find evidence that wealth inequality is a major driver of welfare effects.

3 Stylized Facts

In this section we provide evidence that income inequality is a relevant dimension that the IMF failed to properly taking into account when forecasting the impacts of austerity packages. We do so by following the exercise in Blanchard and Leigh (2013) and showing that income inequality contains robust and statistically significant information regarding output forecast errors made by the IMF. We then provide further evidence regarding the link of income inequality and fiscal multipliers and use the same methodology as in Ilzetzki et al. (2013), running VARs and pooling countries across high and low income inequality groups. The exercise of Blanchard and Leigh (2013) is focused on fiscal consolidation episodes in Europe for 2010 and 2011, and we show that higher income inequality is associated with more recessive impacts of consolidation. The Ilzetzki et al. (2013) exercise is more general and we show that on average, over time, income inequality is associated with more negative impacts of decreases in government consumption expenditures on output.

3.1 Forecast errors and fiscal consolidation forecasts

Blanchard and Leigh propose a standard rational expectation model specification to investigate the relation between growth forecast errors and planned fiscal consolidation during the crisis. The approach consists on regressing forecast errors for real GDP growth on forecasts of fiscal consolidation made in the beggining of 2010. The specification proposed by Blanchard and Leigh is the following

$$\Delta Y_{i,t:t+1} - \hat{E}\{\Delta Y_{i,t:t+1}|\Omega_t\} = \alpha + \beta \hat{E}\{F_{i,t:t+1|t}|\Omega_t\} + \epsilon_{i,t:t+1} \tag{1}$$

where α is the constant, $\Delta Y_{i,t:t+1}$ is the cumulative year-on-year GDP growth rate in economy i in periods t and t+1 (years 2010 and 2011 respectively), and the forecast error is measured as $\Delta Y_{i,t:t+1} - \hat{E}\{\Delta Y_{i,t:t+1}|\Omega_t\}$, with $\hat{E}$ being the forecast conditioned on the information set Ω at time t. $\hat{E}\{F_{i,t:t+1|t}|\Omega_t\}$ denotes the planned cumulative change in the general government structural fiscal balance in percentage of potential GDP, and is used as a measure of discretionary fiscal policy.

Uner the null hypothesis that the IMF forecasts regarding the impacts of fiscal consolidation were accurate, β should be zero. What Blanchard and Leigh (2013) find is that β not only is statistically different from zero, but negative and around 1. This means that the IMF severly underestimated the recessive impacts of austerity, implying that for every additional percentage point of fiscal consolidation, output was about 1 percent lower than what was forecasted. [1]

[1] Blanchard and Leigh (2013) also account for the fact that this result could have been driven by the fact that planned fiscal consolidations were different than actual ones. The authors show that this was not the case, as planned and actual consolidations have a match of almost 1 to 1.

Blanchard and Leigh (2013) then investigate what else could explain the forecast errors. The authors test for initial level of financial stress, initial level of external imbalances, trade-weighted forecasts of trading partners' fiscal consolidation forecasts, the initial level of household debt, the IMF's Early Warning exercise vulnerability ratings computed in early 2010 and other variables. The results are robust and no control is significant. Two conclusions are drawn from this. First, that none of the variables examined is correlated with both the forecast error and planned fiscal consolidation and thus the under-estimation of the recessive impacts of consolidation are not related with these different dimensions. Second, since none is statistically significant, none of these dimensions significantely affected the forecast errors of the IMF.

Here we expand equation 1 to account for income inequality. Using the European Union Statistics on Income and Living Conditions (EU-SILC) dataset, we construct various measures of income inequality for the same 26 European economies used by Blanchard and Leigh (2013). [2]

The specification that we estimate using the different measures of inequality is the following

$$\Delta Y_{i,t:t+1} - \hat{E}\{\Delta Y_{i,t:t+1}|\Omega_t\} = \alpha + \beta \hat{E}\{F_{i,t:t+1|t}|\Omega_t\} + \gamma I_{i,t-1} + \epsilon_{i,t:t+1} \tag{2}$$

where $I_{i,t}$ is the inequality measure for country i.

Results presented in Table 1 indicate that inequality was one dimension that IMF forecasters failed to take properly into consideration as the different measures of inequality are statistically significant and help to explain the forecast errors, with the R^2 increasing considerably when inequality is included.

To test whether inequality helps to explain the impact of fiscal consolidation, we include in the regression an interaction between the planned fiscal consolidation and inequality and

[2] The 26 economies used by Blanchard and Leigh were Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Germany, Denmark, Finland, France, Greece, Hungary, Ireland, Iceland, Italy, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovak Republic, Slovenia, Spain, Sweden, Switzerland, and the United Kingdom.

	(1) Blanchard-Leigh	(2) inequality 4/1	(3) inequality 5/1	(4) inequality 95/1	(5) inequality 100/2	(6) inequality Gini
β	-1.095***	-0.962***	-0.951***	-0.991***	-0.953***	-0.990***
	(0.255)	(0.239)	(0.235)	(0.246)	(0.229)	(0.242)
γ		-0.890*	-0.734*	-0.091	-0.066**	-0.156
		(0.474)	(0.363)	(0.071)	(0.030)	(0.107)
Constant	0.775*	4.135**	4.014**	1.944*	2.438***	5.119
	(0.383)	(1.944)	(1.742)	(1.004)	(0.787)	(3.171)
Observations	26	26	26	26	24	26
R-squared	0.496	0.552	0.564	0.533	0.624	0.535

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 1: GDP forecast errors and income inequality. The income inequality measures that we use are the 25% highest incomes over the bottom 25%, the highest over the lowest 20%, the top over the bottom 10%, top over bottom 5%, highest 1% over the lowest 2% and the income Gini coefficient. We use the inequality measures for the year of 2009, to avoid endogeneity.

estimate the following specification

$$\begin{aligned}\Delta Y_{i,t:t+1} - \hat{E}\{\Delta Y_{i,t:t+1}|\Omega_t\} =& \alpha + \beta \hat{E}\{F_{i,t:t+1|t}|\Omega_t\} + \gamma I_{i,t-1} + \\ & \iota \hat{E}\{F_{i,t:t+1|t}|\Omega_t\} I_{i,t-1} + \epsilon_{i,t:t+1}\end{aligned} \tag{3}$$

Results in Table 2 are illustrative of the role played by inequality in explaining the forecast error and the impacts of fiscal consolidation. The interaction term is statistically significant and the negative sign of the coefficients suggest that the higher the inequality level and the consolidation planned in country i, the more forecasters underestimated its impacts. In other words, income inequality amplified the fiscal multipliers associated with consolidation.

	(1) Blanchard-Leigh	(2) inequality 4/1	(3) inequality 5/1	(4) inequality 95/1	(5) inequality 100/2	(6) inequality Gini
β	-1.095***	1.746	1.157	0.490	-0.431	3.209
	(0.255)	(1.293)	(1.086)	(0.610)	(0.410)	(2.523)
γ		-0.110	-0.204	0.035	-0.030	-0.016
		(0.570)	(0.438)	(0.073)	(0.031)	(0.143)
ι		-0.667**	-0.439**	-0.102***	-0.017*	-0.143*
		(0.292)	(0.209)	(0.035)	(0.009)	(0.082)
Constant	0.775*	1.328	1.791	0.516	1.677*	1.335
	(0.383)	(2.367)	(2.111)	(1.090)	(0.842)	(4.200)
Observations	26	26	26	26	24	26
R-squared	0.496	0.605	0.606	0.598	0.647	0.588

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 2: GDP forecast errors, income inequality and interaction

The results are not only statistically significant and robust but are also economically meaningful. For example, an increase in one standard deviation of the share of agents in the top 25% of the income distribution over the bottom 25% leads to a 74% increase of the mean forecast error.

3.2 SVAR

In this section we provide further evidence regarding the link of income inequality and the recessive impacts of fiscal contractions. We use the methodology proposed by Ilzetzki et al. (2013), running VARs for two different groups of countries pooled across above and below the median income Gini coefficient. We find that for countries with income Gini coefficients above the median, the recessive impacts of decreases in government consumption expenditures are stronger and statistically different than the effects for the group of countries with income Gini below the median.

The objective is to estimate the following system of equations

$$AY_{nt} = \sum_{k=1}^{K} C_k Y_{n,t-k} + u_{n,t} \tag{4}$$

where Y_{nt} is a vector containing the endogenous variables for country n in quarter t. The variables considered are the same as in Ilzetzki et al. (2013): government consumption, output, current account in percentage of GDP and the natural logarithm of the real effective exchange rate. C_k is a matrix of lag own and cross effects of variables on their current observations. Given that A is not observable we cannot estimate this regression directly. We need to pre-multiply everything by A^{-1} and, using OLS, we can recover the matrix $P = A^{-1}C_k$ and $e_{n,t} = A^{-1}u_{n,t}$. So we estimate the system

$$Y_{nt} = \sum_{k=1}^{K} A^{-1} C_k Y_{n,t-k} + A^{-1} u_{n,t} \tag{5}$$

To be able to estimate the effects of fiscal consolidation, we need more assumptions on A so that we can identify the innovations by solving $e_{n,t} = A^{-1}u_{n,t}$. We use the same assumption used by Ilzetzki et al. (2013) and first introduced by Blanchard and Perotti (2002), to identify the responses of output to government consumption expenditures: government consumption cannot react to shocks in output within the same quarter. The plausibility of this assumption comes from the fact that the government's budget is typically set on an yearly basis and can only react to changes in output with a lag. For the ordering of the remaining variables, we also follow Ilzetzki et al. (2013) and let the current account follow output and the real exchange rate follow the current account. Given this, we can identify the impulse responses to a primitive shock in government spending.

The impulse response functions shown in Figure 1 suggest that in countries with higher income inequality, contractions in government spending have a more recessive impact.

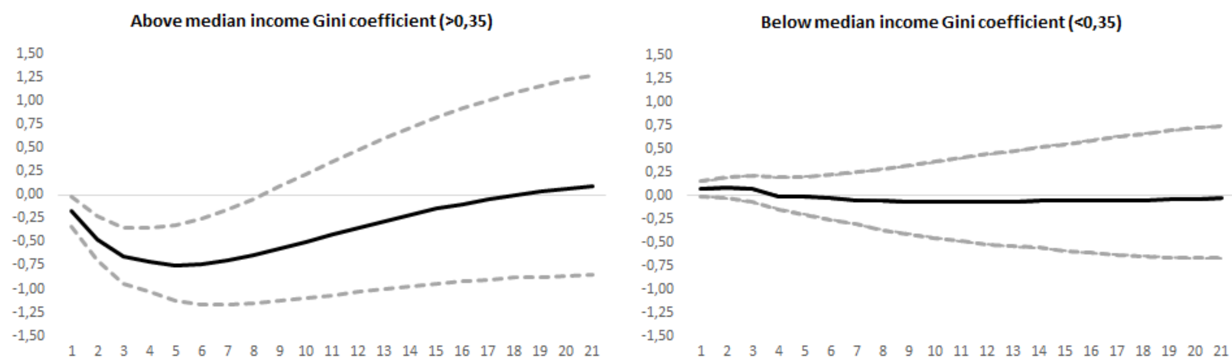

Figure 1: Impulse response functions of output to a 1% decrease in government consumption (95% error bands in gray)

These empirical findings together suggest that income inequality is a relevant dimension to take into account when studying the effects of fiscal policy. In particular, they suggest that higher inequality amplifies the recessive impacts of fiscal consolidation and decreases in government expenditures. In order to gain insights upon the mechanism through which income inequality may play such role, we build a structural model that is introduced in the following section.

4 Model

In this section, we describe the model we will use to study the effects of a fiscal consolidation in different countries. Our model follows closely Brinca et al. (2016).

Technology

There is a representative firm with production function defined by a Cobb-Douglas:

$$Y_t(K_t, L_t) = K_t^{\alpha} \left[L_t\right]^{1-\alpha} \tag{6}$$

with K_t being the capital input and L_t the labor input in efficiency units. Capital evolution is given by

$$K_{t+1} = (1-\delta)K_t + I_t \tag{7}$$

with I_t being gross investment, with capital depreciation rate δ. The firm hires labor and capital in each period to maximize profits:

$$\Pi_t = Y_t - w_t L_t - (r_t + \delta)K_t. \tag{8}$$

The factor prices, under a competitive equilibrium, will be equal to their marginal products given by:

$$w_t = \partial Y_t/\partial L_t = (1-\alpha)\left(\frac{K_t}{L_t}\right)^{\alpha} \tag{9}$$

$$r_t = \partial Y_t/\partial K_t - \delta = \alpha\left(\frac{L_t}{K_t}\right)^{1-\alpha} - \delta \tag{10}$$

Demographics

Our economy is characterized by J overlapping generations households. Recent work by Peterman and Sager (2016) makes the case for the relevance of having a life-cycle dimension for the study of the impacts of government debt. All households are born at age 20 and retire at age 65. Retired households face an age-dependent probability of dying, $\pi(j)$ and die with certainty at age 100. j denotes the household's age and goes from 1 (household's age 20) to 81 (household's age 100). A period in the model corresponds to 1 year, so an household has a total of 40 periods of active work life. We assume there is no population growth. The size of each new cohort is normalized to 1. Denoting the age-dependent survival probability $\omega(j) = 1 - \pi(j)$, at any given period, the mass of living retired agents of age $j \geq 65$ is equal to $\Omega_j = \prod_{q=65}^{q=J-1} \omega(q)$, using the law of large numbers.

Besides age, households are heterogeneous across other four dimensions: idiosyncratic productivity, asset holdings, a subjective discount factor uniformly distributed across agents, assuming three distinct values $\beta \in \{\beta_1, \beta_2, \beta_3\}$ and in terms of ability, which is the starting level of productivity realized at birth. During active work-life an household must choose the amount of hours he wants to work, n, the amount to consume, c, and how much to save, k. Retired households have no labor supply decision and receive a retirement benefit, Ψ_t.

Since we have stochastic survivability, a percentage of households leave unintended bequests which are uniformly redistributed between the households that stay alive. Per-household bequest is denoted by Γ. Retired households' utility is increasing in the bequest they leave when they die.

Labor Income

The wage of an individual depends on his/her own characteristics: age, j, permanent ability, $a \sim N(0, \sigma_a^2)$, and idiosyncratic productivity shock, u, which follows an AR(1) process:

$$u' = \rho u + \epsilon, \quad \epsilon \sim N(0, \sigma_\epsilon^2) \tag{11}$$

These characteristics will dictate the number of efficient units of labor the household is endowed with. Individual wages will also depend on the wage per efficiency unit of labor w. Thus, individual i's wage is given by:

$$w_i(j, a, u) = we^{\gamma_1 j + \gamma_2 j^2 + \gamma_3 j^3 + a + u} \tag{12}$$

$\gamma_{1\iota}$, $\gamma_{2\iota}$ and $\gamma_{3\iota}$ capture the age profile of wages.

Preferences

The household's utility function, $U(c,n)$, depends on consumption and work hours, $n \in (0,1]$, and is defined by:

$$U(c,n) = \frac{c^{1-\sigma}}{1-\sigma} - \chi \frac{n^{1+\eta}}{1+\eta} \tag{13}$$

Retired households gain utility from the bequest they will leave when they die:

$$D(k) = \varphi \log(k) \tag{14}$$

Government

The government is characterized by running a balanced budget social security system. It taxes employees and the representative firm at rates τ_{ss} and $\tilde{\tau}_{ss}$ respectively, and pays retirement benefits, Ψ_t. Taxes consumption, labor and capital income in order to finance public consumption of goods, G_t, public debt interest expenses, rB_t, and lump sum transfers, g_t.

Tax rates on consumption, τ_c, and on capital income, τ_k, are flat. The labor income tax is non-linear and follows the functional form proposed in Benabou (2002):

$$\tau(y) = 1 - \theta_0 y^{-\theta_1} \tag{15}$$

with y being the pre-tax (labor) income, ya the after-tax income, and the level and progressivity of the tax is dictated by the parameters θ_0 and θ_1, respectively.[3].

Given the government's revenues from social security taxes denoted by R_t^{ss}, the govern-

[3]See the appendix for a more detailed discussion of the properties of this tax function

ment budget constraint is given by

$$g\left(45+\sum_{j\geq 65}\Omega_j\right)=R-G-rB, \tag{16}$$

$$\Psi\left(\sum_{j\geq 65}\Omega_j\right)=R^{ss}. \tag{17}$$

Recursive Formulation of the Household Problem

A household is characterized in any period by his asset position k, the time discount factor $\beta \in \beta_1, \beta_2, \beta_3$, his permanent ability a, the idiosyncratic productivity shock u and his age j. We can formulate the working-age household's optimization problem over consumption, c, work hours, n, and future asset holdings, k', recursively:

$$\begin{aligned}
V(k,\beta,a,u,j) &= \max_{c,k',n}\Big[U\left(c,n\right)+\beta E_{u'}\big[V(k',\beta,a,u,j+1)\big]\Big] \\
&\text{s.t.:} \\
c(1+\tau_c)+k' &= \left(k+\Gamma\right)\left(1+r(1-\tau_k)\right)+g+Y^L \\
Y^L &= \frac{nw\left(j,a,u\right)}{1+\tilde{\tau}_{ss}}\left(1-\tau_{ss}-\tau_l\left(\frac{nw\left(j,a,u\right)}{1+\tilde{\tau}_{ss}}\right)\right) \\
n\in[0,1], &\quad k'\geq -b, \quad c>0
\end{aligned} \tag{18}$$

with Y^L being household's labor income post social security taxes paid by the employee, τ_{ss}, and paid by the employer, $\tilde{\tau}_{ss}$, and labor income taxes. The problem of a retired household, who has a probability $\pi(j)$ of dying and gains utility $D(k')$ from leaving a bequest, is:

$$\begin{aligned}
V(k,\beta,j) &= \max_{c,k'}\Big[U\left(c,n\right)+\beta(1-\pi(j))V(k',\beta,j+1)+\pi(j)D(k')\Big] \\
&\text{s.t.:} \\
&c(1+\tau_c)+k' = \left(k+\Gamma\right)\left(1+r(1-\tau_k)\right)+g+\Psi, \\
&k'\geq 0, \quad c>0
\end{aligned} \tag{19}$$

Stationary Recursive Competitive Equilibrium

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

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:

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

4. The government budget balances:

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

5. The social security system balances:

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

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

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

Fiscal Experiment and Transition

The fiscal experiment that we analyze in this paper is a decrease of the debt to GDP ratio by 10 percentage points in 50 periods. The government decreases the government spending (G) or increases revenues (R), by increasing the labor tax τ_l, so that at the end of 50 periods the debt to GDP ratio is 10 percentage points lower. After the debt to GDP ratio is at the new steady state level, we assume the economy takes additional 50 periods to converge to the new steady state equilibrium.

In the context of this experiment, we define a recursive competitive equilibrium along the transition between steady states.

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:

$$K + B = \int k d\Phi$$

$$L = \int (n(k,\beta,a,u,j))\, d\Phi$$

$$\int cd\Phi + \delta K + G = K^{\alpha} L^{1-\alpha}$$

3. The factor prices satisfy:

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

4. The government budget balances:

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

5. The social security system balances:

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

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

$$\Gamma \int \omega(j) d\Phi = \int \left(1-\omega(j)\right) kd\Phi$$

7. Aggregate law of motion:

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

5 Calibration

Our benchmark model is calibrated to match moments of the German economy. For the other countries, calibration is performed using the same strategy. Certain parameters can be calibrated outside the model using direct empirical counterparts. We choose Germany as our benchmark, as it is the largest economy in the European Union and the second economy with higher income inequality, measured by the variance of log wages, just behind France.

Wages

To estimate the wage profile through the life cycle (see equation 12), we use data from the Luxembourg Income and Wealth Study, and for each country, we run the following regression

$$\ln(w_i) = \ln(w) + \gamma_1 j + \gamma_2 j^2 + \gamma_3 j^3 + \varepsilon_i \tag{20}$$

with j being the age of individual i.

The parameter for the variance of ability, σ_a, is equal across countries and set equal to the average of σ_a for the European countries in Brinca et al. (2016). Due to the lack of panel data on individual incomes for European economies to estimate the persistence of idiosyncratic shock ρ, we set it equal to the value used in Brinca et al. (2016), who use U.S.A. data of the Panel Study of Income Dynamics (PSID). The variance of the idiosyncratic risk process σ_ϵ is calibrated to make the model match the variance of log wages in the data.

Preferences

The Frisch elasticity of labor supply, η, has created a considerable debate in the literature. Estimates range from 0.5 to 2 or higher. We decide to set it to 1.0, which is the same value as in Brinca et al. (2016). The other parameters φ, χ, β_1, β_2 and β_3, respectively the utility of leaving bequest, disutility of work and the discount factors, are calibrated to match key moments in the data.

Taxes and Social Security

As described before, we follow Benabou (2002) and use the same labor income tax function (equation 15). Using the OECD data on the German labor income tax we estimate θ_0 and θ_1 for different family types. Then, to have a tax function for the single individual household in our model, we calculate the weighted average of both parameters using the weights of each family type on the overall population.[4]. For Germany we estimate θ_0 and θ_1 to be 0.881 and 0.221 respectively. The social security rate on behalf of the employer is set to 0.206 and on behalf of the employee to 0.21, taking average tax rates between 2001 and 2007. Finally, consumption and capital tax rates are set to 0.233 and 0.155 respectively, following Trabandt and Uhlig (2011).

Parameters Calibrated Endogenously

To calibrate the parameters that do not have any direct empirical counterparts, φ, β_1, β_2, β_3, b, χ and σ_ϵ, we use the simulated method of moments so that we minimize the following loss function:

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

with M_m and M_d being the moments in the data and in the model respectively.

Given that we have seven parameters, we need seven data moments to have an exactly identified system. The seven moments we target in the data are the ratio of the average net asset position of households in the age cohort 75 to 80 year old relative to the average asset holdings in the economy, the three wealth quartiles, the variance of log wages and capital to output ratio. All targeted moments are calibrated with less than 2% of error margin, as displayed in Table 3. Table 4 presents the calibrated parameters

Table 3: Calibration Fit

Data Moment	Description	Source	Data Value	Model Value
75-80/all	Share of wealth owned by households aged 75-80	LWS	1.51	1.51
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	0.189	0.189
Q_{25}, Q_{50}, Q_{75}	Wealth Quartiles	LWS	-0.004, 0.027, 0.179	-0.005, 0.026, 0.182

[4]As we do not have detailed data for the weight of each family on the overall population for European countries, we use U.S. family shares, as in Holter et al. (2015)

Table 4: Parameters Calibrated Endogenously

Parameter	Value	Description
Preferences		
φ	3.6	Bequest utility
$\beta_1, \beta_2, \beta_3$	0.952, 0.997, 0.952	Discount factors
χ	16.93	Disutility of work
Technology		
b	0.09	Borrowing limit
σ_ϵ	0.439	Variance of risk

6 Results

In the context of our debt consolidation experiment, the decrease in debt will shift resources to the productive side of the economy, driving the capital labor ratio up, which will make the marginal product of labor increase, generating a permanent income shock and decreasing labor supply. This will generate a recession in the short run. However, given that productive capital increases progressively during the transition to the new steady state, the economy will converge to a higher level of output.

In the model, there are three sources of wage inequality: age, income risk and the permanent ability level. We abstract from demographic differences across countries in terms of the relative sizes of each cohort. There is an ongoing debate regarding whether income inequality is mainly due to differences across agents determined before the entry into the labor market or differences in the realization of income shocks during the life-course. Huggett et al. (2011) find that about 60% of the variance in lifetime earnings and wealth in the U.S. is due to initial conditions, a result that suggests that both dimensions are important to generate the observed heterogeneity in the data.

What we show in this section is that, in the context of our model, the link between inequality and fiscal consolidation arises from differences across countries in terms of idiosyncratic uninsurable risk and not from differences in pre-determined conditions (ability). To understand this, note that the marginal propensity to work of credit constrained agents is less responsive to positive income shocks. So, an economy with high income inequality arising from idiosyncratic productivity risk, has a smaller percentage of constrained agents due to precautionary savings behavior and a higher aggregate elasticity of labor supply with respect to our fiscal experiment. Therefore, fiscal consolidation will be more recessive on impact in economies with high income inequality. The variance of ability will not affect the precautionary saving behavior of the agents, and changing the variance of ability will have no impact on the number of credit constrained agents.

Next, we perform the a series of experiments that aim to illustrate the mechanism described above.

Variance of ability vs variance of risk

We focus on the two parameters that drive wage inequality in our model to further understand the role that both play in explaining the correlation between income inequality and fiscal multipliers during the consolidation experiment. We show that the correlation between wage inequality and fiscal multipliers captured in the empirical section can only be explained by differences in idiosyncratic risk and not by pre-determined differences in the age profile of wages.

To validate our mechanism we run two different experiments:

- Change the $Var(\ln w)$ in the benchmark model calibrated to Germany, by changing the variance of ability, σ_a;
- Change the $Var(\ln w)$ in the benchmark model by changing the variance of the stochastic income process, σ_ϵ;

We perform these two experiments both for the government spending and the labor tax based consolidations. In both cases we adjust γ_0 by a constant to guarantee that average productivity in the economy stays unchanged.

In Figure 2 we can observe the changes induced in the labor tax consolidation multiplier from changes in the variance of ability and risk. In the left panel we show that the fiscal

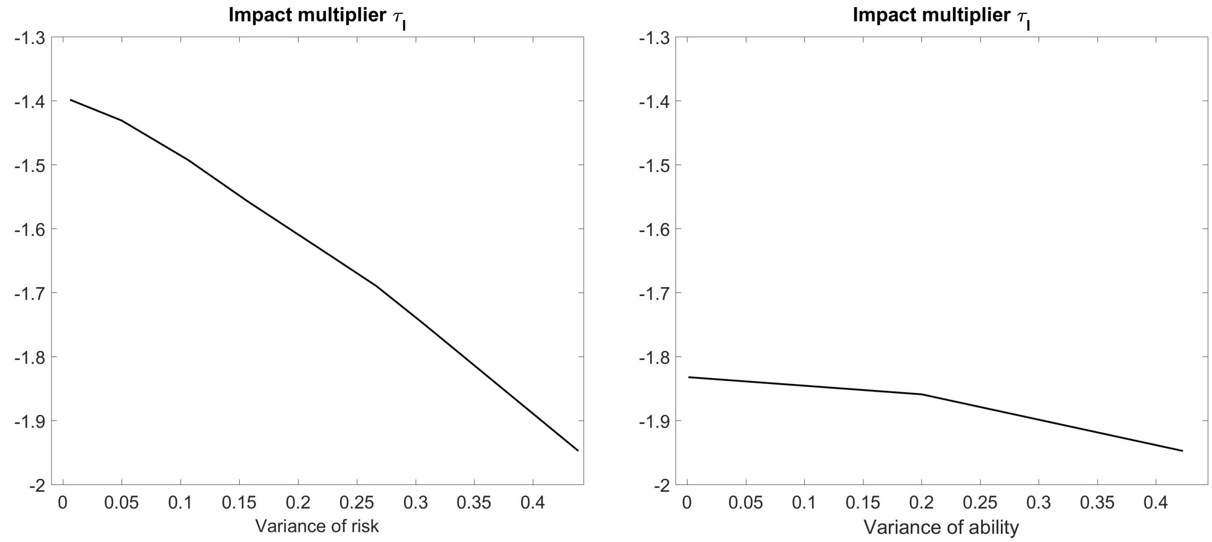

Figure 2: Impact multiplier for the labor tax consolidation in the benchmark model for Germany when changing the variance of risk (left panel) and variance of ability (right panel).

multiplier is very sensitive to changes in income risk, while relatively inelastic w.r.t. changes in ability (right panel). More importantly, there is a positive relationship between income risk and the absolute value of the tax-based consolidation fiscal multiplier, as suggested in our empirical exercise.

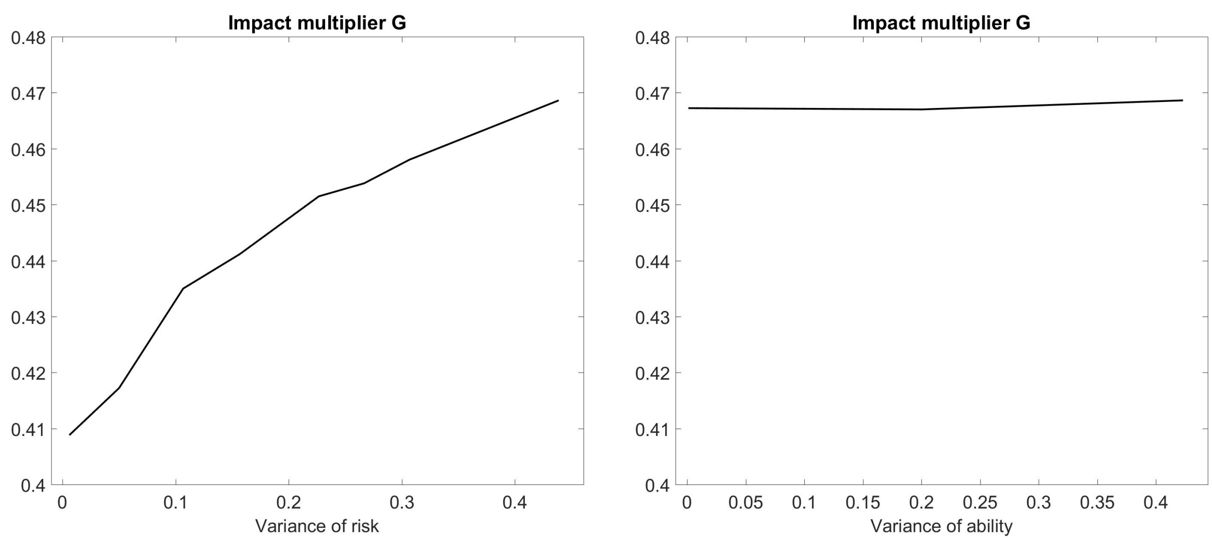

Figure 3: Impact multiplier for the government spending consolidation in the benchmark model for Germany when changing the variance of risk (left panel) and variance of ability (right panel).

The government spending consolidation experiment generates similar results. As can be seen in Figure 3, the changes induced in the multiplier from differences in the variance of risk (left panel) are much larger than the changes induced by changing the variance of ability (right panel). At the same time, only through changes in income risk we can generate a positive relationship between spending based fiscal consolidation and income inequality.

The analysis of Figures 2 and 3 covers changes in risk that go from the highest value in our calibration set of models to zero. In our exercise, the lowest value of the variance of risk was obtained for Greece and equal to 0.12 and the highest equal to 0.5, for France. Note that the amplitude of change in terms of the multiplier is larger for tax-based than spending-based consolidation. Going from the lowest to the highest level of risk, implies an increase of 30% and 8% respectively, in impact multipliers. The effect for spending-based consolidation is smaller, but it is worth noting that the actual consolidations studied in Section 3.1 include both changes in taxes and spending.

As argued before, the relationship between income risk and the fiscal consolidation multipliers stems from economies with higher income risk having a smaller share of credit constrained agents. In Figure 4, we document a negative strong relationship between the variance of risk and the proportion of credit constrained agents in the economy (left panel). Changing the variance of ability does not affect the share of agents with liquidity constraints, as we anticipated (right panel).

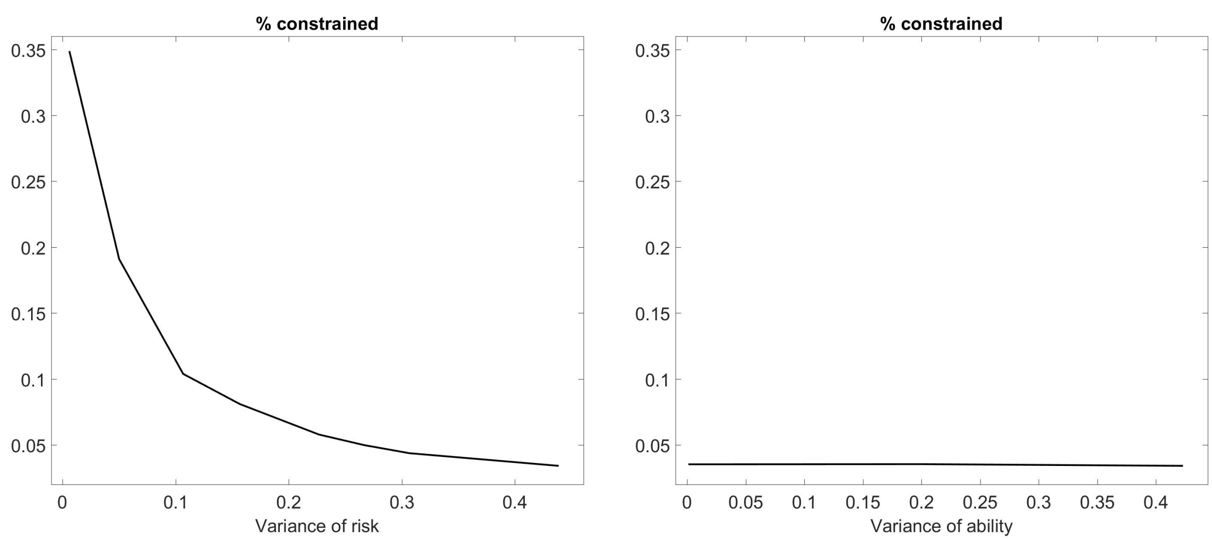

Figure 4: Percentage of agents constrained in the benchmark model for Germany when changing the variance of risk (left panel) and variance of ability (right panel).

In Figure 5 we show the relationship between the share of agents with liquidity constraints and the impact multiplier, for both spending based and tax based fiscal consolidation, stemming from changes in income risk. As it can be observed, there is a strong negative relation between the share of credit constrained agents and the fiscal consolidation multipliers, in absolute value.

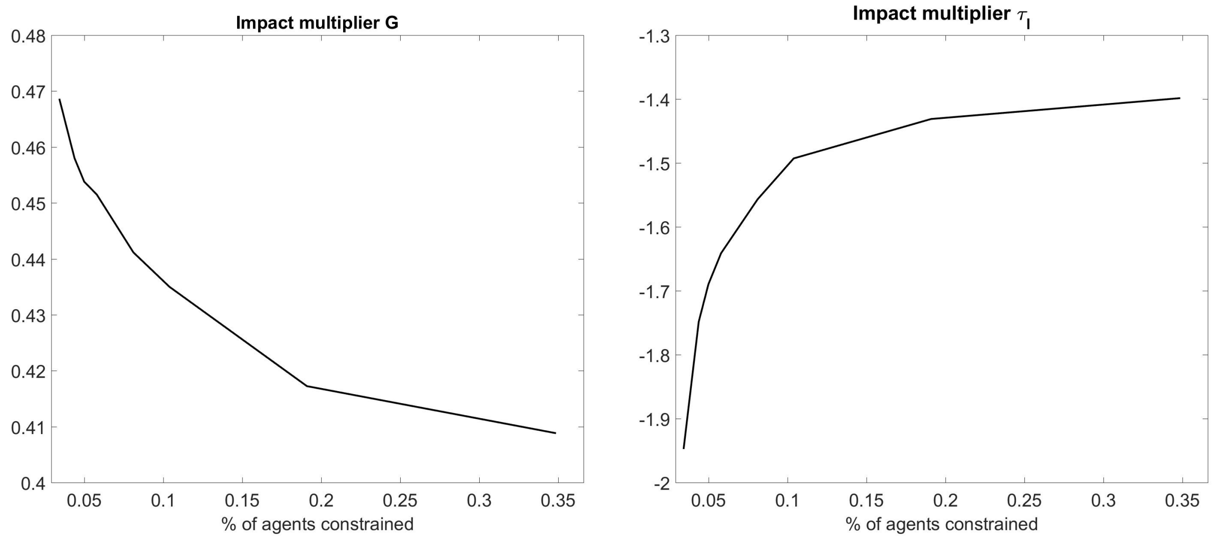

Figure 5: Impact multiplier of the G consolidation (left panel) and of the τ_l consolidation (right panel) and the percentage of agents constrained in the benchmark model for Germany when decreasing the variance of risk.

7 Cross country analysis

In the previous Section we show that our model is capable of reproducing the empirical relationship between income inequality and fiscal multipliers. In this Section we show that such mechanism is strong enough such that, when calibrating our model to the different countries in the sample, we also reproduce the cross-country relationship between both tax and spending-based fiscal consolidation and income inequality[5].

We calibrate the model to 13 European countries[6] keeping the variance of the permanent

[5]In this Section, we focus on the variance of log wages as our income inequality metric, since that was the moment in the data we targeted with our calibration exercise. If we look at inequality in earnings, the correlations are qualitatively similar, though smaller in magnitude and statistical significance.

[6]For this exercise we used only countries which actually went through fiscal consolidation processes after

ability fixed and changing the variance of the idiosyncratic shock to match the variance of log wages in the data. Tables 5 and 6 summarize the wealth distribution, the country specific data that we use to calibrate the model as well as country specific parameters estimated outside of the model. Table 7 summarizes the country specific parameters estimated through the simulated method of moments, as described in Section 5. Parameters kept constant for all the countries, are summarized in Table 8.

In Figure 6 we show that our model is able to reproduce the cross-country empirical relationship between income inequality and the impacts of fiscal consolidation: countries with higher inequality experience larger output drops on impact, for tax and spending based consolidation. These effects are large and economically meaningful. The spending-based multiplier increases about 30% between the country with the lowest income inequality (Czech Republic) and the highest (France). For tax-based consolidation, the difference is even higher: the multiplier increases by 60% in absolute value.

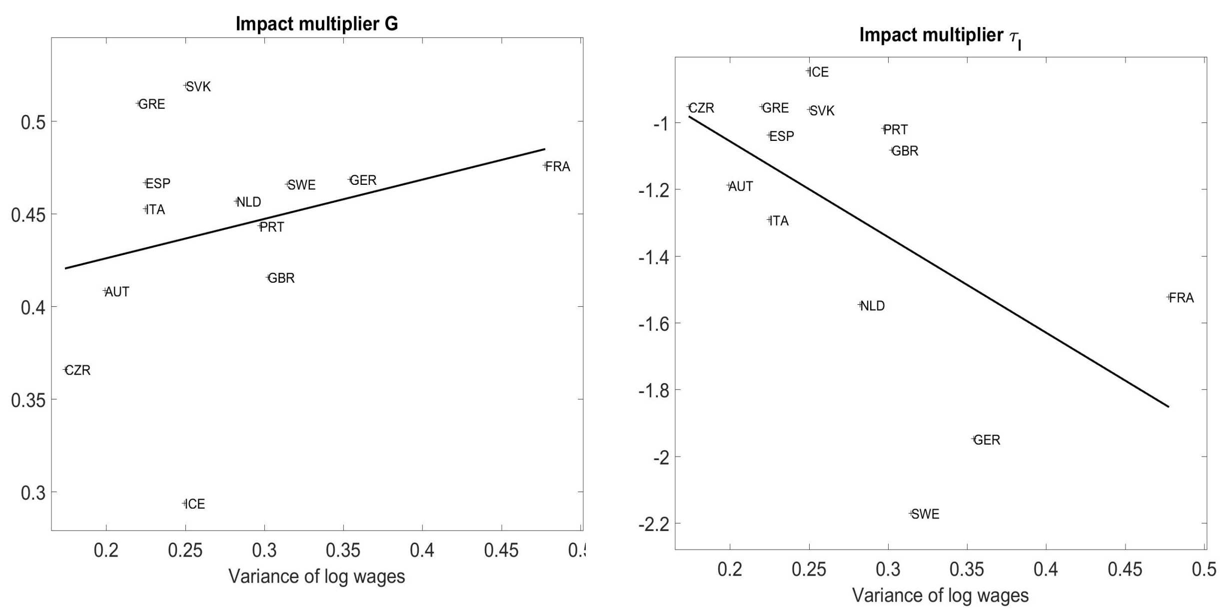

Figure 6: Impact multiplier and Var(ln(w)). On the left panel we have the cross-country data for a consolidation done by decreasing G (correlation coefficient 0.36 , p-val 0.23), while on the right panel we have the cross-country data for a consolidation done by increasing the labor tax (correlation coefficient -0.60 , p-val 0.03).

2009. Compared to Blanchard and Leigh (2013), we also excluded Belgium, Cyprus, Denmark, Ireland, Malta, Norway, Poland, Romania and Slovenia due to data limitations

In the previous Section we argued that the mechanism through which higher income risk translates into larger multipliers was through changes in the share of credit-constrained agents. In Figure 7 this relation is documented for the 13 economies for which we calibrate the model: countries with higher variance of the income risk have a smaller share of agents constrained.

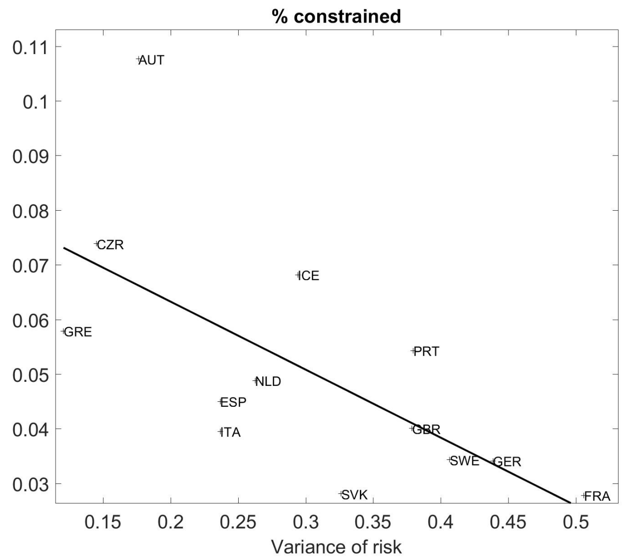

Figure 7: Percentage of agents constrained in the y-axis and variance of idiosyncratic risk on the x axis. Correlation coefficient of -0.73 and p-value of 0.00

As argued before, labor supply of constrained agents is less elastic w.r.t. the fiscal shock and, the larger the percentage of agents constrained, the smaller the multiplier. In Figure 8 this relation is documented for the cross country analysis, with countries with a larger share of agents with liquidity constraints experiencing a smaller output drop for both spending and tax based consolidation. Moreover, note that tax-based consolidations produce deeper recessions across countries. This is not surprising, given the distortionary effects of the labor tax, generating larger drops in labor supply.

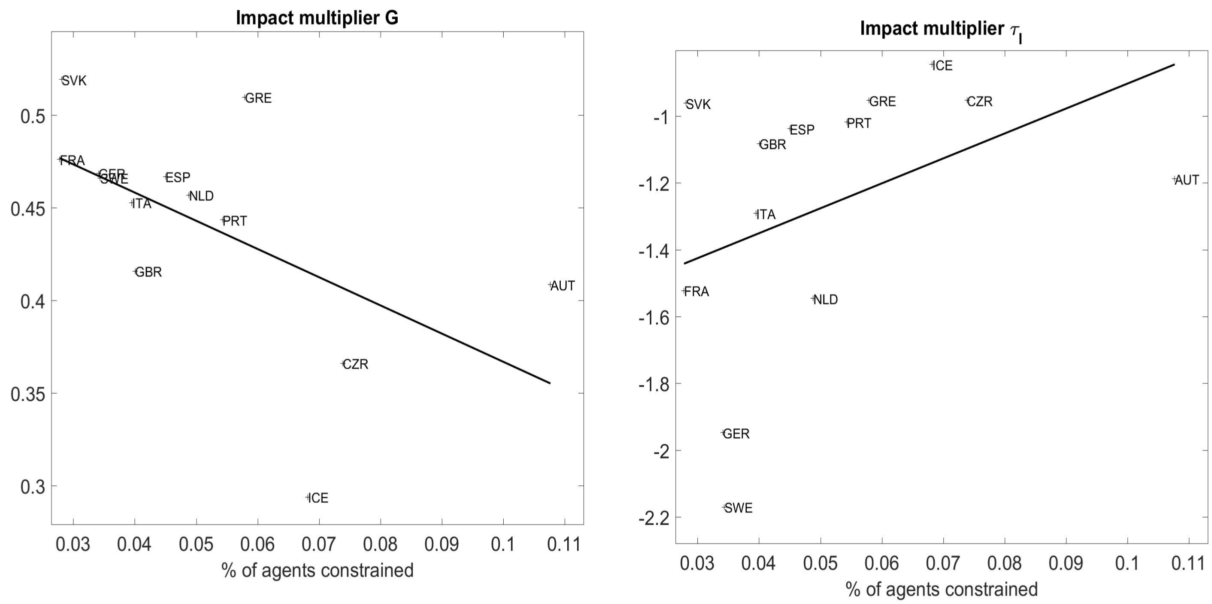

Figure 8: Impact multiplier and percentage of agents constrained. On the left panel we have the cross-country data for a consolidation done by decreasing G (correlation coefficient -0.69 , p-val 0.01), while on the right panel we have the cross-country data for a consolidation done by increasing the labor tax (correlation coefficient 0.55 , p-val 0.06)

8 Conclusion

In this paper, we provide empirical evidence that income inequality is an important factor for studying the impacts of fiscal consolidation and that it was a relevant dimension that the IMF did not take properly into account, leading to large and unanticipated recessive impacts of fiscal consolidation efforts in European economies, in the aftermath of the great Recession. We also show that for countries with high income inequality, the recessive impacts of reducing government expenditures are larger than if compared to countries with low income inequality.

To explain this finding, we develop a life-cycle, overlapping generations economy with uninsurable labor market risk. Results from simulating a decrease of 10 percentage points of the debt to GDP ratio in our model are in accordance with the empirical findings. Moreover, we find that differences in income risk explain the amplification effect that income inequality has on the recessive impacts of fiscal consolidation, regardless of it being through increases in taxes or decreases in government spending. We find that differences in initial conditions regarding the life cycle profile of wages cannot account for the cross-country variation in the impacts of fiscal consolidation we observe in the data.

The relationship between risk and the impacts of consolidation arises because in countries with higher income risk, agents will have higher savings due to precautionary motives and thus there will be a smaller share of credit constrained agents. A decrease of government debt raises the amount of productive capital in the economy, the marginal product of labor and leads to a permanent positive income shock causing labor supply to fall. In the scenario with no risk and more credit constrained agents, the labor supply will be less elastic to the fiscal shock and consequently the output response to the shock will be smaller.

We assess our mechanism in a cross-country exercise. We calibrate our model to match several moments from 13 European economies. We find that countries with lower variance of idiosyncratic risk have a larger percentage of credit constrained agents and consequently the multiplier in these countries is smaller.

In the paper, we analyze a debt reduction by either a decrease in government spending or an increase in the labor tax. Our findings suggest that labor tax consolidations produce deeper recessions than government spending consolidations. A raise in labor tax discourages agents from working, causing a larger fall in labor supply, which translates into larger multipliers.

There are still open questions regarding the fiscal policy transmission mechanisms. Nonetheless, we present evidence that income inequality is an important determinant of the impacts of fiscal consolidation programs.

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9 Appendix

9.1 Tax Function

[7] 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

$$\begin{aligned}
1 - \tau(y) &= \theta_0 y^{-\theta_1} \\
\tau(y) &= 1 - \theta_0 y^{-\theta_1} \\
T(y) &= \tau(y)y = y - \theta_0 y^{1-\theta_1} \\
T'(y) &= 1 - (1 - \theta_1)\theta_0 y^{-\theta_1}
\end{aligned}$$

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

$$1 - \frac{1 - \tau(y_2)}{1 - \tau(y_1)} = 1 - \left(\frac{y_2}{y_1}\right)^{-\theta_1} \tag{22}$$

and therefore independent 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

[7] This appendix is borrowed from Brinca et al (2016)

long as tax progressivity is defined by the tax wedges) the progressivity of the tax code[8] is uniquely determined by the parameter θ_1.

9.2 Eurosystem Household Finance and Consumption Survey - Summary Wealth Statistics

Table 5 presents the cumulative wealth distributions for the countries in the Eurosystem Household Finance and Consumption Survey. We include two additional countries' wealth distributions, from the Luxembourg Wealth Study's compilation of various household wealth surveys.

[8] 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 income levels.

Table 5: Cumulative Distribution of Net Wealth

	10%	20%	30%	40%	50%	60%	70%	80%	90%	Gini
HFCS sample[a]										
Austria	-1.3	-1.1	-0.7	0.2	2.2	6.5	13.5	23.9	40.6	0.732
Czech Republic	-0.2	0.1	0.9	2.9	6.1	10.5	17.4	26.5	39.9	0.691
France	-0.2	-0.1	0.4	1.8	5.4	11.6	20.4	32.3	49.7	0.657
Germany	-0.6	-0.5	-0.1	0.8	2.7	6.4	12.7	23.5	40.4	0.729
Greece	-0.2	0.3	2.4	6.5	12.5	20.3	30.4	43.6	61.6	0.545
Italy	0.0	0.4	1.7	4.9	10.2	17.4	26.7	38.5	55.2	0.590
Netherlands	-3.0	-2.8	-2.0	0.4	5.0	12.3	23.2	38.4	59.8	0.638
Portugal	-0.2	0.1	1.4	4.1	8.2	13.9	21.4	31.9	47.1	0.644
Spain	-0.3	0.6	3.3	7.3	12.9	19.9	28.7	40.1	56.6	0.562
Other sources[b]										
Iceland	-0.2	0.2	1.2	3.7	7.7	13.2	22.0	33.1	48.0	0.642
Slovakia	0.4	3.3	7.9	13.7	20.7	29.0	39.0	51.3	67.3	0.435
Sweden	-8.3	-9.8	-10.0	-9.7	-7.8	-3.2	5.2	19.0	41.7	0.865
UK	-0.8	-0.8	-0.5	1.2	5.4	11.7	21.0	34.0	54.3	0.649

[a] Cumulative distribution of net wealth (survey variable designation: *DN3001*) for a selection of countries from the ECB's HFCS.
[b] Sourced from Luxembourg Wealth Study's most recent entry for each respective country (survey variable designation: *nw1*).

Table 6: Country-specific calibration targets

	Macro ratios		Labour targets			Taxes			
	K/Y	B/Y	$\bar{n}$	$\mathrm{Var}(\ln w)$	$\gamma_1, \gamma_2, \gamma_3$	θ_1, θ_2	$\tilde{\tau}_{ss}, \tau_{ss}$	τ_k	τ_c
Austria	3.359	0.432	0.226	0.199	0.155, -0.004, 3.0E-05	0.939, 0.187	0.217, 0.181	0.196	0.240
Czech Republic	6.203	0.206	0.236	0.174	0.174, -0.004, 3.0E-05	0.988, 0.143	0.350, 0.125	0.182	0.220
France	3.392	0.559	0.184	0.478	0.384, -0.008, 6.0E-05	0.915, 0.142	0.434, 0.135	0.183	0.355
Germany	3.013	0.489	0.189	0.354	0.176, -0.003, 2.3E-05	0.881, 0.221	0.206, 0.210	0.155	0.233
Greece	3.262	1.038	0.230	0.220	0.120, -0.002, 1.3E-05	1.062, 0.201	0.280, 0.160	0.154	0.160
Iceland	3.378	0.213	0.189	0.225	0.161, -0.003, 1.9E-05	0.868, 0.204	0.055, 0.000	0.253	0.200
Italy	4.334	0.893	0.308	0.249	0.114, -0.002, 1.4E-05	0.897, 0.180	0.329, 0.092	0.145	0.340
Netherlands	3.943	0.232	0.200	0.225	0.307, -0.007, 4.9E-05	0.938, 0.254	0.102, 0.200	0.194	0.293
Portugal	2.830	0.557	0.200	0.282	0.172, -0.004, 2.6E-05	0.937, 0.136	0.238, 0.110	0.208	0.234
Spain	3.229	0.368	0.249	0.298	0.114, -0.002, 1.4E-05	0.904, 0.148	0.305, 0.064	0.144	0.296
Slovakia	2.155	0.317	0.233	0.315	0.096, -0.002, 1.7E-05	0.974, 0.105	0.326, 0.131	0.181	0.151
Sweden	2.315	-0.034	0.231	0.302	-0.021, 0.001, -1.2E-05	0.796, 0.223	0.326, 0.070	0.255	0.409
UK	3.799	0.371	0.204	0.250	0.183, -0.004, 2.2E-05	0.920, 0.200	0.105, 0.090	0.163	0.456

[1] Macro ratios: K/Y is derived from Penn World Table 8.0, average from 1990-2011; B/Y is the average of net public debt from 2001-8 (IMF)
[2] Labour targets: $\bar{n}$ is hours worked per capita derived from OECD data, average from 1990-2011; $\mathrm{Var}(\ln w)$ and $\gamma_1, \gamma_2, \gamma_3$ are from the most recent LIS survey available before 2008. Data from Portugal comes from Quadros de Pessoal 2009 database.
[3] Taxes: θ_1, θ_2 are as discussed in Section 9.1; $\tilde{\tau}_{ss}, \tau_{ss}$ are the average social security withholdings faced by the average earner (OECD) from 2001-7; τ_k and τ_c are either taken from Trabandt and Uhlig (2011) or calculated using their approach, representing average effective tax rates from 95-07. τ_k for Iceland comes from the Iceland Ministry of Industries and Innovation.

Table 7: Country-specific Paramater Values
Estimated by SMM

Country	β_1	β_2	β_3	χ	b	σ_u	φ
Austria	0.959	0.959	0.959	14.40	0.96	0.959	0.96
Czech Republic	0.999	0.999	0.999	21.00	1.00	0.999	1.00
France	0.957	0.957	0.957	18.03	0.96	0.957	0.96
Germany	0.952	0.952	0.952	16.93	0.95	0.952	0.95
Greece	0.989	0.989	0.989	16.50	0.99	0.989	0.99
Iceland	0.962	0.962	0.962	7.53	0.96	0.962	0.96
Italy	0.992	0.992	0.992	20.30	0.99	0.992	0.99
Netherlands	0.942	0.942	0.942	14.75	0.94	0.942	0.94
Portugal	0.960	0.960	0.960	11.50	0.96	0.960	0.96
Spain	0.970	0.970	0.970	24.47	0.97	0.970	0.97
Slovakia	0.984	0.984	0.984	20.40	0.98	0.984	0.98
Sweden	0.917	0.917	0.917	9.40	0.92	0.917	0.92
UK	0.939	0.939	0.939	12.40	0.94	0.939	0.94

Table 8: Parameters held constant across countries

Parameter	Value	Description	Source
Preferences			
η	1	Inverse Frisch Elasticity	Trabandt and Uhlig (2011)
σ	1.2	Risk aversion parameter	Literature
Technology			
α	0.33	Capital share of output	Literature
δ	0.06	Capital depreciation rate	Literature
ρ	0.335	$u' = \rho u + \epsilon, \quad \epsilon \sim N(0, \sigma_\epsilon^2)$	PSID 1968-1997
σ_a	0.423	Variance of ability	European economies average from Brinca et al (2016)

Table 9: Predicted and actual consolidation for selected countries

Country	Predicted Consolidation	Actual Consolidation
Austria	-0.011	0.010
Czech Republic	0.002	0.021
France	0.004	0.012
Germany	-0.026	0.003
Greece	0.053	0.103
Iceland	0.022	0.040
Italy	0.005	0.002
Netherlands	-0.001	0.001
Portugal	0.013	0.027
Spain	0.012	0.015
Slovakia	0.011	0.020
Sweden	-0.001	0.009
UK	0.017	0.030