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Fiscal multipliers in the 21st century ☆

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ABSTRACT

Fiscal multipliers appear to vary greatly over time and space. Based on VARs for a large number of countries, we document a strong correlation between wealth inequality and the magnitude of fiscal multipliers. In an attempt to account for 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 OECD economies, including the distribution of wages and wealth, social security, taxes, and government debt and study how a fiscal multiplier depends on various country characteristics. We find that the fiscal multiplier is highly sensitive to the fraction of the population who face binding credit constraints and also to the average wealth level in the economy. These findings together help us generate a cross-country pattern of multipliers that is quite similar to that in the data.

1. Introduction

After the 2008 financial crisis, the global economy went into a substantial economic slowdown. Many countries responded by pursuing expansionary fiscal policies, in some cases financed by austerity measures due to debt buildup and a lack of credit market access. Different policymakers and researchers appear to have had different expectations regarding the effectiveness of the policies pursued, and the ensuing academic literature has actually broadened our views in this regard: it has brought forth the notion that there is no such thing as *a* fiscal multiplier. Instead, the multiplier now appears to be viewed as a function of country characteristics and the state of the economy, in addition to the type of fiscal instrument used; e.g., Ilzetzki et al. (2013).

In parallel, growing wealth inequality has re-entered the public discourse, with particular interest raised by the projections in Piketty (2014), suggesting that we may even be looking at further increases in inequality over the coming century. From our perspective, however, there is significant variation in wealth inequality across countries and also how it has developed over the last decades. Thus, the data offers interesting variation across time and space for assessing the effectiveness of fiscal policy. Moreover, growing wealth inequality may have implications for the future effectiveness of this policy.

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In this paper we use modern, quantitative macroeconomic theory with heterogeneous consumers to ask whether differences in the distribution of wealth across countries can generate differences in their respective aggregate responses to fiscal policy. We focus on a classic fiscal-policy scenario: a one-period unexpected increase in government expenditures, financed by a one-period increase in lump-sum taxation (see, e.g., Baxter and King, 1993). Fiscal multipliers are naturally expected to depend on the fiscal instrument and we leave the response to alternative policies for future research.

We begin our analysis by some empirical documentation. In particular, we estimate relationship between the size of our fiscal multipliers and wealth inequality using SVARs, based on the data and methodology in Ilzetzki et al. (2013), to which we add measures of wealth inequality. Our estimates show that countries with relatively high inequality experience significantly larger responses to increases in government spending.

On a more detailed level, our theoretical framework is a life-cycle, overlapping-generations (OLG) economy with uninsurable labor market risk, i.e., a life-cycle extension of Aiyagari (1994). We calibrate the model to match data from a number of OECD countries along dimensions such as the distribution of income and wealth, taxes, social security, and the level of government debt. We then study the contributions from each of these country characteristics toward the correlation between fiscal multipliers and wealth inequality.

We find that the size of our fiscal multiplier is highly sensitive to the fraction of liquidity-constrained individuals in the economy and also depends importantly on the average wealth level in the economy. Agents who are liquidity-constrained have a higher marginal propensity to consume goods and leisure and respond more strongly to fiscal shocks. Larger labor-supply responses, in particular, lead to larger output responses. The marginal propensity to consume is also higher for relatively wealth-poor agents, since they have a precautionary savings motive. Finally, relatively wealth-poor economies have a higher interest rate and the net present value of an otherwise equally large fiscal shock today is larger when the interest rate is higher. We should therefore expect fiscal multipliers to be high in countries with high inequality, a low savings rate and/or a high debt.

In a multi-country exercise, where we calibrate 15 OECD countries to country-specific data, we obtain raw correlations between the fiscal multipliers generated by our model and the wealth Gini's and capital–output ratios that are 0.62 and -0.68, respectively. The regression coefficients when the fiscal multiplier is regressed on the Gini or on K/Y are, moreover, highly statistically significant. We find that an increase of one standard deviation in the wealth Gini coefficient for the countries in our sample raises the multiplier by about 17% of the average multiplier value.

Changing the steady-state progressivity of the tax system, a mechanism which has received some attention in the literature on automatic stabilizers, has a limited impact on the fiscal multiplier. One reason is that the reduction in the fraction of borrowing-constrained individuals then simultaneously delivers lower average asset holdings and a higher interest rate. The decrease in the multiplier stemming from a reduction in the number of constrained agents is then counteracted by the positive effect on the multiplier of lower average asset holdings and a higher interest rate. Lower wage inequality in the form of less heterogeneity in permanent-ability component of wages also has a limited impact on the multiplier. Idiosyncratic wage risk, on the other hand, is found to be of first-order importance.[1]

The remainder of the paper is structured as follows. We begin with a very brief discussion of some relevant literature in Section 2. In Section 3 we then document an empirical relationship between wealth inequality and fiscal multipliers. Section 4 contains a description of our quantitative OLG economy with heterogeneous agents and a definition of our competitive equilibrium. Section 5 then describes how we calibrate the model to a given country-specific data set. In Section 6 we take a baseline calibration and, by varying some key parameters that are expected to differ across countries, isolate the effects of these parameters—and hence of country characteristics—on the size of the fiscal multiplier. Section 7 presents the results from a multi-country analysis of fiscal multipliers where we simply calibrate the primitive parameters for 15 countries and compute all of their multipliers; this analysis thus allows a comparison between the artificial data for these countries and their actual data. We conclude in Section 8. The appendix discusses data and some properties of our tax function.

2. Some relevant literature

Fiscal multipliers measure the effectiveness of fiscal policy in stimulating economic activity. Empirical evidence suggests that government consumption and tax cuts have a positive impact on output.[2] However, as mentioned previously, research has progressed towards the notion that there is no such thing as *a* fiscal multiplier, but rather that the effect of a fiscal shock on output is dependent on country characteristics, the state of the economy, and the type of fiscal instrument considered. For example, Ilzetzki et al. (2013) argue that multipliers are (i) larger in developing countries than developed countries, (ii) larger under fixed exchange rates but negligible otherwise, and (iii) larger in closed economies than in open economies. The results in Auerbach and Gorodnichenko (2011) indicate that for a large sample of OECD countries the response of output is large in recessions, but insignificant during normal times. Anderson et al. (2013) find that in the context of the U.S. economy, individuals respond differently to unanticipated fiscal shocks depending on age, income level, and education. The behavior of the wealthiest agents, in particular, is consistent with Ricardian equivalence but poor households show evidence of non-Ricardian behavior.

[1] Unfortunately, we do not have the data to make idiosyncratic risk a part of our cross-country analysis.

[2] For a good survey of the various approaches for modeling and measuring the impacts of fiscal policy, see Caldara and Kamps (2008).

In terms of theoretical work, Heathcote (2005) studies the effects of changes in the timing of income taxes and finds that tax cuts can have large real effects and that the magnitude of the effect depends crucially on the degree of market incompleteness. McKay and Reis (2013) study the effects of automatic stabilizers on volatility. In line with our findings, they find that simply making taxes progressive has a limited effect on volatility. Tax-and-transfer programs aimed at reducing inequality and increasing social insurance can, however, greatly enhance the effectiveness of stabilizers.

Relatedly, Ferriere and Navarro (2014) find that for the U.S., expansionary fiscal shocks occurred only during times when they were financed by a temporary increase in the progressivity of the tax schedule, and they then go on to discuss what kinds of models can generate this fact.[3] Based on their model, they conclude that the distributional impacts of fiscal shocks are key in terms of aggregate dynamics. This is also in line with our finding that agents at the bottom of the wealth and income distributions respond more strongly to income shocks. A temporary increase in progressivity will lower the marginal tax rate for agents at the bottom of the income distribution and raise it for agents at the top. If agents at the bottom of the distribution change their behavior much more than do agents at the top, a progressivity shock will result in an increase in output and consumption.

Our work is also closely related to Carroll et al. (2013) who study the impact of the wealth distribution on the marginal propensity to consume. Carroll et al. (2013) also measure marginal propensities to consume for a large panel of European countries, and then calibrate a model for each country using net wealth and liquid wealth. The authors find the same type of relationship as we document for output multipliers below: the higher the proportion of financially constrained agents in an economy, the higher the consumption multiplier.

Kaplan and Violante (2014) propose a model with two types of assets that provides a rationale for relatively wealthy agents' choice of being credit constrained. In a context of portfolio optimization with one high-return illiquid asset and one low-return liquid asset, relatively wealthy individuals may end up credit constrained. Kaplan et al. (2014), using micro data from several countries, then argue that the percentage of financially constrained agents can be well above what is typically the outcome of models where very few agents have their wealth tied up in illiquid assets. Antunes and Ercolani (2015) introduce endogenous borrowing constraints and find that the dynamics of borrowing limits explain a significant share of aggregate dynamics. Finally, Krueger et al. (2015) conduct a case study of the recent U.S. recession in a business-cycle model with infinite horizon. They find that the presence of wealth-poor individuals is important for the response of macroeconomic aggregates to the business-cycle shock.

3. Stylized facts

In this section we document an empirical relationship between wealth inequality and fiscal multipliers in the data. The exercise we perform is similar to the one performed by Ilzetzki et al. (2013) to identify the impact of different factors on fiscal multipliers across countries and time. We use their data; see Appendix A.2. Our metric for wealth inequality is the Gini coefficient, which we take from Davies (2007). First we split the sample into two groups—countries with Gini coefficients above and below the sample mean—and run SVARs for the two groups separately. We find that the group of countries with above-average Ginis have a significantly higher (and thus, by assumption, common) fiscal multiplier. Next we repeat the exercise for individual countries and find a statistically significant positive relationship between a country's estimated fiscal multiplier and its Gini coefficient.

To measure the fiscal multiplier, generally defined as output's response to a change in a fiscal instrument, we follow the approach of Ilzetzki et al. (2013), who in turn adopt the method of Blanchard and Perotti (2002) and model the relationship between the variables as the system of equations in the following equation:

$$AY_{n,t}=\sum_{k=1}^{K}C_kY_{n,t-k}+u_{n,t}, \tag{1}$$

where $Y_{n,t}$ is a vector of endogenous variables in country n during quarter t: $Y_{n,t}=(g_{n,t},y_{n,t},CA_{n,t},dREER_{n,t})'$, where $g_{n,t}$ is the government consumption, $y_{n,t}$ the output, $CA_{n,t}$ the ratio of the current account to GDP, and $dREER_{n,t}$ the change in the natural logarithm of the real effective exchange rate. C_k is a matrix of lag specific own- and cross-effects of variables on their current observations. Eq. (1) cannot be estimated directly, so we pre-multiply the system by A^{-1} and use a panel OLS regression with fixed effects to obtain estimates of $P=A^{-1}C_k, k=1,\ldots,K$ and $e_{n,t}=A^{-1}u_{n,t}$ for both sub-samples. This delivers

$$Y_{n,t}=\sum_{k=1}^{K}A^{-1}C_kY_{n,t-k}+A^{-1}u_{n,t}. \tag{2}$$

In order to be able to compute the impact on output due to an exogenous change in government consumption $\Delta g_{n,t}$, we need to solve the system $e_{n,t}=A^{-1}u_{n,t}$ to identify the primitive innovations and infer a causal effect. To do so we need further assumptions on A.

[3] It should be noted that when we analyze the role of progressivity in our fiscal experiments we change the progressivity of the tax system in steady state. This is different from the temporary change in progressivity studied by Ferriere and Navarro (2014).

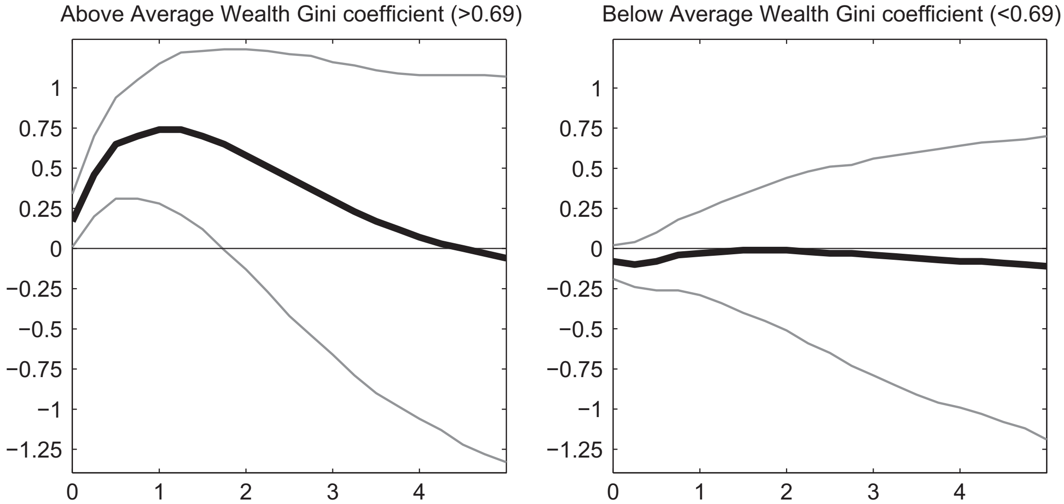

Fig. 1. Impulse responses of output to a 1% increase in government consumption (95% error bands in gray). *Note*: The figure shows that the average response of output to an increase in government spending is stronger for countries with higher inequality than for countries with lower inequality. The difference is statistically significant.

Table 1
OLS estimates for $FM_n = \alpha + \beta_1\ Gini_n + \beta_2\ output_n + \varepsilon_n$ (S.E.s in parenthesis).

α	β_1	β_2	R^2
−9.902	0.153		0.197
(3.993)	(0.057)		
−8.738	0.141	−0.018	0.205
(4.602)	(0.062)	(0.035)	

Note: This table reports the coefficients from regressing our country point estimates of the fiscal multiplier on the wealth Gini. The regression coefficient is highly statistically significant also when controlling for GDP per capita.

The assumption that Blanchard and Perotti (2002) use for identification of the causal effect of government consumption on output is that government consumption is predetermined at the beginning of the year by the annual budget and thus cannot react to changes in output within the same quarter. This assumption, together with further assumptions on the ordering of the remaining variables (the current account follows output and the exchange rate variable follows the current account), allows us to recover the primitive shocks to the system and compute impulse responses.

We find that, empirically, countries with high and low inequality have very different responses to shocks to government consumption conditional on the level of wealth inequality, as can be observed in Fig. 1. The group of economies characterized by high wealth inequality have a significant and positive response to an increase in government consumption up to almost two years after the shock, while the group of low inequality countries do not exhibit a significant change.

In the next exercise we estimate the same model as in Eq. (1) but for a single country at a time. We drop the countries for which there were not enough data points to estimate the system of equations from the sample. The Choleski factorization that Ilzetzki et al. (2013) use to identify the causal effect of government consumption on output implies that for government consumption to have its total effect on output in a year (directly and through the other variables in the system), it takes a total of four quarters. We look at the cumulative multipliers for each country after four periods and take that as country estimates of fiscal multipliers. The raw correlation between the estimated fiscal multipliers and the Gini coefficients is 0.412. We then proceed to estimate the following cross-country model, regressing the estimated fiscal multiplier in country n, FM_n, on the Gini coefficient in country n, $Gini_n$. In a separate regression, we also control for output per capita, $output_n$:

$$FM_n = \alpha + \beta_1\ Gini_n + \beta_2\ output_n + \varepsilon_n. \tag{3}$$

As can be seen in Table 1, the regression coefficient on the Gini index is positive and statistically significant.[4] This holds even when controlling for output per capita, which suggests that the degree of industrialization is not the driving factor behind the result.

[4] It should be emphasized that point estimates for the individual fiscal multipliers have very large variance, given the reduced number of observations that are used for many of the countries. It is therefore even more surprising that we find such a strong and robust correlation between these point estimates and the wealth GINIs.

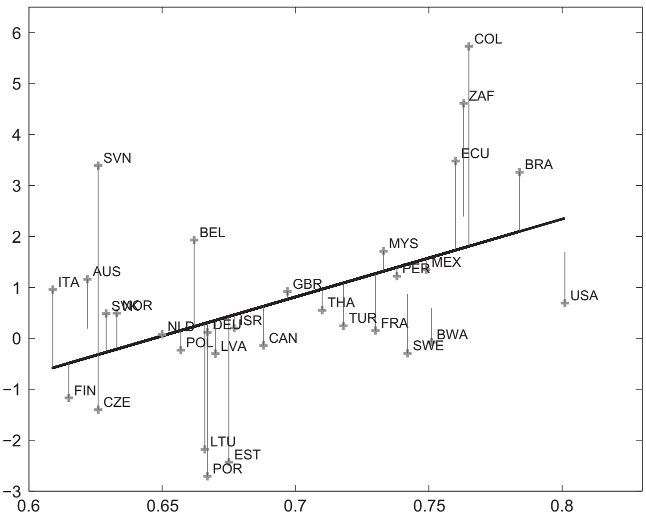

Fig. 2. Fiscal multipliers and wealth Ginis. *Note*: The vertical lines show parts of the 95% confidence intervals for each point; if a line reaches the regression line its end point covers this line. There is a positive and statistically significant correlation between fiscal multipliers and wealth Ginis.

Next we plot the point estimates for the fiscal multipliers against the respective country's fiscal multiplier.[5] The figure also shows regression line from the first model in Table 1.

As expected, given the relatively small number of observations available per country on average, the multipliers vary considerably and there is large uncertainty around point estimates. The vertical lines show parts of the 95% confidence intervals for each point; if a line reaches the regression line its end point covers this line. Estimates that are unrealistically high (low) are associated with higher variance and the confidence interval typically includes the predicted value from the regression line. Regardless, the regression in Table 1 shows that the Gini coefficients alone explain about 20%, as measured by R^2, of the variation in our point estimates for fiscal multipliers.

In light of our findings in Sections 6 and 7—that the percentage of constrained households is a primary driver of the differences between countries' multipliers—one may wonder if there is a strong correlation between the wealth held by the poorest households and the wealth Gini. Since we do not have data on wealth deciles for all the countries in our VARs, we use the sub-sample of countries for which we possess survey data. We find that for the countries in Table 10 the wealth held by the bottom decile is significantly and negatively correlated with the Gini coefficients ($\rho = -0.58$, p-val$=0.02$).

The above empirical findings motivate us to study the impact of wealth and income inequality on fiscal multipliers using a structural model. We build and analyze this model in the following sections.

4. Model

In this section we describe the model we will use to study the response to fiscal stimulus in different countries. Our model is a relatively standard life-cycle economy with heterogeneous agents and incomplete markets.

4.1. Technology

There is a representative firm which operates using a Cobb–Douglas production function:

$$Y_t(K_t, L_t) = K_t^{\alpha}[L_t]^{1-\alpha}, \tag{4}$$

where K_t is the capital input and L_t is the labor input measured in terms of efficiency units.

The evolution of capital is described by

$$K_{t+1} = (1-\delta)K_t + I_t, \tag{5}$$

where I_t is the gross investment and δ the capital depreciation rate. Each period, the firm hires labor and capital to maximize its profits

$$\Pi_t = Y_t - w_t L_t - (r_t + \delta)K_t. \tag{6}$$

[5] Given the large uncertainty around the point estimates we exclude extreme values (the minimum and maximum observations) from the regression in Table 1 and Fig. 2. If we instead run weighted (by the amplitude of the 95% confidence interval) least squares, we still find a positive correlation though only significant at the 10% level.

In a competitive equilibrium, the factor prices will be equal to their marginal products:

$$w_t = \partial Y_t / \partial L_t = (1-\alpha)\left(\frac{K_t}{L_t}\right)^{\alpha} \tag{7}$$

$$r_t = \partial Y_t / \partial K_t - \delta = \alpha\left(\frac{L_t}{K_t}\right)^{1-\alpha} - \delta. \tag{8}$$

4.2. Demographics

The economy is populated by J overlapping generations of finitely lived households. All households start life at age 20 and enter retirement at age 65. Let j denote the household's age. Retired households face an age-dependent probability of dying, $\pi(j)$, and die for certain at age 100.[6] A model period is 1 year, so there are a total of 40 model periods of active work life. We assume that the size of the population is fixed (there is no population growth). We normalize the size of each new cohort to 1. Using $\omega(j) = 1 - \pi(j)$ to denote the age-dependent survival probability, by the law of large numbers the mass of retired agents of age $j \geq 65$ still alive at any given period is equal to $\Omega_j = \prod_{q=65}^{q=J-1} \omega(q)$.

In addition to age differences, households are heterogeneous with respect to asset holdings, idiosyncratic productivity, and their subjective discount factor, which for each household is constant over time but takes one out of the three values $\beta \in \{\beta_1, \beta_2, \beta_3\}$; the distribution of discount factors is uniformly distributed across agents in each cohort. Finally, they also differ in terms of a permanent ability component, i.e., they have a starting level of productivity that is realized at birth. Every period of active work-life they decide how many hours to work, n, how much to consume, c, and how much to save, k. Retired households make no labor supply decisions but receive a social security payment, Ψ_t.

There are no annuity markets, so that a fraction of households leave unintended bequests which are redistributed in a lump-sum manner between the households that are currently alive. We use Γ to denote the per-household bequest.

4.3. Labor income

The wage of an individual depends on the wage per efficiency unit of labor, w, and the number of efficiency units the household is endowed with. The latter depends on the household's age, j, permanent ability, $a \sim N(0, \sigma_a^2)$, and an idiosyncratic productivity shock, u. The idiosyncratic shock follows an AR(1) process:

$$u' = \rho u + \epsilon, \quad \epsilon \sim N(0, \sigma_\epsilon^2). \tag{9}$$

Thus, the wage of an individual i is given by

$$w_i(j, a, u) = w e^{\gamma_1 j + \gamma_2 j^2 + \gamma_3 j^3 + a + u}. \tag{10}$$

The age profile of wages is thus captured by γ_{1_t}, γ_{2_t}, and γ_{3_t}.

4.4. Preferences

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

$$U(c, n) = \frac{c^{1-\sigma}}{1-\sigma} - \chi \frac{n^{1+\eta}}{1+\eta}. \tag{11}$$

4.5. Government

The government runs a balanced social security system where it taxes employees and the employer (the representative firm) at rates τ_{ss} and $\tilde{\tau}_{ss}$, respectively, and pays benefits, Ψ_t, to retirees. The government also taxes consumption and labor and capital income to finance the expenditures on pure public consumption goods, G_t, which enter separably in the utility function, interest payments on the national debt, rB_t, and a lump-sum redistribution, g_t. We assume that there is some outstanding government debt and that government debt-to-output ratio, $B_Y = B_t / Y_t$, does not change over time. Consumption and capital income are taxed at flat rates τ_c and τ_k, respectively. To model the non-linear labor income tax, we use the functional form proposed in Benabou (2002) and recently used in Heathcote et al. (2012) and Holter et al. (2015):

$$\tau(y) = 1 - \theta_0 y^{-\theta_1}, \tag{12}$$

where y denotes pre-tax (labor) income and $\tau(y)$ the average tax rate given a pre-tax income of y. The parameters θ_0 and θ_1

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

govern the level and the progressivity of the tax code, respectively.[7] Heathcote et al. (2012) argue that this function fits the U.S. data well.

In a steady state, the ratio of government revenues to output will remain constant. G_t, g_t, and Ψ_t must also remain proportional to output. Denoting the government's revenues from labor, capital, and consumption taxes by R_t and the government's revenues from social security taxes by R_t^{ss}, the government budget constraint in steady state takes the following form:

$$g\left(45+\sum_{j\geq 65}\Omega_j\right)=R-G-rB, \tag{13}$$

$$\Psi\left(\sum_{j\geq 65}\Omega_j\right)=R^{ss}. \tag{14}$$

4.6. Recursive formulation of the household's problem

At any given time a household is characterized by (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 productivity shock, and j is the age of the household. We can formulate the household's optimization problem over consumption, c, work hours, n, and future asset holdings, k', recursively as follows:

$$\begin{aligned}
&V(k,\beta,\ a,u,j)=\max_{c,k',n}\left[U(c,n)+\beta\omega(j)E_{u'}\left[V(k',\beta,a,u,j+1)\right]\right]\\
&\quad\text{s.t.}\\
&\quad c(1+\tau_c)+k'=\begin{cases}(k+\Gamma)(1+r(1-\tau_k))+g+Y^L & \text{if } j<65\\ (k+\Gamma)(1+r(1-\tau_k))+g+\Psi & \text{if } j\geq 65\end{cases}\\
&\quad Y^L=\frac{nw(j,a,u)}{1+\tilde{\tau}_{ss}}\left(1-\tau_{ss}-\tau_l\left(\frac{nw(j,a,u)}{1+\tilde{\tau}_{ss}}\right)\right)\\
&\quad n\in[0,1],\quad k'\geq -b,\quad c>0,\quad n=0 \text{ if } j\geq 65.
\end{aligned} \tag{15}$$

Here, Y^L is the household's labor income after social security taxes and labor income taxes. τ_{ss} and $\tilde{\tau}_{ss}$ are the social-security contributions paid by the employee and by the employer, respectively.

4.7. Stationary recursive competitive equilibrium

Let $\Phi(k,\beta,a,u,j)$ be the measure of households with the characteristics (k,β,a,u,j). We now define a stationary recursive competitive equilibrium as follows:

Definition.

1. The value function $V(k,\beta,a,u,j)$ and policy functions, $c(k,\beta,a,u,j)$, $k'(k,\beta,a,u,j)$, and $n(k,\beta,a,u,j)$, solve the consumers' optimization problem as stated above.
2. There is full use of resources:

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

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

$$\int c\,d\Phi+\delta K+G=K^{\alpha}L^{1-\alpha}.$$

3. The factor prices satisfy

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

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

[7] A further discussion of the properties of this tax function is provided in the appendix.

4. The government budget is balanced:

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

5. The social security system is balanced:

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

6. The assets of the just deceased are uniformly distributed:

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

4.8. Fiscal experiment and transition

The fiscal experiment that we analyze in the next section is a one-time increase in (wasteful) government consumption ΔG, financed by non-distortionary taxation Δg. This is the classical experiment which most of the literature on fiscal multipliers relates to. We carry out the experiment as an "M.I.T. shock", i.e., as an unexpected, never-again-to-occur departure from an initial steady state. The equilibrium definition follows straightforwardly as an extension of the definition of a steady state, but of course with some important changes. The exogenous drivers are the one-time change to government consumption, G, described above.[8] Government debt is assumed to be unchanged and constant, so g adjusts to balance the government budget. As a result of the transition, a number of variables will be changing over time. We assume that the tax rates $(\tau_l,\tau_c,\tau_k,\tau_{ss},\tilde{\tau}_{ss})$ are constant throughout, which implies that, for the social security system to balance, Ψ must vary over time. Wages and rental rates will of course also vary over time as a result of changes in savings and labor supply. The inheritance transfer Γ will also have to vary over time, as will, of course, the distribution function Φ.

For the sake of brevity, the equilibrium definition will not be stated here but the key change is that the dynamic-programming problem of households needs another state variable: time, t, capturing all the changes in policy and price variables relevant in this maximization problem. The numerical solution of the model necessitates guessing on paths for all the variables that will depend on time and then solving this maximization problem backward, after which the guess is updated; the method is similar to that used in Krusell and Smith (1999).

5. Calibration

We calibrate our benchmark model to the U.S. economy. The calibration of parameters for other countries is conducted in a similar fashion and is described in the Appendix. However, some parameters are held constant across countries: two preference parameters (σ and η), two technology parameters (δ and α), and two parameters of the wage process (ρ and σ_ϵ). Their values are listed in Table 13.

As for the method of calibration, a number of parameters are set directly (i.e., without solving the full model) to match their empirical counterparts whereas we choose other parameters so that the model implications are in line with data. For this, we use the simulated method of moments (SMM).

5.1. Wages

To estimate the life cycle profile of wages (see Eq. (10)), we use data from the Luxembourg Income and Wealth Study and run the below regression for each country:

$$\ln(w_i)=\ln(w)+\gamma_1 j+\gamma_2 j^2+\gamma_3 j^3+\varepsilon_i, \tag{16}$$

where j is the age of individual i. Because we lack panel data for most of our countries we use the PSID to back out the variables governing the idiosyncratic wage shocks and assume that the shocks to wages are the same across countries.[9] We run the wage regression in (16) and obtain residuals, ε_{it}, which we use to estimate ρ and σ_ϵ. Finally, the variance of permanent ability, σ_a, is among the parameters we calibrate by solving the model and then matching the model output to data. The corresponding data moment is the variance of $\ln(w_i)$.

[8] We make the assumption that G changes discretely for one period and then returns to the same relation to GDP as in steady state. This implies that there is an externality via the government budget, as the government maintains its G in constant proportion to output (which of course is endogenous), after the first period.

[9] Keane and Wolpin (1997) find that most of the variation in wages is due to events before an individual enters the labor market. If this is true across economies, most of the cross-country differences in income inequality will be captured by the variance of permanent ability, σ_a.

Table 2
Calibration fit.

Data moment	Description	Source	Data value	Model value
K/Y	Capital–output ratio	PWT	3.074	3.075
Var($\ln w$)	Variance of log wages	LIS	0.509	0.509
$\overline{n}$	Fraction of hours worked	OECD	0.248	0.248
Q_{25}, Q_{50}, Q_{75}	Wealth quartiles	LWS	−0.014, −0.004, 0.120	−0.011, −0.002, 0.122

Note: The table displays the value of the targeted calibration targets for the U.S. benchmark economy in the model and in the data.

Table 3
Parameters calibrated using SMM.

Parameter	Value	Description
Preferences		
$\beta_1, \beta_2, \beta_3$	0.953, 1.002, 0.961	Discount factors
χ	13.3	Disutility of work
Technology		
b	0.142	Borrowing limit
σ_a	0.667	Variance of ability

Note: The table displays the values of the parameters calibrated by SMM for the U.S. benchmark economy.

5.2. Preferences

We set σ to 1.2. There is considerable debate about the Frisch elasticity of labor supply, η, in the literature. We set it to 1, which is similar to that used in a number of recent studies; see, e.g., Trabandt and Uhlig (2011) and Guner et al. (2014). The parameter χ, governing the disutility of working an additional hour, and the discount factors, β_1, β_2, β_3, are calibrated so that the model output matches the data: the corresponding data moments are average yearly hours, taken from the OECD Economic Outlook, and the ratio of capital to output, K/Y, taken from the Penn World Table 8.0.

5.3. Taxes and social security

As described in Appendix A.1 we apply the labor income tax function in Eq. (12), proposed by Benabou (2002). We use U. S. labor income tax data provided by the OECD to estimate the parameters θ_0 and θ_1 for different family types. To obtain a tax function for the single individual households in our model, we take a weighted average of θ_0 and θ_1, where the weights are each family type's share of the population.[10] Table 11 in the Appendix summarizes our findings for different countries.

We assume that the social-security contributions for the employee, τ_{SS}, and the employer, $\tilde{\tau}_{SS}$, are flat taxes. We use the rate from the bracket covering most incomes, 7.65%, for both τ_{SS} and $\tilde{\tau}_{SS}$. We follow Trabandt and Uhlig (2011) and set $\tau_k = 36\%$ and $\tau_c = 5\%$.

5.4. Parameters calibrated using SMM

We use simulated method of moments to calibrate the parameters which do not have any direct empirical counterparts. We choose β_1, β_2, β_3, b, χ and σ_a in order to minimize the loss function below:

$$L(\beta_1, \beta_2, \beta_3, b, \chi, \sigma_a) = \| M_m - M_d \|, \tag{17}$$

with M_m and M_d referring to moments in the model and moments in the data, respectively. We have six instruments and, in order to have an exactly identified system, we target six moments in the data: the three wealth quartiles, the variance of log wages, average fraction of hours worked and the capital output ratio. Table 3 summarizes the calibrated parameters and Table 2 displays the moments and their value in the data and the model. We fit all the targeted data moments with less than 2% error margin.

6. Inspecting the mechanisms

In our model environment, output is supply-determined and most of the short-run effects come from the response of labor supply to the fiscal shock. The rise in government consumption and the corresponding increase in lump-sum taxation

[10] We use U.S. family weights for all countries as we lack detailed demographic data for most countries.

will lead to an increase in labor supply. The increase is particularly strong for credit-constrained agents, and the larger the fraction of such agents in the economy, the stronger the labor-supply response and the impact on output will be.

In terms of consumption and welfare, the increase in lump-sum taxation makes low-income agents more at risk of hitting the constraint after a negative income shock and induces a rise in precautionary savings and a reduction in consumption. The welfare consequences are negative. In our U.S. benchmark economy, the average consumer in a steady state would be willing to pay 0.11% of benchmark GDP every year to avoid the 1-period unexpected increase in lump-sum taxation by an amount equal to 2% of benchmark GDP, which we simulate in our fiscal experiment. The decrease in welfare is larger for wealth-poor individuals. Looking at the welfare of 40-year-old individuals by wealth quartile, quartiles 1, 2, 3 and 4 would be willing to pay 0.27%, 0.03%, 0.07%, and 0.045%, respectively, of benchmark GDP every period of their life to avoid the fiscal shock. The reason for the non-monotonic relationship among the wealthiest quartiles is the mix of individuals with respect to discount factor, permanent ability and the idiosyncratic productivity shock. It is, however, clear that the poorest individuals are willing to pay the most to avoid the shock.

As discussed above, the finding of an empirical relationship between fiscal multipliers and wealth heterogeneity need not imply causation. Countries with low wealth inequality are also characterized by a number of other features such as higher and more progressive taxes, more generous social security systems, and lower returns to labor market experience. These features may all contribute to dampening the fiscal multiplier.

We begin this section by presenting the results of our first fiscal experiment for the U.S. and Italy, two countries that are at opposite ends of our wealth Gini ranking—0.796 in the U.S. and 0.59 in Italy—but also have very different fiscal policies and institutions. Indeed we find, as our theory suggests, that the fiscal multiplier is much larger in the United States. The rest of the section is devoted to studying the effects of the wealth level, binding borrowing constraints, the tax level, tax progressivity, and the age profile of wages. The latter three factors also affect wealth accumulation, so it is not possible to completely isolate the effect of each factor. Nonetheless, our results indicate that the level and distribution of capital are the most promising drivers of fiscal multipliers across countries.

Wealthy economies with little inequality will have fewer credit-constrained individuals and fewer individuals with strong precautionary-savings motives. This lowers the average marginal propensity to consume, reduces the elasticity of labor supply, and reduces the fiscal multiplier. Wealthy economies also have a lower real interest rate (if capital markets are imperfect), which reduces the relative value of a fiscal shock today in the agents' life-time budget constraint and leads to a lower multiplier. An isolated change to a country's steady-state tax policy does not have a large impact on fiscal multipliers. This suggests that other more fundamental factors affecting the wealth distribution, such as technology or impatience, are driving the size of the fiscal multiplier, through their impact on the fraction of the population which is credit-constrained, on precautionary saving, and on the real interest rate.

6.1. *Example: fiscal multipliers in the U.S. and Italy*

We calibrate our model to match key characteristics of the U.S. (the benchmark) and Italian economies, as described in Section 5. We then perform the classical fiscal experiment in the literature: an increase in wasteful government consumption, ΔG_1, financed by a reduction in government transfers, Δg_1. As can be seen from Fig. 3, the response of the macroeconomic aggregates is much larger in the case of the model calibrated to the U.S. economy. In terms of the impact output fiscal multiplier, the difference is 0.119 vs. 0.059, an increase of about 100%. Although our multipliers are somewhat small in absolute size if compared to results from the empirical literature, the relative size difference is large and in line with stylized facts from the real business cycle literature.

Of course, Italy and the U.S. differ along many dimensions that can make multipliers different. In our model representations of the two economies, they have different life cycle profiles of wages, levels and progressivities of taxation,

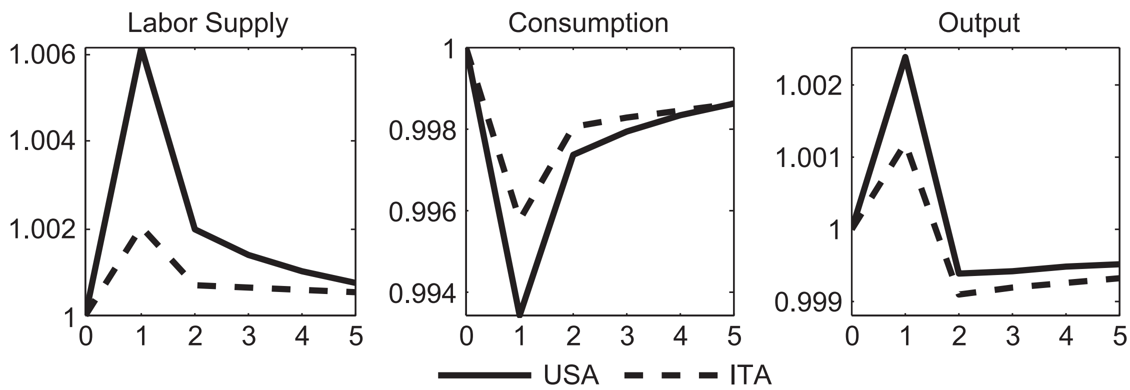

Fig. 3. The Impact of a $\Delta G_1 = 2\%$ increase in government consumption financed by Δg_1. *Note*: The figure displays the response of labor supply, consumption, and output to a 2% increase in government spending for Italy and the U.S. The economy with higher inequality, i.e., the U.S., responds more to the fiscal shock.

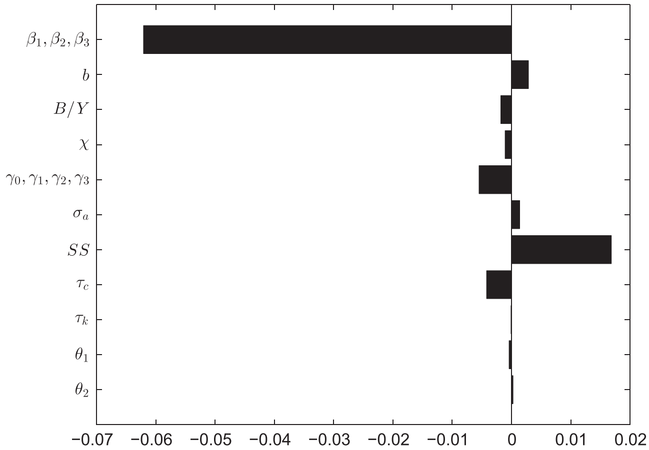

Fig. 4. Decomposing the difference in fiscal multipliers between the U.S. and Italy. *Note*: The vertical line at zero represents the benchmark model, i.e., the model calibrated to the U.S. economy. The horizontal bars display the change in the multiplier obtained when replacing the parameters of the benchmark model with their counterparts, calibrated to the Italian economy. The impact of the parameters governing the wealth distribution quantitatively dominates the impact of other parameters.

Table 4
The effect of a wealthier population.

k_0—*Initial capital*	−0.14	0.00	1.00	2.00	3.00
Impact multiplier	**0.124**	**0.119**	**0.107**	**0.101**	**0.097**
% Borrowing constrained	16.24	13.03	11.67	11.42	11.40
K/Y	3.06	3.07	3.18	3.29	3.41
r (%)	4.78	4.73	4.38	4.03	3.69

Note: The table shows how the impact multiplier, the fraction of liquidity-constrained agents, the K/Y ratio, and the interest rate vary when we change the starting level of assets of the agents in our economy. The fiscal multiplier is decreasing in the initial asset level.

average hours worked, debt-to-GDP ratios, to mention some. Fig. 4 provides a breakdown of the drivers of the difference in the fiscal multipliers between the U.S. and Italy. Thus, in the table we change the parameters that differ in the calibration of the two countries one by one. As the figure shows, the main drivers of the difference are the time discount factors. One may ask whether it is impatience itself, and not wealth, that drives the difference in multipliers. We show below that if we only make people wealthier or change other factors affecting savings and the fraction of borrowing-constrained individuals, in particular idiosyncratic risk, and keep the discount factors constant, we still see significant changes in the multipliers.

6.2. The impact of capital

To isolate the impact of wealth and keeping all other parameters constant, we change the starting asset level, k_0, of agents in our economy (in the benchmark economy all agents start with 0 assets). Table 4 displays the results from this experiment. When agents become wealthier, the fiscal multiplier falls. There are, however, three different channels through which increased wealth may affect the fiscal multiplier. First, the fraction of liquidity-constrained individuals, who have the highest marginal propensity to consume, falls. Second, the precautionary-savings motive of relatively poor non-constrained individuals falls. Third, the real interest rate falls, reducing the value of a fiscal shock today. Below we try to study each of these effects in isolation.

6.3. The impact of liquidity constraints

We now investigate in greater detail the relationship between the percentage of agents constrained in the economy and the size of the government consumption multiplier. During the experiment we keep the K/Y ratio constant.

We start with our benchmark economy, the model calibrated to the U.S., matching the wealth distribution we observe in the data. We then hold the borrowing constraint constant and multiply β_1 and β_2 by a constant ξ. We no longer aim at matching the U.S. wealth distribution but instead make the fraction of the population which is liquidity-constrained, λ, a calibration target. We change ξ, β_3, χ, and σ_α to maintain our targets on the fraction of hours worked, the capital–output ratio, and the variance of log wages in addition to λ. In Fig. 5, we plot the fiscal multiplier as a function of the percent of borrowing-constrained individuals, λ.

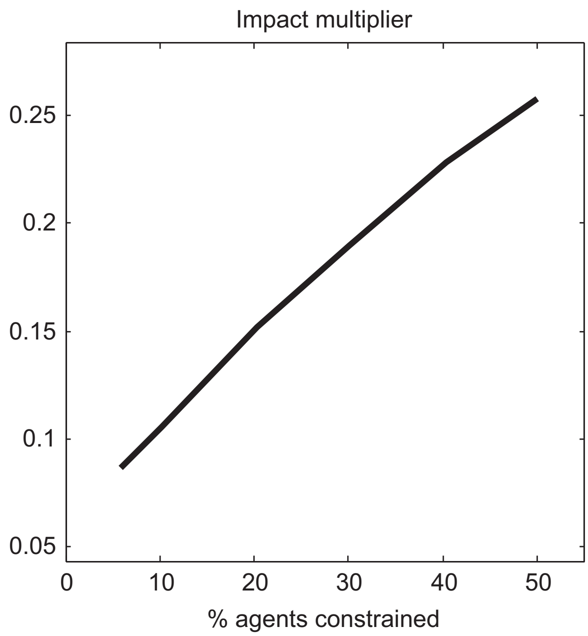

Fig. 5. Impact multipliers and the fraction of liquidity-constrained agents. *Note*: The graph displays the fiscal multipliers for alternative calibrations of the benchmark model, with different fractions of liquidity-constrained individuals. All calibration targets, with the exception of the wealth distribution are still met in these calibrations. As can be seen, there is a strong relationship between the proportion of credit constrained agents and the multiplier.

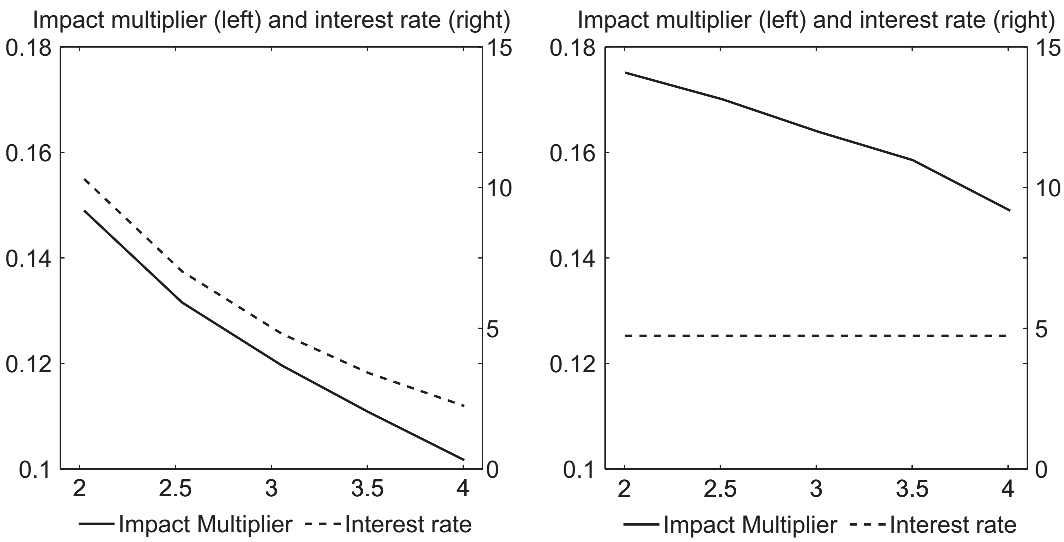

Fig. 6. The Impact of K/Y on the fiscal multiplier for varying and fixed interest rates. *Note*: The graph displays the fiscal multipliers for alternative calibrations of the benchmark model, with different K/Y ratios. The proportion of credit-constrained agents is kept constant at the benchmark level while all calibration targets, with the exception of the wealth distribution, are still met. In the left panel, the interest rate is allowed to vary as K/Y varies, whereas in the right panel it is kept constant at the benchmark level (partial equilibrium). In both cases there is a negative relationship between the capital–output ratio and the fiscal multiplier. The fiscal multiplier does, however, decrease more sharply in K/Y when the interest rate is allowed to vary.

In the context of our calibrated model, the magnitude of the impact multiplier is very sensitive to the proportion of agents constrained. For instance, the benchmark multiplier is 0.11 when 10% of agents are constrained. When 50% are constrained, the multiplier increases to 0.29.

6.4. The impact of wealth level (K/Y) in general and partial equilibrium

To study the impact of the average level of wealth, we conduct an experiment where we keep the fraction of liquidity-constrained individuals in the economy constant at its benchmark level (13.6%) but alter the K/Y ratio. We do this by multiplying the discount factors by a constant and adjusting the borrowing limit. Fig. 6 displays the results.

Table 5
The impact of wage heterogeneity on the impact multiplier and the % of liquidity-constrained agents.

Impact multiplier	% Liquidity constrained	K/Y	$\sigma_u > 0$	$\sigma_a > 0$	Wages Increasing in Age
0.119	13.04	3.08	X	X	X
0.223	39.56	3.01		X	X
0.121	10.25	3.07	X		X
0.107	12.92	3.29	X	X	

Note: The table shows how the impact multiplier, the fraction of liquidity-constrained agents, and the K/Y ratio changes as we shut down different sources of wage heterogeneity.

Table 6
The impact of the tax level on the impact multiplier and the % of liquidity-constrained agents.

$\overline{\tau}(y)$—*Tax level*	0.214	0.180	0.144	0.110	0.075
Impact multiplier	**0.121**	**0.120**	**0.119**	**0.118**	**0.117**
% Liquidity constrained	13.95	13.51	13.06	12.69	12.29
K/Y	3.004	3.039	3.075	3.111	3.148

Note: The table shows how the impact multiplier, the fraction of liquidity-constrained agents, and the K/Y ratio changes when we vary the average tax rate. The impact multiplier is increasing in the average tax rate.

As can be seen from the figure, a higher K/Y ratio is associated with a lower fiscal multiplier—holding the fraction of borrowing-constrained agents constant. This holds both in partial equilibrium, when we keep the interest rate fixed at 4.9%, and in general equilibrium. The precautionary-savings motive is a natural explanation for why wealth matters. The impact of changing K/Y is, however, significantly larger in general equilibrium, indicating that the interest rate itself may play a role. The life-time value of a transfer, g, is larger when the interest rate is higher.

6.5. The impact of wage heterogeneity

To study the impact of the wage distribution on the impact multiplier we shut down the three different types of wage heterogeneity that we have in the model: age profiles, permanent ability types, and idiosyncratic shocks, one by one. When we shut down the different types of heterogeneity, we also adjust γ_0 by a constant to keep average productivity unchanged. Table 5 displays the results from this exercise.

The one type of wage heterogeneity which seems to have a potentially large effect on the multiplier and on the fraction of liquidity-constrained individuals is that coming from idiosyncratic productivity shocks.[11] Shutting down the shocks eliminates any precautionary-savings motive and many individuals with $\beta(1+r)<1$ will want a downward-sloping consumption profile and borrow until they hit the borrowing limit. In the economy without idiosyncratic shocks 39.6% of agents are liquidity-constrained and the impact multiplier is 0.223 or about 87% greater than in the benchmark economy.

Shutting down the variance in permanent abilities greatly reduces wage inequality in our economy. However, the effect on the fraction of liquidity-constrained agents is relatively modest; it falls from 13.0% to 10.3%. The impact multiplier actually rises slightly. One reason for this is that we observe a small fall in savings and the impact multiplier tends to be decreasing in K/Y. However, more importantly, when we reduce inequality with a progressive tax system, the average tax rate falls and the steady-state lump-sum distribution, g, falls.[12] The relative increase in the lump-sum payment is therefore larger when wage inequality is smaller. This leads to a greater multiplier.

Shutting down the age profile of wages has little effect on the number credit-constrained households. However there is a drop in the multiplier because average savings increase and the real interest rate falls.

6.6. The impact of labor income taxation

Our functional form for the labor income tax schedule allows us to easily change the level of taxes without changing tax progressivity and to change tax progressivity while keeping the level of taxes constant. Our measure of progressivity is the "progressivity wedge", PW, below ($\tau(y)$ is the average tax rate):

$$PW(y_1, y_2) = 1 - \frac{1-\tau(y_2)}{1-\tau(y_1)}. \tag{18}$$

[11] Unfortunately we do not have cross-country data on idiosyncratic wage shocks and therefore cannot evaluate the importance of this channel for international variation in fiscal multipliers.

[12] With progressive taxes, taxes paid is a convex function of income and, by Jensen's inequality, the average tax rate falls when we reduce inequality.

Table 7
The impact of tax progressivity on the impact multiplier and the % of liquidity-constrained agents.

θ_2—*Tax progressivity*	0	0.069	0.137	0.206	0.274	0.343	0.411
Impact multiplier	**0.1210**	**0.1197**	**0.1191**	**0.1194**	**0.1201**	**0.1208**	**0.1227**
% Liquidity constrained	13.75	13.45	13.04	12.74	12.39	12.03	11.63
K/*Y*	3.13	3.10	3.08	3.05	3.03	3.01	2.99

Note: The table shows how the impact multiplier, the fraction of liquidity-constrained agents, and the *K*/*Y* ratio changes when we vary the degree of tax progressivity while keeping the tax rate constant.

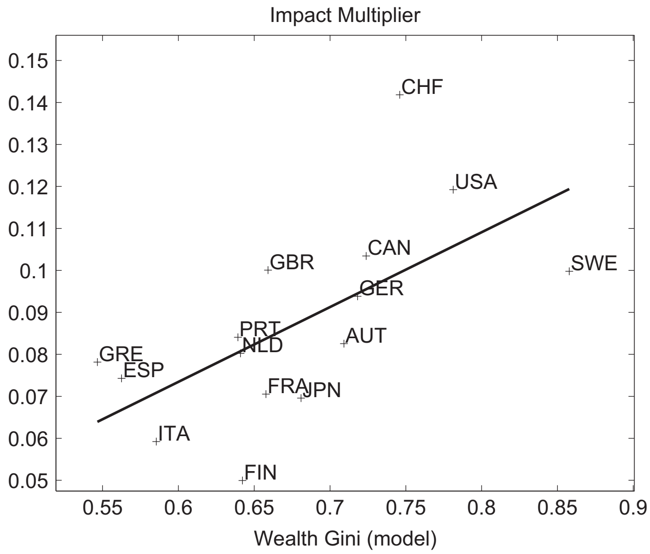

Fig. 7. Impact multipliers and Gini coefficients (model). *Note*: The figure shows that after we calibrate our model to cross-country data, we obtain a strong positive correlation between the impact multiplier and the wealth Gini.

This measure always takes a value between 0 and 1 and increases with the increase in the average tax rate, τ, as earnings increase from y_1 to y_2. If there is a flat tax, then the progressivity wedge would be zero for all levels of y_1 and y_2. Analogous progressivity measures are used by Caucutt et al. (2003), Guvenen et al. (2014), and Holter (2015) among others. With our tax function, $PW(y_1, y_2)$ is uniquely determined by the parameter θ_1; see Appendix A.1.

We begin by examining the effect of the average tax level on the impact multiplier, see Table 6. As we increase the average tax rate from 7.5% to 21.1%, the impact multiplier increases from 0.117 to 0.121. As the tax level goes up, the economy becomes poorer, the capital-to-output ratio, *K*/*Y*, falls, the real interest rate increases, and the wage rate falls. Even if the lump-sum redistribution from the government increases, more people are borrowing-constrained. The overall effect on the impact multiplier is, however, relatively modest for a large tax change and it seems unlikely that labor-income tax levels are a key driver of the cross-country variation in fiscal multipliers.

In Table 7 we keep the average tax rate at its benchmark value but vary the parameter governing tax progressivity, θ_1. As can be seen from the table, a more progressive tax system reduces the number of credit-constrained individuals in the economy. The effect on the impact multiplier is, however, close to 0. More progressive taxes also reduce the average level of wealth and the interest rate increases. This effect counteracts the effect of fewer credit-constrained individuals.

7. Fiscal multipliers across countries

In Section 3 we documented a cross-country correlation between wealth inequality and fiscal multipliers in the data, and in the previous section we showed that differences in the distribution of wealth could produce different fiscal multipliers in our model. In this section we use the model to conduct a cross-country analysis of the relationship between the distribution of wealth and fiscal multipliers. We calibrated the model to data from 15 OECD countries (naturally selected by data availability). We calibrate the model to match the country-specific distribution of wealth as well as to a number of other characteristics such as earnings inequality, taxes, and work hours. Tables 10 and 11 in the Appendix summarize the country-specific data as well as the country specific parameters that we calibrate outside of the model. Table 12 summarizes the country-specific parameters that we estimate by using simulated method of moments. Some parameters, such as the

Table 8
OLS estimates for $IM_n = \alpha + \beta_1\ Gini_n + \varepsilon_n$ (S.E.s in parenthesis).

α	β_1
−0.034 (0.024)	0.178 (0.048)

Note: The table displays the coefficients from regressing the fiscal multipliers from our model calibrated to cross-country data on the wealth Gini and a constant. The coefficient on the Gini is highly statistically significant.

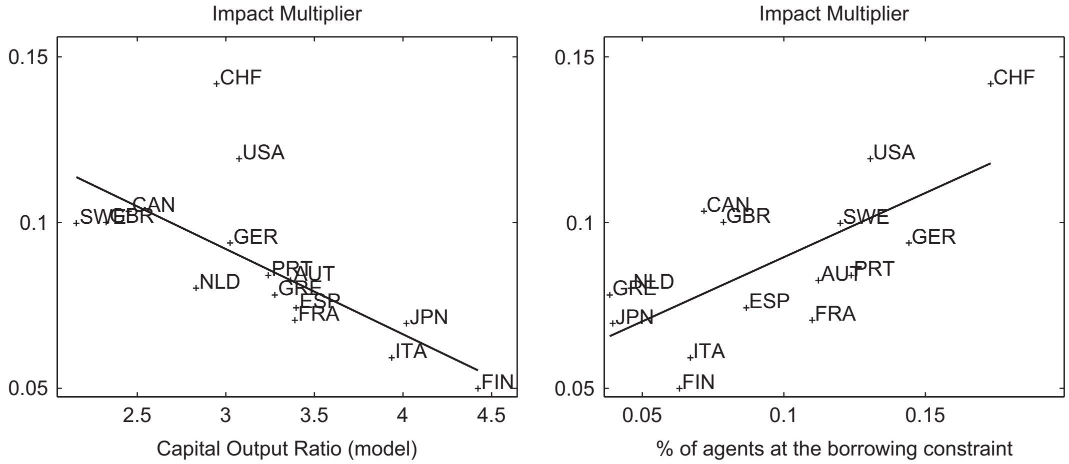

Fig. 8. The Impact of K/Y and the % of constrained agents on the multiplier. *Note*: The left panel shows the correlation between the K/Y ratio and the fiscal multiplier when we calibrate our model to cross-country data. The right panel shows the correlation between the fraction of credit-constrained agents and the fiscal multiplier.

preference parameters governing risk aversion and the elasticity of labor supply, are, however, kept constant for all countries. Table 13 summarizes these parameters. Among the calibration targets, the wealth distribution is of particular interest. We are able to match the wealth data almost perfectly, as the correlation between the Gini coefficients generated by our model and the ones that come from the data is 0.995; see Fig. 9.

In Fig. 7, we plot the simulated fiscal multipliers from our economies, calibrated to cross-country data, on the y-axis against the country wealth Gini on the x-axis. As can be seen from the figure, the variation in country-specific calibration targets generates substantial variation in the fiscal multipliers. The multipliers range from 0.05 for Finland to 0.142 for Switzerland. However, what Fig. 7 also shows is that these differences in multipliers are highly correlated with the measure of wealth heterogeneity used in our replication of Ilzetzki et al. (2013), namely, the Gini coefficient ($\rho = 0.623$, p-val$=0.012$).

Next, we perform a simple linear regression of the impact multipliers on the Gini coefficients. Our estimates suggest that a one standard deviation increase in the Gini coefficient (0.083) would lead to an increase of 0.015 in the size of the multiplier, which corresponds to about 17% of the average multiplier (0.0871) value we find (Table 8).

To check if the results we found in the previous section—regarding the effect of the capital–output ratio and the proportion of agents at the borrowing constraint on the fiscal multiplier—are also reproduced for our sample of countries, we look at the cross-country correlations. The results are shown in Fig. 8. Across our calibrated economies, we can observe a strong correlation between the impact multiplier and capital–output ratio ($\rho = -0.684$, p-val$=0.005$) and the proportion of agents at the borrowing constraint ($\rho = 0.667$, p-val$=0.006$).

These results are in line with our previous analysis in Section 6, where we establish that the capital–output ratio and the proportion of agents at the borrowing constraint are two statistics that have a strong impact on fiscal multipliers through their impact on the marginal propensity to consume (both statistics) and on the real interest rate (K/Y).

8. Conclusion

In this paper we develop a neoclassical macro model with heterogeneous agents, which we calibrate to country-specific data. We show that in the model the size of fiscal multipliers is sharply increasing in the fraction of credit-constrained agents and also decreasing in the capital-to-output ratio, K/Y. These findings are consistent with a positive correlation between wealth inequality and fiscal multipliers, which we document both in the data and in a multi-country analysis within our model.

So far our results focus only on studying the responses of macroeconomic aggregates in the context of a shock to government consumption financed by non-distortionary taxation. However, fiscal multipliers will in general differ for different fiscal instruments. In future research it would be interesting to explore the interplay of wealth inequality and fiscal policy in the context of other fiscal shocks, for instance increases in government transfers financed by domestic or foreign borrowing or a fiscal consolidation process. These fiscal instruments have been the subject of analysis in recent work by Oh and Reis (2012) and Erceg and Lindé (2013).

The question of how the fiscal policy transmission mechanism works is still open and debated, and we do not claim that this paper has the answer. In a new-keynesian framework, the increase in aggregate demand would usually also lead to a decrease in markups and increase in productivity, resulting in a stronger response of output. Extending our analysis in that direction would no doubt be useful.

In general, the effect of government spending will depend crucially on the size of the wealth effects that we document relative to other demand side effects. As an example, labor supply increases more in response to fiscal shocks in countries with more constrained agents in our setting. However, if government spending leads to an increase (rather than a decrease) in household disposable income the relationship would be reversed: countries with a higher share of financially constrained agents would observe a comparably smaller labor (and consequently output) response to the fiscal shock and the relationship between wealth inequality and fiscal multipliers would, *ceteris paribus*, also be reversed. Nonetheless, our SVAR exercise shows that wealth inequality is associated with higher, rather than lower, fiscal multipliers.

Finally, the multipliers we produce, though in line with standard findings in neoclassical models, are small in comparison to results from empirical exercises. As mentioned before, neoclassical DSGE models struggle to produce multipliers of the size found in empirical exercises. It is not our aim to reconcile these two literatures but rather to focus on the relative size of fiscal responses between countries. Our findings do suggest that wealth inequality is an important dimension to take into account for fiscal policy makers as we document a 17% increase in the average output response to a fiscal shock for a one standard deviation increase in the wealth Gini coefficient for the countries in our sample.

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Appendix A. Supplementary data

Supplementary data associated with this paper can be found in the online version at http://dx.doi.org/10.1016/j.jmoneco.2015.09.005.

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