Redistributive Fiscal Policies and Business Cycles in Emerging Economies*

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Abstract

Government expenditures are pro-cyclical in emerging markets and counter-cyclical in developed economies. We show this pattern is most pronounced in social transfers which are also a large component of total government expenditures (28-39%). The discrepancy in the cyclicality of spending on goods and services is smaller, by contrast, and the category accounts for just 11-16% of total government expenditures. In a small open economy model, we find disparate social transfer policies can account for about half of the larger cyclical volatility of consumption relative to output in emerging economies compared to developed. We analyze how differences in tax policy and the nature of underlying inequality amplify or mitigate this result.

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1 Introduction

It has been established that total government expenditures tend to be procyclical in emerging economies and either acyclical or countercyclical in developed economies.[1] In this paper, we document that this contrast is particularly stark in a single, large component of government expenditure— social transfers. We then evaluate the implication of our finding by embedding a simple theory of social transfers in a workhorse open economy business cycle model. We show disparate social transfer policies play a significant quantitative role in generating the business cycle anomalies of emerging small open economies, particularly the excess volatility of consumption.[2] The point we make is as follows. There is a very large, *observable* difference in the size and cyclical behavior of social benefits between developed and emerging economies. Once we account for this difference, a typical emerging economy (with the same stochastic processes for productivity and interest rates as before) may no longer exhibit the puzzling behavior documented in previous studies[3].

The first half of our paper presents results from our exploration of the cyclical characteristics of disaggregated fiscal data in a set of small open economies.[4] We provide evidence that social transfers are a significant contributor to the variation of government expenditure over the business cycle. They account for an average of 36% of the cyclical component of expenditures within the countries in our sample. In comparison, this figure is 19% and 31%, respectively, for each goods and service expenditures and expenditures on employment. The cyclicality of social transfers follows a clear pattern across income groups. They are procyclical in emerging economies and countercyclical in developed economies (correlation with GDP is 0.19 and -0.35, respectively). Furthermore, social transfers are the largest overall expenditure category accounting for 47% of the variance in average total government spending as a share of GDP across our sample. Again, spending levels differ systematically across

[1] An incomplete list of papers establishing this fact include: Kaminsky et al. (2005), Ilzetzki and Végh (2008), and Gavin and Perotti (1997). We replicate a comparable result in our study.

[2] Key works in this field include: Mendoza (1995), Neumeyer and Perri (2005), Uribe and Yue (2006), and Aguiar and Gopinath (2007).

[3] In Michaud and Rothert (2016) we provide estimates for a panel of countries showing how much the role of unobservable shocks is reduced once the package of observable fiscal policy is accounted for.

[4] We focus our analysis on components of government expenditure. Vegh and Vuletin (2015) provide a complete and complementary analysis of the components of government revenues.

income groups: developed economies spend an average of 18% of GDP on social transfers annually (39% of total government spending), whereas emerging economies spend just 8% (28% of total government spending). The large differences in transfers trounce the minor differences in other categories such as Goods Expenses, Fixed Capital, and Employee Compensation. Therefore, understanding the impact of transfers is paramount for understanding the impact of fiscal policy on business cycle outcomes.

The contrasting fiscal policy of emerging markets has been an important area of study because fiscal procyclicality tends to amplify underlying forces driving business cycles. In the second half of our paper, we consider how our empirical finding on the dominance of social transfers in accounting for fiscal procyclicality of emerging markets affects our understanding of how those countries experience business cycles. We do so by modifying a prototypical open economy business cycle model to include a role for government expenditures explicitly modeled as social transfers. The base of our model is the workhorse small open economy model of Mendoza (1991) merged with an endogenous country spread on debt following the framework Neumeyer and Perri (2005). To the base model, we add heterogeneous households in order to provide a meaningful role for social transfers. Households differ in both their labor productivity and access to financial markets. The government provides social transfers to poor households according to an exogenous process replicating the level, standard deviation, and correlation with GDP of social transfers observed in the data. Social transfers are supported by taxes, the composition of which are also calibrated to the data.[5]

We find that differences in fiscal policy go a long way in accounting for one aspect of the contrasting business cycle characteristics of emerging and developed economies—excess volatility of consumption. We estimate the structural fundamentals of the model for a prototype emerging economy to replicate key targets while imposing a social transfer policy calibrated to the average across emerging economies. Among these targets is the relative volatility of consumption (standard deviation of consumption relative to the standard deviation of output) equalling 1.25. We then perform an experiment in which we change the

[5] Sovereign default is obviously an important issue for emerging markets. However, the question we ask in this paper does not require the explicit modeling of default. Instead, we can consider a partial equilibrium interest rate on bonds that depends on the current debt to GDP ratio. This captures the relevant difference in constraints to tax smoothing in emerging and developed countries.

social transfer policies to that of the average developed economy. We find this lowers the relative volatility of consumption, to 1.06, which is equivalent to closing about half of the gap in that statistic between developed and emerging economies. About 40% of that decline is driven by the change in the cyclicality of transfers alone, 40% by the change in the size of social transfers, while the remaining 20% results from the amplification that the larger size of social transfers has on the impact of the cyclicality.

We consider our results as a plausible upper-bound on the impact of disparate social transfer policies on the excess volatility of consumption within a standard framework used to study emerging markets business cycles. This claim is a consequence of our choice of how to model the rich and poor households between which social transfers redistribute resources. We assume rich agents own the capital stock and poor agents are hand-to-mouth consumers with no means of saving. This imposes that all transfers to poor households are consumed within the period, while maintaining the standard inter-temporal savings problem for the rich. As a result, redistribution towards poor households mechanically drives the relative volatility of consumption to income towards one. The second dimension of inequality that we consider is wage-income inequality. We assume rich agents have higher efficiency units of labor than poor agents resulting in a higher wage per unit of time worked. This amplifies the effect of redistribution through social transfers on cyclical properties of consumption. While our definition of a poor household is designed to elicit an extreme result to our experiment, we do quantitatively discipline the share of poor agents in the economy and their share of labor income using country-level data. Our objective is to convince a reader that a disaggregated approach to modelling government expenditures, particularly redistributive policies, is a promising approach towards understanding quantitative properties of business cycles over the course of development. It is in this way we use the theoretical model to provide a ball-park figure of the implications of our empirical findings.

1.1 Literature

Ours is not the first paper to study disparate fiscal policy in the context of emerging markets business cycles. Gavin and Perotti (1997) first document the pattern of procyclical fiscal policy in Latin America. Their work is followed by broader studies on expenditures

(Kaminsky et al. (2005)) and taxes (Ilzetzki and Végh (2008)) reinforcing their findings. Two complementary theoretical literatures are related to these empirical findings: one seeking to understand the implication of fiscal policy in open economy business cycles and one seeking to understand the fundamental cause of why these fiscal policies differ. Our paper belongs to the first literature.[6] The study of fiscal policy in open economy models was included in early works. Backus et al. (1992) show that an increase in government spending causes a real exchange rate depreciation in the open economy neoclassical model. This response has been shown to be counterfactual. For example, Ravn et al. (2012) document that increases in government expenditure on goods deteriorates the trade balance and depreciates the real exchange rate. They provide a theory of deep habits where an increase in government spending leads firms to lower domestic markups relative to foreign providing a real exchange rate depreciation matching the data.

Our contribution to the quantitative theory literature is to explore how the composition of government expenditures, not just the level, may reconcile outcomes in the neoclassical open economy model with empirical observations. As such we depart from the standard modelling assumptions of government expenditures as a sunk expense, or equivalently as separable in the utility function of households. We also add agents who are heterogenous in wealth and income into the analysis. These departures relate our paper to a third, emerging literature on the calculation of government spending multipliers in models with heterogenous agents. Most related is Brinca et al. (2014). They document a positive correlation between fiscal multipliers and wealth inequality. They show a heterogenous agent neoclassical model of incomplete markets can replicate this fact when government spending is modeled as social security and appropriately calibrated. Ferriere and Navarro (2014) study the impact of tax progressivity on multipliers, but model expenditures as "thrown into the ocean". Our work is also distinct in considering an open economy setting.

Our empirical analysis of the IMF's Government Finance Survey is an independent contribution apart from our quantitative theory exercises. Changes in the survey overtime and differences in reporting conventions across countries require significant cleaning of the dataset

[6]The second literature has provided theories related to limited access to international credit markets (Cuadra et al. (2010),Riascos and Vegh (2003)) and political economy motives (Talvi and Vegh (2005), Alesina et al. (2008)).

to provide consistent measures of government expenditure at the categorical level. We devise a detailed methodology to achieve this. We then merge the dataset with key variables from other Macroeconomic datasets and compute a variety of statistics useful for studying issues in growth, international macroeconomics, and political economy.

Our consideration of observed fiscal policy offers another perspective on the origins of business cycle behavior of emerging economies. In the attempt to account for excess volatility of consumption and strongly counter-cyclical trade balance, previous literature explored the role of potentially different productivity process (introduced by Aguiar and Gopinath (2007) and further evaluated by Chen and Crucini (2016), Garcia-Cicco et al. (2010), Chang and Fernández (2013), Rothert (2016), and Rothert and Rahmati (2014)), counter-cyclical interest rates (Neumeyer and Perri (2005), Uribe and Yue (2006), Fernández and Gulan (2015)), or different features of the labor market (Boz et al. (2015), Fernandez and Meza (2015)). In this paper we show that difference in the size and cyclicality of social benefits goes a long way in accounting for the highly volatile consumption.[7]

2 Empirical Regularities in Fiscal Components

Our main dataset for fiscal variables is the Government Finance Statistics Dataset (GFS) maintained by the International Monetary Fund (IMF). The data we use are annual and span an unbalanced panel from 1990 to 2015.[8] The focus of this paper is on the sub-components of government expenses. They include social transfers, compensation of employees, use of goods and services, interest, and subsidies. Social transfers are defined as current transfers receivable by household related to social risks.[9] These include: sickness, unemployment, retirement, housing, and education. Goods and services are defined as "value of goods and services used for the production of market and nonmarket goods and services".

These data in their raw form are not harmonized to provide consistent measures of expenditures by category both across countries and within a country over time. The first challenge

[7] In this paper we link directly to the literature on counter-cyclical interest rates. In Michaud and Rothert (2016) we further explore implications for these other theories.

[8] See the online data appendix for detail on country-specific coverage and variables.

[9] These include both in-kind and cash transfers.

Table 1: List of countries

Emerging	*Argentina, Bolivia, Brazil, Chile, Dominican Republic, Hungary, Iceland Israel, Poland, Romania, Slovak Republic, Thailand, Uruguay*
Developed	*Austria, Belgium, Canada, Czech Republic, Denmark, Finland, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, New Zealand, Portugal Spain, Sweden, United Kingdom.*

is that the nature of fiscal federalism differs across countries.[10] The second challenge is that the data are incomplete: some countries only report spending at certain levels and/or change the level of reporting over time.[11] We develop and implement an algorithm detailed in the online appendix to address these problems. We drop countries for which consistent measures cannot be constructed.

We merge this dataset with data on macroeconomic aggregates spanning 1980-2015 (annual) from the "World Development Indicators" database.[12] We follow convention in the literature by placing countries into two groups: "Emerging" and "Developed" and present population-weighted mean values across countries within a group as stylized facts for that group. We classify a country as Emerging/Developed if it falls under the IMF classification of "Emerging and Developing"/"Advanced", respectively. [13] The resulting sample of 13 emerging and 17 developed countries is presented in Table 1.[14]

We start by summarizing the differences between the two country groups in the business cycle behaviors of major macroeconomic aggregates most relevant to our analysis: standard deviation of real GDP per capita; standard deviation of real household consumption per capita relative to the standard deviation of GDP; and correlation of trade balance with GDP. The average values of these statistics across the two country groups are presented in

[10]For example, Brazil reports almost all social transfers are provided at the central government level while subnational governments provide three-quarters of social transfers in Denmark.

[11]An example of the latter is when a country reports only central government spending in the early sample and then reports only total government spending at all levels in the later sample.

[12](http://data.worldbank.org) accessed on 1/10/2018. These include GDP and its components. Specific series described in the online appendix.

[13]The groupings of "Emerging" and "Developed" countries differ across papers in this literature. For example, the 10 countries in Neumeyer and Perri (2005) are a subset of the 26 countries in Aguiar and Gopinath (2007) and fall in the same groups. Garcia-Cicco et al. (2010) consider 22 countries that only partially overlap with Aguiar and Gopinath (2007).

[14]A few countries including Slovak Republic and Israel change classification over the time sample. We classify them as emerging to be consistent to prior literature.

Table 2: Cyclical Properties of Macroeconomic Variables

Variable	Emerging	Developed
$std(GDP)$	4.72	3.55
$std(C)/std(GDP)$	1.25	0.83
$corr(NX, GDP)$	-0.30	-0.17

Group mean value of country-level statistic. All variables are the residual from a linear-quadratic trend and are in real per-capita terms except Net Exports which are first-differenced.

Table 2. Country specific values are depicted in the bar chart in Figure 1. The moments for each country have been computed after detrending each series with a country-specific linear-quadratic trend.[15] We will use the same procedure later to detrend total government revenues, and both the total and each component of government spending.

Table 2 confirms three main regularities documented in previous literature on emerging markets business cycles: higher volatility of output, excess volatility of consumption, and stronger counter-cyclicality of the trade balance. The excess volatility of consumption has been the main focus of the literature, because it is at odds with a very strong consumption smoothing motive present in dynamic macroeconomic models.[16]

In our sample, the difference in the cyclicality of trade balance is not as stark as documented in previous studies. The reason is that we had to exclude both Mexico and South Korea due to insufficient length of their fiscal series. Both of these countries had a very large negative estimate of the correlation between trade balance and GDP driven by the two large sudden stops episodes of 1995 and 1998.

Table 3 presents stylized facts about average government expenses and revenues, pointing at some important differences across the country groups. Developed countries have higher mean total expenses and total revenues over the sample. The difference in spending on social transfers across the groups is substantial. Developed countries mean spending on social transfers is twice that of emerging economies. This is important because social transfers are also the largest expenditure category in each country group, especially in developed

[15] As in Ravn et al. (2012). The online appendix contains a table using log first-differences for comparison.

[16] Most importantly, it cannot be accounted for by simply reducing access to borrowing and lending, because in the extreme case of financial autarky consumption would move one-to-one with income. In fact, access to international financial markets is necessary for $std(C) > std(Y)$.

Table 3: Composition of Government Spending

Average Share of GDP		
Variable	Emerging	Developed
Total Expenses	29.64	45.01
Social Transfers	8.53	17.60
Goods Expenses	5.08	5.89
Employees	7.61	10.71
Grants	1.38	0.94
Subsidies & Transfers	1.30	1.70
Interest	2.80	3.25
Total Revenues	28.81	43.52

Group mean of country-level statistic. All statistics are as a percentage of real GDP per capita.

countries where they account for more spending than that on goods, services, and employees combined.

We now examine the cyclical properties of expenditures and revenues, shown in Table 4. The cyclical components of total expenditures and revenues are more volatile relative to the cyclical component of GDP in emerging markets than in developed countries. This difference is particularly pronounced for Social Transfers. Volatility of transfers relative to volatility of GDP in emerging markets is double that in developed countries. The country income groups also display differences in the comovements of fiscal variables with GDP over the cycle. Whereas total revenues are pro-cyclical in both groups, expenditures are procyclical only in emerging markets and acyclical or weakly countercyclical in developed. Social transfers have the opposite relationship with the cycle across groups. They are pro-cyclical in emerging and counter-cyclical in developed. Goods expenditures also display differences in cyclicality across groups, but to a lesser extent: they are pro-cyclical in emerging and acyclical in developed.

Table 5 summarizes the contribution of each component of government expenditures to (1) the variation in mean level of government spending across countries, and (2) the volatility of total government expenditures within each country over time. In both cases, the contribution of a component g_j to the variance of total expenditures G is: $\frac{var(g_j)+\sum_{k\neq j} cov(g_j,g_k)}{var(G)}$, where $G \equiv \sum_{j=1} g_j$.

The first column considers cross-country variation in average level of government ex-

Table 4: Cyclical Properties of Fiscal Policy

Variable	Emerging	Developed
std(Gov Expenditure)/sd(GDP)	2.28	2.09
corr(Gov Expenditure), GDP)	0.24	-0.07
std(Gov Revenue)/sd(GDP)	2.49	2.10
corr(Gov Revenue, GDP)	0.75	0.65
std(Social Transfers)/sd(GDP)	3.02	1.50
corr(Social Transfers, GDP)	0.19	-0.35
std(Goods Expenditure)/sd(GDP)	3.60	2.54
corr(Goods Expenditure, GDP)	0.17	0.04

Group mean of country-level statistic. All variables are the residual from a linear quadratic trend and are in real per-capita terms.

Table 5: Variance Decomposition of Total Expenditure

Variable	Across Countries	Within Countries
	Mean Level $\bar{Exp}$	Cyclical Component $\hat{Exp}$
Social Transfers	46.7%	36.1%
Goods/Sevices	13.9%	18.9%
Employees	20.0%	31.0%
Interest	5.0%	4.0%
Subsidies	3.2%	5.6%
Other	11.2%	4.3%

The contribution of each component to the overall variance of: (1) the mean level of expenditures *across countries*; (2) the *cyclical* variance of expenditures *within a country* (measured as the cyclical component).

penditures. One can see that cross-country variation in the average level of spending on social transfers accounts for 47% of the cross-country variation in the average level of total government expenditures, a share on par with all other categories combined.

The second column considers within country variation in expenditures over the business cycle. For this exercise, we perform a variance decomposition for each country, decomposing changes in trend-residual expenditures into changes in each component of expenditures in that country. The statistic listed is the mean of this statistic across countries. Social transfers again appear to be the most important in accounting for the variation in total expenditures. They account on average for 36.1% of the variation in total expenditures within each country over the business cycle, although expenditure on employment is a close second.

3 Model

We now turn to the impact of redistributive policies on the business cycle behavior of small open economies. To do so, we incorporate inequality, social transfers, and taxes into a workhorse business cycle model of a small open economy. In particular, we require a model that can accommodate features of emerging markets business cycles. The most prominent theories in that literature introduce either: (1) trend shocks (Aguiar and Gopinath (2007)), (2) financial frictions in the form of working capital constraint (Uribe and Yue (2006)), or (3) endogenous country risk premium that rises in response to adverse productivity shock (Neumeyer and Perri (2005)).

Chang and Fernández (2013), in their Bayesian estimation of a model that encompasses all three of the aforementioned theories conclude that the model with endogenous country risk premium fits the data on aggregate quantities best. Partly based on their results, and partly motivated by our focus on government fiscal policy where interest rate movements can play a large role, we use a small open economy model with endogenous risk premium. Therefore, we build upon the classical framework of Mendoza (1991) merged with Neumeyer and Perri (2005).

3.1 Households

We introduce redistribution by considering two types of households: (R)ich and (P)oor. A fraction N^R of households are rich, and the remainder $N^P = 1 - N^R$ of households are poor. The difference between a rich and a poor household is twofold. First, rich households have higher efficiency of labor. For each unit of time worked, a rich household provides one unit of labor input, whereas a poor household provides $\gamma < 1$ units of labor input. Second, rich households can own physical capital and have access to financial markets, while the poor households live hand-to-mouth: they can only consume their current income and cannot save or borrow.[17]

[17]While heterogeneity in access to financial markets is much richer in reality, the modeling assumption of two types of households: one with perfect access to financial markets and the other with no access to financial markets; is essentially approximating the distribution of access to financial markets with a distribution that has a two point support.

The Rich A typical rich household solves the following utility[18] maximization problem:

$$\max_{(c_t^R, \ell_t^R, k_t, a_t, x_t)} E_0 \sum_{t=0}^{\infty} \beta^t \frac{\left[c_t^R - \frac{\chi}{1+\nu} {\ell_t^R}^{1+\nu}\right]^{1-\sigma}}{1-\sigma}$$

subject to:

$$c_t^R(1+\tau_{c,t}) + x_t \leq w_t^R(1-\tau_{\ell,t}^R)\ell_t^R + r_t(1-\tau_{k,t})k_{t-1} - \tau_t^{LS} + R_{t-1}a_{t-1} - a_t - \frac{\kappa}{2}(a_t - \bar{a})^2$$

$$k_t = (1-\delta)k_{t-1} + x_t - \frac{\phi}{2}\left(\frac{k_t}{k_{t-1}} - 1\right)^2 k_{t-1},$$

The last term on the right-hand side of the budget constraint is a portfolio adjustment cost introduced to ensure the law of motion for assets in the linearized economy is stationary.[19] The other terms are as follows: c_t^R denotes consumption; x_t denotes investment; ℓ_t^R denotes labor supply; k_t denotes capital stock; a_t denotes the level of net foreign assets; w_t^R denotes wage; R_t is gross interest rate; $\tau_{c,t}$ denotes consumption tax; $\tau_{\ell,t}^R$ denotes labor income tax; $\tau_{k,t}$ denotes capital income tax; τ_t^{LS} denotes a lump-sum tax that is introduced to ensure the government budget is balanced.[20]

The Poor A typical poor household solves the following utility maximization problem:

$$\max_{(c_t^P, \ell_t^P)} E_0 \sum_{t=0}^{\infty} \beta^t \frac{\left[c_t^P - \frac{\chi}{1+\nu} {\ell_t^P}^{1+\nu}\right]^{1-\sigma}}{1-\sigma}$$

subject to:

$$c_t^P(1+\tau_{c,t}) \leq w_t^P \ell_t^P (1-\tau_{\ell,t}^P) + TR_t/N^P.$$

[18]Our choice of GHH preference is largely driven by empirical analysis of competing theories of emerging markets. Specifically, Chang and Fernández (2013) consider preferences that nest GHH and Cobb-Douglas as special cases (following Jaimovich and Rebelo (2009)) and their estimates suggest the model with GHH utility function fits the data on aggregate quantities best.

[19]See Schmitt-Grohe and Uribe (2003) for different ways of ensuring stationarity in small open economy models.

[20]See Section 3.4.3 for the explanation of how Ricardian Equivalence applies to our model.

The last term on the right-hand side, TR_t/N_t^P, is the net social transfer per poor household from the government. Similarly to the rich household, the poor household pays consumption tax $\tau_{c,t}$ and labor income tax $\tau_{\ell,t}^P$ (possibly at a different rate). Contrary to the rich household, the only source of income for the poor household is the labor income.

Notice that in the limit, as $N^R \to 1$, our model collapses to a standard representative agent small open economy model. Thus, we expect the behavior of the rich household to resemble closely the behavior of a stand-in household in the traditional small open economy business cycle model.

3.2 Production

The aggregate production function is Cobb-Douglas: $Y_t = e^{z_t} K_t^\alpha L_t^{1-\alpha}$, where z_t is the log of total factor productivity (TFP). The inputs, K_t and L_t, are aggregate capital stock and aggregate labor respectively. The log of productivity follows an AR(1) process: $z_t = \rho_z z_{t-1} + \epsilon_t^z$. The aggregate capital stock is the sum of all the physical capital owned by rich households. Aggregate labor input is the sum of effective labor inputs of the rich and the poor households:

$$
\begin{aligned}
K_t &= N^R \cdot k_t \\
L_t &= N^R \cdot \ell_t^R + N^P \cdot \gamma \ell_t^P
\end{aligned}
$$

where k_t is capital stock per rich household, ℓ^R and ℓ^P are labor supply of rich and poor household, respectively.

3.3 Interest Rate

The interest rate at which the rich household can borrow and lend is a product of the world interest rate and the country spread: $R_t = R_t^* \cdot CS_t$. The world interest rate follows an AR(1) process:

$$
\log(R_t^*) = (1-\rho^R) r^* + \rho^R \cdot \log(R_{t-1}^*) + \epsilon_t^R, \qquad \epsilon_t^R \sim N(0, \sigma^R)
$$

The country spread responds to country's productivity shocks. We model it in a similar fashion as Neumeyer and Perri (2005):

$$\log(CS_t) = \eta^{CS} \cdot z_t + \epsilon_t^{CS}, \qquad \epsilon_t^{CS} \sim N(0, \sigma^{CS})$$

The parameter η^{CS} captures the response of country spread to productivity shock. It is a reduced form way of capturing the impact of economic conditions on the country's perceived probability of default, which affects the country risk premium.

3.4 Government

The government's only expenditure is social transfers distributed to poor households. The expenditures are financed with labor income, capital income, and consumption taxes imposed on all households, and with lump-sum taxes imposed on the rich households. Transfers and taxes vary over the business cycles.

3.4.1 Cyclicality of transfers

The aggregate social transfers follow the following stochastic process:

$$\log(TR_t) = \log(\overline{TR}) + \eta^{TR} \cdot z_t + \epsilon_t^{TR}, \qquad \epsilon_t^{TR} \sim N(0, \sigma^{TR})$$

The deviation of social transfers from their steady-state value has two sources: the systematic cyclical component $\eta^{TR} \cdot z_t$ and the random (discretionary) component ϵ_t^{TR}. The random component is introduced to match the volatility of social transfers, and to ensure the correlation of social transfers with output could take any value between 0 and 1. Our focus, however, is on the cyclical component $\eta^{TR} \cdot z_t$, and the size $\overline{TR}$.[21]

[21] While the behavior of social transfers in our model is not the outcome of a formally specified decision problem of a policy-maker, the value of η^{TR} will be estimated using simulated method of moments. Our objective is not to understand the reasons behind differences in cyclicality of social transfers. Instead, our goal is to get a sense of the potential effects of the cyclicality of social transfers on the behavior of macroeconomic aggregates.

3.4.2 Cyclicality of taxes

The tax rates follow the following processes:

$$\begin{aligned}
\tau_{c,t} &= \bar{\tau}_c + \eta^{TAX} \cdot z_t + \epsilon_t^{TAX} \\
\tau_{\ell,t}^i &= \bar{\tau}_\ell^i + \eta^{TAX} \cdot z_t + \epsilon_t^{TAX}, \qquad i \in \{R, P\} \\
\tau_{k,t} &= \bar{\tau}_k + \eta^{TAX} \cdot z_t + \epsilon_t^{TAX}, \qquad \epsilon_t^{TAX} \sim N(0, \sigma^{TAX})
\end{aligned}$$

In words, the deviations of the distortionary tax rates from their steady state levels are identical for each type of tax. We make this assumption, because we do not have sufficient data for all countries in our panel that would allow us to estimate separate processes for each type of tax.[22] In our estimation, the parameter η^{TAX} will be the major driver of the cyclicality of tax revenues, and it will be estimated to match that moment.

3.4.3 Balanced budget

The government budget is balanced every period. The budget constraint for the government can be written as follows:

$$N^R \cdot \left(\tau_{c,t} c_t^R + \tau_{\ell,t}^R w_t^R \ell_t^R + \tau_{k,t} \cdot r_t k_t + \tau_t^{LS}\right) + N^P \cdot \left(\tau_{c,t} c_t^P + \tau_{\ell,t}^P w_t^P \ell_t^P\right) = TR_t$$

An alternative specification would be for the government to issue debt instead of impose lump-sum tax on a rich household. However, fixing the stochastic process for distortionary taxes described earlier, it does not matter whether the part of spending that is not covered by these taxes is financed with debt or with lump-sum taxes imposed on the rich households. The reason for that is Ricardian Equivalence - rich household has perfect access to credit markets.

[22] Although Leeper et al. (2010) show that different responses of these distortionary taxes to changes in government debt may have different implications for the behavior of macroeconomics aggregates and estimates of both short- and long-run fiscal multipliers, evidence in Vegh and Vuletin (2015) suggests the cyclical response of different types of taxes is quite similar. They claim that "tax rates change, on average, about every 5 years for corporate and personal income taxes and every 8 years for value-added taxes", and characterize tax policy as being a-cyclical in industrial and more pro-cyclical in emerging economies.

3.5 Solution method

We solve the model with local methods by linearizing the equilibrium conditions around the non-stochastic steady-state. We use Dynare for this step. Equilibrium conditions are described in the appendix.

4 Quantitative Analysis

4.1 Model parameters

We impose the values of some standard parameters to be identical across both "emerging" and "developed" country groups. The remaining parameters are either calibrated or estimated by targeting population-weighted average statistics, separately for each country group as in Section 2.[23]

4.1.1 Imposed parameter values

The discount factor is set to $\beta = 0.96$; the coefficient of relative risk aversion is set to $\sigma = 2$; the depreciation rate is set to $\delta = 0.04$; the capital share in the production function is set to $\alpha = 0.33$. Following Neumeyer and Perri (2005), we set the curvature parameter on labor on the utility function to $\nu = 0.6$ (implying the elasticity of labor supply of 1.66) and we choose the weight on labor disutility such that the average household spends 33% of its time working (i.e. $N^R \bar{\ell}^R + N^P \bar{\ell}^P = 0.33$). This corresponds to a value of $\psi = 1.45$.

4.1.2 Steady-state calibration

The share of rich households N^R equals the fraction of households with access to a formal savings account reported in Demirguc-Kunt (2012). The remaining six parameters — tax rates $\bar{\tau}_c$, $\bar{\tau}_k$, $\bar{\tau}_\ell^P$, and $\bar{\tau}_\ell^R$; steady-state level of social transfers $\overline{TR}$; relative labor efficiency of the poor household γ — are calibrated jointly to match the following six steady-state model moments with their data targets: (1) revenue share of Value Added Tax (VAT), (2)

[23] For example, the data target "standard deviation of GDP" in a typical emerging economy is calculated as: $\sigma(GDP)_{\text{EMERGING}} \equiv \frac{1}{N} \sum_{i \in \{\text{EMERGING}\}} \sigma(GDP)_i$. Other data targets are calculated in the same manner.

Corporate Income Tax (CIT), (3) Personal Income Tax (PIT) in each group, (4) the ratio of highest marginal tax rate to the average tax rate on personal income, defined in the model as $\tau_\ell^R \div$ (Total labor tax / Total labor income), (5) the share of social transfers in GDP, which in the model equals $\overline{TR}/Y$, and (6) the income share of GDP earned by the fraction N^R of the richest households.

The data moments on tax revenues and rates are calculated using un-weighted averages of countries reported in Ilzetzki and Végh (2008). We assume VAT is the empirical equivalent of the consumption tax in our model, CIT is the empirical equivalent of the capital income tax, and PIT is the empirical equivalent of the labor income tax and social security contributions. We decided to treat the latter as part of the labor income tax, because in practice they create a wedge between the wage received by workers and the one paid by employers. The income share of GDP earned by the rich is calculated using country-specific income distribution reported in Pinkovskiy and Sala-i-Martin (2009). Table 6 reports the calibrated parameters together with data targets for the two groups of countries. Both calibrations matched the data targets exactly.

Table 6: Calibrated Parameters and steady-state targets

Parameter	Values		Steady-state	Values	
	Emerging	Developed	target	Emerging	Developed
$\overline{TR}$	0.028	0.133	TR / GDP	0.091	0.173
τ_c	0.028	0.033	VAT %	0.190	0.135
τ_ℓ^P	-0.084	0.042	PIT %	0.322	0.423
τ_ℓ^R	0.115	0.160	CIT %	0.161	0.066
τ_k	0.061	0.041	Marg / Avg Tax	1.917	1.238
γ	0.347	0.580	Inc share of rich	0.786	0.813
N^R	0.178	0.446	% Rich	0.178	0.446

Notes: N^R is taken directly from the data in Pinkovskiy and Sala-i-Martin (2009). The top 6 parameters are calibrated jointly to match the six steady-state targets (all six targets are matched exactly).

4.1.3 Method of moments estimation

We set the world interest to be the US annual real interest rate and estimate parameters driving its shock process - persistence ρ^R and standard deviation σ^R. Our point estimates on annual US data are: $\rho^R = 0.81$ and $\sigma^R = 0.0229$. We then jointly estimate 9 parameters with simulated method of moments. The 9 parameters are: standard deviation and persistence of the productivity shock—σ^z and ρ_z; standard deviations and cyclicality parameters of social transfers and taxes—σ^{TR}, σ^{TAX}, η^{TR}, and η^{TAX}; investment adjustment cost ϕ; standard deviation and cyclicality parameter for the country spread—σ^{CS} and η^{CS}. We use 10 moments: standard deviation of real GDP and real interest rate; relative (to that of GDP) standard deviation of consumption, investment, social transfers, and tax revenues; correlation of social transfers, tax revenues, and real interest rate with GDP; correlation of first differences of trade balance with GDP growth; and the autocorrelation of real GDP series.[24]

The resulting parameter estimates are presented in Table 7. The targeted data moments and model fit are presented in Table 8. The parameter estimates are largely consistent with previous literature. The counter-cyclical response of the country spread, η^{CS}, is much stronger in the average emerging economy (point estimate of -2.03 comparing to -0.52 in the average developed economy)[25]. The volatility of the country spread shock is also larger in the average emerging economy (0.041 comparing to 0.026). Somewhat contrary to prior literature, the estimated standard deviation and persistence of productivity shocks are very similar in the two groups of countries. This result is akin to our finding in Michaud and Rothert (2016) where we emphasize that accounting for *observable* disparate fiscal policy rules dampens the estimated differences between fundamentals in the two groups of countries.

For the purpose of our analysis, the most important result is the difference in the point estimate of the cyclical response of social transfers. The point estimate of the parameter η^{TR}

[24]We compute the model moments in the same way in which we computed the data moments (e.g., we define the cyclical component as deviation from linear-quadratic trend.). Moments are weighted using an identity weighing matrix.

[25]Neumeyer and Perri (2005) estimate $\eta^{CS} = -1.04$. There are three reasons behind the difference in our estimates. First, we have a different model with additional shocks that can affect movements in the country's interest rate. Second, they use Argentine data in their estimation, while we use cross-country averages. Finally, their model is quarterly, while ours is annual.

is 4.45 for the average emerging economy and it is -1.32 for the average developed economy, which accounts for the very large difference in the cyclicality of social transfers between the two groups of countries.

Table 7: Estimated Parameters

Parameter	**Emerging**		**Developed**	
	Estimate	**(s.e.)**	**Estimate**	**(s.e.)**
η^{CS}	-2.026	(0.815)	-0.518	(0.174)
ϕ	32.513	(2.554)	25.019	(1.883)
η^{SB}	4.454	(1.477)	-1.321	(0.277)
η^{TAX}	0.290	(0.032)	0.123	(0.018)
ρ_z	0.938	(0.026)	0.882	(0.025)
σ^z	0.005	(0.001)	0.009	(0.001)
σ^{CS}	0.041	(0.004)	0.026	(0.002)
σ^{SB}	0.118	(0.014)	0.046	(0.003)
σ^{TAX}	0.002	(0.001)	0.003	(0.000)

Notes: estimates based on 2000 replications of the model; each replication consisted of 500 periods; model moments were computed on the last 50 periods.

4.2 Transfers, taxes, and inequality - impact on business cycles

We now investigate the impact of different cyclical behavior and/or size of social transfers, taxes, and inequality on business cycle statistics. Our analysis proceeds as follows. We start with a benchmark emerging economy whose business cycle behavior is driven by parameters reported in Tables 6 and 7. We then compute business cycle statistics from counter-factual simulations, in which we change certain characteristics of the average emerging economy to resemble those of the average developed economy. These counterfactuals will inform how much of the factual statistics are driven by social transfers and inequality.

4.2.1 Social transfers and taxes.

We start by looking at the impact of fiscal policy - transfers and taxes - on business cycles in an emerging economy. Table 9 presents the results of 5 counter-factual experiments. In

Table 8: Simulated Method of Moments Estimation - Model vs. Data

	Emerging		Developed	
Moments	**Data**	**Model**	**Data**	**Model**
$\sigma(y)$	4.72	4.81	3.55	3.59
	(0.56)	(0.48)	(0.44)	(0.87)
$\sigma(c)/\sigma(y)$	1.25	1.26	0.83	0.86
	(0.24)	(0.28)	(0.10)	(0.10)
$\sigma(inv)/\sigma(y)$	4.07	4.09	3.19	3.23
	(0.63)	(0.89)	(0.23)	(0.48)
$\sigma(sb)/\sigma(y)$	3.02	2.97	1.50	1.48
	(0.35)	(0.99)	(0.12)	(0.26)
$\sigma(tax)/\sigma(y)$	2.49	2.44	2.10	2.10
	(0.36)	(0.50)	(0.29)	(0.23)
$\sigma(R)$	5.11	5.10	3.47	3.47
	(1.27)	(0.36)	(1.20)	(0.23)
$\rho(sb, y)$	0.19	0.18	-0.35	-0.38
	(0.05)	(0.09)	(0.01)	(0.08)
$\rho(tax, y)$	0.75	0.64	0.65	0.72
	(0.05)	(0.10)	(0.04)	(0.07)
$\rho(\Delta nx, \Delta y)$	-0.30	-0.37	-0.17	0.05
	(0.06)	(0.06)	(0.04)	(0.07)
$\rho(R, y)$	-0.23	-0.21	-0.11	-0.23
	(0.13)	(0.10)	(0.10)	(0.10)
$\rho(y_t, y_{t-1})$	0.75	0.98	0.77	0.89
	(0.03)	(0.01)	(0.01)	(0.04)

Notes: Model moments based on 2000 replications of the model; each replication consisted of 500 periods; business cycle statistics were computed on the last 50 periods. Empirical standard errors calculated using Generalized Method of Moments.

the first experiment (counterfactual (1) in the table) we change the size of social transfers from 9% to 17% of GDP. The result of that change is a decline in the relative volatility of consumption, which drops from 1.26 in the benchmark model to 1.18 in that counter-factual. In the second experiment (counterfactual (2)), we set the cyclical response of social transfers, η^{TR}, to -1.32: the value we have estimated for an average developed economy. The relative volatility of consumption drops by 0.08, to 1.18 (compared to the benchmark). Finally, in the third experiment (counterfactual (3)), we change both the size and the cyclicality of the transfers. The results is a large decline in the relative volatility of consumption which drops to 1.06. These results indicate two things. First, cyclicality of transfers can have a substantial impact on the volatility of consumption. Second, that impact can be reinforced by the larger size of the transfers.

In order to see how the size and cyclical response of social transfers reinforce each other's impact, consider the log-linearized budget constraint of the poor household (for simplicity, without the consumption and labor income taxes):

$$\hat{c}_t^P \approx \frac{\bar{w}\bar{\ell}^P}{\bar{c}^P}\left(\hat{w}_t^P + \hat{\ell}_t^P\right) + \frac{\bar{TR}/N^P}{\bar{c}^P}\hat{TR}_t = \frac{\bar{w}\bar{\ell}^P}{\bar{c}^P}\left(\hat{w}_t^P + \hat{\ell}_t^P\right) + \frac{\bar{TR}/N^P}{\bar{c}^P} \cdot \underbrace{\left(\eta^{TR} z_t + \epsilon_t^{TR}\right)}_{=\hat{TR}_t}. \quad (4.1)$$

During productivity-driven recessions ($\hat{z}_t < 0$) both wages and employment of the poor households falls, which drives down the consumption of the poor (see the first term on the right-hand side in the equation (4.1) above). When social transfers are counter-cyclical ($\eta^{TR} < 0$), the fall of c^P during recessions is dampened. The dampening impact of counter-cyclical social transfers will be larger when the size of these transfers relative to the steady-state level of the poor's consumption is larger. The interaction effect can be read directly from the last term on the right hand-side of (4.1).

Next, we look at taxes. Counterfactual (4) in the table shows simulated moments from the model of the average emerging economy with the size, composition, and cyclical response of taxes that are the same as in a typical developed economy. Changing the tax policy mildly increases both the volatility of output, and the excess volatility of consumption. It also makes the trade balance slightly more counter-cyclical.

Table 9: Counter-factual experiments: social transfers and taxes

Moments	Emerging benchmark		Counter-factual experiments: Fiscal Policy					Developed benchmark	
			Transfers			Taxes	Both		
	data	**model**	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**model**	**data**
$\sigma(y)$	4.72	4.81	4.81	4.81	4.81	4.85	4.83	3.59	3.55
		(0.48)	(0.48)	(0.48)	(0.48)	(0.51)	(0.50)	(0.87)	
$\sigma(c)/\sigma(y)$	1.25	1.26	1.18	1.18	1.06	1.38	1.19	0.86	0.83
		(0.28)	(0.27)	(0.26)	(0.23)	(0.30)	(0.26)	(0.10)	
$\sigma(TR)/\sigma(y)$	3.02	2.97	2.97	2.76	2.76	2.86	2.66	1.48	1.50
		(0.99)	(0.99)	(0.96)	(0.96)	(0.93)	(0.91)	(0.26)	
$\sigma(tax)/\sigma(y)$	2.49	2.44	1.75	2.42	1.72	1.78	1.36	2.10	2.10
		(0.50)	(0.30)	(0.50)	(0.29)	(0.33)	(0.18)	(0.23)	
$\rho(TR, y)$	0.19	0.18	0.18	-0.06	-0.06	0.20	-0.06	-0.38	-0.35
		(0.09)	(0.09)	(0.07)	(0.07)	(0.09)	(0.07)	(0.08)	
$\rho(tax, y)$	0.75	0.64	0.74	0.65	0.75	0.70	0.82	0.72	0.65
		(0.10)	(0.08)	(0.09)	(0.08)	(0.09)	(0.07)	(0.07)	
$\rho(\Delta nx, \Delta y)$	-0.30	-0.37	-0.30	-0.35	-0.26	-0.42	-0.30	0.05	-0.17
		(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.07)	
Altered parameters									
η^{TR}		4.45		-1.32	-1.32		-1.32	-1.32	
η^{TAX}		0.29				0.12	0.12	0.12	
Altered steady-state targets									
Transfers / GDP	0.09		0.17	0.09	0.17		0.17		0.17
VAT/Taxes	0.19					0.13	0.13		0.13
PIT/Taxes	0.32					0.42	0.42		0.42
CIT/Taxes	0.16					0.07	0.07		0.07
Marg / Avg Tax	1.92					1.24	1.24		1.24

Counter-factual experiments - benchmark model emerging economy with the following changes:
(1) - Experiment 1—size of social transfers as in developed economy: $\frac{\text{Transfers}}{GDP} = 0.17$
(2) - Experiment 2—cyclical response of social transfers as in developed economy: $\eta^{TR} = -1.32$
(3) - Experiment 3—Experiments 1 and 2 combined
(4) - Experiment 4—size, composition, and cyclical response of taxes as in developed economy
(5) - Experiment 5—Experiments 3 and 4 combined

Finally, we combine the two sides of fiscal policy. Counterfactual (5) in the table shows simulated moments from the model of the average emerging economy with social transfers and tax policies that are the same in the benchmark developed economy (in terms of size, composition, and cyclical response). Although they work in opposite directions— developed social transfer policy decreases volatility while developed tax policy increases it— we find the net impact of both policies combined reduces volatility. Quantitatively, the impact of social transfers outweighs the impact of changing the size and behavior of taxes.

In summary, our results suggest that, in terms of reducing volatility of aggregate consumption, a typical emerging economy could benefit sizeably from adopting social transfer policies of similar sizes and cyclically to those found in developed countries. However, additionally adopting the revenue structure of developed countries' fiscal policy would work in the opposite direction to increase volatility.

4.2.2 Inequality

Next we explore how our main results regarding the effect of disparate fiscal policies on business cycle properties depend on our calibration of inequality. The results of our analysis are summarized in Table 10. We first look at the effect of wealth inequality (counterfactual (6) in the table). In our model, reducing wealth inequality means that larger fraction of households owns capital and has access to international financial markets, which means we increase N^R from 0.18 to 0.45. Reduction in wealth inequality increases the excess volatility of consumption. While the result may seem surprising, it is very intuitive. In the model, the excess volatility of consumption is driven primarily by the behavior of the rich households, because they are the ones with access to financial markets. In the benchmark model, the country spread is counter-cyclical which results in a counter-cyclical interest rate. As a result, during expansions credit is cheaper and households with access to credit (the rich) have a strong incentive to borrow and increase their consumption more than their income increases. In terms of log-deviations during expansions, we will always have $\hat{c}_t^R > \hat{c}_t^P$.

Next, consider the log-deviation of the aggregate consumption from its steady-state value.

It is given by the following expression:

$$\hat{c}_t = N^R \cdot \frac{\bar{c}^R}{\bar{c}}\hat{c}_t^R + N^P \cdot \frac{\bar{c}^P}{\bar{c}}\hat{c}_t^P \tag{4.2}$$

In the equation above $\bar{c}$ is the steady-state level of aggregate consumption, $\bar{c}^R$ and $\bar{c}^P$ are steady state levels of consumption of the rich and poor, respectively. The log-deviation of the aggregate consumption from its steady-state is thus a weighted average of the log-deviations of consumptions of the rich and the poor. Increasing N^R will put a higher weight on $\hat{c}_t^R$ which is the larger one.

Next, we turn to income inequality. We change income inequality to be the same as in the average developed country (counterfactual (7) in Table 10), by setting $\gamma = 0.58$. Increasing γ reduces excess volatility of consumption. The intuition can again be read from Equation (4.2). The log-deviation of the aggregate consumption is the weighted average of $\hat{c}_t^R$ and $\hat{c}_t^P$ with weights proportional to steady-state levels of the poor's and rich's consumptions. When income inequality declines, the difference between steady-state values of these consumptions shrinks. As a result the weight $\bar{c}^R/\bar{c}$ drops while the weight $\bar{c}^P/\bar{c}$ increases.

The previous two experiments showed that in our model the two types of inequality had opposing effects on the volatility of aggregate consumption. In experiment (8) we combine the previous two. It turns out that the impact of changing wealth inequality outweighs the impact of changing income inequality - relative volatility of consumption rises from 1.36 to 1.40.

4.2.3 Social transfers, taxes, and inequality.

Finally, we combine counterfactuals 5 (fiscal policy) and 8 (inequality) into one. The result is presented in Table 11. Our main result here is that when we interact the effects of changes in fiscal policy with reduction in income and wealth inequality, the reduction in the volatility of aggregate consumption is larger. The mechanics of these results can be explained by looking

Table 10: Counter-factual experiments: inequality

Moments	Emerging benchmark data	Emerging benchmark model	Inequality: Wealth (6)	Inequality: Income (7)	Inequality: Both (8)	Developed benchmark model	Developed benchmark data
$\sigma(y)$	4.72	4.81	4.81	4.81	4.81	3.59	3.55
		(0.48)	(0.48)	(0.80)	(0.80)	(0.87)	
$\sigma(c)/\sigma(y)$	1.25	1.26	1.58	0.95	1.34	0.86	0.83
		(0.28)	(0.36)	(0.17)	(0.30)	(0.10)	
$\sigma(TR)/\sigma(y)$	3.02	2.97	2.97	2.97	2.97	1.48	1.50
		(0.99)	(0.99)	(0.99)	(0.99)	(0.26)	
$\sigma(tax)/\sigma(y)$	2.49	2.44	2.09	4.48	2.52	2.10	2.10
		(0.50)	(0.40)	(1.08)	(0.53)	(0.23)	
$\rho(TR, y)$	0.19	0.18	0.18	0.18	0.18	-0.38	-0.35
		(0.09)	(0.09)	(0.09)	(0.09)	(0.08)	
$\rho(tax, y)$	0.75	0.64	0.69	0.50	0.63	0.72	0.65
		(0.10)	(0.09)	(0.11)	(0.10)	(0.07)	
$\rho(\Delta nx, \Delta y)$	-0.30	-0.37	-0.39	-0.38	-0.39	0.05	-0.17
		(0.06)	(0.06)	(0.06)	(0.06)	(0.07)	
Altered parameters / steady-state targets							
% of the Rich	0.18		0.45		0.45		0.45
γ		0.35		0.58	0.58	0.58	

Counter-factual experiments - benchmark model emerging economy with the following changes:
(6) - Experiment 6—% of households that own capital the same as in developed countrys $N^R = 0.45$
(7) - Experiment 7—labor efficiency of the poor households set to $\gamma = 0.58$
(8) - Experiment 8—Experiments 6 and 7 combined

at equations (4.1) and (4.2) jointly:

$$\hat{c}_t \approx N^R \cdot \frac{\bar{c}^R}{\bar{c}}\hat{c}_t^R + N^P \cdot \frac{\bar{c}^P}{\bar{c}}\hat{c}_t^P$$
$$\hat{c}_t^P \approx \frac{\bar{w}\bar{\ell}^P}{\bar{c}^P}\left(\hat{w}_t^P + \hat{\ell}_t^P\right) + \frac{\bar{TR}/N^P}{\bar{c}^P} \cdot \left(\eta^{TR} z_t + \epsilon_t^{TR}\right).$$

Consider a positive productivity shock: $z_t > 0$. Larger size ($\bar{TR}/N^P/\bar{c}^P$) and cyclical response (η^{TR}) of social transfers dampens the positive impact of the productivity shock on the consumption of the poor, making $\hat{c}_t^P$ smaller. In addition to that, we are now considering an economy with smaller income inequality, which means that $\bar{c}^P/\bar{c}$ is higher. In addition to that, social transfers are larger, which results in an even greater increase in $\frac{\bar{c}^P}{\bar{c}}$, thus putting an extra larger weight on $\hat{c}_t^P$ when calculating the log-deviation of the aggregate consumption $\hat{c}_t$. This way, the size of social transfers interacts with the decrease in income inequality, which makes the movements of the the poor households' consumption play a larger role in the movements of the aggregate consumption.

The impact of different social transfers and income inequality on aggregate consumption of course translates to the the impact on the cyclicality of the trade balance. The natural consequence of less volatile aggregate consumption is the smaller counter-cyclicality of the trade balance, also reported in Table 11. Overall, our results indicate that the differences in the conduct of redistributive policies can go a long way in accounting for the differences in the behavior of aggregate consumption and trade balance between developed and emerging economies.

4.3 Relation to existing theories of emerging markets business cycles

Our research proposes an important quantitative role for including redistributive fiscal policy in the comparative study of emerging markets business cycles. For the analysis in this paper, we built upon the Neumeyer and Perri (2005) framework with endogenous country spread. The counter-cyclical spread in this framework is the fundamental that generates the excess volatility of consumption relative to GDP. What we did was to show that social transfers

Table 11: Counter-factual experiment: inequality and fiscal policy

Moments	Emerging benchmark		Counterfactual experiments			Developed benchmark	
			Fiscal	Inequality	Both		
	data	model	(5)	(8)	(9)	model	data
$\sigma(y)$	4.72	4.81	4.83	4.81	4.83	3.59	3.55
		(0.48)	(0.50)	(0.80)	(0.82)	(0.87)	
$\sigma(c)/\sigma(y)$	1.25	1.26	1.19	1.34	1.17	0.86	0.83
		(0.28)	(0.26)	(0.30)	(0.26)	(0.10)	
$\sigma(inv)/\sigma(y)$	4.07	4.09	3.97	4.09	3.97	3.23	3.19
		(0.89)	(0.83)	(0.89)	(0.83)	(0.48)	
$\sigma(TR)/\sigma(y)$	3.02	2.97	2.66	2.97	2.66	1.48	1.50
		(0.99)	(0.91)	(0.99)	(0.91)	(0.26)	
$\sigma(tax)/\sigma(y)$	2.49	2.44	1.36	2.52	1.43	2.10	2.10
		(0.50)	(0.18)	(0.53)	(0.21)	(0.23)	
$\sigma(R)$	5.10	5.10	5.10	5.10	5.10	3.47	3.47
		(0.36)	(0.36)	(0.36)	(0.36)	(0.23)	
$\rho(TR, y)$	0.19	0.18	-0.06	0.18	-0.06	-0.38	-0.35
		(0.09)	(0.07)	(0.09)	(0.07)	(0.08)	
$\rho(tax, y)$	0.75	0.64	0.82	0.63	0.79	0.72	0.65
		(0.10)	(0.07)	(0.10)	(0.08)	(0.07)	
$\rho(\Delta nx, \Delta y)$	-0.30	-0.37	-0.30	-0.39	-0.30	0.05	-0.17
		(0.06)	(0.06)	(0.06)	(0.06)	(0.07)	
$\rho(R, y)$	-0.23	-0.21	-0.23	-0.21	-0.23	-0.23	-0.11
		(0.10)	(0.10)	(0.10)	(0.10)	(0.10)	
$\rho(y_t, y_{t-1})$	0.75	0.98	0.98	0.98	0.98	0.89	0.76
Altered parameters / steady-state targets							
η^{TR}		4.45	-1.32		-1.32	-1.32	
η^{TAX}		0.29	0.12		0.12	0.12	
γ		0.35		0.58	0.58	0.58	
Transfers / GDP	0.09		0.17		0.17		0.17
VAT/Taxes	0.19		0.13		0.13		0.13
PIT/Taxes	0.32		0.42		0.42		0.42
CIT/Taxes	0.16		0.07		0.07		0.07
Marg / Avg Tax	1.92		1.24		1.24		1.24
% Rich	0.18			0.45	0.45		0.45

Counter-factual experiments: benchmark model emerging economy with the following changes:
(5) - Experiment 5—fiscal policy of a developed economy
(8) - Experiment 8—inequality of a developed economy
(9) - Experiment 9—Experiments 5 and 8 combined

reduce this excess volatility. This is important because it implies that the inferred differences in fundamentals (country-spread) necessary to match differences in consumption dynamics between country income groups are dampened when observed differences in transfer policy are included in the analysis. This idea generalizes to other theories that use different fundamentals to generate excess volatility of consumption. One example would be trend shocks as in Aguiar and Gopinath (2007).[26] The conclusion would be similar: disparate outcomes are partially driven by disparate shocks, but these implied differences in the properties of underlying shock processes are muted when disparate transfer policies are also considered.

4.4 Welfare

Finally, we turn our analysis to the welfare effects of changing the size, composition, and cyclicality of fiscal policy in our model emerging economy. For each experiment, we simulate the economy for 2,000 periods, drop first 500 observations and then calculate the realized life-time utility of both rich and poor households, as well as the population-weighted average over the remaining 1,500 periods. We do so 10,000 times and average over each replication to obtain a measure of the expected utility.

Table 12 reports the results. Each column corresponds to a different fiscal policy experiment (1 through 5, as described earlier). For each experiment we compute the percentage change in life-time consumption in the benchmark emerging economy that would yield identical change in welfare to the one resulting from a given experiment. We compute that statistic for the poor and for the rich. We also compute the utilitarian welfare change as the population-weighted average of the changes experienced by the rich and the poor.

The results are striking. Changing the size of social transfers from 9% to 17% of GDP would have large welfare effects for both the poor (positive) and the rich (negative). Given the large proportion of the poor in the emerging economies' population, such a change would result in a large increase in utilitarian welfare. However, given that the rich would experience a welfare decline equivalent to a 19% decrease in their life-time consumption, it is not surprising emerging economies do not implement such policies if we believe the rich

[26] We consider that framework in Michaud and Rothert (2016)

Table 12: Life-time consumption equivalent of policy/environment change

	Transfers			Taxes	Both	TFP	R and CS
	size	cycle	both			constant	constant
Poor	20.43%	0.02%	20.42%	-3.28%	15.89%	0.10%	0.00%
Rich	-18.91%	0.00%	-18.92%	2.72%	-13.82%	0.27%	0.40%
Total	18.12%	0.02%	18.12%	-3.12%	14.46%	0.10%	0.00%

have a major say in designing fiscal policies.

Notice also, that changing only the cyclicality of the social transfers has a negligible impact on welfare. The welfare effect for the rich households is zero, because the timing of lump-sum payments doesn't matter for them. The poor households experience welfare gain equivalent to 0.02% in their life-time consumption. [27]. This is consistent with Lucas' point about the welfare costs of business cycles (Lucas (1987)): welfare effects of changing long-run growth rate are of the order of magnitude larger than welfare effects of reducing business cycle fluctuations.

For comparison, we also present the welfare effects of removing the two sources of fluctuations. First, we shut down fluctuations in total factor productivity. The welfare gain from doing so equals 0.10% increase in the life-time consumption for the poor households and 0.27% for the rich households. Second, we shut down the fluctuations in the real interest rate (including the endogenous response of the spread to TFP shocks). Not surprisingly, this has no effect for the poor households, and somewhat moderate effect for the rich households which experience a welfare gain equivalent to 0.40% increase in their life-time consumption.

5 Conclusions

In this paper we investigated the cyclical behavior of government expenditures in a sample of emerging and developed economies. We found that social transfers are the major element of fiscal expenditures whose behavior is different in emerging and in developed countries. They are weakly procyclical in emerging markets and strongly counter-cyclical in developed

[27] If we increase σ (the coefficient of relative risk aversion in the utility function) to 5 (from the benchmark value of 2) the welfare gain of changing the cyclicality of transfers rises to 0.14% for the poor households.

economies. They are also much larger in developed economies, constituting 17% of GDP, comparing to only 9% of GDP in emerging economies. Comparing to differences in the size and cyclicality of social transfers, other categories of fiscal expenses look quite similar between the two groups of countries.

We then explored how our documented differences in social transfer policies may affect emerging markets business cycles in a small open economy Real Business Cycle framework. Our main result is that, if the average emerging country introduced a social transfers policy of the same size and cyclicality of the average developed country, their relative volatility of consumption would fall from 1.26 to 1.06. However, the adoption of the same tax structure of the average developed country to finance these transfers would work in the opposite direction to increase consumption volatility. Still, the adoption of the whole structure of a developed country's transfers and taxes combined would none-the-less result in a modest drop in consumption volatility: from 1.26 to 1.19.

Overall, our results indicate that the disaggregated approach to modelling government expenditures, particularly redistributive policies, is a promising approach towards understanding quantitative properties of business cycles over the course of development. We believe it can offer new perspective on problems such as graduation from pro-cyclical fiscal policy (Frankel et al. (2013)), populist macroeconomic policies (Dornbusch and Edwards (1990); Dovis et al. (2016)), or the fear of free falling (Vegh and Vuletin (2012)). Understanding the role of social benefits in these problems is a fruitful area for further research.

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Appendices

A Figures and Tables

Excess Volatility of Consumption

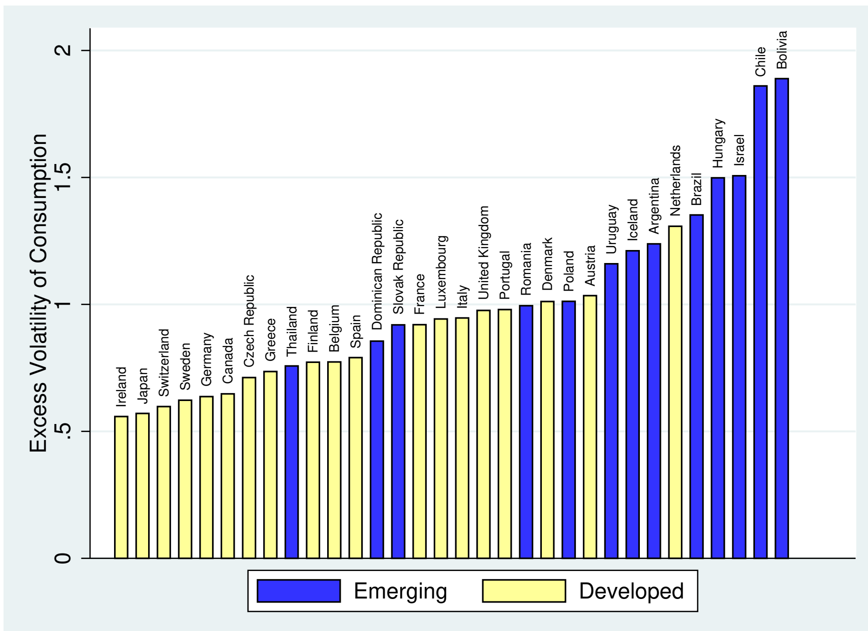

Figure 1: Excess Volatility of Consumption equals $\frac{sd(\hat{C})}{sd(\hat{Y})}$.

Median Total Government Spending

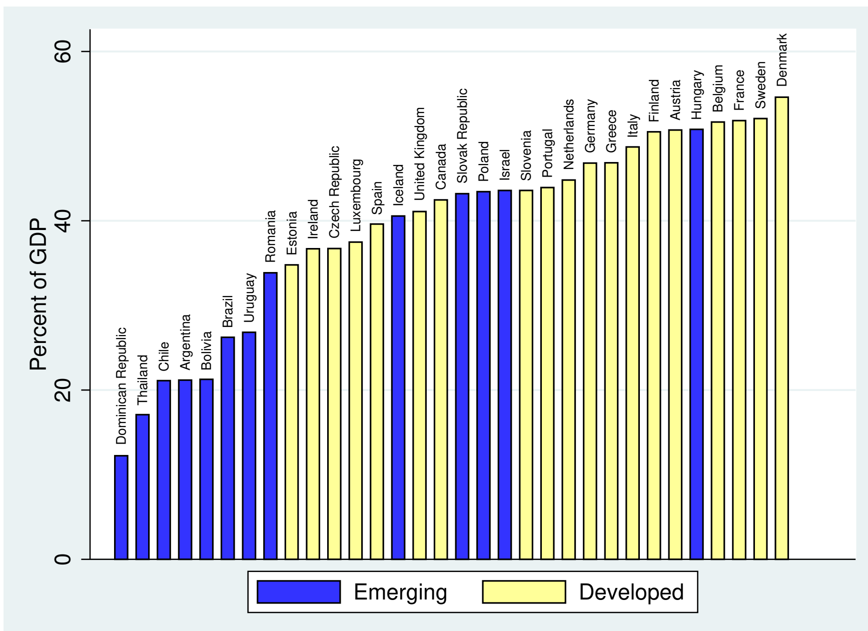

Figure 2: Mean over the time series. As a percent of GDP.

Median Government Spending on Social Transfers

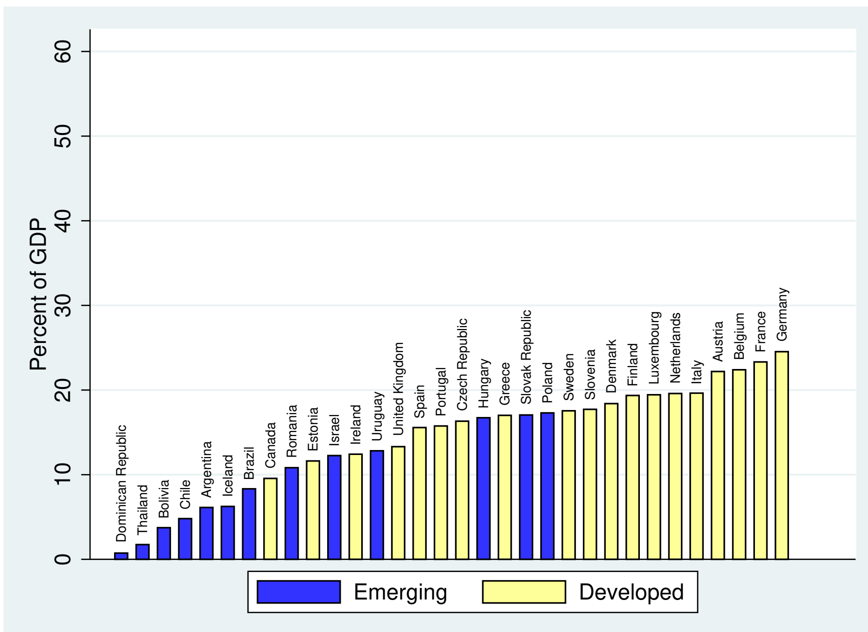

Figure 3: Mean over the time series. As a percent of GDP.

Median Government Spending on Goods & Services

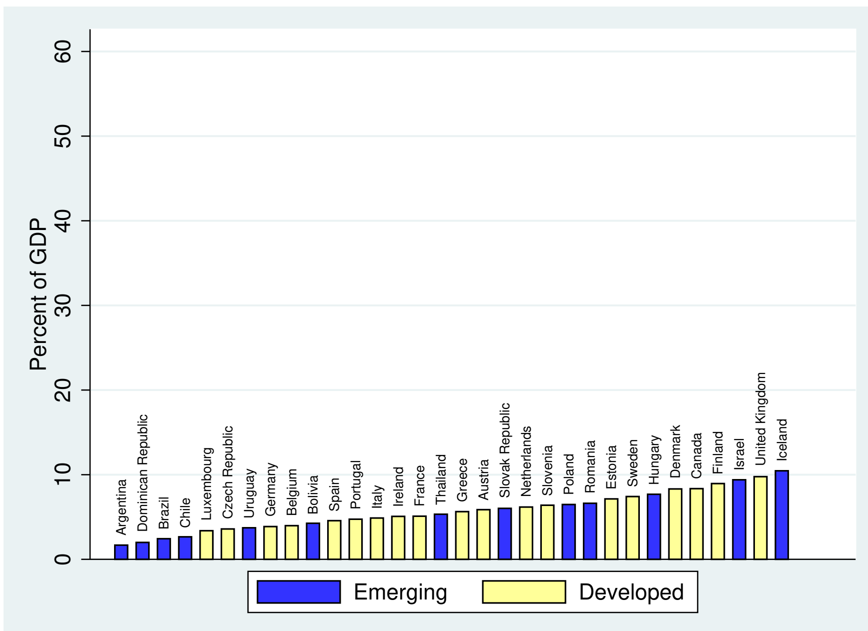

Figure 4: Mean over the time series. As a percent of GDP.

Cyclical Correlation of Total Government Spending with GDP

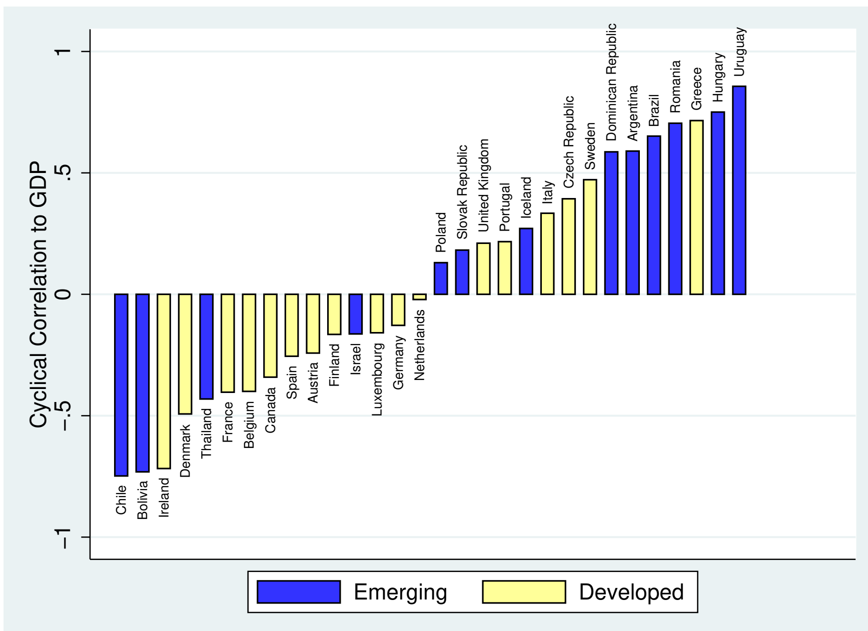

Figure 5: Residuals from linear-quadratic trends.

Cyclical Correlation of Government Spending on Social Transfers with GDP

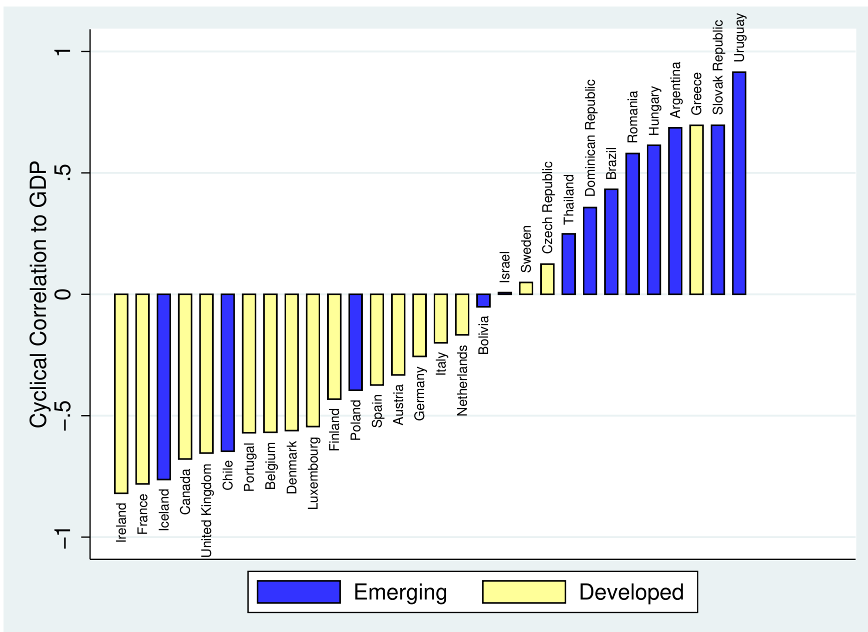

Figure 6: Residuals from linear-quadratic trends.

Cyclical Correlation of Government Spending on Goods & Services with GDP

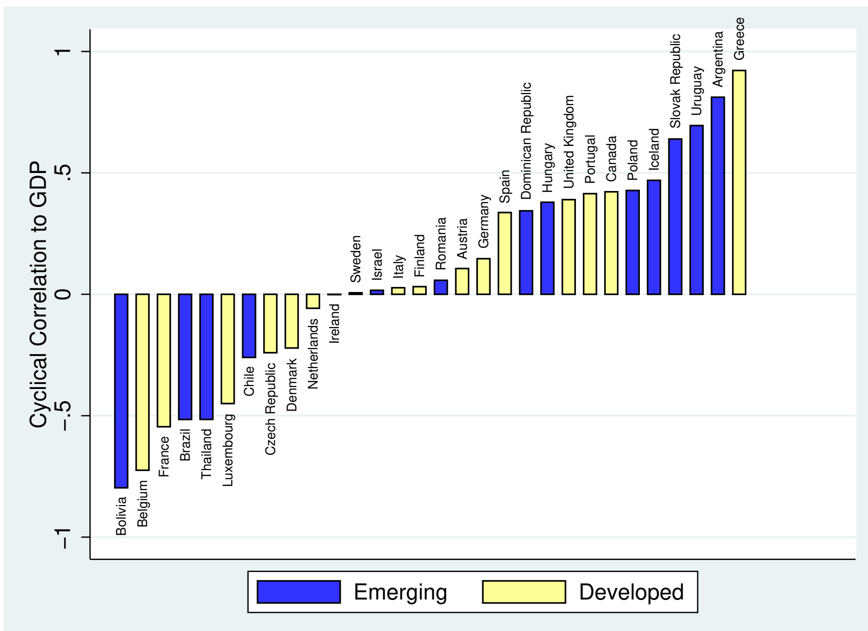

Figure 7: Residuals from linear-quadratic trends.

Table 13: Counter-factual experiments - complete results

Moments	**Emerging benchmark**		**Counter-factual experiments**									**Developed benchmark**	
			Fiscal Policy					Inequality			All		
			Benefits			Taxes	Both	Wealth	Income	Both			
	data	**model**	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**	**model**	**data**
$\sigma(y)$	4.72	4.81	4.81	4.81	4.81	4.85	4.83	4.81	4.81	4.81	4.83	3.59	3.55
		(0.48)	(0.48)	(0.48)	(0.48)	(0.51)	(0.50)	(0.48)	(0.80)	(0.80)	(0.82)	(0.87)	
$\sigma(c)/\sigma(y)$	1.25	1.26	1.18	1.18	1.06	1.38	1.19	1.58	0.95	1.34	1.17	0.86	0.83
		(0.28)	(0.27)	(0.26)	(0.23)	(0.30)	(0.26)	(0.36)	(0.17)	(0.30)	(0.26)	(0.10)	
$\sigma(inv)/\sigma(y)$	4.07	4.09	4.09	4.09	4.09	3.97	3.97	4.09	4.08	4.09	3.97	3.23	3.19
		(0.89)	(0.89)	(0.89)	(0.89)	(0.83)	(0.83)	(0.89)	(0.89)	(0.89)	(0.83)	(0.48)	
$\sigma(TR)/\sigma(y)$	3.02	2.97	2.97	2.76	2.76	2.86	2.66	2.97	2.97	2.97	2.66	1.48	1.50
		(0.99)	(0.99)	(0.96)	(0.96)	(0.93)	(0.91)	(0.99)	(0.99)	(0.99)	(0.91)	(0.26)	
$\sigma(tax)/\sigma(y)$	2.49	2.44	1.75	2.42	1.72	1.78	1.36	2.09	4.48	2.52	1.43	2.10	2.10
		(0.50)	(0.30)	(0.50)	(0.29)	(0.33)	(0.18)	(0.40)	(1.08)	(0.53)	(0.21)	(0.23)	
$\sigma(R)$	5.10	5.10	5.10	5.10	5.10	5.10	5.10	5.10	5.10	5.10	5.10	3.47	3.47
		(0.36)	(0.36)	(0.36)	(0.36)	(0.36)	(0.36)	(0.36)	(0.36)	(0.36)	(0.36)	(0.23)	
$\rho(TR,y)$	0.19	0.18	0.18	-0.06	-0.06	0.20	-0.06	0.18	0.18	0.18	-0.06	-0.38	-0.35
		(0.09)	(0.09)	(0.07)	(0.07)	(0.09)	(0.07)	(0.09)	(0.09)	(0.09)	(0.07)	(0.08)	
$\rho(tax,y)$	0.75	0.64	0.74	0.65	0.75	0.70	0.82	0.69	0.50	0.63	0.79	0.72	0.65
		(0.10)	(0.08)	(0.09)	(0.08)	(0.09)	(0.07)	(0.09)	(0.11)	(0.10)	(0.08)	(0.07)	
$\rho(\Delta nx,\Delta y)$	-0.30	-0.37	-0.30	-0.35	-0.26	-0.42	-0.30	-0.39	-0.38	-0.39	-0.30	0.05	-0.17
		(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.07)	
$\rho(R,y)$	-0.23	-0.21	-0.21	-0.21	-0.21	-0.23	-0.23	-0.21	-0.21	-0.21	-0.23	-0.23	-0.11
		(0.10)	(0.10)	(0.10)	(0.10)	(0.10)	(0.10)	(0.10)	(0.10)	(0.10)	(0.10)	(0.10)	
$\rho(y_t,y_{t-1})$	0.75	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.89	0.76
		(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.04)	
Altered parameters													
η^{TR}		4.45		-1.32	-1.32		-1.32				-1.32	-1.32	
η^{TAX}		0.29				0.12	0.12				0.12	0.12	
γ		0.35							0.58	0.58	0.58	0.58	
Altered steady-state targets													
TR / GDP	0.09		0.16	0.09	0.17		0.17				0.17		0.17
VAT/Taxes	0.19					0.13	0.13				0.13		0.13
PIT/Taxes	0.32					0.42	0.42				0.42		0.42
CIT/Taxes	0.16					0.07	0.07				0.07		0.07
Marg / Avg Tax	1.92					1.24	1.24				1.24		1.24
% Rich	0.18							0.45		0.45	0.45		0.45

B Fiscal Data- Government Finance Statistics (GFS) Dataset

Our main dataset for fiscal variables is the Government Finance Statistics Dataset (GFS) maintained by the International Monetary Fund (IMF)[28] The data collection began in 1972 with further guidelines established in 1986 intended to harmonize reporting of fiscal measures across countries. These guidelines have subsequently been updated twice: once in 2001 and again in 2014. These changes have little impact on our analysis with the exception of the expansion in the inclusion of nonmonetary transactions. Most countries switched from cash accounting to accrual in the mid-1990s' early 2000's.

We use annual data. Higher frequency- monthly and quarterly data- are limited to a smaller group of mostly developed countries.

Reported transactions are delineated by sub-sectors of the total Public Sector. Starting from finest to coarsest, the sector-level reporting concepts we consider are:

1. Budgetary Central Government: a single unit encompassing financial activities of the judiciary, legislature, ministries, president, and government agencies. It is funded by the main operating budget of the nation, generally approved by the legislature. Items not included in the budgetary central government statistics include extra-budgetary units and transactions;[29] and social security funds.

2. Central Government: the central government includes all transactions not operated through a public corporation (ex: central bank and other financial institutions) that are implemented at the national level (ie: not state or local governments). These statistics may or may not include social security, depending on the country reporting. Social security refers to social insurance schemes operated by a budget of assets and liabilities separate from the general fund.

3. General Government: the sum of central, state, and local financial activities plus social security. This does not include financial corporations.

[28]Information for this section comes from the 2014 GFS manual.

[29]For example, units with revenue streams outside of the central budget, external grants received, etc.

Constructing Consistent Measures of Revenues and Expenditures. Constructing consistent measures of revenues and expenditures at the categorical level is non-trivial. The main hurdle is that different countries implement fiscal policy through different government bodies. For example, Brazil reports almost all social benefits are provided at the central government level while subnational governments provide three-quarters of social benefits in Denmark. This is a potential problem because the data are incomplete: some countries only report spending at certain levels.[30] Our algorithm for choosing a time-series is as follows. In cases where we observe general government spending in ten or more years, we use this category. In cases where we only observe central government spending in ten or more years, we continue to use the time series if Social Benefits reported at the central level are more than 85% of Social Benefits reported at the level of total government spending in the years where general government spending is observed as well.[31] A second hurdle is that some countries switch from reporting cash to non-cash payments or switch the level at which they report payments: general, central, or budgetary general. We handle each of these issues on a case-by-case basis. In many cases the time-series remains smooth despite changes in the reported accounting scheme. If these changes occur in the two years after the GFS survey is updated (1995-6, 2001-2) we use the two series as one consistent series. Sectors we use are reported in Table 14.

The transactions we analyze fall into the categories of revenues and expenses affecting net worth. The specific breakdown is as follows.

- Revenue: transactions that increase *net* worth. These do not include transactions that simply affect the composition of assets and liabilities in the balance sheet such as the payments of loans or sale of financial assets.

    1. Tax Revenue: compulsory, unrequited accounts receivable by the government. Does not include, fines, penalties, and most social security contributions (as these are requited). Taxe revenue can be further disaggregated into: (a) taxes on income, profits and capital gains; (b) payroll taxes; (c) property taxes; (d) taxes on goods and services; (e) taxes on international trades and transactions.

[30] The main issue is the exclusion of local governments for the emerging economies.

[31] For Argentina, we sum State and Central statistics as local are not available.

2. Social Contributions: revenue of social insurance schemes. May be voluntary or compulsory.
3. Grants: transfers relievable that are not taxes, social contributions, or subsidies. May come from domestic or international organizations and units.
4. Other: revenues not fitting in the aforementioned categories. Include: (a) property income, (b) sales of goods and services, (c) fines, etc.

- Expense: transactions that decrease *net* worth. These do not include transactions that simply affect the composition of assets and liabilities in the balance sheet.

  1. Compensation of Employees: renumeration payable, both cash and in-kind, to employees of the government unit. Includes contractors.
  2. Use of Goods and Services: "value of goods and services used for the production of market and nonmarket goods and services". Includes consumption of fixed capital and goods purchased by the government for direct distribution. Consumption of fixed capital is also reported separately.
  3. Interest: interest fees on liabilities generated by both financial and non-financial services consumed by the government. Includes intra-government liabilities for disaggregated units.
  4. Subsidies: unrequited transfers to enterprises based on production activities. *Includes implicit subsidies of central banks.*
  5. Social Benefits: current transfers receivable by household related to social risks. These include: sickness, unemployment, retirement, housing, and education.
  6. Other: transfers not otherwise classified, non-interest property expense, premiums and fees on nonlife insurance schemes.

C Macroeconomic Aggregates Data- World Development Indicators (WDI)

We merge in several Macroeconomic variables from the World Development Indicators. They are as follows with the specific series as listed when using "wdiopen" package in STATA given in parenthesis. Government Consumption (ne.con.govt.zs); Household Consumption (ne.con.petc.zs); Exports (ne.exp.gnfs.zs); Imports (ne.imp.gnfs.zs); Real GDP per Capita (ny.gdp.pcap.kn); Interest Rate (fr.inr.rinr); Population (sp.pop.totl); and Real Exchange Rate (px.rex.reer). All variables we study are transformed into log-per capita terms and detrended with the exception of net exports, the interest rate, and the real exchange rate.

D Inequality Data

D.1 Global Financial Inclusion Database (Global Findex)

We use data from the Global Findex to calibrate the share of "rich" and "poor" in our model economies. Our model definition of rich is a household that can own shares of the capital stock. Effectively, it leaves the poor households in our model as "hand-to-mouth" households- they cannot save. By this logic, our measure of this concept of rich households in the data is the share of households who saved any money in a financial institution in the given year (2011).[32]

D.2 Pinkovskiy & Sala-i-Martin (2009)

We use data provided by the authors of the paper "Parametric Estimates of the World Distribution of Income" to construct measures of income inequality. Pinkovskiy & Sala-i-Martin estimate log-normal distributions of income for the countries we study. Using these parametric distributions, we calculate the share of income earned by the rich, where the share of rich and poor households satisfy the model-consistent definition using the Global Findex.

[32]Statistics for Norway and Switzerland are from 2014, due to no availability in 2011.

Table 14: Sector Definitions

Country	Sector	Macro Agg.	Fiscal Comp.	Country	Sector	Macro Agg.	Fiscal Comp.
Austria	Central	1980-2015	1995-2015	Israel	General	1980-2015	2000-2015
Belgium	General	1980-2015	1995-2014	Italy	General	1980-2015	1995-2014
Bolivia	Central	1980-2015	1990-2007	Luxembourg	General	1980-2015	1999-2015
Brazil	Central	1980-2015	1990-2014	Netherlands	General	1980-2015	1995-2015
Canada	General	1980-2015	1990-2015	New Zealand	Central	1980-2015	2001-2015
Chile	General	1980-2015	2000-2015	Poland	General	1980-2015	1995-2015
Czech Rep	General	1980-2015	2000-2015	Portugal	General	1980-2015	1995-2014
Denmark	General	1980-2015	1995-2015	Romania	General	1980-2015	1995-2014
Dom. Rep	Central	1980-2015	1993-2015	Slovak Rep	General	1980-2015	1995-2015
Finland	General	1980-2015	1995-2015	Spain	General	1980-2015	1995-2014
Germany	General	1980-2015	1991-2014	Sweden	General	1980-2015	1995-2015
Greece	General	1980-2015	1995-2014	Thailand	General	1980-2015	2000- 2015
Hungary	General	1980-2015	1995-2015	U.K.	General	1980-2015	1990-2014
Iceland	General	1980-2015	1998-2015	Uruguay	Central	1980-2015	1990-2015
Ireland	General	1980-2015	1995-2015				

The time span for Macro Aggregates is based on availability of GDP and its components: Private Consumption, Investment, and Net Exports from the World Development Indicators Database. The time span for Fiscal Components from the Global Financial Statistics Database is based on the availability of consistent measures for social transfers.

E Sample Selection and Detrending

Sample. Our sample selection algorithm is as follows. We begin with all countries that have WDI data we require available for the time period 1980-2015 (126 countries). We then exclude countries with a Penn World Table v9.0 data quality grade of "C" or worse.[33] Next, we drop countries that do not have a consistent measure of social transfer data for 15 consecutive years within our time-frame. From the remaining 34 countries, we exclude Norway and Bahrain due to their unique situation as heavy oil-exporting countries with high government involvement in these industries. We exclude Australia due to accounting rule changes that introduce a spurious time break in the middle of the sample. We exclude Nicaragua as an outlier. This leaves our 30 country sample.

Emerging vs Developed Classification. We classify each country within this dataset as Emerging/Developed if it falls under the IMF classification of "Emerging and Develop-

[33]See Feenstra et al. (2015) for a description of Penn World Tables

Table 15: Cyclical Properties of Fiscal Policy

Variable	Linear Quadratic		First Differences	
	Emerging	Developed	Emerging	Developed
std(Gov Expenditure)/sd(GDP)	2.28	2.09	2.04	1.52
corr(Gov Expenditure), GDP)	0.24	-0.07	0.16	-0.04
std(Gov Revenue)/sd(GDP)	2.49	2.10	2.93	1.39
corr(Gov Revenue, GDP)	0.75	0.65	0.69	0.64
std(Social Transfers)/sd(GDP)	3.02	1.50	2.81	0.83
corr(Social Transfers, GDP)	0.19	-0.35	0.36	-0.46
std(Goods Expenditure)/sd(GDP)	3.60	2.54	3.54	1.96
corr(Goods Expenditure, GDP)	0.17	0.04	0.11	0.07

Group mean of country-level statistic. All variables are the residual from a linear quadratic trend and are in real per-capita terms.

Table 16: Cyclical Properties of Macroeconomic Aggregates

Variable	Linear Quadratic		First Differences	
	Emerging	Developed	Emerging	Developed
$std(\hat{Y})$	4.72	3.55	3.27	2.34
$std(\hat{C})/std(\hat{Y})$	1.25	0.83	1.33	0.80
$corr(\hat{NX}, \hat{Y})$	-0.30	-0.17	-0.30	-0.17

Group mean of country-level statistic. All variables are the residual from a linear quadratic trend and are in real per-capita terms.

ing"/"Advanced", respectively. [34] In our sample, 17 countries are classified as developed and 13 are classified as emerging.

Detrending. We identify the "business cycle" component of the following time series as deviations from a country-series-specific linear-quadratic trend. The alternative detrending of the data only makes our results on the differences in cyclicality of social transfers even stronger.

[34] A few of the countries change classification from emerging to developed in the middle of our time period: Iceland, Israel,and the Slovak Republic. We classify them as "Emerging".

F Model equilibrium conditions (for on-line publication only)

The variable in the dynamic model are expressed in logs if we know their steady-state value must be positive. These equations are provided as input into Dynare to find model's decision rules using first-order approximation around the steady-state.

Production function:

$$y_t = z_t + \alpha \log K_{t-1} + (1-\alpha) \log L_t \tag{F.1}$$

where

$$L_t = N^R \exp(\ell_t^R) + N^P \gamma \exp(\ell_t^P)$$

and

$$K_{t-1} = N^R \exp(k_{t-1})$$

Law of motion for capital stock:

$$\exp(k_t) = (1-\delta)\exp(k_{t-1}) + \exp(x_t) - \frac{\phi}{2}\left(\exp(k_t - k_{t-1}) - 1\right)^2 \exp(k_{t-1}) \tag{F.2}$$

Interest rate = world interest + country spread:

$$r_t = r_t^{USA} + cs_t \tag{F.3}$$

Intra-temporal Euler equations:

$$\chi \exp(\ell_t^R)^\nu = w_t^R \exp(-\tau_{\ell,t}^R)\exp(-\tau_{c,t}) \tag{F.4}$$

$$\chi \exp(\ell_t^P)^\nu = w_t^P \exp(-\tau_{\ell,t}^P)\exp(-\tau_{c,t}) \tag{F.5}$$

where the wages are given by:

$$w_t^R = (1-\alpha)\cdot \exp(y_t)/L_t, \qquad \text{and} \qquad w_t^P = \gamma w_t^R$$

Aggregate consumption:

$$\exp(c_t) = N^R \cdot \exp(c_t^R) + N^P \cdot \exp(c_t^P) \tag{F.6}$$

NIPA identity:

$$\exp(y_t) = \exp(c_t + \tau_{c,t}) + N^R \exp(x_t) + NX_t \tag{F.7}$$

where

$$NX_t = (a_t - \exp(r_{t-1}) * a_{t-1}) * NR$$

Trade balance over GDP ratio:

$$nxy_t = NX_t / \exp(y_t) \tag{F.8}$$

Inter-temporal Euler equation for capital stock:

$$U_{c,t} \cdot (1 + \phi \cdot (\exp(k_t - k_{t-1}) - 1)) = E_t \beta U_{c,t+1} \left\{ (1 - \delta) + r_{t+1}(1 - \tau_{k,t+1}) + \frac{\phi}{2} \left(\exp(k_{t+1} - k_t)^2 - 1 \right) \right\} \tag{F.9}$$

Inter-temporal Euler equation for international borrowing and lending:

$$U_{c,t} = E_t \beta U_{c,t+1} \exp(r_t) \frac{1}{1 - \frac{\kappa}{2} (\bar{a} - a_t)} \tag{F.10}$$

Poor households' budget constraint:

$$\exp(c_t^P + \tau_{c,t}) = w_t^P \exp(-\tau_{\ell_t}^P) \exp(\ell_t^P) + \frac{TR_t}{N^P} \tag{F.11}$$

Stochastic processes:

$$r_t^{USA} = (1-\rho^R)r^* + \rho^R r_{t-1}^{USA} + \epsilon_t^R \tag{F.12}$$

$$z_t = \rho^z z_{t-1} + \epsilon_t^z \tag{F.13}$$

$$cs_t = \eta^{CS} z_t + \epsilon_t^{CS} \tag{F.14}$$

$$\log(TR)_t = \log \overline{TR} + \eta^{TR} z_t + \epsilon_t^{TR} \tag{F.15}$$

$$\hat{\tau}_t = \eta^{TAX} z_t + \epsilon_t^{TAX} \tag{F.16}$$

where $r^* = -\log(\beta)$.

F.1 Steady-state

The variables in this part are expressed in levels. The equations characterizing the steady-state of the economy are as follows:

$$\begin{aligned}
Y &= (N^R \cdot k)^\alpha (N^R \ell^R + N^P \gamma \ell^P)^{1-\alpha} \\
Y &= (N^R \cdot c^R + N^P \cdot c^P)\exp(\tau_c) + N^R \cdot \delta k + N^R \bar{a}(1-\exp(r^*)) \\
c^P \exp(\tau_c) &= \gamma MPL \exp(-\tau_\ell^P)\ell^P + \overline{TR}/N^P \\
\chi(\ell^R)^\nu &= MPL \exp(-\tau_\ell^R)\exp(-\tau_c) \\
\chi(\ell^P)^\nu &= \gamma MPL \exp(-\tau_\ell^P)\exp(-\tau_c) \\
1 &= \beta\left(1-\delta+(1-\tau_k)\alpha\frac{Y}{N^R \cdot k}\right)
\end{aligned}$$

where $MPL = (1-\alpha)Y/(N^R\ell^R + N^P\gamma\ell^P)$.

In the system of six equations above there are six unknowns: Y, k, ℓ^R, ℓ^P, c^R, c^P. The steady-state values of all other endogenous variables can be then recovered from the remaining model equations. The values of $\overline{TR}$, τ_c, τ_k, τ_ℓ^R, τ_ℓ^P, and γ are jointly calibrated to make sure that the model steady-state targets are identical to data averages (see Section 4.1).