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Imperfect Financial Markets, External Debt, and the Cyclicity of Social Transfers

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Imperfect Financial Markets, External Debt, and the Cyclical of Social Transfers

Maren Froemel*

July 23, 2013

PRELIMINARY

Abstract

This paper deals with optimal government spending over the business cycle in the presence of financial frictions. I document evidence that government expenditure tends to be more procyclical the higher are a country's borrowing cost. Decomposing government expenditure components shows that the cyclical correlations of social transfers and insurance spending are the most important in driving cross-country differences. I build a simple model of optimal fiscal policy and income inequality where government spending is financed by taxation and by external debt in form of a risk free bond. Government spending consists of a public good providing direct utility, and of transfers to private agents. Transfers are used for redistribution and to smooth low income agents consumption. The government is benevolent but cannot commit to repay its debt. This generates endogenous risk premia due to default risk, which act like borrowing constraints. The government runs a procyclical tax policy in the neighborhood of the constraint and a countercyclical policy when it does not face risk premia. Transfer policy is procyclical also for some debt levels for which risk premia are zero. The government already anticipates a borrowing constraint in case of an enduring recession. Since it cannot borrow easily without hitting the borrowing constraint quickly, transfers cannot fulfill their role of consumption smoothing, but only redistribute income to some extent. In contrast, government spending on public goods is always procyclical. The result is stronger the higher the inequality in income.

JEL classification: E62, F34, F41.

Keywords: Procyclical fiscal policy, default risk, redistribution, emerging markets.

1 Introduction

Why is government expenditure countercyclical in countries with high GDP per capita and better access to international financial markets? In this paper I argue that the extent to which a government can use international financial markets for smoothing revenue and expenditure is important in determining the cyclical of government spending. In particular, market conditions affect mostly government spending that is supposed to facilitate private consumption smoothing. I use a break down of government spending according to economic function, such

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as health, defense, social assistance, and public order. Government spending that is targeted towards a certain group of the population - such as social assistance - has a transfer character and acts as a substitute to private spending. Other spending components - such as defense spending or public order - have a public good character, and are complementary or neutral in a utility sense to private consumption.

Existing studies such as Kaminsky, Reinhart and Végh (2005) or Vegh and Vuletin (2012) focus on the behaviour of total government expenditure. Ilzetki and Vegh (2008) look at both government consumption and government expenditure, and find that the cyclical behaviour of government consumption as a function GDP per capita is less clear than that of government expenditure. They conclude that the big difference across countries is in transfers. I use data for small open economies to show evidence that transfer like spending components are countercyclical in rich countries, whereas they are procyclical in the Latin American countries. The cyclical behavior of government transfers and the relative sizes of the spending components determine the overall cyclicity of government spending. On the other hand, government transfers constitute a lower fraction of total government spending in developing countries. Thus, even when during longer periods of good financial conditions for these countries redistributive policies could be set for an overall countercyclical policy, the correlation between government expenditure and GDP might be still be positive due to the minor importance of transfer spending.

I set up a small open economy model with a benevolent government who faces frictions in international financial markets. Government spending is divided into a public good, which optimally comoves with private consumption, and redistributive transfers. The government needs to finance spending using costly taxation. In absence of the borrowing friction, the government uses financial markets to distribute the tax cost optimally over the business cycle and transfers to low income agents are countercyclical. When borrowing constraints bind, transfers are procyclical and total government spending becomes very procyclical.

The aftermath of the recent financial crisis has seen a large number of countries in economic decline. Subsequently many governments are facing rising risk premia due to default risk and find themselves in fiscal distress. In many of these cases, governments embark on some sort of spending cuts program in order to limit or reverse the primary deficit. This runs contrary to the belief that fiscal policy should stabilize economic activity during downturns, which is consistent with countercyclical government expenditure. In developed countries, government expenditure indeed tends to be countercyclical. To a large part this is due to automatic stabilizers. These are spending components that react in order to smooth consumption of private households despite income fluctuations and to maintain aggregate demand. The spending cuts and austerity programs that we observe in countries like Greece were not a regular feature during the past decade, but can find parallels during events like the Great Depression.¹ In contrast, the perceived borrowing constraints and the inability of governments to smooth out recessions by subsidizing private sector spending is usually a more common phenomenon in developing countries and emerging markets.

The recent experience in developed economies confirms the importance of my suggested mechanism, which links procyclical government expenditure and policies to borrowing constraints due to default risk. I argue that these endogenous borrowing constraints can help to explain why governments run procyclical policies during recessions when they anticipate to hit a borrowing constraint, or if they find themselves already unable to issue more debt and need to cut spending. In this case, not only the public goods component of government expenditure falls. This part would optimally fall during recessions, because it is positively correlated with private consumption. When borrowing becomes expensive, governments will also lower transfers during

¹For the experience in the case of Germany, see Fisher and Hornstein (2002) and the references therein.

recessions and fiscal policy becomes strongly procyclical.

This paper contributes to the literature on optimal fiscal policy business cycle models with financial market imperfections. In particular, I show that financial market incompleteness is theoretically and quantitatively an important factor for the correlation of government expenditure components and GDP over the business cycle. Government expenditure tends to be negatively related to GDP over the business cycle in developed countries, and positively in developing economies. The same holds for the menu of assets available to public and private entities to insure against idiosyncratic country risk, the so-called 'incompleteness of financial markets'. Limited access to international financial markets is further restricted by high interest rates (low bond prices).

Neumeyer and Perri (2005) and also Uribe and Yue (2006) find these to be highly countercyclical in emerging markets and many developing countries. They impose the relationship between interest rates and GDP (total factor productivity) from the data in their model as an exogenous function. The findings suggest that countercyclical interest rates can explain key stylized facts of emerging markets, such as countercyclical current account and the excess volatility of consumption. Papers in the class of Arellano (2008) and Cuadra, Sanchez and Saprizza (2010) try to explain jointly the behavior of country interest rates and macroeconomics variables. These models internalize the repayment decision and can thus generate risk premia when the country is expected to default on its debt.

The literature on fiscal policy over the business cycle with a focus on developing countries can be divided into two main strands. The first strand emphasizes political economy frictions. Here, the paper closest to mine is Ilzetzki (2011), who analyzes optimal transfers under political disagreement and stochastic turnover regarding different groups in the population. In his model, transfers are procyclical when disagreement, or 'ethnic polarization', is sufficiently high. In contrast to this paper, agents in his model are homogeneous in terms of individual preferences and labor productivity, whereas I study transfers as an insurance and redistributory device in the presence of income inequality. In his model, redistribution happens solely because the government does not place a positive weight on all agents. As a consequence the welfare gain from the public good that goes to a part of the population more than offsets the welfare loss from taxation, because the remaining agents do not enter the objective function of the government. Furthermore, the government in the model has commitment to repay its international obligations, so it can borrow and save freely at the risk free rate. Lastly, the model predicts a positive comovement between the tax rate and wages, whether or not the government effectively faces a borrowing constraint. This is partly at odds with the literature emphasizing a countercyclical relation during severe macroeconomic recessions.

The second strand focuses on the role of budgetary constraints for the cyclical properties of fiscal policies. In a widely cited paper, Aizenman, Gavin and Hausmann (2000) analyze a two period model of tax policy with endogenous credit constraints due to default risk. They show that when bond spreads rise during a recession, the government increases the tax rate when (partial) default is still too costly. The model cannot make any quantitative statements on the probability of those situations to occur. More recently, some authors have developed quantitative business cycle models with credit constraints. Cuadra et al. (2010) find that the endogenous borrowing constraints that arise due to the default option for the government, optimal tax policy becomes procyclical when the constraint starts binding, while government consumption is procyclical regardless of the introduction of a borrowing constraint. The authors use a representative agent model with government consumption only and thus cannot provide a further breakdown of government expenditures as I do here.

Recently, Golosov and Sargent (2012) have studied optimal redistribution using a closed economy with income inequality and domestic debt. In their model, the government can borrow and save with agents who can use a risk free bond to (partly) insure against aggregate risk. The authors find that the level of public and private debt are indeterminate in this economy, due to the presence of lump-sum transfers and the desirability of redistribution. Furthermore, tax smoothing now needs to be traded off with redistribution, which is contrary to the result in the corresponding economy with a representative agent. My model differs in several dimensions: first, I do not allow agents to borrow. Second, I assume that the government can target transfers towards low income households. Third, I use an open economy and focus on the interactions of borrowing constraints with redistribution.

I introduce income redistribution into a small open economy model to show the impact of external financial market imperfections on the properties of government expenditures. In my model, government spending is financed by costly taxation and facilitated by borrowing and saving in international financial markets. The government can only set a single proportional tax rate on income. Redistribution happens via lumpsum transfers to private household. I illustrate the basic mechanism using the extreme cases of autarky and complete international financial markets. Between these two cases government transfers are qualitatively different: they are countercyclical under complete markets, and procyclical in autarky.

To the end of quantitative assessment, I use an incomplete markets economy where an additional friction arises because the government cannot commit to repay its debts to external creditors. Depending on the level of debt and endogenous risk premia, the economy switches between states of relative financial autarky and insurance. A simulation of the model with data-driven parameter values shows that the presence of borrowing constraints indeed drives the qualitative difference in transfer policy over the business cycle. In the neighborhood of the borrowing constraint, the policy function for bonds flattens out because the government is anticipating the constraint and tries to avoid a sharp drop in consumption. Consequently, international borrowing and saving become less good an instrument to smooth consumption over the business cycle and transfers become procyclical in this area of the distribution of assets. When debt is outside this region, transfers are countercyclical because the government can jointly use taxes and assets to stabilize domestic demand.

I also find that the procyclicality of transfers is higher the tighter is the borrowing constraint for the government. Furthermore, higher inequality exacerbates the procyclicality of public spending, because marginal welfare losses from redistribution are higher and impede insurance policies in the absence of external insurance.

The paper is organised as follows. First, I present data on government expenditure and a break down into different. Then, I set up a model with exogenously incomplete markets and default risk. The mechanism is illustrated. Section 4 contains the numerical solution and and the results from simulating the model. Section 5 concludes.

2 Data

There is a strong positive correlation between the cyclicity of government expenditure and the average external borrowing cost for governments. Figure 2 plots the correlation of the cyclical government spending component with GDP against S&P's foreign currency sovereign credit rating.² Credit rating letters have been encoded into numbers ranging from $AAA = 1$ ("lowest

²Rating as of January 28, 2013.

cost”), to $B- = 16$ (“highest cost”). Countries with a better credit rating, thus lower and less volatile average interest rates, tend to have more countercyclical government expenditures. Borrowing costs are also reflected by a country’s bond spreads. These are higher in developing countries and strongly countercyclical (Neumeyer and Perri 2005).

Total government expenditure is the sum of government consumption expenditure, transfer payments including social security contributions, government investment expenditure and interest payments. A similar graph is in Ilzetki (2011), Kaminsky et al. (2005), and Vegh and Vuletin (2012). The latter use central government data.

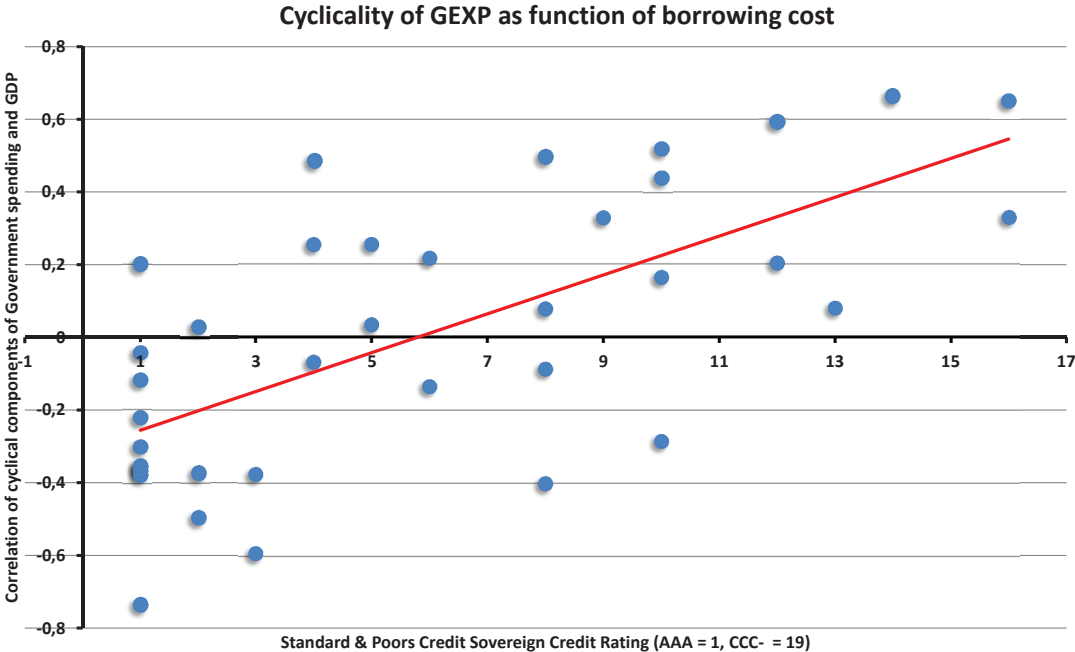


Figure 1: Correlation between cyclical components of total government spending and GDP as a function of sovereign credit rating.
 Source: IMF (2013a), IMF (2013b), OECD, Oxford Economics Database, National Statistics, S&P.

There are several ways of decomposing government spending. The United Nation’s Classification of the Functions of Government [COFOG] is a convenient breakup because it is consistent with my theoretical approach to government expenditure. It divides government spending into categories such as *Defence*, *Health*, *Education*, and most importantly for us *Social protection*.³ Data are bundled according to this classification in the IMF’s Government Finance Statistics, in the EUROSTAT database, and in the General Government Accounts of the OECD.

I present empirical evidence for four variables, *Defence* [GDEFENSE], *General Public Services* [GPUBSERV], *Health* [GHEALTH], and *Social Protection* [GSOCIAL]. The order ranks the categories according to their public good character. I call a public good a good that is non-excludable, non-rivalrous, and whose provision by the government cannot easily be substituted by a decentralized market. *Defence* has the strongest public good character, and *Social protection*. Please consult the appendix with an overview over the remaining categories subject to data availability.

³See <http://unstats.un.org/unsd/cr/registry/regcst.asp?Cl=4&Lg=1&Top=1>, accessed on January 24, 2013.

My sample consists of 17 countries, 8 of which are emerging small open economies: Argentina, Brazil, Colombia, Chile, Mexico, Thailand, Paraguay, and Uruguay. 9 are rich countries: Australia, Austria, Canada, Denmark, Netherlands, New Zealand, Norway, United Kingdom, and the USA. All series are annual and have been filtered using differences in logs. The table below lists the correlation between components of government expenditure and GDP. I chose this method due to the lack of sufficiently long series in several cases to apply a more developed filter, such as the HP-Filter. However, for the series where a comparison was possible, the difference with HP-Filtered series was not qualitative. Rather, the filtering through differencing exaggerates correlations at 'business cycle frequency' as defined by the HP Filter.

	GEXP	GDEFENSE	GPUBSERV	GHEALTH	GSOCIAL
Argentina	0,32753018		-0,01831137	0,2100088	0,419415
Brazil	0,49570163	0,23144137	-0,0006252	0,5016354	0,48017806
Chile	0,48537246	0,35622248	0,02696144	0,52085446	0,18873582
Colombia	0,1635308	0,01623589	-0,16676945	0,05696128	0,07088576
Mexico	0,32649282	0,27819195	0,16944643	0,24600632	0,46833424
Paraguay	0,07919135	n.a.	0,36156168	0,44143726	0,08508199
Thailand	0,07711857	0,19555213	0,12238288	0,18721293	-0,07408101
Uruguay	0,51731804	-0,0772117	-0,15988898	0,18020122	0,34394049
Australia	-0,22182007	-0,23225949	-0,39267209	0,41810859	-0,13939765
Austria	0,02850962	-0,20374675	0,23753728	0,04549469	-0,14437755
Canada	-0,11485444	0,14356734	-0,23897319	0,1786028	-0,40399325
Denmark	-0,35471235	0,11397517	-0,45148735	-0,31357452	-0,20484302
Netherlands	-0,19279696	-0,16638247	0,03326213	0,03420548	-0,1796104
New Zealand	-0,59241916	n.a.	0,12107986	0,25966175	-0,04913966
Norway	-0,35166414	-0,00962319	-0,37500106	-0,08887552	-0,37243331
United Kingdom	-0,30063075	n.a.	0,27095679	-0,22215879	-0,62678866
USA	-0,4964541	0,2225776	0,18713724	-0,37545344	-0,55107401

Table 1: Correlations of government expenditure components and GDP

Table 1 shows the correlations of public spending components with GDP. The countries are grouped by development status (except for lonely Portugal). As we can see, government expenditure is countercyclical or acyclical in our sample of rich countries. We cannot say this for GDEFENSE or GPUBSERVE. Only for GHEALTH and GSOCIAL, strongest for the last category, does a clear pattern as for total expenditure emerge.

I add several figures to argue for the different impact of functional spending components on the cyclicity of government consumption. My argument links the strength of the relationship of category-wise cyclicity compared to that of overall spending and its contribution. Figure 3 plots the relationship between the cyclicity of government expenditure and of GDEFENSE, GSOCIAL, respectively. There is no significant relationship between GDEFENSE and GEXP in this sample. In contrast, GSOCIAL is almost perfectly aligned with GEXP.

Figure 2 shows the intermediate public good categories, GPUBSERV and GHEALTH. There is a relationship between GHEALTH and GEXP, but it is weaker than that of GSOCIAL. For GPUBSERV finally, the relationship is not statistically significant in this sample, but seems to exist at first sight.

The empirical evidence confirms the various roles of different government spending components.

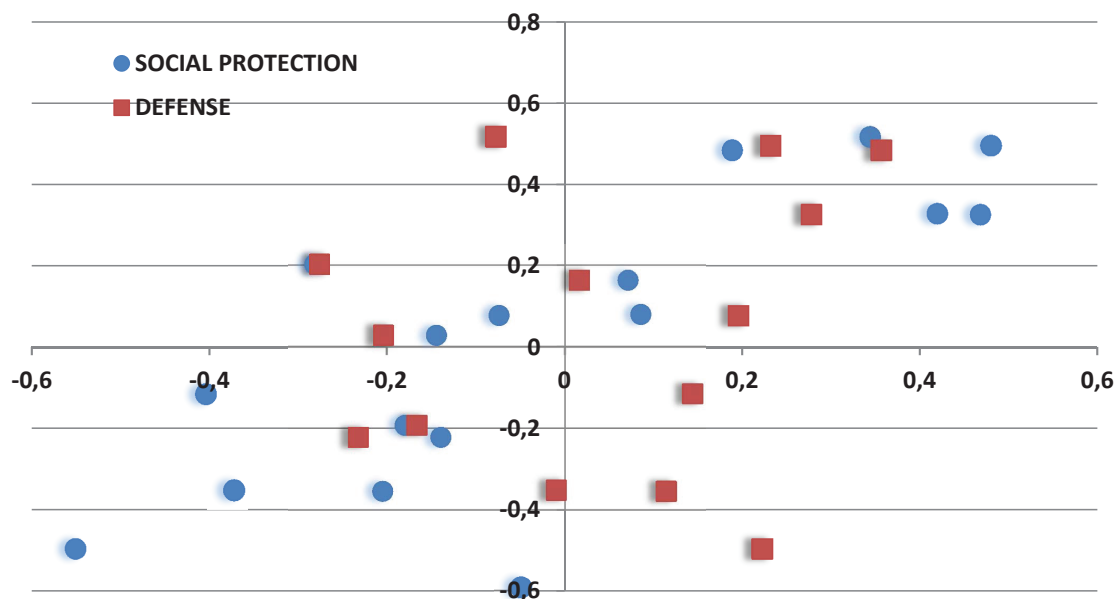


Figure 2: Cyclical correlations of GHEALTH and GPUBSERV. x-axis: correlation of GEXP and GDP.

While the traditional spending components do not seem to greatly influence the overall cyclical-ity of government expenditure, spending components that are a prominent feature of developed economies today are. These are predominantly targeted towards a certain group in the pop-ulation, such as social transfers. Here the development status makes a big difference, and if we see economic development as a proxy for financial development, then financial frictions can contribute to explain fiscal procyclicality along a new dimension.

2.1 External debt

External debt is an important source of government finance in Latin American emerging markets. Table 2 shows figures for 2001 for 18 Latin American countries for total general government debt, and the share of which is external.⁴ Debt in this dataset is external according to the residence of the creditor.

Consistent with **Reinhart and Rogoff [cite paper]**, total government debt overall is moderate in Latin America. Still, a sizeable proportion of debt is issued in a foreign currency and held by foreign creditors. In the case of Mexico, this share has declined substantially over the past 20 years: in 1996, just after the Tequila crisis, the share of external debt was 45%. The role of external finance for the government over the business cycle can thus be stated as important.

⁴The year 2001 has been chosen because the following years are somewhat special due to Argentinian default, and the data coverage in the previous years is more limited.



Figure 3: Cyclical correlations of GDEFENSE and GSOCIAL. x-axis: correlation of GEXP and GDP.

	Total (%)	Share external (%)
Latin America	49	56
LA without Brazil, Mexico, Chile	48	63
Mexico	42	25
Brazil	70	17 ⁵
Chile	14	34

Table 2: Government debt, total and fraction of external, 2001. Source: ECLAC (2013), IMF (2013c), and national central banks.

2.2 The case of Mexico

Table 3 shows basic business cycle characteristics of the Mexican economy, as the benchmark emerging market economy. Table 4 gives a broad overview over the statistics of the aggregates and prices. The data are quarterly from 1980:1-2006:Q4. I construct a real interest rate following Neumeyer and Perri (2005) using the EMBI Global spread for Mexico, the US 90-days T-Bill rate, and expected inflation from the GDP deflator. The effective tax rate is constructed as in Mendoza, Razin and Tesar (1995). The tax revenues are for VAT and taxes on "special goods", respectively. The series are deflated using the GDP deflator. The variables are seasonally adjusted, and filtered using the HP-Filter. For comparison I also report the statistics from Baxter-King filtered series. The data for the aggregate variables are from Banco de Mexico. In particular, I construct a series for transfers to private households and firms as reported in the public sector finance statistics. This measure for 'insurance spending' is imperfect, but it is the

only one currently available at this frequency, so I use it as a proxy for the total.⁶ Transfers to public sector enterprises are subtracted from the total figures. The correlation with GDP is consistent with the one of annual social spending with GDP, considering that frequency and filtering method differ.

The Mexican business cycle is characterized by excess volatility of consumption and much stronger of government expenditure. Furthermore, the interest rate and the trade balance to GDP ratio are countercyclical and there is evidence of procyclical tax and transfer policy. Total expenditure accounts for around 28% of GDP during the period, and transfers are around 5% of total expenditures (1.3% of GDP).

Variable	HP Filter		Baxter-King Filter	
	Std(x) (%)	corr(x,GDP)	Std(x) (%)	corr(x,GDP)
GDP	2.37		2.06	
C	2.90	0.92	2.67	0.94
GEXP	6.32	0.35	3.39	0.4
Transfers	14.03	0.41	14.37	0.41
Tax	0.47	-0.30	0.44	-0.19
TB/Y	2.03	-0.72	1.86	-0.8
R	2.32	-0.36	1.49	n.a.

Table 3: Business Cycle statistics Mexico

	Mean (%)	Median (%)	Std
GEXP/GDP	28.26	27.62	3.19
TRANS/GEXP	4.83	4.92	1.68
TRANS/GDP	1.34	1.35	0.44
C/Y	70.03	69.89	1.98
GCONS/Y	10.58	10.75	0.96
TB/Y	3.39	3.34	0.04
R	7.21	7.29	3.99

Table 4: Basic Descriptive Statistics, Mexico

3 Model

I consider a production economy with heterogeneous agents, a benevolent government and competitive international financial markets with risk neutral investors. The government provides a public good and can give out uniform (non-targeted) transfers to private households. Expenditures are financed by taxing households and by borrowing and saving internationally. Taxation is costly because the government cannot collect lump sum taxes. Instead, it can only levy a proportional consumption tax on households. With elastic labor supply, it is possible that the marginal output loss due to taxation depends positively on total factor productivity. I assume that the government has access to a risk free bond in external financial markets only, and it has no commitment to repay the debt. I build on the small open economy framework with endogenous default risk due to willingness-to-pay as in Arellano (2008), with a Ramsey approach to optimal fiscal policy.

⁶The GFS data with social transfers, health spending, etc., are only available on an annual basis, so I use the category from the economic classification instead.

After the setup of the model, I demonstrate the effect of financial market incompleteness using the two extreme scenarios: complete international financial markets, and autarky, before I report results from simulating the numerical solution of the exogenously incomplete markets model with default risk.

The household sector in the domestic economy is populated by a continuum of agents. The population size is constant and equal to 1. Agents differ according to their labor productivity e^i . e^i can take on two values, $\{e^h, e^l\}$. Households supply labor elastically, and I denote hours worked of household with productivity e^i h^i . There is aggregate productivity risk in the economy, A , such that total pre-tax income is $Ae^i h^i$. A fraction σ has high labor productivity e^h . This fraction can depend on the current realization of total factor productivity, as in Krusell and Smith (1998), where the transition probability into and out of unemployment is a function of aggregate productivity. I assume that A can be represented by a stationary first order autocorrelated process.

Households value their expected lifetime utility, a discounted stream of instantaneous utility functions that depend on consumption and hours worked and on government consumption on a public good:

$$\mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t [\kappa u(c_t^i, h_t^i) + (1 - \kappa)v(g_t^P)],$$

subject to the budget constraint

$$(1 + \tau_t)c_t^i = A_t e^i h_t^i + g_t^T, \quad \forall i = h, l.$$

g_t^P is government spending on a public good, which is additively separable in the utility function. The weights on private and public consumption are κ and $(1 - \kappa)$, respectively. With this formulation, the marginal utility of private consumption is independent of public consumption. Hence, public and private consumption are not complements in the utility function. Still, demand for public consumption will be increasing in private consumption because the utility functions are concave. τ_t is a tax rate on consumption expenditures. g_t^T is a lumpsum subsidy payment from the government. It is not restricted to be positive, but as long as productivity differences are large enough, transfers will optimally be positive. (see section 3.2)

I assume that agents have no access to financial markets. Thus, two interpretations of productivity heterogeneity are possible in this framework: On the one hand, agents can be assumed to be ex ante identical; due to the absence of financial market access their productivity level will be the only relevant state variable. On the other hand, the economy is one of persistent inequality, both in income and in the distribution of skills. Both interpretations are not out of the way for the case of Latin America.

The state variables of the individual problem are A and e^i . The problem in state space form reads:

$$V^i(A, e^i) = \max_{h^i} \kappa u(c^i, h^i) + (1 - \kappa)v(g^P) + \beta \mathbb{E}[V(A', e^{i'}) | A, e^i] \quad (1)$$

subject to

$$(1 + \tau)c^i = Ae^i h^i + g^T, \quad \forall i = h, l. \quad (2)$$

Denote by c^{i*}, h^{i*} the policies that solve the household problem.⁷ The first order optimality

⁷For notational simplicity, we suppress further details. The household policy functions will depend on the tax rate, transfers, aggregate and individual productivity.

conditions of the household satisfy the equations (2) and

$$-\frac{u_n(c^{i*}, h^{i*})}{u_c(c^{i*}, h^{i*})} = \frac{Ae^i}{(1 + \tau)}, \quad \forall i = h, l. \quad (3)$$

Total output net of total factor productivity to $\sigma e^h n^{h*} + (1 - \sigma)e^l n^{l*} \equiv y(A)$, and GDP is $Y \equiv Ay(A)$.

The government can borrow and save in international bond markets with risk neutral creditors. Risk neutral creditors discount future consumption at a constant rate $\delta = (1 + r)^{-1}$. The government likes to front load consumption because the world interest rate is lower than its subjective discount rate: $\beta < (1 + r)^{-1}$. This prevents divergent positive asset holdings in the stationary equilibrium of this economy. It also implies a persistent difference between interest rates in the country and the rest of the world.

The government cannot commit to repay its international obligations. Instead, it can decide in each period whether to default on current outstanding debt or whether to repay. If it defaults, it defaults on all currently outstanding debt and loses access to financial markets. If it repays, it retains market access. Denote by $V^{aut}(A_s)$ the value function of the government if it defaults on its debt given the realization of total factor productivity. $V^{nd}(b_s, A_s)$ is the value function if the government does not default but repays its debt. Default occurs if

$$V^{aut}(A_s) > V^{nd}(b_s, A_s).^8 \quad (4)$$

The default decision is made in the beginning of each period, after the realization of the current productivity state. The value function of the government reads:

$$V^0(b, A) = \max_d (dV^{aut}(A) + (1 - d)V^{nd}(b, A)). \quad (5)$$

where

$$d(b, A) = \begin{cases} 1 & \text{if } V^{aut}(A) > V^{nd}(b, A) \\ 0 & \text{otherwise} \end{cases}$$

International creditors have perfect information about the borrowing countries' fundamentals and anticipate default decisions. Denote by $\pi^{def}(b', A)$ the probability that the country defaults when borrowing b' today. $\pi^{def}(b', A)$ is the sum of conditional probabilities of the future state given the current state A , for which default occurs. There is free entry in the credit market. Thus, creditors set the bond price in order to satisfy the zero profit condition

$$-q(b', A)b' + \frac{(1 - \pi^{def}(b', A))}{1 + r}b' = 0. \quad (6)$$

If $\pi^{def}(b', A)$ is non zero, the bond price falls. If the government wants to roll over its debt, it needs to use additional resources to finance the repayment since creditors are only willing to extend new debt at a discount. Hence default risk leads to endogenous borrowing constraints.

The government maximizes ex ante welfare. A benevolent government will place equal weights on all agents in the population when agents are ex ante identical. When productivity differences

⁸Whenever the government is indifferent between defaulting and repaying, it is assumed that it repays.

across agents are persistent, this problem is the one of a utilitarian government. It chooses optimal policies such that the households' first order conditions are satisfied, and its own budget constraint holds. Define aggregate consumption as

$$C^* = \sum^i \sigma^i c^{*i}.$$

When the government has market access, this budget constraint is

$$g^P + g^T + qb' = \tau C^* + b. \quad (7)$$

If the government defaults on its debt, I follow the literature and I assume that it immediately loses market access and defaults on all outstanding debt. With a constant probability μ it regains access to markets in subsequent periods. It re-enters markets with zero assets and no negative credit history. Furthermore, the country incurs an asymmetric output loss during the default spell. An output cost can be justified by trade embargoes and losses of access to trade credits for exporting firms. I assume as Arellano (2008) that

$$A^d = g(A) = \begin{cases} A & \text{if } A < \mathbb{E}[A] \\ \phi \mathbb{E}[A] & A \geq \mathbb{E}[A] \end{cases} \quad (8)$$

When the government is currently in the state of default, its budget constraint reads accordingly

$$g_d^P + g_d^T = \tau C_d^*. \quad (9)$$

In the following, I set up the government's maximization problem and define the equilibrium in this economy.

3.1 Recursive Ramsey Equilibrium

When the government repays, it chooses a 4-tuple as a function of the governments' state variables (A, b) , $\{\tau(A, b), g^T(A, b), b(A, b), g^G(A, b)\}$. It solves the following maximization problem:

$$V^{nd}(A, b) = \max_{\{\tau, g^T, b', g^G\}} [\kappa \sum_i \sigma^i u(c^{*i}, h^{*i}) + (1 - \kappa)\nu(g^P)] + \beta \mathbb{E}[V^0(A', b')|A, b] \quad (10)$$

subject to

$$-\frac{u_n(c^{*i}, h^{*i})}{u_c(c^{*i}, h^{*i})} = \frac{Ae^i}{(1 + \tau)}, \quad \forall i = h, l. \quad (11)$$

$$(1 + \tau)c^{*i} = Ae^i h^{*i} + g^T, \quad \forall i = h, l. \quad (12)$$

$$g^P + g^T + qb' = \tau C^* + b. \quad (13)$$

$$b_{-1} = 0. \quad (14)$$

The price of consumption is normalized to 1; hence the relative price of output is equal to $(1 + \tau)^{-1}$. Effective insurance payments are therefore equal to $\tilde{g}^T \equiv \frac{g^T}{1 + \tau}$, whereas g^T only measures the output value of the transfer.

When the government defaults, it chooses g_d^P, g_d^T, τ_d as to solve the following maximization problem:

$$V^d(A^d) = \max_{\{\tau_d, g_d^T, g_d^G\}} \left[\kappa \sum_i \sigma^i u(c^{*i}, h^{*i}) + (1-\kappa)\nu(g_d^P) \right] + \beta \mathbb{E}[\mu V^0(A', b') + (1-\mu)V^d(A^{d'}) | A, b] \quad (15)$$

subject to

$$-\frac{u_n(c^{*i}, h^{*i})}{u_c(c^{*i}, h^{*i})} = \frac{A^d e^i}{(1 + \tau_d)}, \quad \forall i = h, l. \quad (16)$$

$$(1 + \tau)c^{*i} = A^d e^i h^{*i} + g^T, \quad \forall i = h, l. \quad (17)$$

$$g_d^P + g_d^T = \tau_d C^*. \quad (18)$$

Denote by d, nd , the policy functions for default and repayment, respectively. The aggregate state of the economy is defined as $s \equiv \{b, A\}$.

Definition: Recursive ramsey equilibrium

A recursive ramsey equilibrium in this economy is a set of policy functions for households $\{c_k^i(s), h_k^i(s)\}$, $k = \{d, nd\}$, $i = \{h, l\}$, the government, $\{g_k^T(s), g_k^P(s), b(s), \tau(s), d(s)\}$, and a bond price policy function $q(s)$, such that

- (a) Given bond prices and government policies, the household policy functions solve the households' maximization problem summarized by (2) and (3).
- (b) Given bond prices and household policies, the government policies solve the government's maximization problem in (10)-(14), and (15)-(18).
- (c) Lenders' beliefs are consistent with default probabilities and the resulting bond prices satisfy the zero profit condition in (6).

In what follows, I assume that household preferences are of the GHH (1988) form:⁹

$$u(c, h) = \frac{(c - \frac{h^{1+\frac{1}{\psi}}}{1+\frac{1}{\psi}})^{1-\gamma}}{1-\gamma} \quad (19)$$

These preferences assume away a wealth effect on labor supply - the marginal rate of substitution between consumption and hours worked is independent of consumption. I make this assumption for two reasons: first, it simplifies the analysis by abstracting from direct supply side effects of transfers. Second, these preferences have been shown to match the stylized facts of small open economies quite well. The elasticity of hours worked with respect to the wage rate is constant and equal to ψ .

Optimal hours worked can be solved for using the marginal rate of substitution directly:

$$h^{*i} = \left[\frac{A_t e^i}{(1 + \tau)} \right]^\psi, \quad \forall i = h, l. \quad (20)$$

And consumption becomes, using households' budget constraint:

⁹Greenwood, Hercowitz and Huffman (1988).

$$c^{*i} = \left[\frac{A_t e^i}{(1 + \tau)} \right]^{\psi+1} + \frac{g^T}{1 + \tau}, \quad \forall i = h, l. \quad (21)$$

Furthermore, note that

$$\frac{\partial h^i}{\partial \tau} = -\psi \frac{1}{(1 + \tau)} h^i \quad (22)$$

and define the elasticity of labor supply in response to the tax rate $\xi_{h^i, \tau}$ as

$$\xi_{h^i, \tau} = \frac{\partial h^i}{\partial \tau} \frac{\tau}{h^i} = -\psi \frac{\tau}{(1 + \tau)}. \quad (23)$$

The first aggregate condition (when the government has market access) is the Euler equation which determines aggregate consumption dynamics:

$$(1 - \kappa) v'(g) \left[q(b', A) + b' \frac{\partial q(A, b')}{\partial b'} \right] = \beta \mathbb{E}_{A': d(A', b')=0} (1 - \kappa) v'(g') \quad (24)$$

There are two interesting aspects of this equation are. The first is the right hand side. When choosing bond policy today, marginal utility of government consumption is equalized only with marginal discounted expectation of future marginal utility in the states when the government repays. This is of course because there is no inter temporal decision to be made when defaulting, and the allocation is not time dependent, so it does not affect the bond choice directly. The effect is only through the interaction with transition and default probabilities, and the bond price.

Secondly, the pricing term on the left hand side shows the effect of default risk as a borrowing constraint on consumption. $b' \frac{\partial q(A, b')}{\partial b'}$ is zero whenever the country is not going to default on its debt in any state in the future. However, when $\pi^{def} > 0$ for some A given b' , then the derivative will positive. Since $b' < 0$, the whole term falls. Hence, ceteris paribus, when the bond price falls due to a risk of default (and does so when debt increases), marginal utility is higher: the government needs to cut down consumption when the borrowing constraint starts binding.

Equation (25) is the optimal choice of the tax rate. The aggregate distortion on output and hence labor supply, summarized by the elasticity of labor supply with respect to the tax rate, must equal the deviation from the socially optimal allocation of risk sharing, weighted by individual consumption and output, respectively. In other words, the tax rate is set such that the difference in marginal utilities in consumption units, corresponds to the marginal utility cost of the output loss due to the tax distortion, converted to output units. The elasticity is constant *for a given tax rate*, and it is increasing in the tax rate (equation (23)). Thus, the distortion due to the taxation of labor supply and the welfare loss are convex in τ .

$$\sum_i \sigma^i [\kappa u_c^i(c^i, h^i) - (1 - \kappa) v'(g^P)] c^i = (1 - \kappa) v'(g^P) A \sum_i \sigma^i \epsilon^i h^i \xi_{h^i, \tau}. \quad (25)$$

Lastly, (26) shows the optimal choice of the lump sum transfer. The government chooses the transfer such that the weighted sum of marginal utilities from consumption equal the marginal utility from spending on the public good. It is important to note that there is no restriction on the positivity

$$\kappa \sum_i \sigma^i u_c^i(c_t^i, h_t^i) = (1 - \kappa)v'(g^P). \quad (26)$$

Whether or transfers are optimally positive depends on parameter values. Using benchmark parameter values, I will illustrate optimal taxes, transfers, and implications for redistribution in section 3.2.

The extent to which the government can use international financial markets also determines residual idiosyncratic income risk. If financial markets are a good instrument to smooth consumption, borrowing and saving will be a complementary instrument to the tax rate. Public consumption is not an instrument to help smooth private consumption, as its demand by private households is complementary to their own consumption.

There is no analytical solution to this problem, so I will use a stylized version of the model to demonstrate how the limit to market access affect the cyclical behavior of transfer policy in 3.3. I confront a closed economy with a world of a full set of state contingent assets. Results for the numerical solution of the model with a tentative calibration are presented and discussed in section 4.

3.2 Redistribution with lump sum transfers

When is it optimal for the government to give out positive transfers to agents? And what is the implication for after tax, or consumption inequality depending on the dispersion of individual productivity levels? This section addresses these questions quantitatively. I assume that parameter values are as in section 4. Apart from total factor productivity, which is set to 1 (its long run average value), and the 90/10 earnings ratio, which is varied for the exercise. The government's foreign assets are equal to zero.

Despite the inability of the government to condition policy instruments on household characteristics, redistribution is achieved by a uniform vertical downward shift of the total net tax paid. This corresponds to a counter-clockwise tilting of the curve describing the relationship between disposable income (which is equal to consumption in this model) and gross earnings. Figure 4 describes this relationship.

While a lump sum transfer in general narrows the gap between disposable income and earnings, How is the incidence distributed across agents, and how is it affected by the degree of (productivity) inequality in the economy? Figure 5 shows the ratio between earnings and disposable income as a function of the 90/10 earnings ratio.

The relationship is nonlinear. For a low degree of inequality, the government uses her instruments in favor of high productivity agents, and low productivity agents suffer disproportionately more than high productivity agents. The relationship is reversed and 'gross redistribution' occurs at an earnings ratio around 2.5. Figure 6 shows that this is the critical value for the existence of nonnegative transfers.

However, gross redistribution does not imply that low income households are effectively subsidized, that is, have a higher disposable income than gross earnings. This case occurs at an

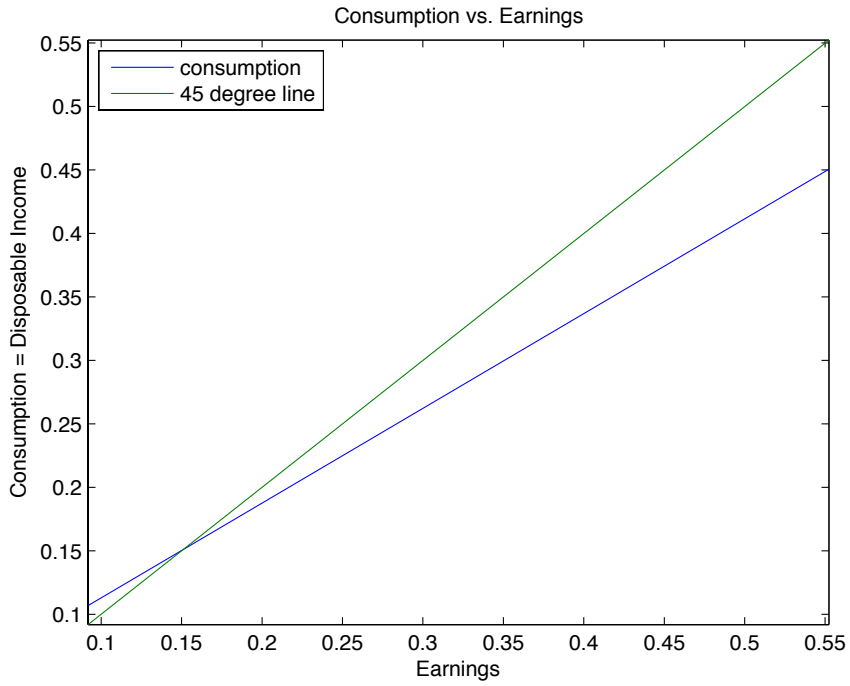


Figure 4: Redistribution with constant marginal tax rates and lumpsum transfers: Disposable Income and Earnings, 90/10 Earnings ratio of 6.

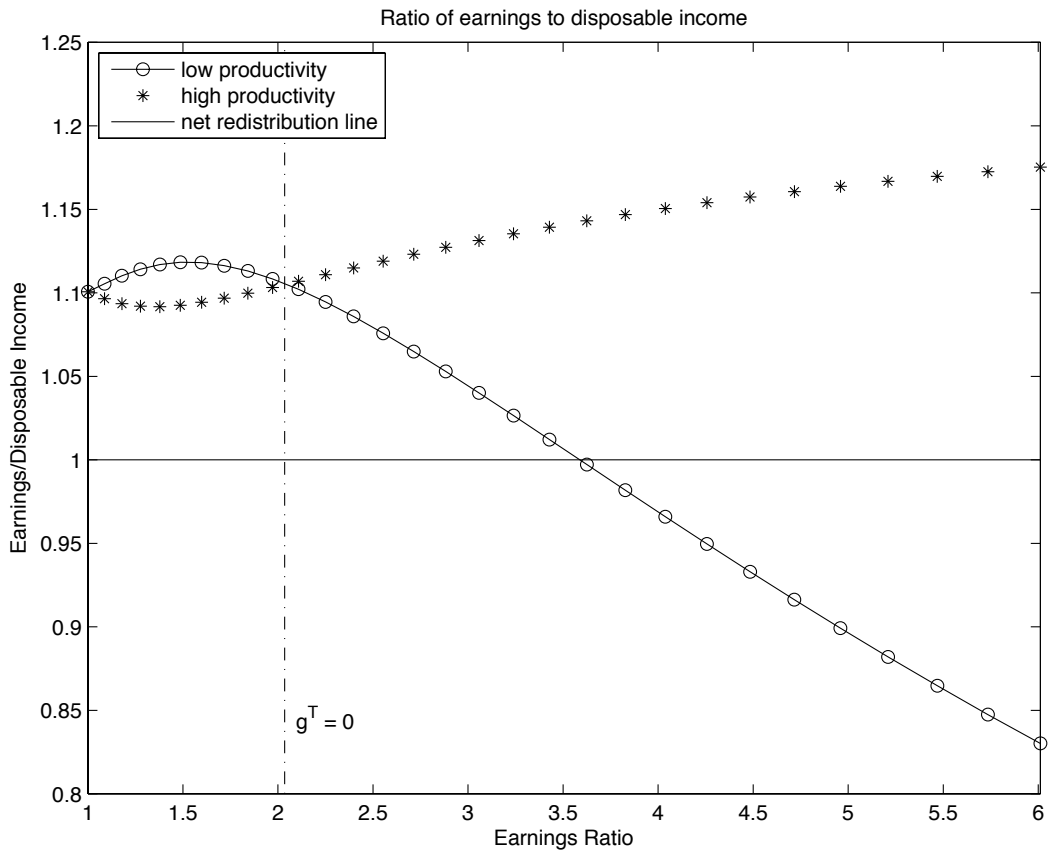


Figure 5: Redistribution with constant marginal tax rates and lumpsum transfers: Ratio of disposable income and earnings, 90/10 as a function of the earnings ratio.

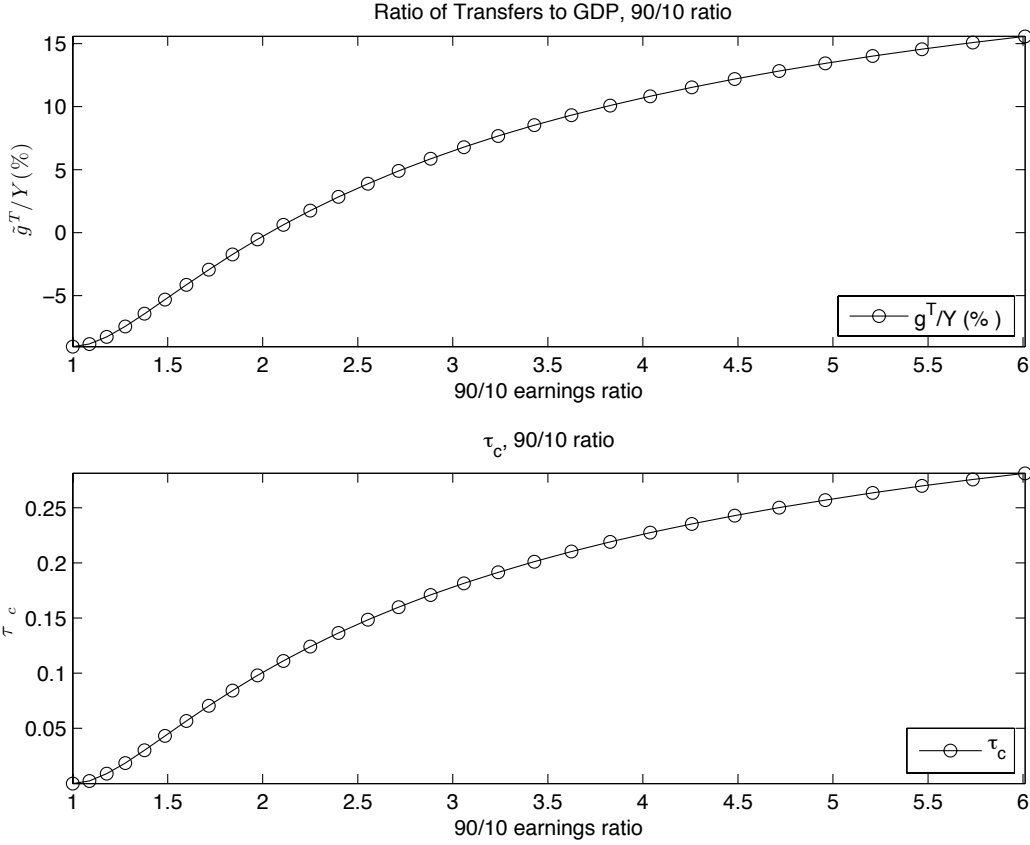


Figure 6: Redistribution with constant marginal tax rates and uniform transfers: The tax rate and transfer spending as a fraction of GDP as a function of the earnings ratio. Top: Transfer to GDP ratio. Bottom: Tax rate.

earnings ratio around 4.5. For all degrees of inequality beyond this point, the government effectively subsidized the bottom 10% of the income distribution. As inequality increases, both the ratio of transfers to GDP and the tax rate increase because it becomes more costly for the government to tolerate consumption inequality. As labor supply is elastic and also implies a welfare loss that is increasing in the level of the tax rate, both functions are concave in the earnings ratio.

Empirically, the model has some relevance, as the region of net subsidies attained for a broad range of countries: For instance, the 90/10 earnings ratio for the US is around 8 (Golosov and Sargent, 2012). In Mexico, the ratio for equalized household income is around 8 (SEDLAC). Effective income tax rates are negative for the lowest income decile in many countries.

3.3 Polar Cases: Full Insurance and Autarky

The parameter values (except for the earnings ratio, i.e. individual productivity levels) are the same as in table 5 in section 4. This section derives analytical results for the two polar cases of full insurance and financial autarky. Throughout this part, I assume that the earning ratio is such that g^T is positive.

Under full insurance, the government has access to a full set of state contingent assets that it can trade with competitive risk neutral investors. There are no commitment problems. Hence, there is no aggregate risk in the economy, and the marginal utility cost of resources is constant.

The price of an arrow security for the productivity realization A^r when the current realization is A^u is $\beta\pi(r|u)$, with $\pi(\cdot)$ is the conditional switching probability. From the Euler equation,

$$\nu'(g^P(r)) = \nu'(g^P(u)), \quad \forall r \neq u.$$

The risk sharing condition implies for households that

$$\sigma\Delta u_c(c^h, h^h) = -(1 - \sigma)\Delta u_c(c^l, h^l). \quad (27)$$

The optimal policy either equalizes marginal utilities of consumption across states, or sets taxes and transfers such that marginal utilities move in opposite directions. Consider a policy that implies a procyclical $u_c(c^l, h^l)$, and a countercyclical $u_c(c^h, h^h)$. Since agents are risk averse, this implies that the change in consumption for the low productivity agent needs to be strictly lower than for the high productivity agent, which points towards higher transfers during periods of low aggregate productivity. On the other hand, because $e_h > e_l$, the income change will be larger for high productivity agents, implying a larger change in consumption keeping transfers constant. Finally, higher transfers mean that taxes cannot be decreased by as much because the government cannot finance both public good spending and transfers via external finance. Hence, transfers will be countercyclical only if the insurance motive for the government is strong enough and the additional welfare cost from taxes are moderate.

Proposition Under complete markets, the government provides consumption insurance to low income agents. Their marginal utility of consumption is procyclical, whereas that of high income agents is countercyclical. This policy is associated with countercyclical \tilde{g}^T .

$$\frac{\partial MUC(h)}{\partial A} > 0, \frac{\partial MUC(l)}{\partial A} < 0 \quad \Leftrightarrow \frac{\partial \tilde{g}^T}{\partial A} < 0. \quad (28)$$

A necessary condition for this to hold is that the government chooses not to undo productivity shocks completely using taxes. Since taxes are distortionary, such policy does not solve the ramsey problem independently of the assumption on market access.

$$\xi_{\tau,A} \frac{\tau}{1+\tau} = \frac{\partial \tau}{\partial A} \frac{\tau}{1+\tau} < 1 \quad (29)$$

Proof: See appendix B

In autarky, there is no possibility to smooth income. the marginal utility cost of resources and public consumption vary with aggregate productivity. It is optimal for the government to keep the tax rate constant with productivity.¹⁰ The proceeds are used to finance public good expenditure and transfers, which are procyclical due to procyclical revenues and the public good spending pattern.

The left panel in figure 3.3 shows the optimal tax as a function of GDP for autarky and complete markets, respectively. Optimal transfer policy is depicted in the right panel. While the tax rate remains constant under autarky it comoves with GDP. Transfers are countercyclical under complete markets because the government insures private agents against aggregate shocks.

¹⁰See appendix C

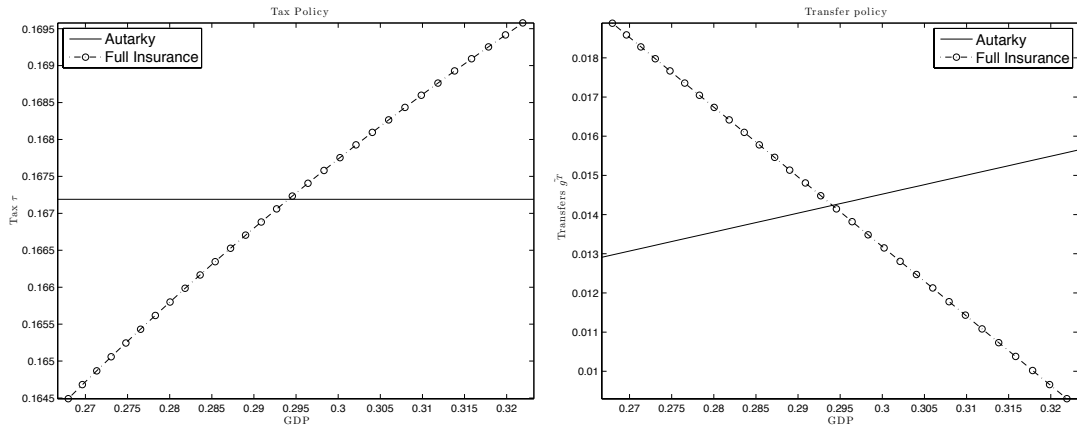


Figure 7: Optimal taxes (left) and transfers (right) as a function of GDP, different financial market environments. Autarky.: solid line. Full insurance: circles.

4 Numerical Solution and Results

We assume that the utility functions has CRRA:

$$u(c) = \frac{(c - \frac{n}{1+\frac{1}{\psi}})^{1-\gamma}}{1-\gamma}, \quad \nu(g) = \frac{g^{1-\gamma_g}}{1-\gamma_g}. \quad (30)$$

Total factor productivity is stochastic, and it follows a lognormal AR(1) process.

$$\log(A_t) = \rho \log(A_{t-1}) + \epsilon_t, \quad \epsilon_t \sim N(0, \sigma_\epsilon) \quad (31)$$

We assume the following parameter values:

parameter	value	target
γ, γ_g	2	coefficient of relative risk aversion
σ	0.2	share of high productivity agents
β	0.97	$std(G)/std(Y)$
r	0.01	risk free interest rate
κ	0.875	share of public good
e^h, e^l	1, 0.5	earnings ratio 90/10
ρ	0.85	GDP volatility Mexico
σ_ϵ	0.0675	GDP volatility Mexico
μ	0.1	average time spend in default
θ	0.99	debt service to GDP ratio

Table 5: Parameter values for model

The stochastic process is discretized following Tauchen and Hussey (1991), using 20 states for aggregate productivity. The incomplete markets model is solved with value function iteration. The statistics below are from simulating the model 1000 times for 100 periods, discarding the first 50. The series have then been filtered using the HP-Filter. The model is calibrated to the Mexican economy. Persistence parameter ρ and standard deviation of the innovation σ_ϵ are set as to match the output volatility in Mexican data for the period 1980Q1-2007Q1.

β , the countries' exogenous discount factor, calibrates the relative volatility of public consumption relative to GDP. The coefficient for relative risk aversion of the private sector is a value

commonly used for small open economy models of emerging markets. I follow Cuadra et al. (2010) and set the coefficient of relative risk aversion for public good also to $\gamma_g = 2$. The share of high productivity agents reflects the 20% upper part of the earnings distribution. The ratio between e^h, e^l approximate the degree of earnings inequality. (SEDLAC 2013) The Frisch elasticity of labor supply, ψ is set to 2, which is between the values of Greenwood et al. (1988) and Cuadra et al. (2010). κ is set as to match the ratio of public good to insurance spending spending 40% for the period 1980-1998. I calibrate the asymmetric output loss in (8) such that the model generates an average debt service to GDP ratio of around 4.5%. μ is taken from Cuadra et al (2010) who use results from the literature on average time without market access.

4.1 The role of default risk

Default risk has several effects in this model. First, it endogenously limits the debt that can be accumulated by the country. Second, it potentially limits the government's ability to smooth income when the bond price falls and an endogenous borrowing constraint starts binding. If the government cannot borrow when it incurs a series of bad shocks, transfers cannot be 'smoothed', that is - in this model - set in a procyclical fashion. When borrowing constraints are slack, the correlation of transfers and GDP is lower than when they are tight. Thus, this model shows that borrowing constraints lead to more procyclical transfer policies and strongly procyclical government expenditure.

The policy function for transfers and bond holdings illustrate the mechanism. Figure 8 plots the policy function for bonds for high and low aggregate productivity, respectively. As we get closer to the borrowing constraint, the policy function for low aggregate productivity flattens out. Hence, relative to a situation when the country finds itself further away from the borrowing limit (with higher asset levels), it is optimal to borrow less in order to make it less costly when the borrowing constraint is eventually hit. In this model, the government already anticipates higher borrowing costs when it has assets, so the distance between borrowing during good and bad times becomes smaller quite quickly.

The endogenous borrowing constraint and its anticipation also affect the policy function for transfers and taxes. I start to discuss transfers, which are plotted in figure 9. For higher levels of assets, the government borrows unconstrained during bad times and pays out more transfers to low income households. However, when the policy function for bonds starts flattening out, the relationship reverses for transfers during good and bad times. Now the government does not borrow enough during bad times in order to run a countercyclical transfer policy and relatively more resources are allocated to cutting back borrowing. The gap between transfers during good and bad times is widening the closer asset holdings approach the borrowing constraint.

The graph includes an indicator for a positive spread (dashed line). The policy function for transfers is steeper during low productivity realizations throughout the range plotted in the graph. The slope increases further when bond policy becomes flat in the immediate neighbourhood of the borrowing constraint, and when the spread becomes positive. This illustrates the gradual adjustment of government expenditure to anticipated and acute financing restrictions. The actual bond price is plotted in figure 14. When the country defaults (to the left of the current graph), transfers jump as a result of the wealth effect in the default period. Recall that the model assumes that default has no additional cost when aggregate productivity is below the unconditional mean, and default is full. Thus, the marginal increase in resources is non-negligible.

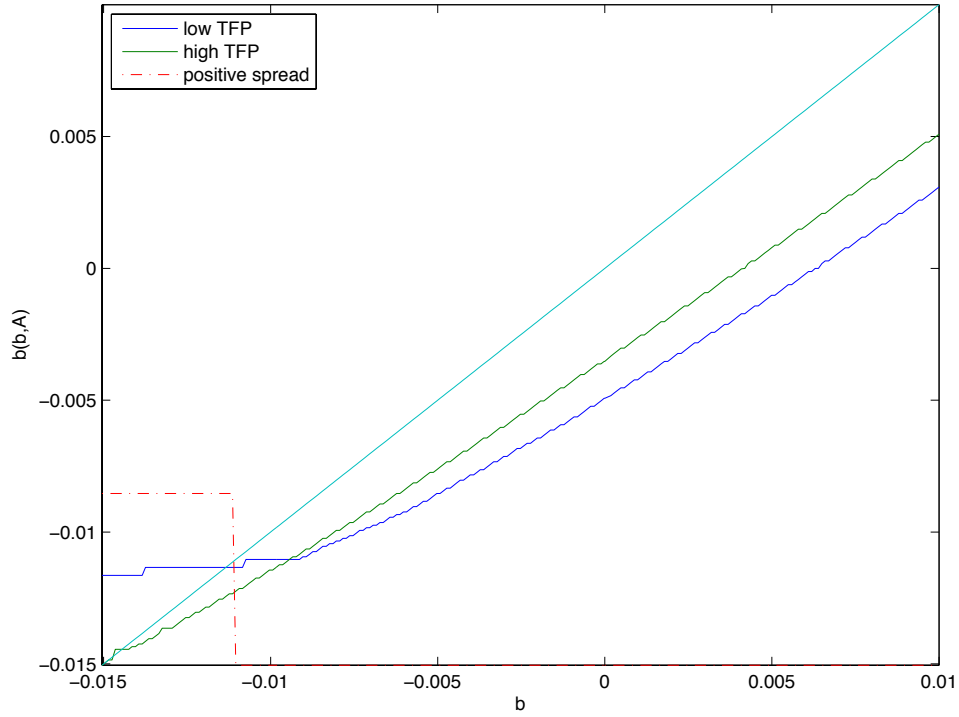


Figure 8: Asset choice as a function of asset holdings: Around the borrowing constraint.

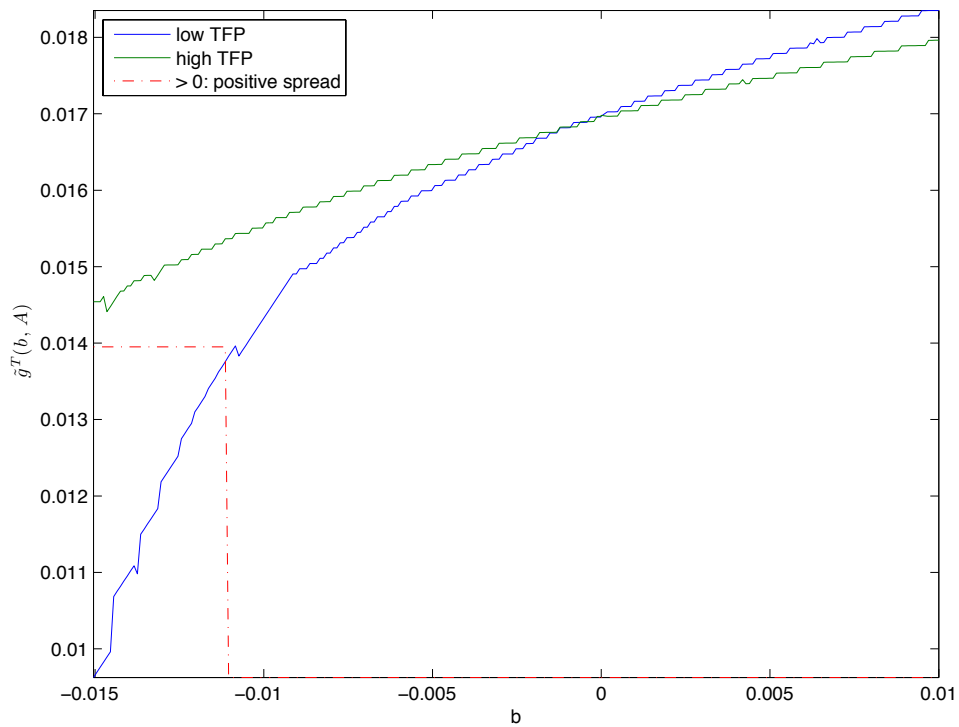


Figure 9: Transfers as a function of asset holdings

The relationship between the borrowing constraint and transfers can be recovered also by simulating the model. I plot the correlation between transfers and GDP against mean asset holdings for 1000 different series of shock realizations. The results in figure 10 confirm the intuition from the state dependent policy function. The lower is the upper bound for our bond interval, the higher is the correlation between transfers and GDP. This stands in contrast to the region of

assets for which the relationship between transfers and GDP is reversed, which would be on the right side of figure 9: the correlation is negative and more so, the further we move away from the borrowing constraint.

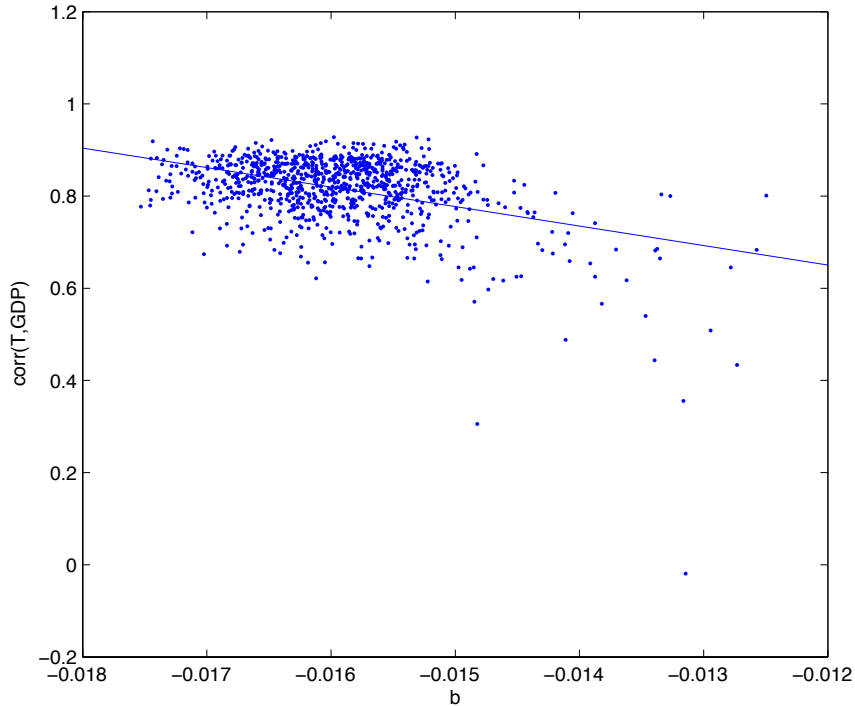


Figure 10: Correlation between transfers and GDP, simulated data.

The other component of government expenditure, government spending on public goods, is always procyclical when markets are incomplete. Thus, the presence of a borrowing constraint does not qualitatively effect government spending that enters the maximization problem in this way. Government consumption falls during recessions and it falls relatively more than transfers.

Figure 4.1 shows the ratio of aggregate transfers to spending on public goods. As the level of debt falls, transfers increase by more than government consumption. The ratio of transfers to public good spending is also countercyclical, which follows from countercyclical transfer policy for high levels of assets. However, it is still countercyclical until the borrowing constraint effectively binds and the bond price falls. Now the revenue from taxation goes into financing of the debt.

The policy function for taxes displays similar dynamics as the policy function for transfers. In figure 12 we can see the optimal tax rate for two levels of aggregate productivity (low and high, respectively) in the neighborhood of the borrowing constraint. As for the case with transfers, the policy functions cross in this region. For asset levels higher than the critical point, the tax rate is positively correlated with GDP, which I denote as 'countercyclical tax policy' in line with the literature. For asset levels lower than the crossing point, tax policy becomes procyclical. This is consistent with results from the recent quantitative literature on fiscal policy and default risk: When the government cannot borrow, it will shift towards financing expenditure by increasing the tax rate. As opposed to transfer policy, the reversal of cyclicity occurs at a different point. Whereas for transfers, this was the case at much higher levels of assets - or lower levels of debt, for this region tax policy is still countercyclical. The government tries to avoid increasing the

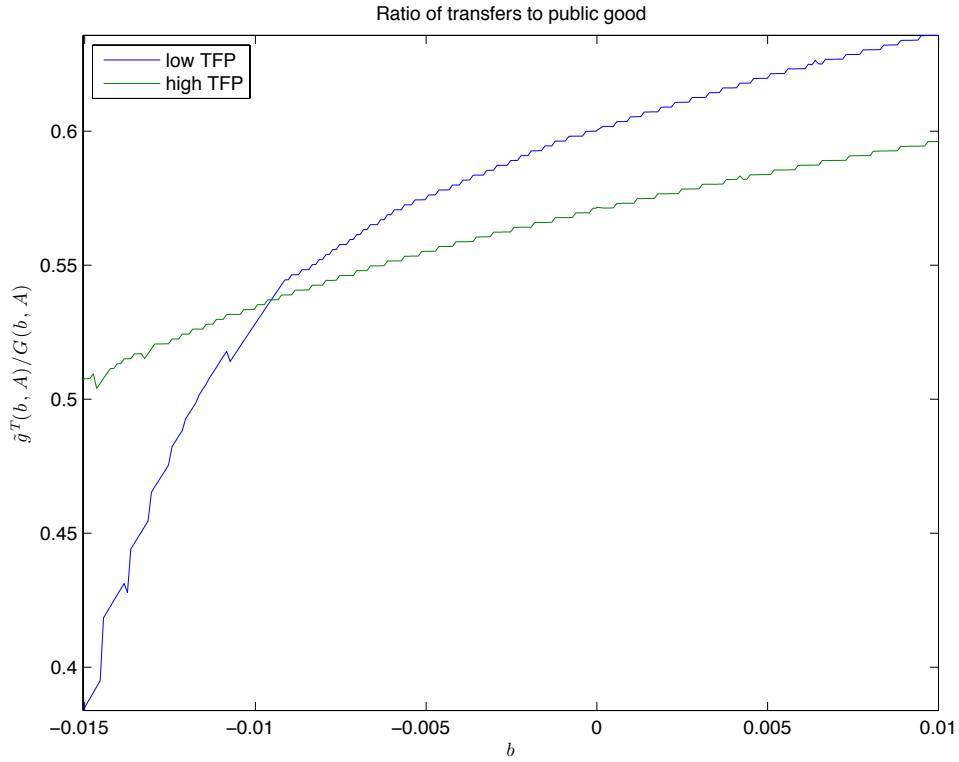


Figure 11: The ratio of insurance spending to public good

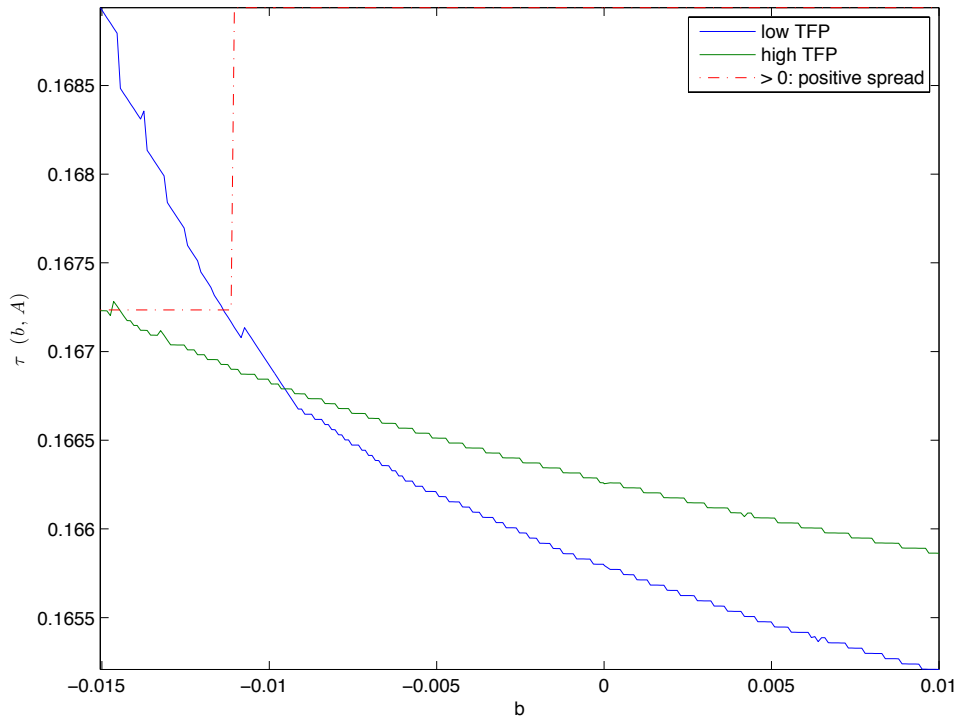


Figure 12: Tax rate as a function of asset holdings.

cost of taxation during recessions until it faces active borrowing constraints.

Finally, in figure 4.1 I plot consumption dispersion for high and low debt levels as a function of aggregate productivity. We can see that consumption dispersion is procyclical. This is related both to distortionary taxation and to procyclical income dispersion (see below). An

increase in the tax rate induces higher welfare losses during recessions than during booms, which limits the scope for consumption smoothing with imperfect financial markets. Furthermore, when the government is approaching the borrowing constraint, transfers become procyclical and consumption dispersion does not fall during recessions as it would if the government were able to borrow against low income. Instead, there is a sharp increase in consumption inequality in the neighborhood of the default region, because transfers are decreased sharply and taxes become procyclical. The government still redistributes income across agents, but it does not provide insurance to private households anymore.

When the government has defaulted, its problem is static and it pursues the autarky policy. With the present specification of preferences, transfers exactly follow the revenue pattern of the constant tax rate, such that the ratio of consumption is independent of aggregate productivity.

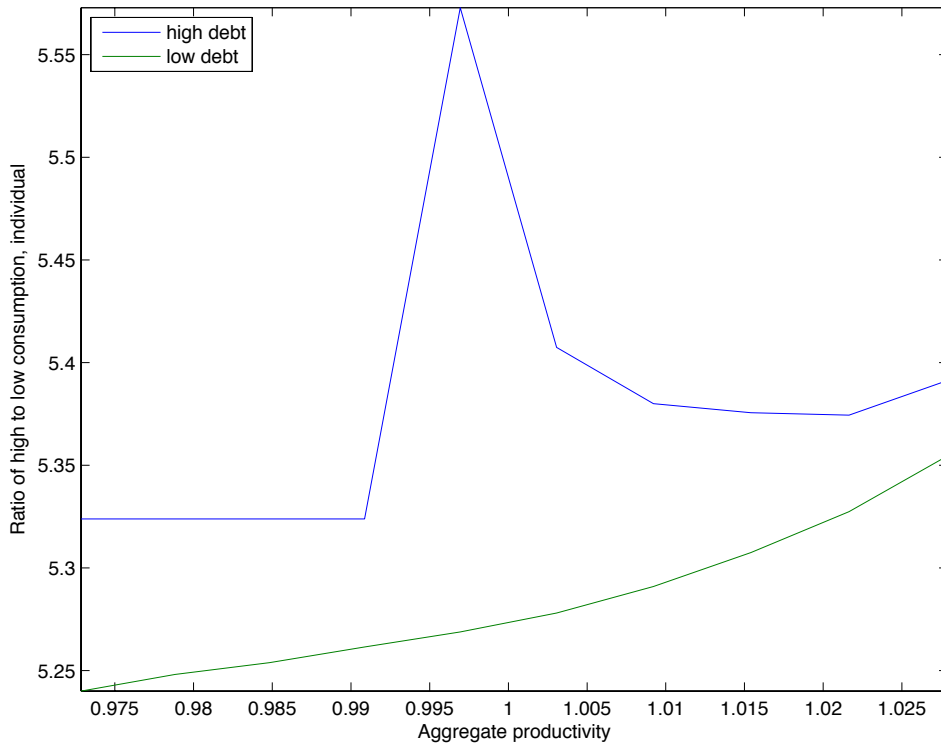


Figure 13: Consumption dispersion as a function of aggregate productivity

For the quantitative assessment of default risk and implications, the model is simulated and I compute several moments in table 4.1. The first column reproduces some moments of Mexican data as discussed in section 2. The GINI coefficient is an average for several years from the SEDLAC database. The second column gives the results using the benchmark calibration from table 5. The 90/10 earnings ratio of 8 gives a GINI coefficient around 0.46, which is slightly below the target. This might be because two values of productivity cannot reproduce the highly skewed income distribution that is observed in many emerging markets. Government expenditure, which is computed as the sum of public good spending,

$$g = g^P + g^T \tag{32}$$

is much more volatile in the data than in the model. The correlation of government expenditure and GDP, and of transfer and GDP is near perfect, whereas in the data the values are more moderate. Given that public good spending is highly correlated with private consumption (which is strongly procyclical), overall government expenditure will be procyclical because transfers are procyclical as well.

	data	benchmark calibration	low GINI	no default
$GINI$	0.5	0.41	0.38	0.41
$std(Y)$	2.37	2.36	2.36	2.30
$std(GEXP)/std(Y)$	2.6	1.27	1.45	0.40
$corr(G^T, Y)$	0.41	0.92	0.78	-0.87
$corr(GEXP, Y)$	0.35	0.94	0.89	-0.73
$corr(\tau, Y)$	-0.3	-0.40	-0.41	0.98

Table 6: Results from numerical solution of the model

As one important modification, I change the degree of inequality in the economy as measured by the GINI coefficient. The third column gives the results from simulating a model with $GINI = 0.38$. The impact of lower inequality is mostly through transfer policy, which becomes less procyclical. Intuitively, this happens because changes in the tax rate are less costly in terms of welfare, and it is easier for the government to redistribute income also in bad times. Changes in the tax rate are less costly with lower inequality for two reasons. First, since the same marginal tax rate applies to all agents, the average welfare loss from a change in the tax rate is higher than when productivity is distributed more equally. Second, section 3.2 illustrated that transfers and the tax rate are higher for higher levels of inequality in the model. Hence, the marginal welfare cost of increasing the tax rate is higher for economies with higher inequality.

Lastly, I remove the assumption of limited commitment in order to demonstrate that borrowing constraints indeed drive procyclical transfer policies. While maintaining the same discount factor for the government, the risk free rate is increased as to match the higher *average* interest rate for external debt of emerging economies. Furthermore, I assume a debt-elastic lump sum portfolio adjustment cost which translates into a form of debt-elastic interest rate. However, the movements in the interest rate are much smaller than in the model with endogenous risk premia and do not impact on the moments of the model (Schmitt-Grohe and Uribe 2003). The result for this model is in column four. Most importantly, transfers in this model are strongly countercyclical, and given the share in overall spending (around 50%), total government expenditure is fairly countercyclical, despite the strong procyclicality in the spending on the public good.

5 Conclusion

I have used a simple model of income redistribution in order to show the impact of external financial market imperfections on the cyclical properties of government expenditures. In the model, the government finances expenditures with distortionary taxation and by issuing non state contingent one period bonds in external debt markets. The government cannot commit to repay its debt, which leads to endogenous borrowing constraints due to default risk. Government expenditures are composed of spending on public goods and social transfers. Both components are lumpsum. I illustrate the main mechanism using two extreme cases of autarky and full insurance. Between these two cases government transfers are qualitatively different: they are countercyclical under complete markets, and procyclical under incomplete markets.

The example illustrates the two roles of social transfers: (i) the redistribution of income, which can also be viewed as the partial insurance against idiosyncratic shocks. (ii) To help consumption smoothing of low income households across aggregate states. The lack of market access shuts down the second role, so transfers are procyclical.

I use a model with endogenous production, distortionary taxation and default risk to show that default risk indeed drives the qualitative difference in transfer policy over the business cycle. In the neighborhood of the borrowing constraint, the policy function for bonds flattens out because the government is anticipating the constraint and tries to avoid a sharp drop in consumption. Consequently, international borrowing and saving becomes less good an instrument to smooth the tax cost over the business cycle and transfers become procyclical in this area of the distribution of assets. I also find that the procyclicality of transfers is higher the tighter is the borrowing constraint for the government. Consistent with the recent literature on financial market imperfections and fiscal policy, I find that tax policy is also procyclical due to the borrowing constraint. However, the effect of the borrowing constraint on optimal transfers is much stronger than on taxes.

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A Tables and Figures

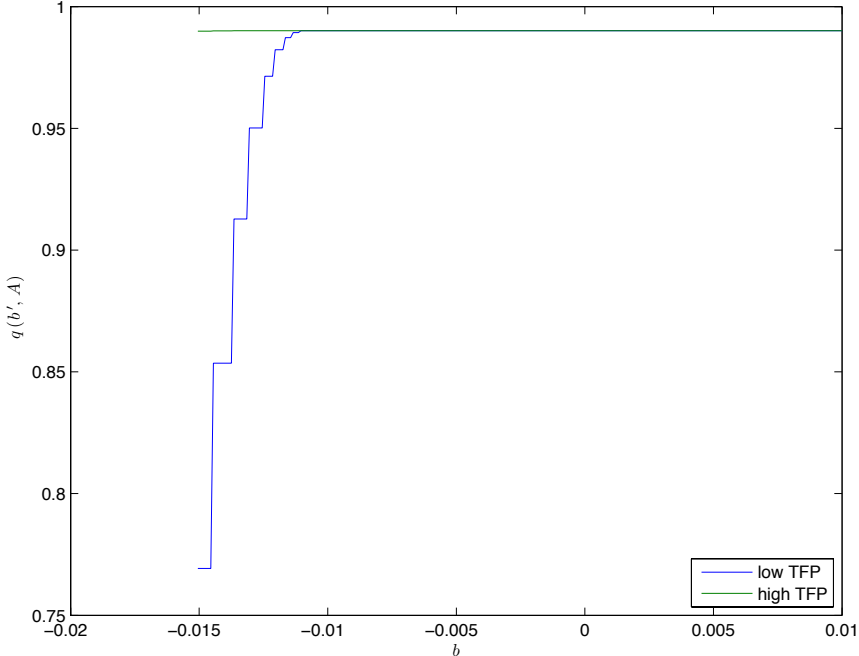


Figure 14: Bond price for each issuing choice b' for low and high value of aggregate productivity, respectively.

	GCONS	GEXP	GEDU	GORDER	GHOUSE	GCULT
Argentina	0,32829734	0,32753018	0,22641477	0,52996458	0,18468944	0,55909868
Brazil	0,3220468	0,49570163	0,56018494	0,44707592	-0,08106177	0,64166925
Chile	0,49304207	0,48537246	0,45602455	0,14389305	0,67637057	
Colombia	0,17596204	0,1635308	0,28243308	0,33431492	-0,14664506	0,15284975
Mexico	0,6273889	0,32649282	0,68137402	0,57770396	0,57396253	0,20707412
Paraguay	0,34612261	0,07919135	0,33357796	0,62825266	0,38343529	0,51530004
Thailand	0,30542896	0,07711857	0,2012479	0,46539622	0,25454251	0,07491949
Uruguay	0,41485616	0,51731804	0,39534634	0,29720283	0,15359418	0,19764504
Australia	-0,15556793	-0,22182007	-0,22558606	-0,05806825	-0,01207668	-0,18306943
Austria	0,41802421	0,02850962	-0,10782897	0,55387006	0,15416843	0,1854202
Canada	-0,2209612	-0,11485444	0,13371363		-0,01523523	0,17313415
Denmark	-0,2503154	-0,35471235	-0,2907727	0,44719876	-0,01975115	0,18393033
Netherlands	0,02430191	-0,19279696	0,19779928	-0,05332874	-0,18561426	-0,13433656
New Zealand	0,25406857	-0,59241916	0,24201827	0,12596566	0,53098881	-0,13239822
Norway	0,08870319	-0,35166414	-0,09793476	-0,19604678	-0,17641903	-0,32927827
United Kingdom	-0,10301281	-0,30063075	0,25170586	-0,14163843	-0,14949276	0,17081649
USA	-0,08564601	-0,4964541	-0,0668813	-0,18409775	-0,22231505	-0,03029374

Table 7: Cyclical correlation of government spending components and GDP. *GCONS*: Government consumption. *GEXP*: Total government expenditure. *GED*: Education. *GORDER*: Public order. *GHOUSE*: Housing and community amenities. *GCULT*: Recreational, cultural, religious services.

B Optimal policy with full insurance

This section proves that optimal policy is indeed countercyclical using simple algebra. Suppose again that

$$u(c, h) = \frac{(c - h^{1+\frac{1}{\psi}})^{1-\gamma}}{1-\gamma}, \quad v(g) = \frac{g^{P1-\gamma}}{1-\gamma}.$$

Consider first the condition on the behaviour of taxes. If the (normalized) elasticity of taxes is equal to 1, this implies that

$$\begin{aligned} \frac{\partial h^i}{\partial A} &= \frac{\partial h^i}{\partial A} + \frac{\partial h^i}{\partial \tau} \frac{\partial \tau}{\partial A} \\ &= \frac{1}{A} \psi h \left(1 - \frac{\tau}{1+\tau} \underbrace{\frac{\partial \tau}{\partial A} \frac{A}{\tau}}_{=\xi_{\tau,A}} \right) \\ &= 0. \end{aligned}$$

Here the government fully undoes the consumption fluctuations implied by fluctuations in A . However, such policy implies a convex deadweight loss and can thus not be optimal. (Neither can be the case when $\xi_{\tau,A} > 1$, which would imply output that is negatively related to productivity.)

In the following, I assume the earnings ratio is such that the government wants to give out positive insurance payments. Starting from the risk sharing condition under full insurance,

$$\sigma \Delta u_c(c^h, h^h) = -(1-\sigma) \Delta u_c(c^l, h^l), \quad (33)$$

I establish that the optimal policy is indeed countercyclical. Denote the effective insurance payment $\tilde{g}^T = \frac{g^T}{(1+\tau)}$ and consider a marginal change in A , and define as the normalized elasticity of the tax rate with respect to A : $\tilde{\xi}_{\tau,A} \equiv \frac{\tau}{1+\tau} \xi_{\tau,A}$. Under the proposition, this gives

$$\frac{\partial MUC(h)}{\partial A} = -\gamma MUC(h)^{1+\gamma} \left(\frac{Ae^h}{(1+\tau)} A^{-1} [1 - \tilde{\xi}_{\tau,A}] + \frac{\tilde{g}^T}{A} [\xi_{T,A} - \tilde{\xi}_{\tau,A}] \right) \quad (34)$$

$$\stackrel{!}{<} 0$$

$$\frac{\partial MUC(l)}{\partial A} = -\gamma MUC(l)^{1+\gamma} \left(\frac{Ae^l}{(1+\tau)} A^{-1} [1 - \tilde{\xi}_{\tau,A}] + \frac{\tilde{g}^T}{A} [\xi_{T,A} - \tilde{\xi}_{\tau,A}] \right) \quad (35)$$

$$\stackrel{!}{>} 0.$$

After rearranging,

$$\frac{Ae^l}{(1+\tau)} A^{-1} \left[1 - \frac{\tau}{1+\tau} \xi_{\tau,A} \right] < \underbrace{\frac{\tilde{g}^T}{A} [\tilde{\xi}_{\tau,A} - \xi_{T,A}]}_{\equiv -\xi_{\tilde{g}^T,A}} < \frac{Ae^h}{(1+\tau)} A^{-1} \left[1 - \frac{\tau}{1+\tau} \xi_{\tau,A} \right]. \quad (36)$$

Since $\xi_{\tau,A} < 1$, this condition holds as long as $e^l < e^h$ and implies that

$$\xi_{\tilde{g}^T,A} < 0 \quad \Leftrightarrow \quad \frac{\partial \tilde{g}^T}{\partial A} < 0. \quad (37)$$

In other words, the tax rate reacts stronger to changes in productivity than the insurance payment.

C Optimal policy in autarky

The solution to the autarky case under the functional forms used in the remaining analysis can be shown using guess and verify.

Consider the setup of the model without access to external financial markets. Suppose that

$$u(c, h) = \frac{(c - h^{1+\frac{1}{\psi}})^{1-\gamma}}{1-\gamma}, \quad v(g) = \frac{g^{P1-\gamma}}{1-\gamma}.$$

Then the following policy rules satisfy the first order conditions to the ramsey problem:

1. $\tau(A) = \bar{\tau}$
2. $g^T(A) = \bar{g}^T A^{1+\psi}$
3. $g^P(A) = \bar{g}^P A^{1+\psi}$

Combine the budget constraint of households and the government to obtain:

$$\bar{g}^P A^{1+\psi} + \frac{\bar{g}^T}{1+\bar{\tau}} A^{1+\psi} = \frac{\bar{\tau}}{1+\bar{\tau}} A^{1+\psi} \left[\sigma e^{l^{1+\psi}} + (1-\sigma)e^{h^{1+\psi}} \right],$$

which is proportional to $A^{1+\psi}$, because c^i, h^i are proportional to it as well, and thus holds for all A with the policy rules.

Similarly,

$$u_c^i(c^i, h^i) = \left(\left(\frac{Ae^i}{1+\bar{\tau}} \right)^{1+\psi} + \frac{\bar{g}^T}{1+\bar{\tau}} A^{1+\psi} \right)^{-\gamma}, \quad u_g(g^P) = \left(\bar{g}^P A^{1+\psi} \right)^{-\gamma}$$

are proportional in $A^{-\gamma(1+\psi)}$, and thus hold for all A . Analogously to the last two steps, the first order condition for taxes holds because of the proportionality of marginal utilities and optimal household choices.