University of Konstanz
Department of Economics

Imperfect Financial Markets and the Cyclicality of Social Spending

Maren Froemel

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Imperfect Financial Markets and the Cyclicality of Social Spending*

Maren Froemel†

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Abstract

I develop a novel link between frictions in international financial markets and fiscal procyclicality. Complementing existing evidence, A decomposition of government expenditure into social spending and public good spending reveals that the cyclical correlation of social spending exhibits the biggest differences across countries. I build a small open economy model with income inequality, endogenous fiscal policy and sovereign default risk to rationalize this spending procyclicality. Government spending, divided into a public good and social spending, is financed by taxation and external debt. External debt is subject to endogenous risk premia because the government cannot commit to repay its debt. The government conducts a procyclical tax and social spending policy when debt is in or close to the risky zone. Social spending then only redistributes income, failing to smooth private consumption over time. Far away from the crisis zone, fiscal policy is countercyclical, only public goods spending is always procyclical. Social spending is cut most when the government faces positive risk premia, because it is better a substitute of private income than public good spending. It also accounts for the largest part in fiscal adjustment: because taxes are distortionary and cannot be targeted well. Fiscal procyclicality becomes stronger with higher economic inequality as revenue raising through taxation becomes more costly.

JEL classification: E62, F34, F41.
Keywords: Procyclical fiscal policy, default risk, income inequality, redistribution, emerging markets, social spending.

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†Department of Economics, University of Konstanz, Box 145, 78457 Konstanz, Germany. E-mail: maren.froemel@uni-konstanz.de.

1 Introduction

In stark contrast to fiscal policy in developed economies, there is ample evidence that governments in emerging markets conduct *procyclical* fiscal policy.[1] This observation is particularly salient in periods of financial distress; for instance, Végh and Vuletin (2012) show evidence on tax procyclicality in developing countries, Real and Vicente (2008) report procyclical tax policies in Latin America during periods of financial distress. Kaminsky et al. (2005) document cross-country differences in the cyclicality of government expenditure, and Molina (2003) show that social spending was cut disproportionately to the fall in GDP during the Latin American debt crisis of the 1980s.

In this paper, I demonstrate how financial frictions can explain the procyclicality of fiscal policy, in particular that of government expenditure, in emerging economies. Emerging markets generally have a high reliance on external debt for financing government expenditures (Reinhart and Rogoff 2011) and face countercyclical interest rates, meaning high borrowing costs during recessions exacerbate the financing problem.[2] Additionally, the cross-country differences in government expenditure cyclicality cannot be explained by government consumption and government investment, but rather are driven by differences in transfer spending (Ilzetzki and Vegh 2008). I hypothesize here that the borrowing costs faced by developing countries especially during periods of financial distress drive the procylicality of social spending, which in turn accounts for the puzzling finding of procyclical fiscal policy.

My paper has three main objectives. First, I contribute to the empirical evidence on the sources of government expenditure procyclicality by dividing expenditure into public good and social spending components. Second, I propose a theory how the cyclicality of these two components of government expenditure is linked to financial market frictions. Third, I build a model of fiscal policy that formalizes this theory, incorporating a different trade-off for providing these two components of government expenditures. Using this model, I analyze how financial market frictions affect this trade-off and hence optimal fiscal policy over the business cycle, and how the government uses policy instruments at its disposal when it faces credit constraints.

I begin by documenting the cyclicality of government expenditure. First, I show that government expenditure is more procyclical when the average borrowing cost for a government is higher. Second, I utilize a break-down of government spending according to economic functions such as health, defense, social assistance, and public order to classify government spending as either public goods or transfer spending. For example, health, housing, education, and social assistance have characteristics of transfers, and act as a substitute to private spending. Other spending components - such as defense spending or public order - have public good characteristics, and are complementary or neutral to private consumption. I argue that due to the high reliance of

[1] For Latin America and industrial countries: Cf. Gavin and Perotti (1997). For more countries: Kaminsky, Reinhart and Végh (2005), and Ilzetzki and Vegh (2008). The definition of procyclical fiscal policy in this paper is standard, and refers to the behavior of taxes, spending, and (consequently) the fiscal surplus: taxes and the fiscal surplus move in the opposite direction from GDP, and spending and GDP comove

[2] See Kaminsky et al. (2005) and Neumeyer and Perri (2005),Uribe and Yue (2006) for evidence of countercyclical interest rates.

governments on external debt, external financing constraints can qualitatively affect government spending that is supposed to facilitate private consumption, and not public goods.

My framework builds on the small open economy model with default risk of Arellano (2008). I endogenize production and introduce a government, following Cuadra, Sanchez and Sapriza (2010). The novel features of my model are heterogenous households and the role and composition of government expenditure. Primary government expenditure is divided into two components. First, a transfer good, which is a perfect substitute to private income. Second, a public good, which provides direct utility to private agents, but is not a substitute to private income. Households differ in their labor productivity. This inequality motivates social spending as a way to redistribute income. Social transfers are paid to households in a lump sum fashion. The government can finance its expenditure by raising revenue through taxation or by borrowing and saving in international financial markets, but it has no commitment to repay its debt. Repayment cannot be enforced, and there is only an imperfect punishment in case the government defaults on its debt. Taxes are distortionary because labor supply is elastic. The domestic economy is subject to persistent shocks to total factor productivity, so external financial markets are the only way to insure against aggregate income fluctuations.

When income inequality is non-negligible, the government effectively redistributes income using a positive tax rate and positive transfers.[3] The degree of redistribution is limited by the convex cost of distortionary taxation, and the government trades off utility gains from equalizing consumption against output and welfare losses arising from taxation.

During periods of low productivity, it is more costly to use taxation to raise revenue and to redistributive income. With good access to financial markets, the government relies more on borrowing and lending abroad to raise revenue for government expenditure. Taxes fall in recessions and transfers increase. The increase in transfers happens for two reasons. First, total household income falls and the government tries to smooth all households' incomes across productivity realizations. Second, income fluctuations are more costly for low income households, so countercyclical transfers shift relatively more resources to poor households during recessions, leading to procyclical consumption dispersion. Furthermore, public good consumption will be procyclical and comove with private consumption. Due to the countercyclicality of social spending, the ratio of social spending to public good spending is countercyclical.[4] Empirically, social spending accounts for a large fraction of total spending, both in developed economies as well as in emerging markets. For this relative size, total government expenditure will be countercyclical in this economy, as observed in developed countries.

Default risk limits access to financial markets because it lowers the price of debt issued by the government. The incentives to default are typically higher during recessions, as additional income losses are more costly because of risk aversion. As a result, the current account deficit will become smaller during an enduring recession. The government has less resources at its disposal, and cuts social and public good spending, because the welfare and output cost from

[3] In the absence of inequality, all expenditures will be financed by a negative lump sum transfers.

[4] At most, public good spending will be acyclical if the government is able to insure perfectly against country specific productivity shocks.

taxation outweigh the insurance gains from counteryclical redistribution. When spreads are high, the current account - here equal to the fiscal balance - reverses and the government needs to effectively transfer resources to its creditors. This is consistent with what Gavin and Perotti (1997) find for Latin American countries. Social spending is cut even more strongly, and the tax rate is increased. Because of the additional welfare loss (deadweight loss) of taxation, the government is willing to give up more of social spending, which is a perfect substitute to private income and has no additional cost, while the government has the objective to smooth public good spending. The ratio of social spending to public good spending now becomes procyclical. Thus, procyclical government expenditure can be rationalized by countercyclical interest rate, and, in the absence of international financial institutions and bail out programs, emerges as the optimal policy prediction.

In times of debt crises, fiscal adjustment is indispensable in debtor countries. The appropriate choice of instruments, taxes or spending, is an ongoing discussion in the literature.[5] Policy-makers also face this question recurrently in emerging markets and developing countries, but also at present for several developed countries in the face of the European debt crisis: Greece, Italy, Ireland, and Portugal, and during the Great Depression.[6] This paper contributes to the discussion using a standard structural model with a particular trade-off between taxes and spending. Tax increases lead to excessive welfare losses and output reductions, but spending cuts are also detrimental for welfare because of economic inequality. In this particular case of lump sum spending and linear taxation, I show that both instruments are used for adjustment, but spending suffers from a more severe spending cut.

I calibrate the model to the Mexican economy as a representative emerging market economy. The simulation of the model shows that default risk indeed induces qualitative and quantitative differences in fiscal variables transfer policy over the business cycle. Transfers are procyclical for a range of debt levels beyond positive interest rate spreads, because the government does not run a large enough deficit in recessions relative to booms. This happens because the government is anticipating the constraint and tries to avoid switching to procyclical tax policy and the need for sharp fiscal adjustment. As the debt level increases, financial market access worsens, both because the government preventively borrows less, and eventually because of rising risk premia. Social spending is still cut less relative to public good spending in recessions, until borrowing constraints become effective, and the current account reverses. When the government holds assets, transfers eventually become countercyclical because the fiscal deficit worsens enough in response to productivity shocks, and 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.

[5]See Alesina and Ardagna (2013) for a recent contribution.
[6]Cf Fisher and Hornstein (2002) for the case of Germany.

The paper is organised as follows. I provide an overview of related literature in section 2. In section 3, I present data on government expenditure and a break down into different components. Then, I set up a model with redistribution, exogenously incomplete markets and default risk in section 4. I also give a brief discussion about redistribution and consumption smoothing in this model using the polar cases of autarky and full insurance. Section 5 presents the calibration and functional forms that I used, and I show my results and their discussion in section 5.1. I conclude in section 6.

2 Literature

This paper contributes to and builds on the literature on optimal fiscal policy over the business cycle. The two most related works are Cuadra et al. (2010) and Ilzetzki (2011). Cuadra et al. (2010) extend the default model of Arellano (2008), introducing endogenous production and distortionary taxes. They 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. Furthermore, their calibration implies a low degree of default risk and might therefore underestimate the procyclicality of taxes. Their findings are consistent with Aizenman, Gavin and Hausmann (2001), who analyze the same question, but not quantitatively.

A second strand of literature focuses on political economy frictions as a reason for procyclical fiscal policy. Talvi and Végh (2005) show how volatile tax revenues can translate into strongly procyclical government expenditures when governments face political pressure to run budget deficits and engage in excessive spending to their constituencies during booms. However, their model is deterministic and thus abstracts from the role of financial market frictions. In Andreasen, Sandleris and Van Der Ghote (2013), economic inequality and the progressivity of the tax system matters for the default decision of the government and determines debt sustainability, because spending cuts can only be made by political agreement. A more unequal economy with regressive taxes will be less likely to accept strong fiscal tightening. While I abstract from the political sustainability of spending cuts, my paper has a complementary idea of the role of economic inequality and a lack of progressivity in making countercyclical policies more costly to sustain.

Ilzetzki (2011) analyzes optimal transfers under political disagreement and stochastic turnover regarding different groups in the population. In his model, transfers are procyclical when disagreement, or 'ethnical 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 redistributive device in the presence of income inequality. In his model, redistribution happens because the government does not place a positive weight on all agents and can target the transfer to a specific group, whereas in my paper transfers are lump sum . 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. In contrast, my paper belongs to the literature emphasizing a countercyclical relation during severe macroeconomic recessions.[7]

The paper is also related to three other strands of literature. First, empirical literature on fiscal policy in financial markets has pointed out that fiscal policy is procyclical in emerging markets (Gavin and Perotti 1997). They report that the fiscal surplus is much more sensitive to changes in GDP in industrial countries than in Latin America. Furthermore, they find that Latin American countries experience an improvement in the fiscal balance during big recessions, whereas the reverse happens in developed economies. Kaminsky et al. (2005) confirm the result for the inflation tax, and of government expenditure. They also emphasize that current accounts are countercyclical in developing countries, making it even more difficult to sustain countercyclical policies.

Second, there is a large literature on how default risk and countercyclical interest rates affect business cycle characteristics in emerging markets. Neumeyer and Perri (2005) and also Uribe and Yue (2006) find show that interest rates are highly counteryclical in emerging markets, and they can account for counteryclical current accounts and excess volatility in consumption. They impose the relationship between interest rates and GDP (total factor productivity) from the data in their model as an exogenous function. Models in the vein of Arellano (2008) and Cuadra et al. (2010) use quantitative business cycle models building on Eaton and Gersovitz (1981). They 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. Mendoza and Yue (2012) use a general equilibrium model to explain business cycle characteristics of emerging markets and provide a microfoundation for asymmetric output costs of default using imperfectly substitutable imported inputs, where production requires working capital. Kuralbayeva (2013) argues that countercyclical interest rates can contribute to explain fiscal procyclicality in resource rich countries. She uses a model with a debt-elastic interest rate to illustrate that in this case tax policy is procyclical and public investment reacts much stronger to productivity shocks than in a developed country.

Chatterjee and Eyigungor (2012) and Arellano and Ramanarayanan (2012) relax the assumption of using bonds of a single, short term maturity only. Several authors have shown that the optimal maturity structure of bonds can near replicate the allocation of an economy with a complete set of state contingent assets (Angeletos 2002). This case is likely to be true for developed countries. However, the option to default limits the range and quantity of different maturities available to the government and impedes consumption smoothing. Debt of different maturities can help to

[7] See for anecdotal evidence, Real and Vicente (2008), Talvi and Végh (2005), OECD (1999), and Végh and Vuletin (2012) for cyclical correlation.

increase the sustainability of higher debt levels in quantitative models. I abstract from maturity choice in this paper, because it is unlikely to have a qualitative impact on my results.

Third, the paper is also related to recent research on redistribution with lump sum transfers. Redistribution is optimal also when taxes are distortionary if households cannot insure themselves against income risk. If income risk is sufficiently high, Alonso-Ortiz and Rogerson (2010) show that redistribution lump sum transfers increases welfare and output per hours worked. They study a stationary economy where agents have access to incomplete insurance markets. Bhandari, Evans, Golosov and Sargent (2013) consider optimal redistribution with aggregate shocks 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. However, unlike in Alonso-Ortiz and Rogerson (2010), inequality is permanent, thus saving saves as insurance against aggregate risk only. Tax smoothing with aggregate shocks now needs to be traded off with redistribution, which is contrary to the result in the corresponding economy with a representative agent. In contrast to their paper, I abstract from domestic debt, and I use an open economy to focus on the interactions of borrowing constraints with redistribution.

3 Data

In this section, I present empirical evidence for the cyclicality of government expenditure and external debt in emerging markets. In my quantitative analysis in section 5.1 I will calibrate the model to a typical emerging markets economy: Mexico, thus I also present business cycle statistics from Mexico at the end of this section.

There is a strong positive correlation between the cyclicality of government expenditure and the average external borrowing cost for governments. Figure 1 plots the correlation of the cyclical government spending component with GDP against S&P's foreign currency sovereign credit rating.[8] Credit rating letters have been encoded into numbers ranging from $AAA = 1$ ("lowest 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[9]

Total government expenditure is the sum of government consumption expenditure, transfer payments including social security contributions, government investment expenditure and interest payments.[10]

There are several ways of decomposing government spending. The United Nation's Classification

[8] Rating as of January 28, 2013.

[9] Cf. Neumeyer and Perri (2005), Arellano (2008).

[10] Ilzetzki (2011), Kaminsky et al. (2005), and Végh and Vuletin (2012) plot the cyclicality of government expenditure against GDP per capita as a proxy for development and for development of financial markets.

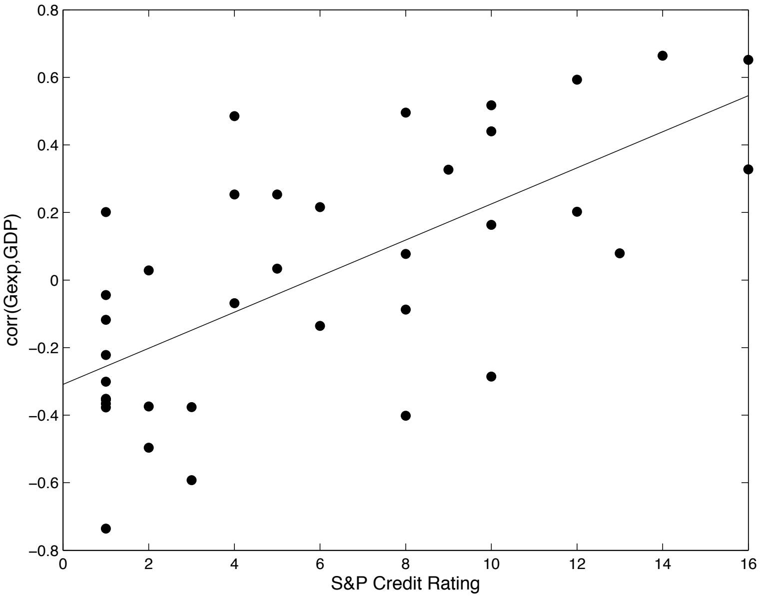

Figure 1: Correlation between cyclical components of total government spending and GDP as a function of sovereign credit rating.
Source: IMF (2013a), IMF (2013b), OECD, Oxford Economics Database, National Statistics, S&P.

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 *social protection.*[11] Data are bundled according to this classification in the IMF's Government Finance Statistics.[12]. I present evidence for four variables, *Defense* [GDEFENSE], *General Public Services* [GPUBSERV][13], *Health* [GHEALTH], and *Social Protection* [GSOCIAL]. The order ranks the categories according to their public good character. A public good in this context is a good that is non-excludable and non-rivalrous, and whose consumption is neutral or complementary to private consumption. *Defense* has the strongest public good character, and *social protection* has the strongest insurance character.[14]

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.

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

[12] For European countries, this is also available in the EUROSTAT database, and for OECD countries in the General Government Accounts of the OECD

[13] An important spending item in this varaible is *foreign aid*.

[14] Please consult the appendix with an overview over the remaining categories subject to data availability.

	GEXP	GDEFENSE	GPUBSERVE	GHEALTH	GSOCIAL
Argentina	0.33	NaN	-0.02	0.21	0.42
Brazil	0.50	0.23	-0.00	0.50	0.48
Chile	0.49	0.36	0.03	0.52	0.19
Colombia	0.16	0.02	-0.17	0.06	0.07
Mexico	0.33	0.28	0.17	0.25	0.47
Paraguay	0.08	NaN	0.36	0.44	0.09
Thailand	0.08	0.20	0.12	0.19	-0.07
Uruguay	0.52	-0.08	-0.16	0.18	0.34
Australia	-0.22	-0.23	-0.39	0.42	-0.14
Austria	0.03	-0.20	0.24	0.05	-0.14
Canada	-0.11	0.14	-0.24	0.18	-0.40
Denmark	-0.35	0.11	-0.45	-0.31	-0.20
Netherlands	-0.19	-0.17	0.03	0.03	-0.18
New Zealand	-0.59	NaN	0.12	0.26	-0.05
Norway	-0.35	-0.01	-0.38	-0.09	-0.37
United Kingdom	-0.30	NaN	0.27	-0.22	-0.63
USA	-0.50	0.22	0.19	-0.38	-0.55

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. Government expenditure is countercylical 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 cyclicality of goverment consumption. My argument links the strength of the relationship of category-wise cyclicality compared to that of overall spending and its contribution. Figure 3 plots the relationship between the cyclicality 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. My evidence on the procyclicality of social spending is consistent with that of Molina (2003). Moreover, *social spending* is defined as the sum of spending components that can readily be classified as insurance and substitute spending, which confirms the intuitive breakup of expenditure into public and insurance goods and their distinctive role over the business cycle.[15] Social spending accounted on average for 47% of total government operations in Latin American countries between 1990-2010.[16] It is thus safe to conclude that the cyclicality of social spending has an impact on overall expenditure cyclicality.

[15]Definition by ECLAC [Economic Commission for Latin America and the Caribbean], or CEPAL in Spanish. Breceda, Rigolini and Saavedra (2008) define *social spending* as all public spending on education, health, clean water, basic sanitary services, housing subsidies, direct transfers to the poor, social assistance, and social security, but excluding pensions.

[16]Unweighted average of countries excluding Cuba and Honduras. The latter for lack of data. Data from CEPAL.

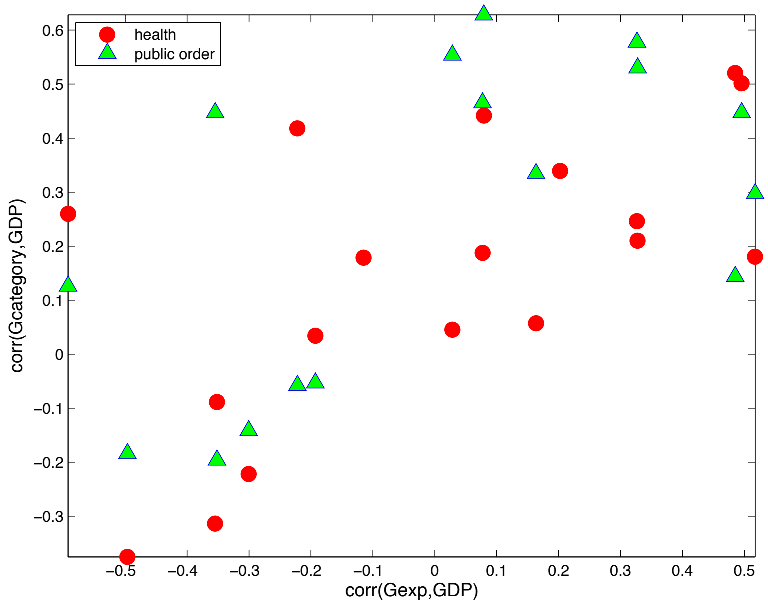

Figure 2: Cyclical correlations of GHEALTH and GPUBSERV. x-axis: correlation of GEXP and GDP.

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.

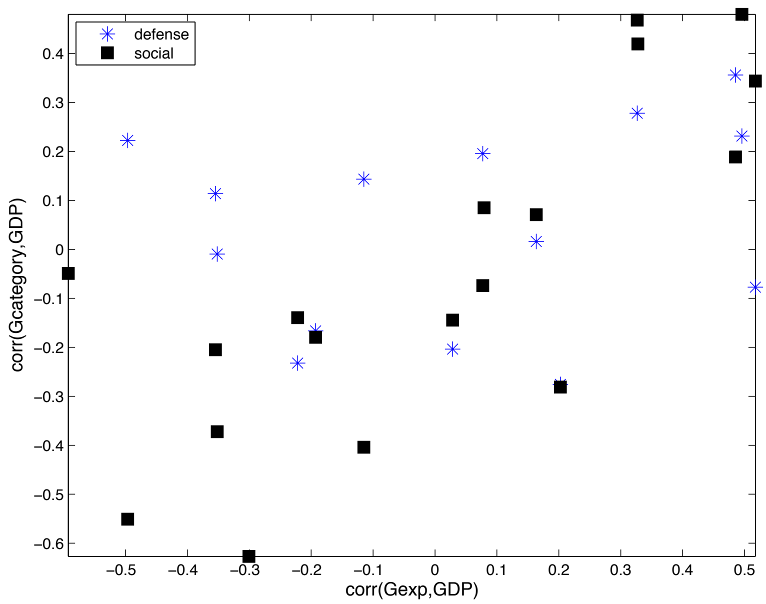

Figure 3: Cyclical correlations of GDEFENSE and GSOCIAL. x-axis: correlation of GEXP and GDP.

The evidence confirms the various roles of different government spending components. While the traditional spending components do not seem to greatly influence the overall cyclicality of government expenditure, spending components that are a prominent feature of both developed economies and latin american countries today are. These are predominantly targeted towards a certain group in the population or serve as an insurance device for private households, such as social transfers and health spending. Here the development status makes a big difference; economic development is usually seen as a proxy for financial development; hence financial frictions can potentially contribute to explain fiscal procyclicality.

3.1 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.[17] Debt in this dataset is external according to the residence of the creditor.

	Total (%)	Share external (%)
Latin America	49	56
LA without		
Brazil, Mexico, Chile	48	63
Mexico	42	25
Brazil	70	17[18]
Chile	14	34

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

Consistent with Reinhart and Rogoff (2011), 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.

3.2 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 (1994). 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 HP-Filtered. 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

[17] The 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.

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.[19] 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 primary expenditure accounts for around 21% of GDP during the period, and transfers are around 5% of total expenditures (1.3% of GDP).

	HP Filter		Baxter-King Filter	
Variable	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. Smoothing parameter $\lambda = 1600$.

	Mean (%)	Median (%)	Std
GEXP/GDP	21.72	20.86	3.52
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

4 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 social spending in the form of uniform 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

[19]The 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.

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.

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 different values in the interval, $e^i \in (0,1]$. Households supply labor elastically, and I denote hours worked of household with productivity e^i h_t^i. There is aggregate productivity risk in the economy, A_t, such that total pre-tax income is $A_t e^i h_t^i$. A constant fraction σ^i has high labor productivity e^i. I assume that $\log(A_t)$ can be represented by a stationary first order autocorrelated process.

Households maximize expected lifetime utility, a discounted stream of utilities from consumption, hours worked, and a public good. Instantaneous utility depends positively on private consumption and the consumption of a public good and negatively on hours worked:

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

subject to the budget constraint

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

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 lump sum transfer 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 4.2)

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.

Define that aggregate state of the economy as $S = (A, b)$. The state variables of the individual problem are S and the individual state variable e^i. The problem in state space form reads:

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

subject to

$$(1+\tau)c^i = Ae^i h^i + g^T, \qquad \forall i. \tag{2}$$

Denote by c^{i*}, h^{i*} the policies that solve the household problem.[20] The first order optimality conditions of the household satisfy the equations (2) and

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

Total output net of total factor productivity is $A \sum_i \sigma^i e^i h^{i*} \equiv y(A)$, and GDP is $Y \equiv A\, y(S)$.

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 temporarily loses access to financial markets. If it repays, it retains market access. Denote by $V^d(S)$ the value function of the government if it defaults on its debt given the realization of total factor productivity. $V^{nd}(S)$ is the value function if the government does not default but repays its debt. The government will repay the debt if

$$V^{nd}(S) \geq V^d(S). \tag{4}$$

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:

$$V^0(S) = \max_d (dV^d(S) + (1-d)V^{nd}(S)). \tag{5}$$

where

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

[20] For notational simplicity, we suppress further details. The household policy functions will depend on the tax rate, transfers, and the state variables.

International creditors have perfect information about the borrowing countries' fundamentals and anticipate default decisions. Denote by $\pi^{def}(b'(S), A)$ the probability that the country defaults when borrowing b' today. $\pi^{def}(b'(S), A)$ 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

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

If $\pi^{def}(b'(S), A)$ is positive for some A, 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 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

$$g^P + g^T + qb' = \tau C^* + b. \tag{7}$$

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 proportional productivity loss θ during the default spell. The total output loss is endogenous due to elastic labor supply. Recently, Mendoza and Yue (2012) have provided a microfoundation how asymmetric productivity and output losses can arise in equilibrium.[21] I assume as Arellano (2008) that

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

[21] Mendoza and Yue (2012) show that output costs increase with productivity in equilibrium if firms use imported inputs in production. Limited access to trade credits forces them to increasingly use imperfectly substitutable domestic products.

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

$$g_d^P + g_d^T = \tau C_d^*. \tag{9}$$

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

4.1 Ramsey Equilibrium

When the government repays, it chooses a 4-tuple as a function of the aggregate state variables $S = (A, b)$, $\{\tau(S), g^T(S), b(S), g^P(S)\}$. It solves the following maximization problem:

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

subject to

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

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

$$g^P + g^T + qb' = \tau C^* + b. \tag{13}$$

$$b_{-1} = 0. \tag{14}$$

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:

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

subject to

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

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

$$g_d^P + g_d^T = \tau_d C^*. \tag{18}$$

Denote by d, nd, the policy functions for default and repayment, respectively.

Definition: Ramsey equilibrium

A Ramsey equilibrium in this economy is a set of policy functions for households $\{c_k^i(S), h_k^i(S)\}$, $k = \{d, nd\}$, the government, $\{g_k^T(S), g_k^P(S), b_k'(S), \tau_k(S), d(S)\}$, 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:[22]

$$u(c,h) = \frac{\left(c - \chi \frac{h^{1+\frac{1}{\psi}}}{1+\frac{1}{\psi}}\right)^{1-\gamma}}{1-\gamma}, \qquad \nu(g^P) = \frac{g^{P\,1-\gamma}}{1-\gamma}. \tag{19}$$

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: hours worked are positively correlated with GDP.[23] The elasticity of hours worked with respect to the wage rate is constant and equal to ψ.

For simplicity, I suppress the functional dependence of the optimal policies on the state variables in the following paragraphs. Optimal hours worked can be solved for using the marginal rate of substitution directly:

$$h^{*i} = \left(\frac{1}{\chi}\frac{Ae^i}{(1+\tau)}\right)^{\psi}, \qquad \forall i = h, l. \tag{20}$$

And consumption becomes, using households' budget constraint:

$$c^{*i} = \frac{1}{\chi}^{\psi}\left(\frac{Ae^i}{(1+\tau)}\right)^{\psi+1} + \frac{g^T}{1+\tau}, \qquad \forall i = h, l. \tag{21}$$

Furthermore, note that

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

[22] Greenwood, Hercowitz and Huffman (1988).

[23] Using the preferences of Bhandari et al. (2013) does not affect the results quantitatively. Preliminary results are available upon request

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

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

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

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

There are two interesting aspects of this equation. When choosing bond policy today, today's 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 because there is no intertemporal 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. $b'\frac{\partial q}{\partial b'}$ 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 elasiticity of labor supply with respect to the tax rate, must equal the deviation from the socially optimal allocation of risk sharing, the *risk sharing wedge*, 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.

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

Lastly, (26) determines the relationship between private and public good consumption when social spending is chosen optimally. 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. In other words, the risk sharing wedge is zero on average:

$$\kappa\sum_i \sigma^i u_c^i(c^i,h^i) = (1-\kappa)v'(g^P). \tag{26}$$

There is no restriction on the positivity of g^T. Whether or not transfers are optimally positive depends on parameter values, most importantly on relative productivity differences. (Cf. 4.2)s

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 good spending is not an instrument to help smooth private consumption, as its demand by private households is complementary to their own consumption. This happens also in the case of additive separability, and it is due to public good spending being a normal good.

The assumption of elastic labor supply is important for two reasons: first, without elastic labor supply, taxation is not costly and the government can adjust the tax rate to finance her spending, independently of the size of the tax rate, and the state of the economy. There is thus no well defined trade-off between taxation and spending. Second, and as a consequence, if the tax rate is not distortionary, it is optimal for the (utilitarian) government to tax away all income and equalize consumption across agents. Unless the country can fully insure against domestic productivity shocks, consumption will comove with GDP. Even if full insurance is possible, transfers (and consumption) could at most be acyclical. Because all income derives from transfers, transfers will be procyclical. This case is both counterintuitive because the trade-off between taxing and spending is missing and counterfactual, because this correlation is not observed in the data.

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 4.3, where I confront a closed economy with a world of a full set of state contingent assets. Results for the calibrated model are presented and discussed in section 5.1.

4.2 Static 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 both qualitatively and quantitatively. I assume that functional forms and parameter values for preferences are as in section 5. Total factor productivity is set to its unconditional mean. For the examples where the 90/10 earnings ratio is varied, I assume that there are two types, and I set the shares in the population such that I match the Mexican Gini coefficient and the 90/10 earnings ratio simultaneously. The government's foreign assets in this first part 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.[24] In an environment with high inequality, the government effectively subsidizes households up to the fifth decile.

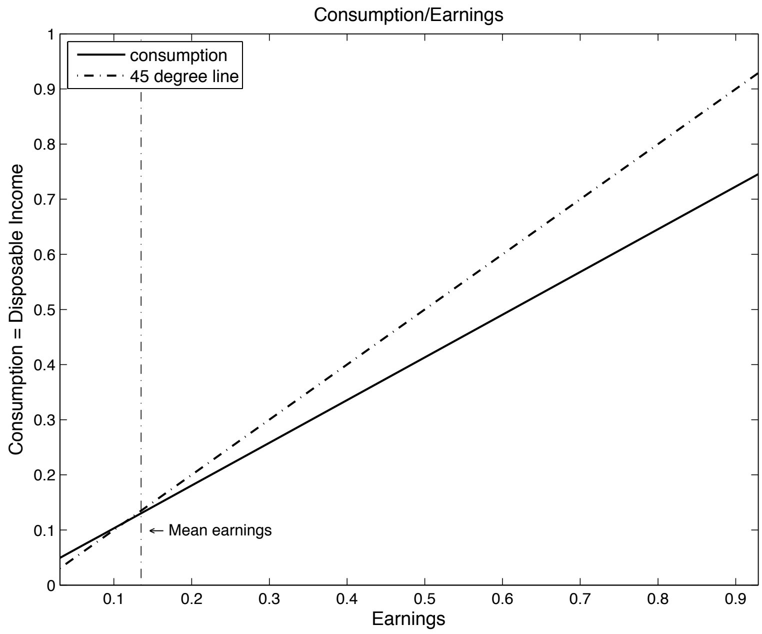

Figure 4: Redistribution with constant marginal tax rates and lump sum transfers: Disposable Income and Earnings, Gini coefficient 0.49, 90/10 earnings ratio from Esquivel (2008)

The relationship between consumption and disposable income is not monotone with respect do the degree of inequality as measured by the GINI coefficient. Figure 5 shows the ratio between earnings and disposable income as a function of the 90/10 earnings ratio. 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 3. Figure 5 and 6 show that this is the critical value for optimally positive transfers.[25]

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 earnings ratio around 7.5. For all degrees of inequality beyond this point, the government effectively subsidizes low income households. 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. This also reflected in the behavior of the Gini coefficient: for small changes in relative productivities, it initially increases a lot, but the change flattens out with higher productivity dispersion. Finally, the ratio of public good spending to GDP slightly increases, because GDP falls by more

[24] This example uses the calibration of households' productivity distribution and the Gini coefficient as in section 5.

[25] Initially, earnings are higher than disposable income because the government taxes agents to finance public good spending, which is about 11% of GDP (cf. figure 6).

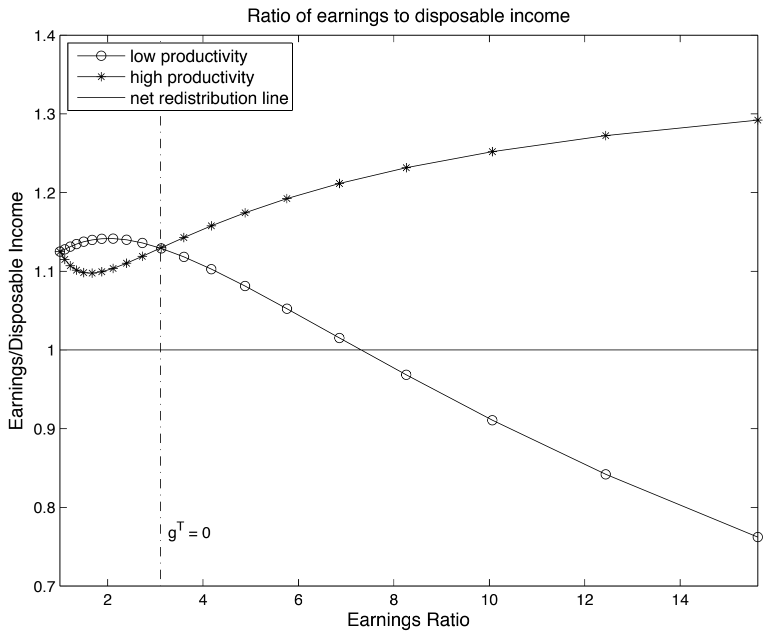

Figure 5: Redistribution with constant marginal tax rates and lump sum transfers: Ratio of disposable income and earnings, 90/10 as a function of the earnings ratio.

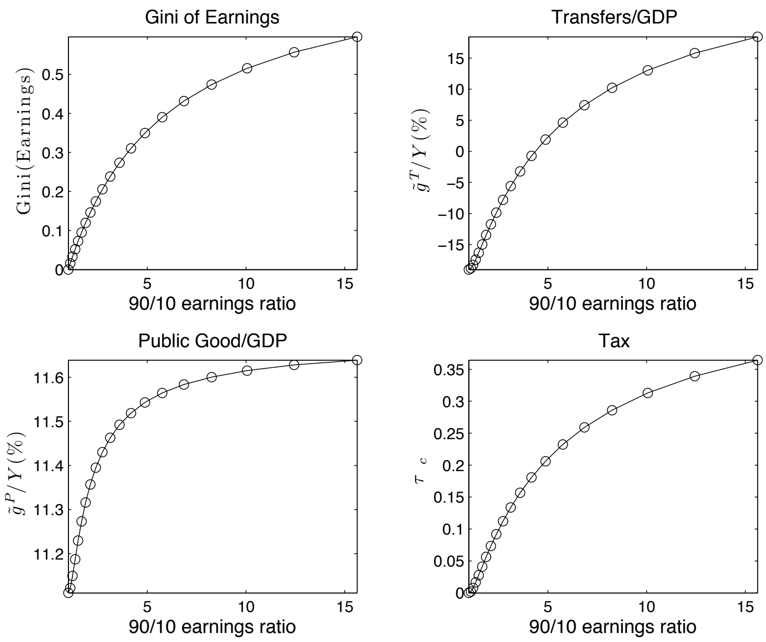

Figure 6: Redistribution with constant marginal tax rates and uniform transfer as a function of the earnings ratio. Top left: Gini coefficient. Top right: Transfers to GDP ratio. Bottom left: public good spending to GDP ratio. Bottom right: Consumption tax rate.

than public good spending. GDP falls because average productivity is lower, and public good spending falls as a consequence, because the right hand side of the risk sharing equation (26) increases.

The model is empirically relevant, as the region of net subsidies attained for a broad range countries: For instance, the 90/10 earnings ratio for the US is around 8 (Bhandari et al. 2013). In Mexico, the ratio for equivalized household income is around 8 (SEDLAC). Effective income tax rates are negative for the lowest income decile in many countries.

4.3 Polar Cases: Full Insurance and Autarky

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. The functional form for preferences is the same as in 4.1. There are two types of households, high productivity e^h and low productivity e^l households, with population shares σ, $(1-\sigma)$, respectively.

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,

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

The risk sharing condition implies for households that

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

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, but higher than zero.

The last requirement is derived from a necessary condition for countercyclical transfer policy: the government chooses not to undo productivity shocks completely using taxes. When taxes are distortionary, such policy does is not a solution to the Ramsey problem independently of the assumption on market access.

$$\xi_{\tau,A}\frac{\tau}{1+\tau} = \frac{\partial \tau}{\partial A}\frac{\tau}{1+\tau} < 1 \tag{28}$$

Under complete markets, the government provides consumption insurance to private households, but most effectively 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 $\tilde{g}^T$, as summarized by the following proposition. Furthermore, consumption dispersion is procyclical.

Proposition Suppose preferences are such that (28) holds. Then:

$$\frac{\partial MUC(h)}{\partial A} > 0, \frac{\partial MUC(l)}{\partial A} < 0 \qquad \Leftrightarrow \frac{\partial \tilde{g}^T}{\partial A} < 0. \tag{29}$$

Proof: See appendix B.

In autarky, there is no possibility to smooth income and the marginal utility cost of resources and public consumption move with aggregate productivity. With GHH preferences and constant *relative inequality*, it is optimal for the government to keep the tax rate constant with productivity.[26] The proceeds are used to finance public good expenditure and transfers, which are procyclical due to procyclical revenues and the public good spending pattern.

Since there is no possibility to save or borrow, the main objective of the government is redistribution. While relative inequality is constant, absolute inequality (the absolute earnings difference) is procyclical. Thus, to maximize the social welfare function, social spending is procyclical reflecting the procyclial policy motive. The optimal policy will result in constant relative consumption over the business cycle.

The left panel in figure 4.3 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.

5 Calibration and Functional Forms

In this section, I will first state the functional forms and parametrization for the numerical solution of the model. Then, I will present the policy functions and business cycle moments from simulating the model, and discuss the results from the benchmark model and two counterfactuals. The counterfactuals are lower inequality, and a calibration for which the government does not enter the zone of positive risk premia. I will give particular attention to the mechanism driving the procyclicality of transfers.

[26] See appendix C

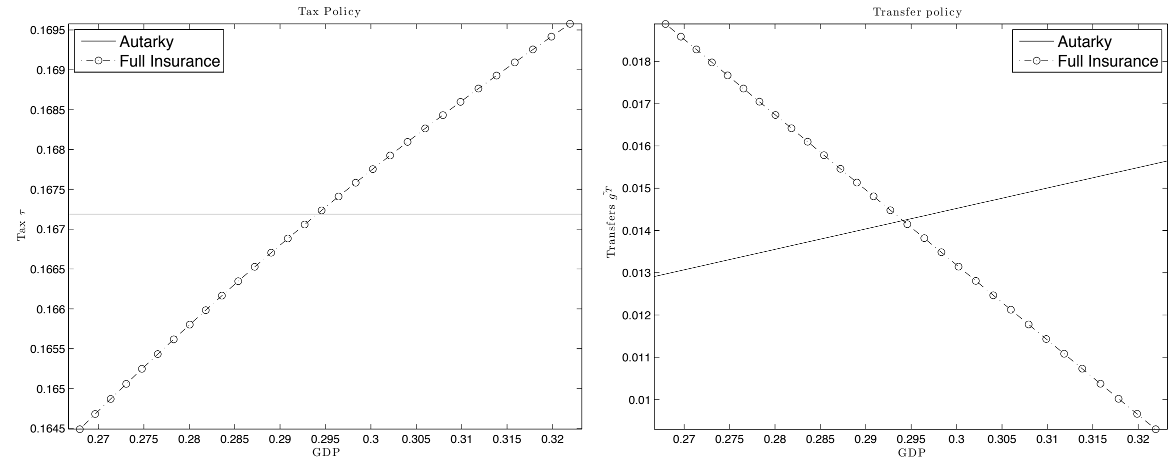

Figure 7: Optimal taxes (left) and transfers (right) as a function of GDP, different financial market environments. Autarky.: solid line. Full insurance: circles.

I assume that the utility functions exhibits constant relative risk aversion (CRRA):

$$u(c) = \frac{\left(c - \chi \frac{n^{1+\frac{1}{\psi}}}{1+\frac{1}{\psi}}\right)^{1-\gamma}}{1-\gamma}, \qquad \nu(g^P) = \frac{g^{P\,1-\gamma}}{1-\gamma}. \tag{30}$$

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

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

The calibration is shown in table 5.

Parameter	Value	Target/Source
	Set Parameters	
r	1.0 %	3 month T-Bill
γ	2	Arellano (2008), CSS (2010)
ψ	0.5	CSS (2010), GHH (1988)
μ	0.16	Literature
	Calibration	
β	0.94	Default Probability
ρ_A	0.8355	Persistence GDP Mexico
σ_ϵ	0.0063	Std GDP Mexico
χ	0.80	Average Hours worked
θ	0.9834	Debt service/GDP ratio
κ	0.80	Share of social spending
e^i	[0.399,1]	Gini / Earnings Quintiles

Table 5: Parameter Values and Calibration Targets

The stochastic process is discretized following Tauchen and Hussey (1991), using 30 states for aggregate productivity. The incomplete markets model is solved with value function iteration using the two-loop algorithm suggested by Hatchondo, Martinez and Sapriza (2010). The statistics below are from simulating the model 100 times for 1000 periods, discarding the first 50 periods.

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 dynamics in the HP-filtered Mexican data for the period 1980Q1-2007Q1.

β, the country's exogenous discount factor, is set to approximate the observed default probability of Mexico in the years after 1945. The coefficient for relative risk aversion of the private sector is a value commonly used for small open economy models of emerging markets. I assume five types of households in the economy, and relative labor productivities are set to match quintiles of the earnings distribution and the GINI coefficient for monetary/labor income in Mexican data, as in SEDLAC (2013), Esquivel (2011) and Esquivel (2008) . 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). χ helps to match an average of hours worked of 41 % of total time. (Neumeyer and Perri (2005) and OECD Employment Outlook, Statistical Annex) κ is set as to match the ratio of public good to insurance spending spending 45% 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 set to 0.16, which is in line with an average value for countries to re-access markets after a default of 12 quarters found by Gelos, Sahay and Sandleris (2011) , and values used commonly in the literature.[27]

5.1 Results

This section presents the results from the solusion and simulation of the calibrated model. 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 the equilibrium current account illustrate the mechanism. Figure 8 plots the current account for high and low aggregate productivity, respectively. As we approach the borrowing constraint, the current account deficit starts falling rapidly. With a positive spread, the slope increases strongly. Eventually, the country experiences capital outflows during a recession. Hence, relative to a situation when the country finds itself further away from the borrowing constraint (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 elasticity of the current account with respect to productivity shocks declines more than proportionately with respect to the asset

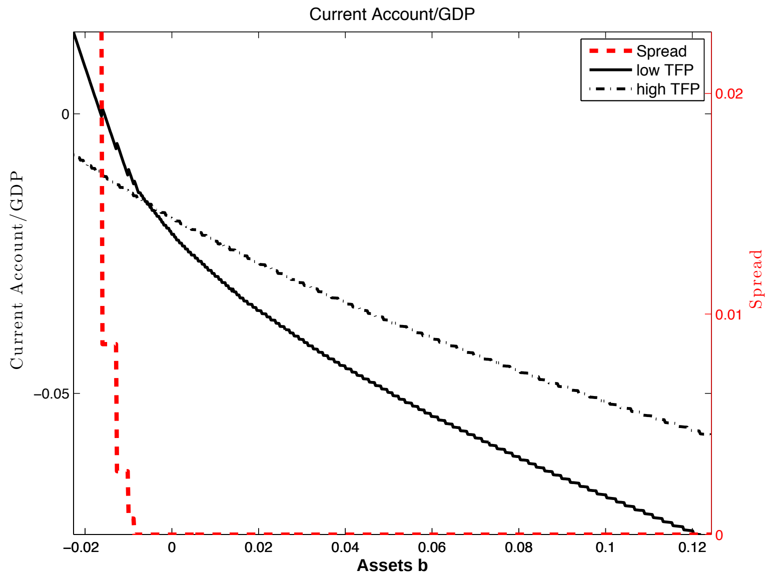

Figure 8: Asset choice as a function of asset holdings: Around the borrowing constraint.

level.

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 graduate adjustment of government expenditure to anticipated and acute financing restrictions. The actual bond price is plotted in figure 13. 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.

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.

[27]Cf. Arellano (2008), Aguiar and Gopinath (2006) for Argentina, Cuadra et al. (2010) for Mexico.

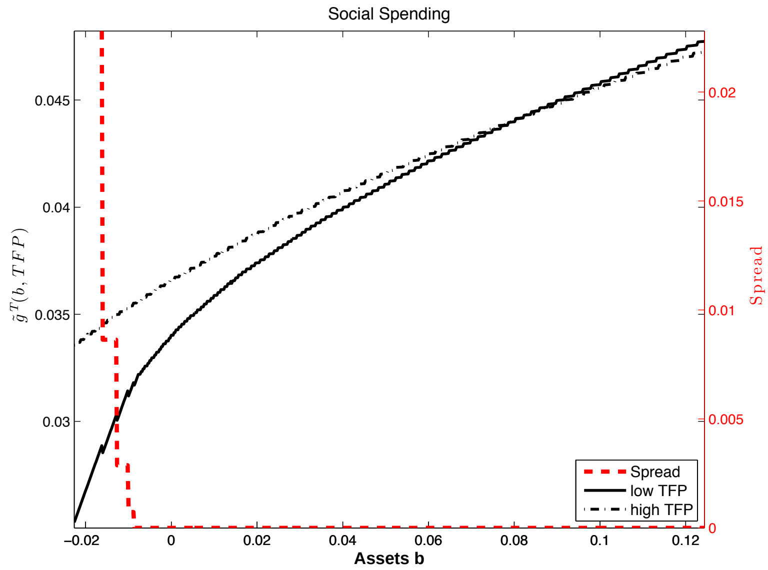

Figure 9: Transfers as a function of asset holdings

Figure 10 shows the ratio of social spending to spending on public goods. As the level of assets increases, social spending increases by more than spending on public goods. The ratio of transfers to public good spending is countercyclical when spreads on new debt are zero. When spreads are positive, social spending falls rapidly and the ratio becomes procyclical. For high levels of assets, these dynamics follow directly from fact that transfers are countercyclial and public good spending is procyclical, so the ratio is countercyclical. For intermediate asset levels and low debt, the current account is still procyclical, so the government will be able to use part of the newly issued debt to smooth households' consumption. Thus, transfers fall by less than public good spending. The situation changes when borrowing becomes effectively costly. Now a larger share of revenue from taxation goes into financing of the debt. Furthermore, since the current account is procyclical, social spending is adjusted more than proportionately in response to productivity shocks. Spending adjustment here is relatively less costly, because transfers are a perfect substitute to earnings, whereas taxes will lower output further and make even less resources available for redistribution.

The policy function for taxes displays similar dynamics as the policy function for transfers. In figure 11 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 cyclicality 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

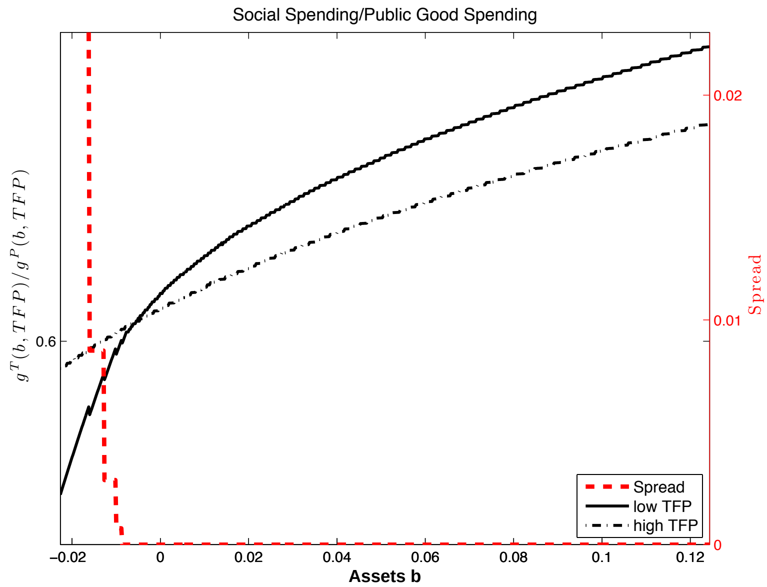

Figure 10: The ratio of insurance spending to public good

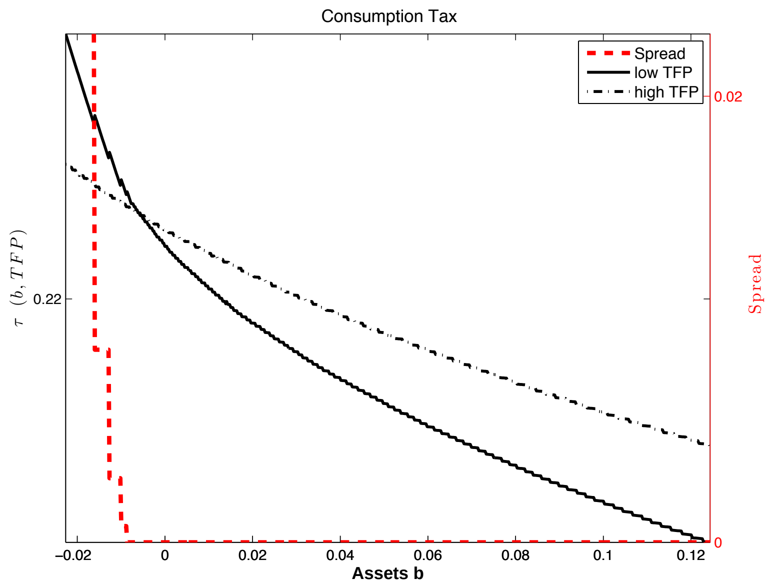

Figure 11: Tax rate as a function of asset holdings.

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

Finally, in figure 12 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.

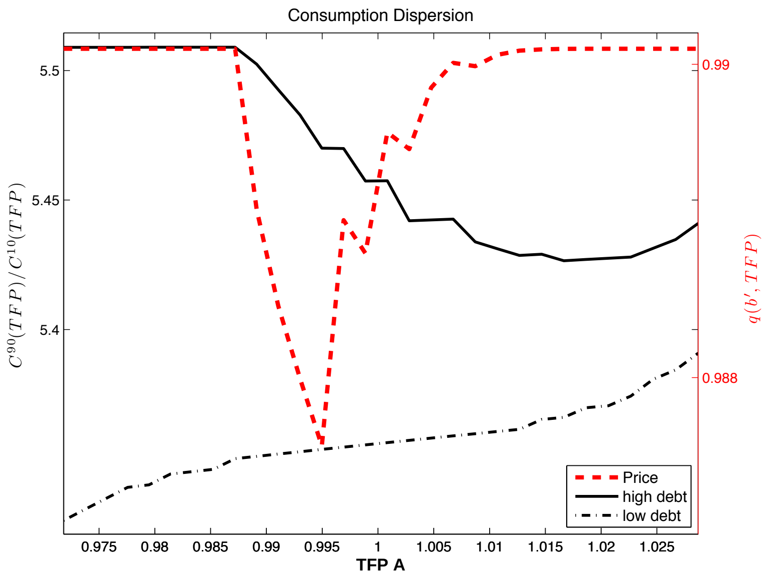

Figure 12: Consumption dispersion as a function of aggregate productivity, high and low debt.

Table 6 lists moments computed from the simulated model. The first column reproduces some moments of Mexican data as discussed in section 3. (Primary) Government expenditure is computed as the sum of public good spending,

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

and is much 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. The interest rate is countercyclical as in the data, because bond prices tend to fall (spreads tend to rise) in recessions. This result is well known and has been discussed extensively in the literature.[28]

Next, I change the degree of inequality in the economy as measured by the GINI coefficient, to match the earnings distribution of Canada. The third column gives the results from simulating

[28] Cf. Neumeyer and Perri (2005), Arellano (2008), Aguiar and Gopinath (2006). Hatchondo et al. (2010) point out that solving the model by discretization generates spurious interest rate movements; the volatility of the interest rate (not reported) is likely to be overstated, while the correlation with GDP is likely to be understated. They also argue that the model with stationary shocks may be better suited to explain emerging market dynamics than the model with trend shocks. In this respect, my results are not affected qualitatively, and quantitatively only to a lesser extent, since a strongler countercyclicality of the interest rate would lead to a better fit. See their table 3 and discussion of results.

Statistic	Data	Benchmark Model	Lower Inequality	No Spread
$GINI$	0.49	0.49	0.38	0.48
$std(Y)$	2.37	2.37	2.37	2.09
$std(C)/std(Y)$	1.22	1.09	1.09	0.79
$std(g^T)/std(Y)$	5.9	1.81	2.51	0.48
$std(g^{EXP})/std(Y)$	2.6	1.64	1.85	0.29
$corr(g^T, Y)$	0.41	0.84	0.75	-0.73
$corr(g^{EXP}, Y)$	0.35	0.87	0.83	-0.39
$corr(\tau, Y)$	-0.3	-0.47	-0.46	0.97
$corr(r, Y)$	-0.36	-0.28	-0.30	0.00

Table 6: Results from Calibrated Model and Counterfactuals

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 4.2 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.

The result points towards the findings of Aizenman and Jinjarak (2012).[29] On the other hand, social spending and overall government expenditure becomes more volatile. As depicted in figure 10, this is driven by the behavior during prolonged recessions when spreads are high. The poor households in this economy are relatively less poor compare to the high inequality economy. Hence, a cut in social spending ceteris paribus has a smaller adverse welfare effect.

Lastly, I calibrate the model such that the government never accumulates enough debt to enter the region in the neighborhood of positive risk premia, to demonstrate that borrowing constraints indeed drive procyclical transfer policies. While maintaining the same risk free rate, the discount factor of the government is set to $\beta = \frac{1}{(1+r)} - \epsilon$.[30] 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 countercyclical, despite the strong procyclicality in the spending on the public good.

6 Conclusion

This paper proposes a novel mechanism linking financial market frictions to procyclical government expenditure. Empirical evidence has shown that fiscal policy is procyclical in Latin America, while it is countercyclical in developed countries. The most recently quoted fiscal pol-

[29] In the current model, higher inequality does not lead to more frequent default or significantly higher average spreads. To explore this effect of income inequality would be an interesting extension.

[30] ϵ is chosen such as to narrow the asset range for the stationary equilibrium.

icy instruments are government spending, taxes and borrowing. However, recent research has pointed out that differences in the cyclicality of government expenditure depend on the spending category. I corroborate this evidence by decomposing government expenditure into public goods and social spending, and show that the difference in social spending is more pronounced between emerging markets in Latin America and developed small open economies.

I then build a simple model where both of the expenditure types are included. Public goods are valued by households, and social transfers are motivated by earnings inequality. 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. 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 counteryclical 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 calibrate the model with incomplete markets to the Mexican economy 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

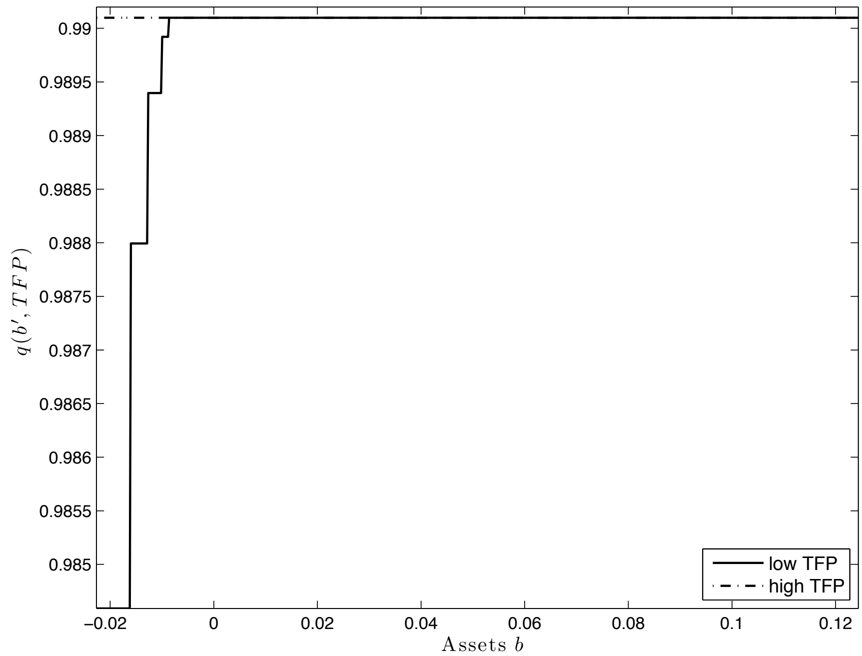

Figure 13: Bond price for each issuing choice b' for low and high value of aggregate productivity, respectively.

	GCONS	GEXP	GEDUC	GORDER	GHOUSE	GCULT
Argentina	0.33	0.33	0.23	0.53	0.18	0.56
Brazil	0.32	0.50	0.56	0.45	-0.08	0.64
Chile	0.49	0.49	0.46	0.14	0.68	NaN
Colombia	0.18	0.16	0.28	0.33	-0.15	0.15
Mexico	0.63	0.33	0.68	0.58	0.57	0.21
Paraguay	0.35	0.08	0.33	0.63	0.38	0.52
Thailand	0.31	0.08	0.20	0.47	0.25	0.07
Uruguay	0.41	0.52	0.40	0.30	0.15	0.20
Australia	-0.16	-0.22	-0.23	-0.06	-0.01	-0.18
Austria	0.42	0.03	-0.11	0.55	0.15	0.19
Canada	-0.22	-0.11	0.13	NaN	-0.02	0.17
Denmark	-0.25	-0.35	-0.29	0.45	-0.02	0.18
Netherlands	0.02	-0.19	0.20	-0.05	-0.19	-0.13
New Zealand	0.25	-0.59	0.24	0.13	0.53	-0.13
Norway	0.09	-0.35	-0.10	-0.20	-0.18	-0.33
United Kingdom	-0.10	-0.30	0.25	-0.14	-0.15	0.17
USA	-0.09	-0.50	-0.07	-0.18	-0.22	-0.03

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 countercyclical.
Suppose again that

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

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,

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

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

$$\begin{aligned}
\frac{\partial MUC(h)}{\partial A} &= -\gamma MUC(h)^{1+\gamma} \left(\frac{Ae^h}{(1+\tau)}^{1+\psi} A^{-1}\left[1 - \tilde{\xi}_{\tau,A}\right] + \frac{\tilde{g}^T}{A}\left[\xi_{T,A} - \tilde{\xi}_{\tau,A}\right] \right) && (34) \\
&\overset{!}{<} 0 \\
\frac{\partial MUC(l)}{\partial A} &= -\gamma MUC(l)^{1+\gamma} \left(\frac{Ae^l}{(1+\tau)}^{1+\psi} A^{-1}\left[1 - \tilde{\xi}_{\tau,A}\right] + \frac{\tilde{g}^T}{A}\left[\xi_{T,A} - \tilde{\xi}_{\tau,A}\right] \right) && (35) \\
&\overset{!}{>} 0.
\end{aligned}$$

After rearranging,

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

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

$$\xi_{\tilde{g}^T,A} < 0 \qquad \Leftrightarrow \qquad \frac{\partial \tilde{g}^T}{\partial A} < 0. \tag{37}$$

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

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

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:

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

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,

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

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.