Sovereign Spreads and the Poverty Head-Count Ratio*

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Abstract

National poverty head-count ratios (proportion of the population below the poverty line) and country default risk (measured as sovereign bond spreads) are positively correlated. For example, a nation with 40 percent of the population below the poverty line faces an average spread that is 120 basis points higher than a nation with a 10 percent proportion of poor, ceteris paribus. This result is robust to the inclusion of a number of country specific variables related to poverty including the country Gini and per capita GDP. To explain this new correlation, we build a sovereign default model with two types of households – those earning average income and those who earn a very low level of income. The government runs a social safety net which taxes the average income household in order to transfer consumption to the poor. A political constraint that ensures that all households wish to participate in the safety net program constrains the fiscal choices of the government. The novel aspects of the model are calibrated using international data on income, poverty and transfers while the usual calibration targets in the literature are also deployed. We build a variant of this benchmark economy with a higher proportion of poor households and find that this economy displays higher default risk than the benchmark economy. Defaults allow transfers to the poor to be kept from falling too much while also maintaining participation of others in the social safety net. Defaults occur when too large of a fraction of taxes will be needed for debt repayment and this occurs more often in economies with a larger proportion of the poor. We show that this result survives even after controlling for the increase in inequality implied by increasing the proportion of poor households. This is achieved by simultaneously increasing the income of the poor. We show that the worse borrowing terms faced by the High-poverty economy come with welfare losses due to the lower debt that it can afford and that it would default much less frequently if it faced the same terms as the benchmark economy.

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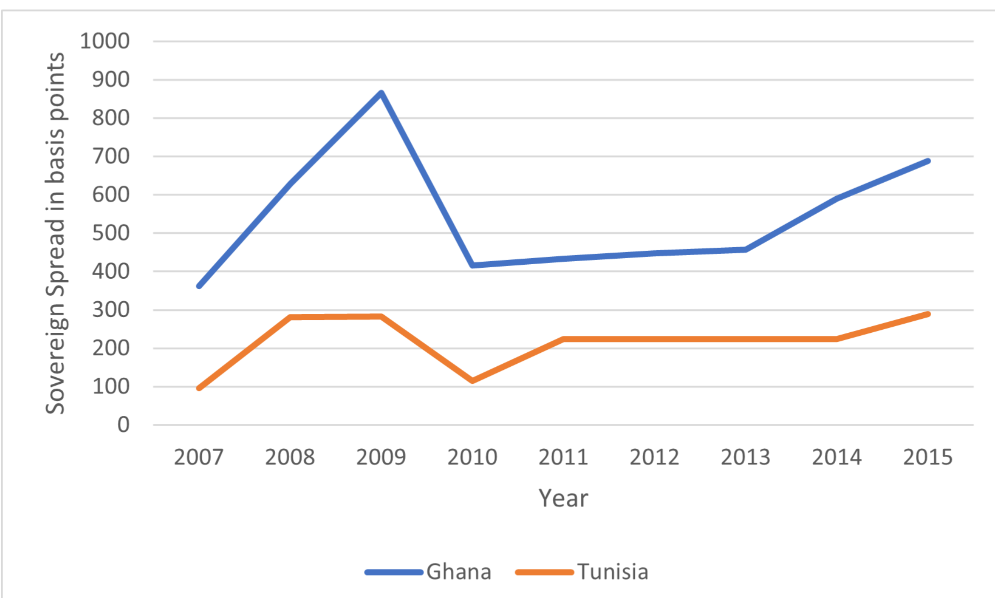
1 Introduction

Countries vary widely in the number of citizens who live below the poverty line. For example, the proportion of the population that lives on less than $1.90 per day is around 5 percent in Tunisia while it is about 25 percent in Ghana. Governments facing high rates of poverty may wish to provide a social safety net for these indigent citizens by providing transfers in order to prevent their consumption levels from getting too low. The public revenues of poor nations, however, are severely constrained by the local tax base and they may wish to use international debt markets in order to supplement their resources, especially when facing a recession. Their ability to access international resources depends on the terms at which credit is made available and these terms vary widely from nation to nation, even when averaged over decades. Figure 1 plots the sovereign spread on the government debt of Tunisia and Ghana for the period 2007-2015. As is evident from the graph,the sovereign spread for Tunisia was less than half of that of Ghana at any given year between 2007 and 2015.

Figure 1: Sovereign spreads (2007-2015)



In this paper, we begin with an empirical analysis to explore the relationship between the average spread paid by a national government and the average poverty rate of that nation, as captured by the poverty head-count ratio. Next, we build a sovereign default model of a small open economy in the tradition of Eaton and Gersovitz (1981) where a proportion of households are distinguished from the rest by having a much lower level of income than average. The government implements a social safety net using a tax and transfer system while also borrowing on international markets using one period debt. These bonds are subject to default risk, so international lenders price the debt accordingly. The government maximizes utilitarian social welfare where the utility of the poor and the rest are weighted according to social welfare weights. The level of the transfers implied by the social safety net are constrained by a political constraint that ensures that all households are willing to participate in the policy. We calibrate the model parameters using the average properties of the international data on debt, sovereign spreads, real per capita income, the poverty head-count ratio and fiscal data. In order to use our model to shed light on the positive correlation between poverty rates and spreads documented in the paper, we build a variant of the benchmark model – the High poverty economy has a larger proportion of poor households than the benchmark economy. We show that the High poverty economy faces worse borrowing terms and a higher default risk than the benchmark economy. As a result, it is able to borrow less than the benchmark economy and this lowers welfare considerably. Poor households have lower consumption levels in the high-Poverty economy than in the Benchmark economy despite receiving the same endowment stream in both economies. This occurs because transfers to the poor are much lower. We decompose these effects into those that can be attributed to the smaller number of households able to pay taxes and those that emerge from the worse credit terms available to the High-Poverty economy. If an international aid agency could replicate the spread-debt menu offered by private lenders to the Benchmark economy, not only would welfare and consumption rise in the High-Poverty economy, defaults would be much less likely to occur.

We compare the default risk of the High Poverty economy to an analogous economy with the same level of inequality as the Benchmark economy and show that the additional default risk is primarily driven by the increase in the number of poor households as opposed to the increase in inequality that this creates. We also show that controlling for the relatively lower GDP in the High Poverty economy does not eliminate the results discussed above.

Why is the High poverty economy more likely to default? There are two factors that influence this. First, the government of this economy would like to provide the same consumption to the poor as in the Benchmark economy given the same endowment streams and social welfare weight of the poor but have access to a smaller tax base due to the smaller number of non-poor households. When income is low, the marginal utility of the poor is high and governments may prefer to default rather than send precious resources abroad as debt repayment. Defaults in this situation are similar in spirit to the standard sovereign default models that follow Arellano (2008) and we will refer to them as standard defaults. Second, in the presence of the political constraint, the limited tax base can interact with high borrowing costs to create defaults that occur for political reasons. Non-poor households are willing to pay taxes as a form of consumption insurance whose effectiveness depends on the level of transfers promised by the government. If too large a fraction of tax receipts flow out of the economy as debt repayment, then the social safety net looks less attractive and this limits the level of taxes that the government can charge. At low levels of debt, borrowing provides a means to keep transfers high relative to taxes but as the debt burden rises or as income falls, too large a fraction of tax receipts start to flow out of the social safety net towards debt repayment. As this dynamic worsens, non poor households will eventually be unwilling to participate in the tax-transfer scheme. Defaults at this juncture occur to keep the political constraint binding and we call these political defaults. We show that in our calibrated Benchmark economy, political defaults almost never occur while a large fraction of the higher default risk of the High Poverty economy are due to political defaults. The high-Poverty economy is able to sustain a lower level of transfers relative to taxes and for any debt level, it hits that critical ratio when default becomes desirable at higher levels of income. Similarly, for any income level, the political constraint starts to bind at much lower levels of debt than in the Benchmark economy beyond which default is preferable.

1.1 Related Literature

Our paper is related to recent work that links inequality to default risk and especially to Andreasen et al. (2019) who show that income inequality and regressive taxes make default more likely for a given level of debt, and tighter political constraints reinforce this effect. While our work shares an interest in the role that feasibility of fiscal policies play in determining default risk, not only is our focus on international differences in poverty rates, the specifics of the political constraint and fiscal policies are quite different. They have exogenously given taxes that depend on the income of the agent whereas our taxes are endogenous and may be positive or negative depending on income. Moreover we focus on a tax-transfer scheme that acts like a social safety net whereas they primarily focus on tax receipts to finance debt. For this reason, either everyone pays taxes or receives transfers from the government whereas in our model a fraction may pay taxes while the rest receive transfers. In Andreasen et al. (2019), the fiscal plan of the government must be approved by the population otherwise a default occurs. While this sounds similar to our political constraint there are important modelling differences which are driven by the context of the studies. When deciding whether to participate or not households in our model compare the expected value of participating in the social safety net with the value of not participating, not with the value available to them in default (as happens in Andreasen et al. (2019)). Indeed, the tax-transfer scheme may continue to be implemented in default in our model whereas this is ruled out by assumption in theirs. We found it unreasonable to assume that there is no fiscal plan in operation while the government is in default in our context whereas it makes sense in theirs since taxes are only collected to repay debt. In our model, the government only proposes tax-transfer schemes that will be approved by households and sometimes these schemes involve defaults on existing debt. The strong assumptions regarding the effect of the political constraint is needed in their paper because the tax structure is set in stone and does not respond to the state of the economy. In contrast, ours responds each period and households evaluate their willingness to participate each period.

Our paper is also related to Jeon and Kabukcuoglu (2018) which explores how income inequality matters for government borrowing and default decisions. The authors add time varying inequality shocks to a model with two types of households and impose a taxation regime that can be more or less progressive. They show that rising income inequality within a country increases the probability of default significantly. The idea is that during times of adverse inequality, the marginal utility of the poor is significantly higher than that of the rich and the government is tempted to default in order to try to equate the marginal utility of the two types. In contrast, the tax-transfer scheme in our model is endogenously determined and the amount of taxes that can be charged to the agents is limited by the political constraint discussed above. Moreover we focus on variation in poverty rates across economies, not over time. The implied differences in inequality between economies remain constant as a result. Deng (2021) also explores the role of income inequality on sovereign default risk with an emphasis on worker migration. The main channel through which inequality affects the spread is that the government of an economy with more inequality will use more progressive taxes for redistribution and to reduce consumption inequality. The progressive tax not only discourages labor supply but also induces emigration from the nation and shrinks the tax base, thus reducing government's ability to repay debt. At the same time higher inequality increases the temptation of the government to use defaults as a means to increase the progressivity of the tax base. She finds that income inequality and its interaction with migration explain about one-third of the average government spread. Our work differs in several ways from these studies in that we show that the proportion of poor agents in an economy has an independent role to play beyond inequality in determining the level of sovereign risk. While an increase in the proportion of poor households in an economy increases inequality, we show that the impact of this change on the terms of credit offered by international lenders and the debt choices of the government are robust to controlling for inequality. Moreover, we deliberately switch off any distortions caused by changing taxes either through labour supply distortions or through worker migration in order to highlight the interaction of the political constraint with the international cost of borrowing which lies at the heart of our mechanism. [1] Finally, Cotoc and Johri (2021) link cross-country differences in sovereign spreads to the average bribe rate in the country. Their model implies a positive relationship between the average amount of diversion of public resources and the average spread.

The remainder of the paper is structured as follows: Section 2 presents the empirical findings that motivate the theoretical analysis. Section 3 presents the model, characterizes the equilibrium, and describes the mechanism of the model. Section 4 describes the calibration of the model and presents the main results and quantitative implications. Section 5 concludes

[1] Azzimonti et al. (2014) find that higher income inequality translates to higher individual income risk which in turn results in more public debt. Similarly, Arawatari and Ono (2017) reveal that higher income inequality causes politicians to shift the fiscal burden from the present generation to future generations. This implies politicians finance some part of their government expenditure by issuing public debt. In other work, Bi (2012) finds that the government's ability and willingness to repay its debt depend on fiscal limit which, in turn, is determined by underlying economic fundamentals such as political uncertainty and size of the government.

the paper.

2 Empirical motivation

In this section, we provide empirical results that support the positive relationship between the sovereign spread of a country and the proportion of its population that lies below the poverty line. The poverty line is measured using the poverty headcount ratio at $1.90 per day. The headcount ratio identifies the share of a country's population with income less than the poverty line. The current international poverty line is set at $1.90 per day in 2011 purchasing power parity terms. This represents the mean of the national poverty lines found in the poorest 15 countries ranked by per capita consumption (World Bank, World Development Indicators). We use JP Morgan's Emerging Market Bond Index (EMBI) spreads which capture the difference between the yield of sovereign bonds of a country in basis points and the yield of US 10-year treasuries between the the period 2006-2018.

In order to show that the positive correlation between poverty headcount ratios and sovereign spreads is robust to conditioning on other factors, we use the following empirical specification:

$$spread_{it} = \alpha + poverty_i + X_{it} + Z_i + Y_t + u_{it}$$

where Y_t refers to global variables that are common to all countries but vary over time, Z_i refers to country averages that do not change over time, while X_{it} refers to other control variables that vary over time and across countries. We would like to emphasize that the goal of this specification is not to establish a causal link but rather to establish the robustness of the correlation in question.

Data on domestic macroeconomic control variables are collected from the World Development Indicators data set of World Bank. The global variables, which include the ten year US treasury bill rate and the ten-year to one-year treasury yield curve, are taken from the Federal Bank of St Louis FRED database. We include the debt to GDP ratio as a domestic control variable because higher levels of debt are expected to be correlated with higher spreads both in theory and in previous empirical work. We also include the GDP growth rate of the country as a conditioning factor as default risk has been shown to increase in recessions.

Finally, we control for output volatility of the country since theory suggests that increasing the volatility of an economy increases default risk and hence spreads. Another strand of literature suggests that volatility induces higher default risk, reduces the debt/GDP threshold, and thereby increases the interest rate (Catão and Kapur (2004); Genberg and Sulstarova (2008)).

Table 1: Poverty and Spread Regression

	(i)	(ii)	(iii)	(iv)	(v)	(vi)
poverty proportion	4.82* (1.89)	5.02*** (1.35)	3.82** (1.38)	3.85** (1.35)	5.24*** (1.36)	5.31*** (1.36)
debt/GDP	14.52*** (1.81)	13.96*** (1.10)	14.90*** (1.11)	14.70*** (1.09)	-	
10 year US Tbill	-	27.54 (16.75)	17.15 (16.70)	20.11 (16.62)	23.02 (17.10)	21.61 (17.01)
US yield curve 10/1	-	55.02* (22.30)	52.81* (21.78)	52.90* (21.83)	56.07* (22.50)	56.44* (22.37)
GDP_growth	-	-27.30*** (4.73)	-25.23*** (4.71)	-26.60*** (4.88)	-36.00*** (4.68)	-34.30*** (4.69)
output_ volatility	-	0.16*** (0.03)	0.17*** (0.03)	0.18*** (0.004)	0.16*** (0.03)	0.15*** (0.03)
bribe rate %	-	-	40.26*** (7.22)	40.51*** (7.27)	-	-
Gini coefficient	-	-	1.09 (2.21)	-	-	-
GDP per capita	-	-	-	-0.004 (0.007)	-	-
previous debt	-	-	-	-	13.15*** (1.09)	12.99*** (1.08)
Default events	-	-	-	-	-	550.01** (193.86)

Standard errors are reported in parentheses. ***,**,* represent significance level at 1%, 5% and 10% respectively.

Our results are reported in Table 1 where column (i) presents the regression of spread on poverty and current level of debt as a proportion of GDP only while column (ii) refers to the benchmark specification. Both specifications indicate that there exists a positive and significant relationship between the spread of a country and the poverty rate. The results suggest that on average nations with poverty headcount ratios of 40 percent will display average sovereign spreads that are 120 basis points higher than nations with poverty headcount ratios of 10 percent. The control variables in column (ii) also exhibit their expected signs – higher debt burdens and more volatile GDP are both associated with higher spreads, whereas higher GDP growth is associated with lower spreads. Among global variables, the positive relationship with US treasury bill yields is not significant while the positive relationship with global risk as measured by the US treasury ten year to one year yield curve is positive and significant. We conclude that the positive correlation between poverty rates and spreads is robust to the inclusion of the usual conditioning factors.

Countries with more poor people have been shown to have a higher level of inequality as well as weak institutions resulting in a higher incidence of corruption. These nations also tend to have lower GDP per capita. The existing literature on sovereign debt has discussed some of these sources of default risk (see for example the role of the bribe rate of a nation in Cotoc and Johri (2021) and the impact of inequality in Deng (2021) and Jeon and Kabukcuoglu (2018)). Cotoc and Johri (2021) argue that when bureaucrats are known to divert funds from public projects, the government has an additional incentive to default relative to an economy without diversion since default may curtail stealing. Jeon and Kabukcuoglu (2018) shows that periods of rising income inequality within a country increases the probability of default significantly. Finally, Erdem and Varli (2014) demonstrates that a country is more likely to issue sovereign bonds in the global market when it has higher per capita GDP, and that lower primary yield spreads are strongly associated with higher per capita GDP. In the next two specifications, we wish to see if the inclusion of these factors influences our results. In specifications (iii), we add the bribe rate and the Gini coefficient as a measure of inequality while in column (iv) we add per capita GDP to our benchmark model. As is evident from Table 1, poverty continues to be positively correlated with spreads. While the bribe rate coefficient is positive and significantly different from zero in both specifications, neither the Gini coefficient nor per capita GDP appears to be statistically significant.

In column (v), we use one-period lagged debt-to-GDP in our benchmark specification of column (ii) to reduce the endogeneity of debt with similar results. Finally, following the logic in Catão and Mano (2017) we control for countries that have experienced default in column (vi), because countries which have defaulted in the past appear to experience higher spreads well into the future. This variable emerges as very strongly correlated with higher spreads but leaves the relationship of interest intact. Overall, in all six specifications, the proportion of population lying below the poverty line is found to be positively correlated with sovereign spreads. Moreover, the results in Table 1 suggest that poverty rates have an additional marginal impact on country spreads beyond the fact that high poverty headcount ratios occur in nations with low per capita income and display high rates of income inequality. As such, we build a model in the next section where an economy with a higher proportion of poor people will display higher default risk.

3 Model

Consider a small open economy inhabited by a continuum of households of measure one and a government. At every point in time, there are two types of households: poor households comprise λ proportion of the population and non-poor households make up $1-\lambda$ proportion of the population. A non-poor (representing the average per capita income of the economy) household earns an income given by y while a poor household earns income given by $y_p = \alpha y$ with $\alpha \in (0,1)$. We can think of α as the income gap between the average household and the poor household.

A representative non-poor household's preferences are given by:

$$u(c_t) \tag{1}$$

The household pays non distortionary taxes(transfers) at the rate τ_t which is given by government policy and consumes whatever remains from their endowment y_t.

$$c_t = y_t - \tau_t \tag{2}$$

where the endowment process evolves stochastically according to the transition density $f(y', y)$. Households of either type do not save and make no dynamic decisions. We note that in this version of the model, we deliberately eschew distortionary taxation in order to focus on the relationship between the proportion of the poor in an economy and its default risk.

Naturally, if higher distortionary taxes are required by the social safety net then the ensuing output losses could by themselves be a source of default risk. This idea has already been explored in the literature (see Deng (2021) for an example where the economy suffers from distortions due to both a decrease in labour supply as well as migration out of the economy.

Similarly, the representative poor household's preferences are given by

$$u(c_t^p) \tag{3}$$

where the p superscript denotes variables for the poor households. Once again the budget constraint is:

$$c_t^p = y_t^p + \tau_t^p \tag{4}$$

where the notation assumes that a poor household will receive transfers though this is determined in equilibrium. We note that the income gap of the two types of households is always held constant. This deliberately distinguishes us from Jeon and Kabukcuoglu (2018) which studies the role of time varying inequality on default risk. Aggregate output or GDP is the weighted sum of household endowments:

$$Y_t = \lambda y_t^p + (1-\lambda)y_t = (\lambda\alpha + 1 - \lambda)y_t \tag{5}$$

and we note that aggregate output, Y_t is proportionate to the endowment of the non-poor, y_t.

3.1 The Government

The government maximizes a social welfare function where the utility of the poor and the non-poor households are weighted according to the parameters λ_{pol} and $1-\lambda_{pol}$ respectively. These social welfare weights used by the government are not necessarily equal to the proportion of poor and non-poor households but govern the *desired* size of the social safety net that the government implements through its tax-transfer scheme. They can be viewed as the outcome of a social process outside the scope of the model or simply as capturing the average ideology of the nation which underpins the government's choice of social policy.

The government is the only agent in the economy who can borrow and lend in international credit markets and borrows from abroad by selling one-period discount bonds d' at price

$q(d', y)$. The government cannot commit to repaying its debts. If the government does not default, it repays existing debt and can issue new debt d'. The transfers made to the poor as part of the social safety net is the only domestic expenditure incurred by the government so its budget constraint is given by:

$$d + \lambda\tau^p = (1-\lambda)\tau + q(d', y)d' \tag{6}$$

where the left hand side of the equation provides the uses of public funds while the right side provides the sources of public funds.

The government is limited in its ability to redistribute income using taxes by a political constraint which states that households must be willing to participate in the tax-transfer scheme. The idea here is that government's fiscal choices either face a referendum or the government takes into account that it must win elections which are lost if households are unhappy with the utility delivered by fiscal policy.

In order to motivate the non-poor to participate in a tax-transfer policy we offer two possible rationalizations. The first is the need for a social safety net to cover the possibility of an idiosyncratic shock. We assume that in every period there is a constant probability, p, that a non-poor household may become a poor household. In this situation, the tax-transfer scheme acts as an insurance device against the small probability of income loss from change in type. We assume that the aggregate proportion of poor remains unchanged in this situation and government policy operates with the aggregate in mind. The other rationalization assumes that non-poor households care about the utility of poor households to a limited extent and p is the relative utility weight attached to the poor while 1-p is attached to own utility. We can attribute this benevolence to feelings of justice, charity, equity etc. While a non-poor household is willing to give up some consumption to raise the consumption of poor households, a fiscal plan that gives too much away to the poor at the expense of the non-poor will have that plan voted down. Similarly a plan that gives the poor too little will also be viewed as unsatisfactory.

That is, government policy must satisfy the political support constraint:

$$W_\tau \geq W_0 \tag{7}$$

where W_τ is the utility in period t given the proposed fiscal plan (τ, τ_p), while W_0 is the utility without any fiscal program where all households consume their endowment (y, y_p).

$$W_\tau = pu(c_p) + (1-p)u(c) \tag{8}$$

$$W_0 = pu(y_p) + (1-p)u(y) \tag{9}$$

As explained earlier, p has two interpretations. First it is the ex-ante risk of becoming a poor household in which case W_τ may be thought of as the expected utility of a household under the tax-transfer scheme while W_0 is in its absence. Alternately it is the weight of poor consumption in non-poor preferences.

We can think of this constraint as if the government proposes its tax-transfer scheme knowing that it must pass a referendum which would not pass if the political constraint was violated. The implementability constraint thus limits the possibility of redistribution to the poor. It can, in certain states, also limit the ability of the government to collect taxes for repaying existing debt. As such, it can influence the government's decision to default or repay, which we discuss below.

Given these constraints, the government chooses the optimal fiscal policies (τ, τ_p) in response to the realization of the income shock. The goal of the government is to smooth consumption across both households and time by minimizing the gap in weighted marginal utilities of consumption between household types. The first-order conditions given by the government's optimization problem give rise to the following relation between the marginal utility of consumption between the two types of households:

$$U_c(c) = U_{c_p}(c_p)\left(\frac{\lambda_{pol}(1-\lambda)}{\lambda(1-\lambda_{pol})}\right) \tag{10}$$

Timing The timing in the model is as follows:

1. The output shock y is realized.

2. The government decides whether to repay its debt obligations or default and how much to borrow.

3. Given the debt choices, the government proposes the optimal tax-transfer scheme in order to satisfy equation (10) taking into account the political constraint (7).

4. Households calculate their expected utilities with and without the tax-transfer program, and then they vote in favor of or against the fiscal plan.

5. Finally households consume with respect to their types.

3.2 Value functions and recursive equilibrium

Each period, the government chooses between honoring its outstanding foreign debt or defaulting on it. When the government defaults, it gets excluded from the credit market for a stochastic number of periods. Following default, the government may regain access to the international credit market with an exogenous probability θ, and it does so with no debt burden, $d = 0$. Default also entails direct costs such that output is lower during the periods the government is in autarky. That is, each non-poor person's endowment is

$$y_{def} = h(y) \leq y \tag{11}$$

while each poor person's endowment is

$$y^p_{def} = \alpha h(y) \leq y_p \tag{12}$$

Given the initial foreign debt d, and realization of the endowment process, the government chooses whether to repay or default as well as how much to borrow if not defaulting. In either situation, the government also chooses the levels of τ, τ_p. The value function when the government has access to international credit market and an amount of debt d given endowments (y, y_p) is given by $V^0(d, y)$. The government decides whether to default or repay its debts in order to maximize the welfare of households. It does so by comparing the value associated with paying back and remaining in the credit market $V^c(d, y)$ with the value associated with defaulting and going to temporary autarky $V^d(y)$. The problem can thus be expressed as:

$$V^0(d, y) = max[V^c(d, y), V^d(y)] \tag{13}$$

When the government decides to remain in good terms, the value conditional on not defaulting is given by the following optimization problem:

$$V^c(d,y) = max[(1-\lambda_{pol})u(c^*) + \lambda_{pol}u(c^{*p}) + \beta \int_{y'} V^0(d',y')f(y',y)dy'] \quad (14)$$

subject to

$d = (1-\lambda)\tau - \lambda\tau^p + q(d',y)d'$

$c^* = y - \tau$

$c^{*p} = y^p + \tau^p$

$W_\tau \geq W_0$

$U_c(c) = U_{c^p}(c^p)(\frac{\lambda_{pol}(1-\lambda)}{\lambda(1-\lambda_{pol})})$

On the other hand, when the government defaults on its debt, the value of default is given by the following problem:

$$V^d(y) = max[(1-\lambda_{pol})u(c^*_{def}) + \lambda_{pol}u(c^{*p}_{def}) + \beta \int_{y'} [\theta V^0(0,y') + (1-\theta)V^d(y')]f(y',y)dy'] \quad (15)$$

subject to

$(1-\lambda)\tau - \lambda\tau^p = 0$

$c^*_{def} = y_{def} - \tau$

$c^{*p}_{def} = y^p_{def} + \tau^p$

$W_\tau \geq W_0$

$U_c(c_{def}) = U_{c^p}(c^p_{def})(\frac{\lambda_{pol}(1-\lambda)}{\lambda(1-\lambda_{pol})})$.

Later we will show that if the 7 cannot be satisfied, the government will default in order to prevent too large a share of tax revenue from leaving the country, however the government may default even when the political constraint is satisfied. We also note that while it is not guaranteed in autarky that both 7 and 10 will be satisfied this is true for our parameterizations.

The default policy of the sovereign is thus characterized by:

$$D(d,y) = \begin{cases} 1 & V^d(y) \geq V^c(d,y) \\ 0 & otherwise \end{cases}$$

As such, given a level of debt d, the default set can be characterized as :$\mathcal{D}(d) = \{y \in Y : D(d,y) = 1\}$.

There are a large number of identical foreign lenders who can borrow or lend at the risk free rate r and participate in a perfectly competitive market to lend to the small open economy. The lenders have perfect information about the economy's endowment process, the distribution of poor households, as well as other parameters governing the economy and can observe y every period. They are risk neutral and they maximize their expected profits ϕ given by:

$$\pi = -qd' + \frac{\delta(d', y)}{1+r}0 + \frac{(1-\delta(d', y))}{1+r}d' \tag{16}$$

where $\delta(d', y)$ is the endogenous probability that the government defaults on its debt. With perfect competition in the credit market, a zero profit condition for the foreign creditor is satisfied. Hence the bond price is given by:

$$q(d', y) = \frac{(1-\delta(d', y))}{1+r} \tag{17}$$

Thus the equilibrium bond price $q(d', y)$ reflects the probability of default of the government $\delta(d', y)$ which is determined by the government incentives to repay debt.

3.2.1 Equilibrium

The recursive equilibrium for this economy is characterized by a set of policy functions for (i) consumption c, and c^p, (ii) government's borrowing decision d' and default rule D, (iii) government's fiscal choice τ and τ_p, and (iv) a bond price $q(d', y)$

such that:

1. Given the sovereign bond price $q(d', y)$ and the political constraint $W_\tau \geq W_0$, the government's policy set $\{d'(d, y),\ D(d, y),\ \tau(d, y),\ \tau_p(d, y)\}$ satisfies the government's optimization problem.

2. Given the government's policy set $\{d'(d, y),\ D(d, y),\ \tau(d, y),\ \tau_p(d, y)\}$, the household's consumption choices $c(d, y)$ and $c^p(d, y)$ satisfy the political constraint and the resource constraint.

3. The sovereign bond prices $q(d', y)$ reflect the government's default probabilities and are consistent with lender's expected zero profit condition and government's optimization problem.

4 Calibration

Table 2: Parameter values

persistence	ρ	0.74	Estimation
sd of ε	σ_y	0.031	Estimation
risk aversion	σ	2	Prior literature
risk-free rate	r	0.04	Prior literature
re-entry probability	θ	0.32	Prior literature
proportion of poor households	λ	0.136	Data
income share of poor households	α	0.26	Data
political weight	λ_{pol}	0.12	calibration
perceived probability of being poor	p	0.1	calibration
discount factor	β	0.843	calibration
default cost	ϕ	0.91	prior literature

We use annual data and solve the model numerically with value function iteration. We assume that the aggregate output follows an AR(1) process:

$$lnY_t = \rho lnY_{t-1} + \epsilon_t, \tag{18}$$

with $|\rho| < 1$ and $\epsilon_t \sim N(0, \sigma_\epsilon^2)$. In order to estimate ρ and σ, we use logged and linearly de-trended data for each country covering the period 1995-2015. The mean of these country estimates then give a value of 0.74 for ρ and 0.031 for σ.

Following the standard values used in the real business cycle literature for small open economies as well as in the quantitative sovereign defaults literature, we assume a coefficient relative risk aversion of 2 and a risk-free rate of 4 percent annually. The probability of re-entry after default into international credit market is set to 0.32, such that the government remains in financial autarky for a period of 3 years on average following a default event. This is consistent with the empirical findings of Mendoza and Yue (2012) and Gelos et al. (2011).

Table 3: Targeted and non-targeted moments

Moments	Data	Benchmark model
$\sigma(spread)$	198.02	203.63
Mean debt/GDP	13	12.873
Mean spread	250	246.89
$\rho(spread, y)$	-0.7231	-0.6897

Next, the proportion of poor household's λ is computed from data using the poverty headcount ratio at 1.90 dollar per day measured as a percentage of population. The value of 0.136 is the mean over all nations in our data. Similarly, we calculate the income share of poor households α using the data on per capita income of each country and the international poverty line. Specifically, we multiply \$1.90 by 365 days per year to obtain the annual income equivalent of the poverty line and express it as a percent of per capita income for each country and use the mean value taken over all nations in our data.

We calibrate the socio-political welfare weight of the poor in the government's social welfare function λ_{pol}, so that our benchmark model can match the transfers to GDP ratio in the data when averaged across nations. This value in our data is 8.8 percent and is reported in Table 5. Finally, we jointly calibrate the discount factor β, default cost parameter ϕ and the probability of becoming a poor household p so as to match the GDP-weighted average spread and debt/GDP moments from our data set. The target for the spread is 250 basis points obtained by weighing the spread of each country by GDP. Similarly, the target debt to GDP ratio of 13 percent is found by taking the average debt-to-GDP ratio for all countries in the data.

As evident from table 3, we have successfully matched the mean debt/GDP ratio of 13.0 and the mean spread is also close to 250 basis points. Moreover, the model is also able to deliver the key business cycle properties. As observed in data, both spreads and trade balance/GDP are countercyclical, and spreads are positively correlated with trade balance to GDP.

5 Results

In order to shed light on the empirical correlation between nations with high proportions of households below the poverty-line and their default risk, we modify the Benchmark economy by setting $\lambda = 0.4$ while keeping all other parameters unchanged. We will refer to this economy as the High-Poverty economy. Figure 2 depicts default regions associated with the two economies where the endowment level is shown on the vertical axis and the level of debt divided by mean GDP is on the horizontal axis. The red line refers to the Benchmark economy, while the green line relates to the High-Poverty economy. Each line divides the state space into two regions, such that the government of that economy will default in the represented states under the respective curve. The main message of the paper is immediately apparent from Figure 2 – the High-Poverty economy's default set is larger and will be associated with higher default risk. Moreover, focusing for the moment on the red line, for any level of debt/GDP above 0.034, a sufficiently low realization of income leads to default. As the level of debt rises, the income level that is needed to avoid default also rises but the government will default at even the highest income level when debt/GDP exceeds 0.59. Finally note that at a sufficiently low level of debt, the government will not default at even the lowest income levels. These properties of the default region of an economy are quite standard in the quantitative sovereign default literature. Turning to the green line, we see that it can support much less debt without defaulting at even the highest income levels. On the other hand, the level of debt at which default can be avoided, even at the lowest income levels is only slightly lower than the Benchmark economy. As such we would expect the High-Poverty economy to display a much lower debt to GDP ratio than the Benchmark economy.

The implications of the larger default region of the High-Poverty economy are reinforced using Figure 3 which shows the menu of debt and interest rate spreads on offer to the two economies at mean endowment levels. Note that the the interest rate spread is calculated as the interest rate currently paid by an economy minus the world interest rate so that when there is very little debt in either economy, the spread is zero. From that level, the spread in either economy is increasing in the amount of debt chosen which is consistent with the default regions discussed above. At any given level of debt/GDP, the green line lies above the red line, implying that the High-Poverty economy will pay higher spreads. We can also see that the debt limits are endogenously imposed by the equilibrium menus (since the spread rises to extreme levels at debt levels approaching this limit), and that this limit is much lower for the High-Poverty economy. Figure 3 shows the much harsher terms of credit available to the High-Poverty economy even at the mean debt level of the Benchmark economy – the spread is 12 percent vs. 1.98 percent. As a result, the government of the High-Poverty economy will choose lower equilibrium debt levels than the Benchmark economy and this can be seen in

Figure 2: Default Regions

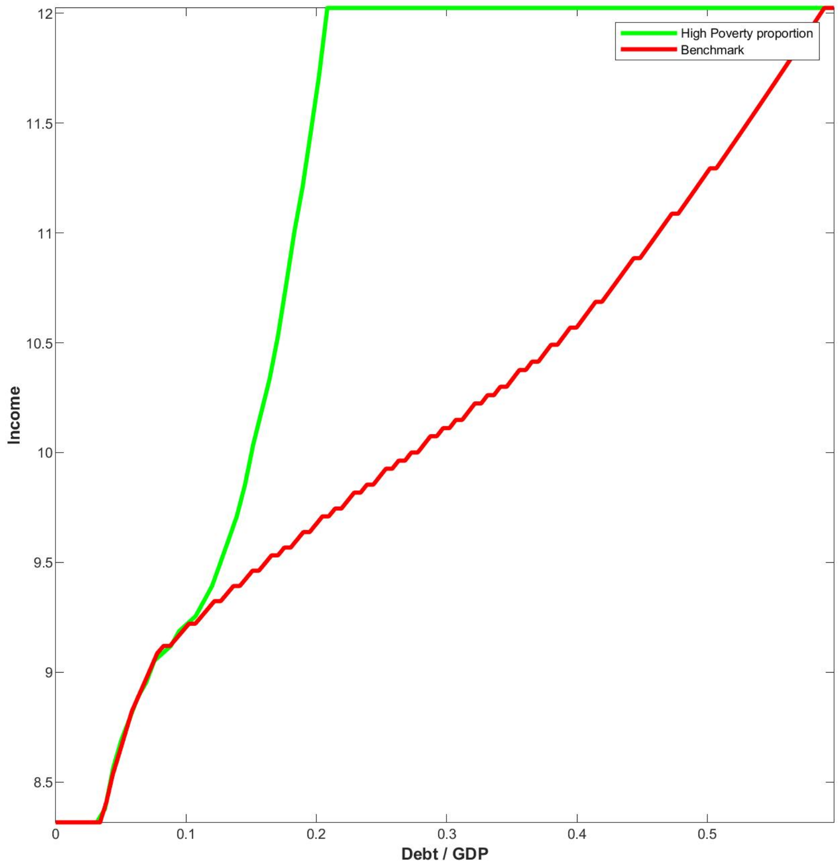


Figure 4 which plots the current debt level state to mean GDP on the horizontal axis and the corresponding debt choice of the government on the vertical axis while the endowment is held at the mean. The figure shows that at low current debt levels, the governments of both economies wish to increase their debt. For example, at a debt to mean GDP level of 0.1, the Benchmark economy will choose slightly more than 0.12 for next period while the High-Poverty economy will choose less than 0.12. This gap between debt choices widens as current debt increases due to the differential increase in spreads discussed earlier. At higher debt levels, first the High-Poverty economy and then the Benchmark economy start to lower debt below current levels and eventually the vertical lines indicate the point at which no debt is sustainable.

Figure 3: Spread-debt menu

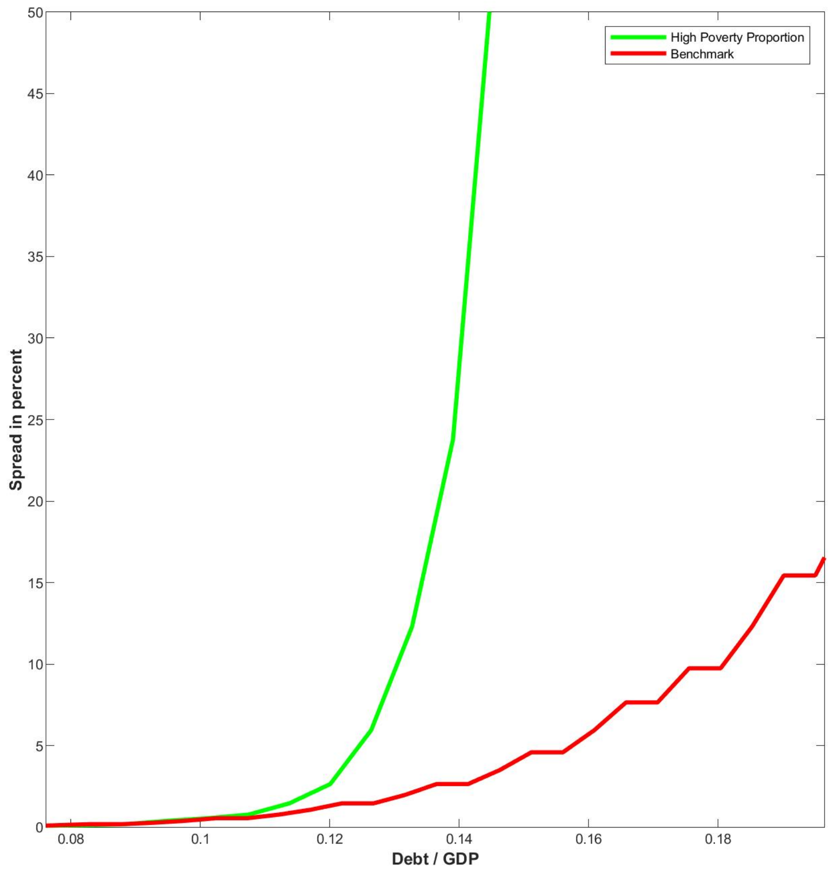


Figure 4: Debt Choice

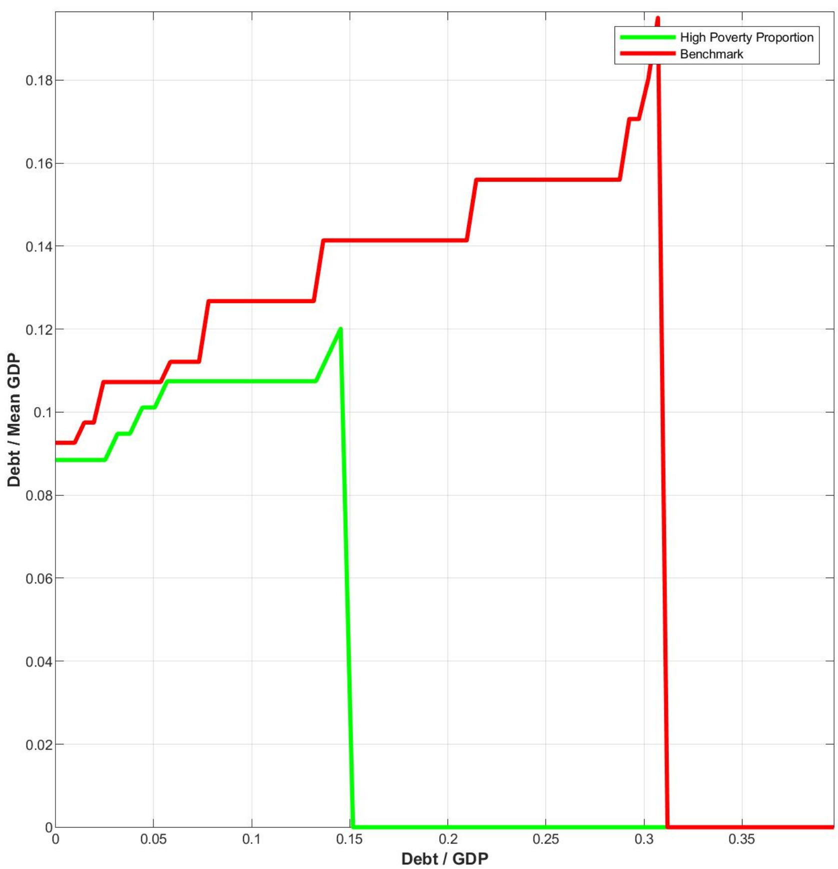


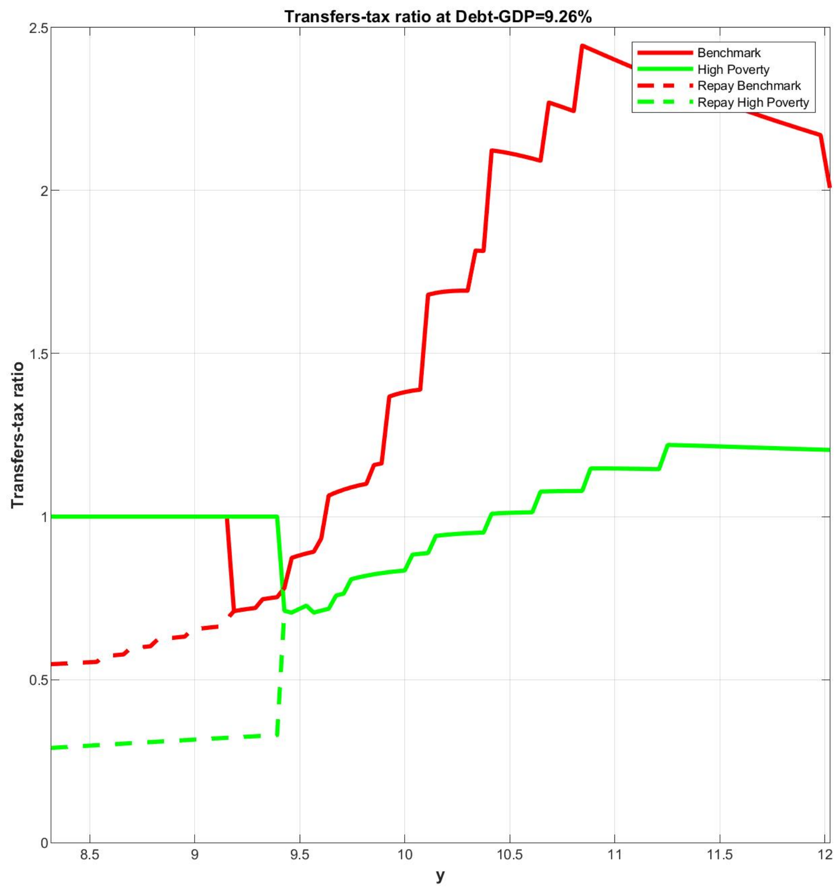
Table 4: Poverty and Spread Regression using simulated data

variable	coefficient	Standard error
debt/GDP	1.57***	0.099
poverty Proportion	6.91***	0.043

In order to validate the above result that the High-Poverty economy is associated with a higher default risk and higher spread, we run a simple regression of spread on poverty proportion and debt to GDP. The regression is run using simulated data from our model for the benchmark economy with a poverty head count ratio of 0.136 and eight other economies with different values of poverty proportion, ranging from 0.20 to 0.40. As evident from Table 4, we see that the estimated coefficient of poverty proportion is positive and statistically significant at 1% level of significance even after controlling for the level of debt to GDP. This is also consistent with our empirical results presented in Table 1 of Section 2.

Figure 5 plots the transfer to tax ratio (measured as total transfers made relative to total tax collected) for both economies, holding debt to mean GDP at 9.26 %. The red line refers to the benchmark economy while the green line represents the High-poverty economy. The dotted lines show what the transfer-tax ratio would have been if the two economies always chose to repay. It can be seen that at higher level of income, the transfer to tax ratio is above 1 for both the economies. This implies that the transfer payment is greater than the revenue collected from tax, so the remaining transfer is financed by borrowing from international credit market. But as the aggregate income in the economy falls or as debt increases, transfer to tax ratio keeps on falling and eventually it falls below 1. This indicates that part of the tax collected from non-poor households are being used for repayment of debt. And as this ratio reaches significantly low, default occurs after which the transfer to tax ratio is restored back to 1. These types of defaults occur because governments wish to maintain the consumption levels of poor households and may be called non-political or regular defaults. Another noteworthy

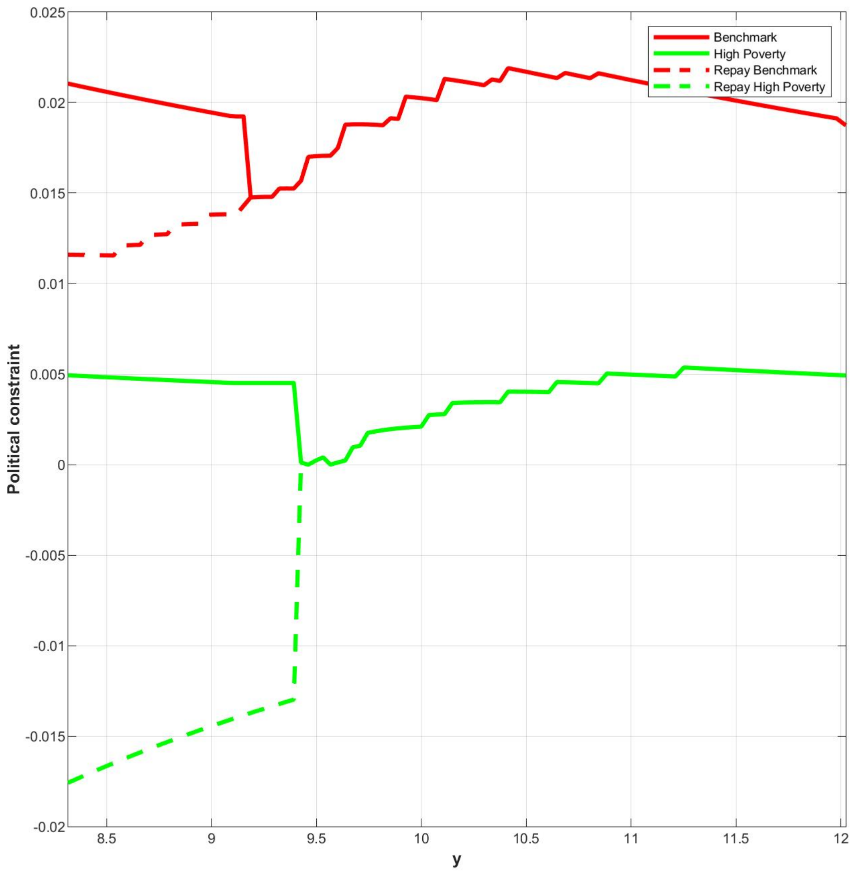
Figure 5: Transfer to tax ratio at Debt/GDP=9.26%



feature that is evident from Figure 5 is that the transfer to tax ratio line for the high-poverty economy is always below that of the benchmark country prior to default. This is because in the economy where there is larger proportion of people lying below the poverty line, the amount of revenue collected from tax is smaller as the local tax base is narrower. Moreover, with more people lying below poverty line, the average transfer payment is also much lower, thus making the transfer to tax ratio smaller than in the benchmark economy.

Additional intuition regarding the role of the political constraint can be gained from Figure 6 that portrays the political constraint of the high-poverty economy and the benchmark economy. The political constraint is formulated by taking the difference between the ex-ante

Figure 6: Political Constraint at Debt/GDP=9.26%



expected utility of a household with and without tax-transfer policy. Households vote for the tax-transfer policy as long as this constraint is positive. The political constraint graph for both the economies in Figure 6 is always positive, implying that the fiscal policies implemented by the government are politically feasible. When the aggregate income of the economy is high, the constraint is well above zero but as income falls, the constraint keeps on decreasing and it reaches its minimum at the point where default occurs in the corresponding economies. Referring back to Figure 5, it can be seen that these are the exact income levels where the two economies reached its minimum points of transfers to tax ratio. This is obvious because at these income levels, 21 percent of the tax is flowing out of the economy. Hence the government is forced to default after which the political constraint rises back to a higher value in both the economies. Moreover, it is worth noting that for the high poverty economy, the green dotted line is negative indicating that if the government chose to repay rather than defaulting, that would be violating the political constraint. This implies that, for the High-poverty country, the government defaults simply to keep the political constraint binding, giving rise to a political default. However, for the benchmark economy, the red dotted line is still positive beyond the default point, implying that the political constraint would still be satisfied if the government chose to repay. So, default in the benchmark economy occurs merely because the marginal utility of the poor is high and governments may prefer to default rather than send precious resources abroad as debt repayment–similar to what we called a standard default earlier.

Next, we plot the political constraint for just the benchmark economy at two levels of income to see if the political constraint ever binds at any level of debt in this economy. As evident from 7, the political constraint remains positive even for debt levels higher than the default point if the government chose to repay (dashed lines) rather than defaulting. And this holds true for both levels of income: low and average. This corroborates the impression that the predominant kind of default that occurs in the benchmark economy is standard default.

Figure 7: Political Constraint at low and high income level for the benchmark economy

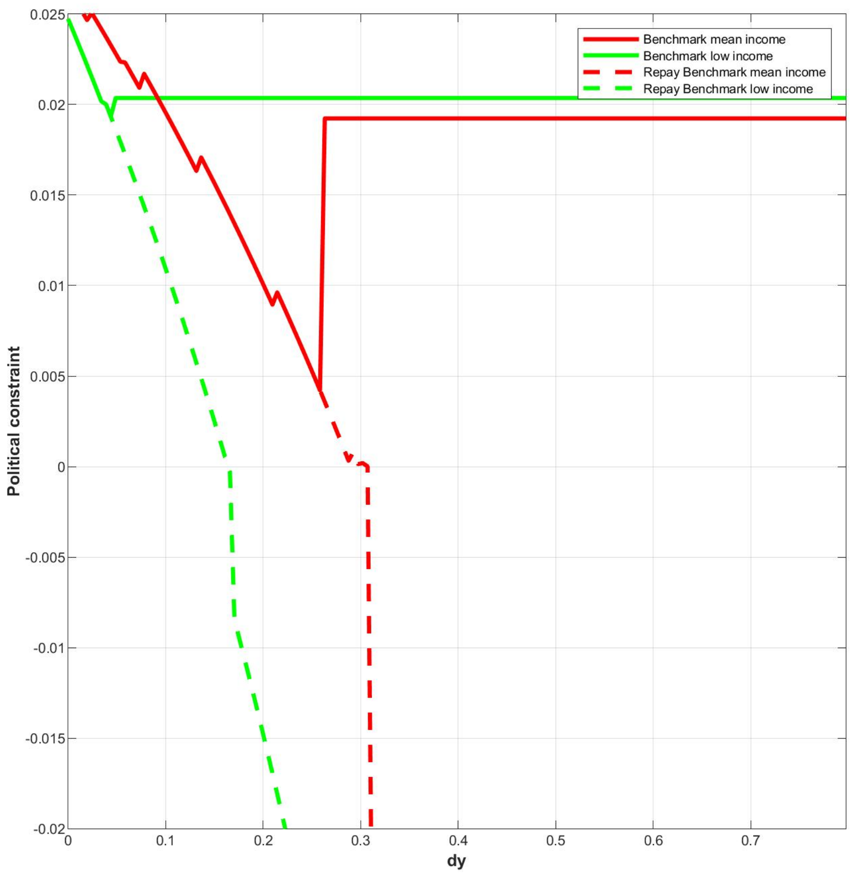


Table 5: Simulation Results

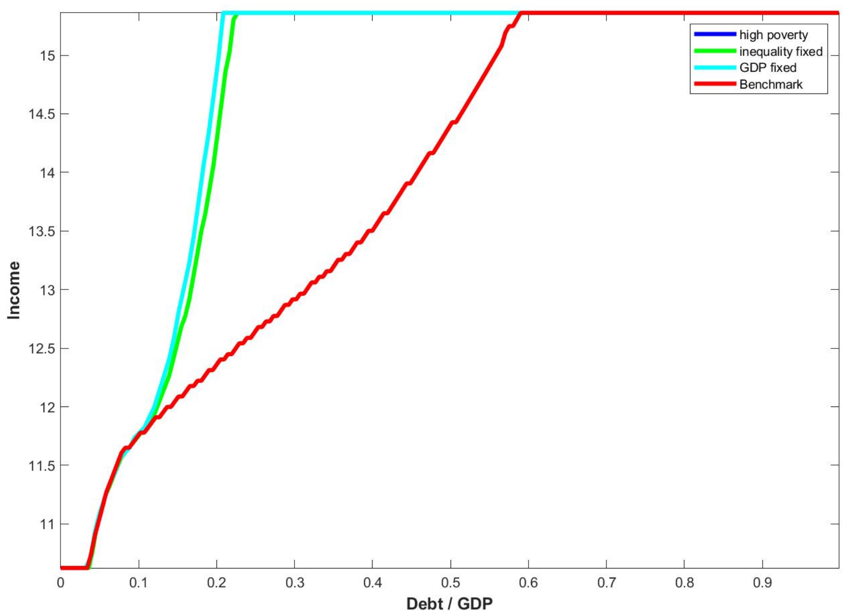
	Benchmark Economy	High-Poverty Economy ($\lambda = 0.4$)	High welfare weight ($\lambda_{pol} = 0.25$	High-Poverty inequality-controlled	High-Poverty GDP-controlled
Mean Debt/GDP	12.9	9.7	12.9	10.1	9.7
Mean Spread	246.9	175.6	246.4	183.4	176.9
Mean tax	1.00	1.04	1.61	-0.96	1.32
Mean Transfer	5.81	1.46	9.68	-1.57	1.86
Mean Transfer/GDP	0.09	0.08	0.15	-0.07	0.08
Gini coefficient	0.097	0.252	0.097	0.097	0.252
Mean GDP	9.04	7.05	9.05	8.62	9.04

5.0.1 simulation results

Column 1 in Table 5 presents some key moments for the Benchmark Economy while column 2 depicts the corresponding moments for the High-Poverty Economy in which we raise $\lambda = 0.4$ while keeping all other parameters unchanged. A quick inspection of the results show that the economy with a higher proportion of poor households takes on a much lower level of debt relative to GDP on average as expected. This lower debt level is an endogenous response to harsher borrowing terms shown in Figure 3 which cause the government to attempt to lower interest costs. The resulting average spread is much lower on average than in the Benchmark Economy. While the average tax paid is roughly the same as in the benchmark economy, per capita transfers have fallen significantly. Despite this, the transfer to GDP ratio, $\frac{\lambda \tau_p}{Y}$, has remained almost the same because with more people lying below the poverty line, λ has gone up, but τ_p has decreased, and the aggregate output has shrunk as well.

In column 3, we demonstrate that the social welfare weight parameter λ_{pol}, primarily affects the level of the tax-transfer scheme while barely affecting default risk and debt to GDP ratios. This is demonstrated by raising λ_{pol} from 0.12 in the Benchmark Economy to a value of 0.25 while keeping all other parameters at the Benchmark Economy levels used in column 1. It is apparent that the default decisions and spreads are unaffected by changing welfare weights. This implies that the social welfare weights do not play any role in determining the default decisions, but they do govern the size of transfers.

Figure 8: Default Regions



Since the proportion of poor households rises in the High-poverty economy, this has two additional implications. First, inequality as measured by the mean value of the Gini coefficient rises from 0.097 in the Benchmark economy to 0.25 in the High-Poverty economy. Second, overall GDP is reduced from an average value of 9.04 in the Benchmark economy to 7.05 in the High-Poverty economy. In order to show that the main underlying factor increasing the default risk of the High-Poverty economy is the rise in poor households as opposed to changes in inequality or GDP, we will control these in columns 4 and 5 respectively. In column 4, we control for inequality by raising α until Gini is restored to the value in the Benchmark economy. Note that in this economy there are more poor people but they are not as poor as in the Benchmark economy. Column 4 makes it clear that the average debt to GDP ratio is similar to the value in the High-poverty economy while the mean spread is marginally higher suggesting that variation in the proportion of poor households plays an important role in default risk assessment by international lenders. Turning to column 5, we control for the fall in GDP in the High-Poverty economy by also increasing the income of all households so that mean GDP remains unchanged from the Benchmark economy. Once again we see in column

5 that the debt to GDP ratio and the mean spread are virtually identical to that in column 2 which suggests that the changes relative to column 1 occur from changing the proportion of the poor as opposed to a fall in GDP. The message in these averages is reinforced by Figure 8 which plots the default regions for the Benchmark and High-Poverty economy along with the economies where GDP and Gini are held fixed when λ is increased. The light blue default curve for the GDP fixed economy sits exactly on top of the blue curve for the High-Poverty economy showing that the default risk of the two economies is identical. The default region of the Inequality fixed economy is only slightly different which suggests that the main source of the change in default regions relative to the Benchmark economy is λ.[2]

5.1 Welfare

The worse borrowing terms faced by economies with a higher proportion of the population lying below the poverty line comes with sizable welfare losses. In order to analyze the welfare effect, we solve the high-poverty economy using the spread menu of the benchmark economy. We will refer to this economy as the counterfactual economy. Any resulting change in welfare in the counterfactual economy relative to the High-poverty economy will provide a measure of how much the high-poverty economy loses due to facing worse credit terms.

Figure 9 presents the default regions associated with the two economies: the original high-poverty economy and the high-poverty economy projected with benchmark bond prices. It is evident from the figure that the income level needed to avoid default rises with the level of debt for both the economies. However, the income level needed to avoid default at any given level of debt is significantly lower for the counterfactual economy than the actual high-poverty economy. This gives rise to a smaller default region for the counterfactual economy. The resulting decrease in default risk for the projected economy can be attributed to the improvement in borrowing terms.

[2]We conjecture that the reason that inequality plays such a small role in our quantitative results is because the tax-transfer system does not impose output losses on the economy. This distortionary effect is already explored in Jeon and Kabukcuoglu (2018) and has been turned off in our work.

Figure 9: Default Region of High Poverty Economy:decomposition

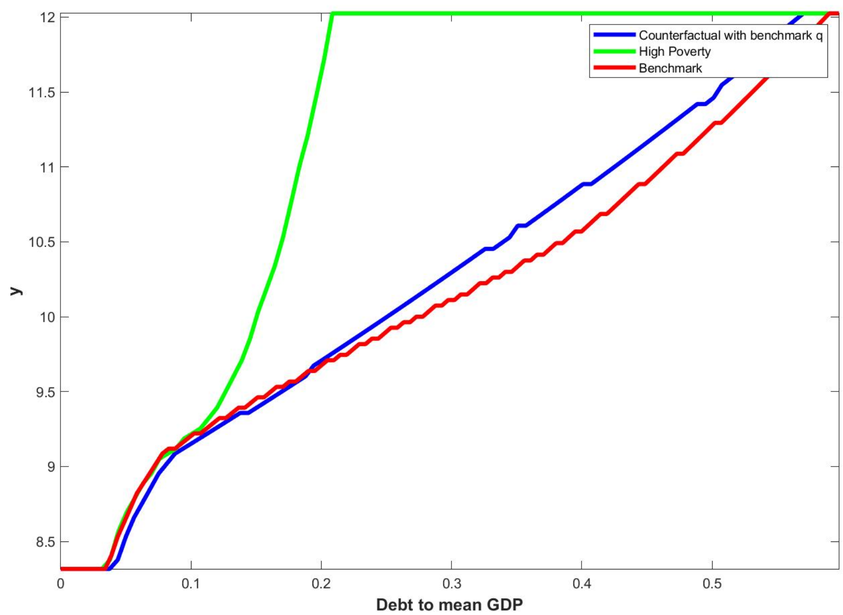


Figure 10: Debt Choices

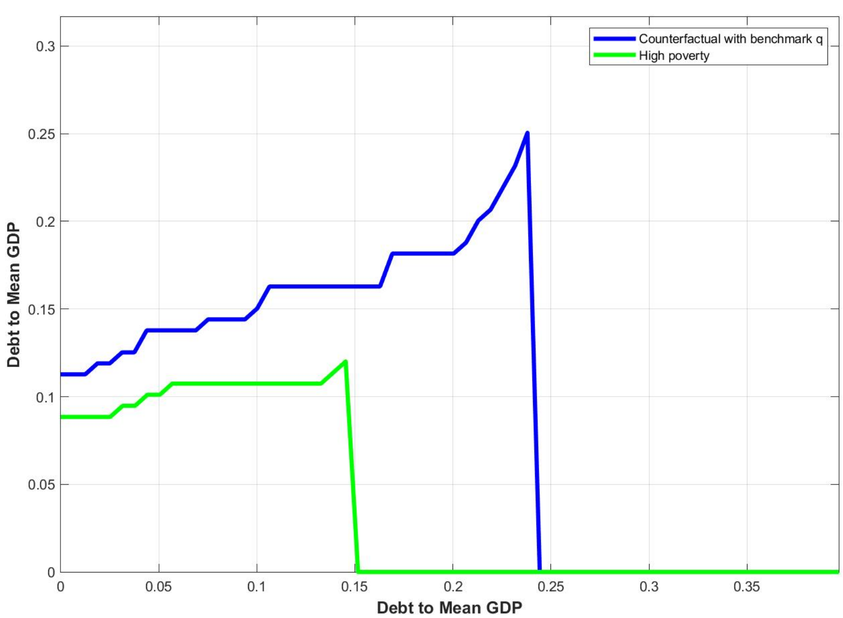


Figure 11: Transfers to poor Households

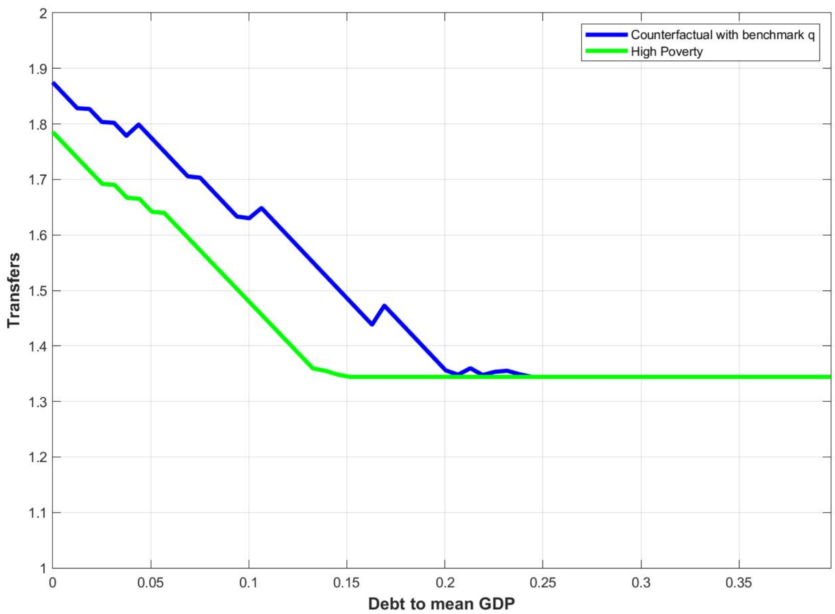
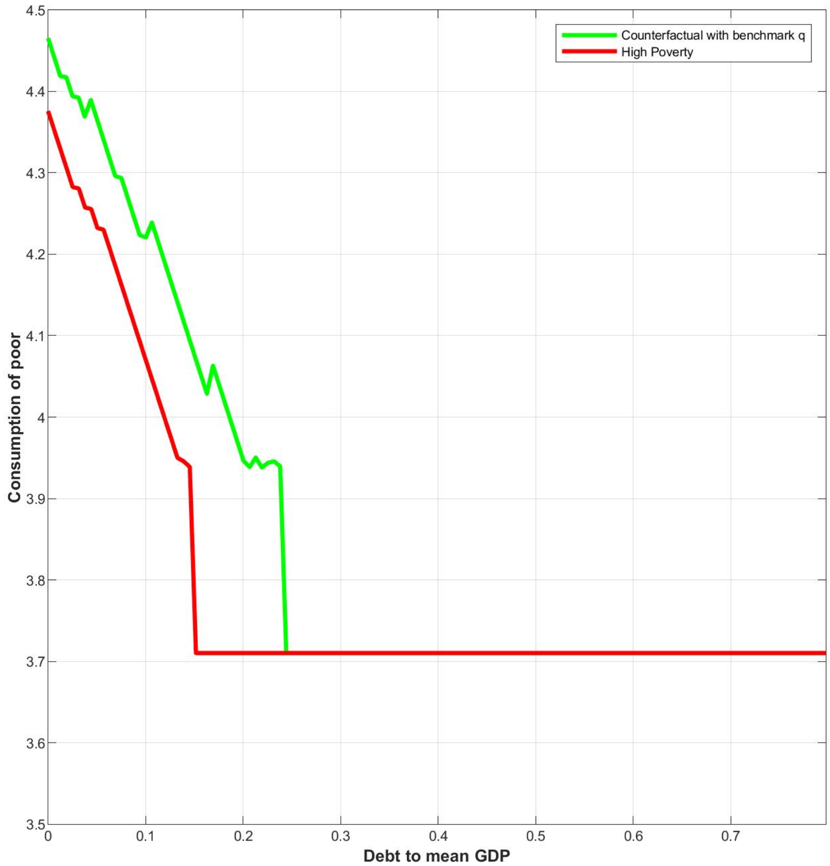


Figure 10 shows another immediate implication of the improved borrowing terms faced by the high-poverty economy. Again it is evident that the harsher credit terms faced by the original high-poverty economy forced them to choose lower level of debt for any current debt level. However, the counterfactual economy, facing the spread of the benchmark economy, always chooses to borrow larger amount for any given debt level. In fact the endogenous debt limit above which debt is no longer sustainable is also much higher for the counterfactual economy than the pure high-poverty economy.

The lower debt choices due to the harsher borrowing terms faced by the high-poverty economy has adverse effect on the economy's transfer payments. Figure 11 features the change in transfer payments to poor households by the high-poverty economy when faced with their actual spread menu vs the counterfactual ones. As shown in the figure, the counterfactual economy with benchmark spread menu is able to make bigger transfer payments to the poor at any level of debt to gdp prior to default. Once, it defaults, it loses access to international resources, and the only source to finance the social safety net is through local tax base. The higher transfer payments in the counterfactual economy implies that the poor households can

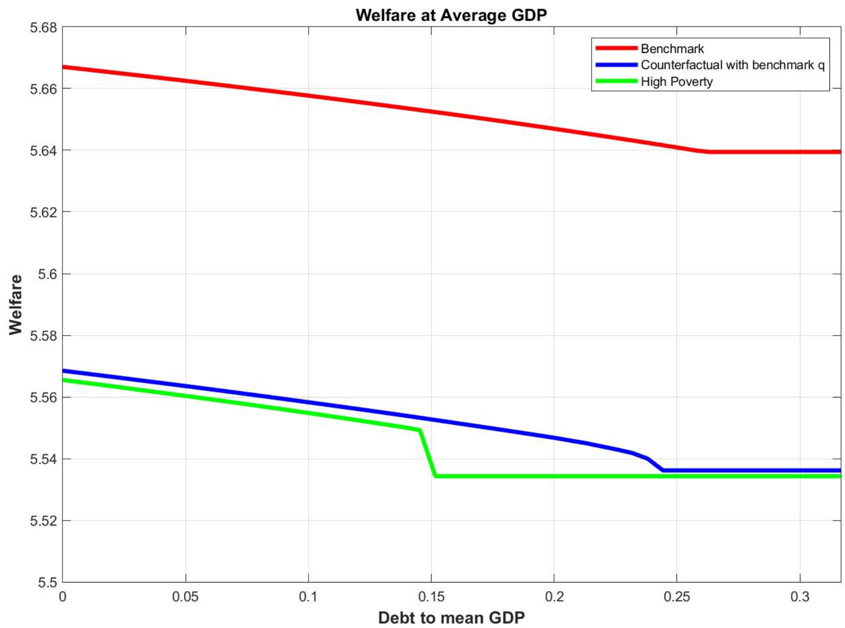
Figure 12: Consumption of poor Households



enjoy higher consumption for any level of debt to GDP. This is represented by Figure 12 which illustrates the loss in consumption that the poor households suffer in the pure high-poverty economy as they face harsher credit terms in the international borrowing market.

The higher consumption and higher transfer payments to the poor driven by higher debt choice which is facilitated by improved borrowing terms eventually allow the projected economy to enjoy bigger welfare as illustrated by Figure 13. For any level of debt to mean GDP, the welfare line of the pure high-poverty economy always lies below the counterfactual economy. This shows that the interaction of lower aggregate income in high-poverty countries

Figure 13: Welfare at Average GDP



with worse borrowing terms in international credit market has adverse impact on the welfare of the economy.

6 Conclusions

To be written..

7 Appendix

7.1 List of countries included in the Empirical analysis

Angola, Argentina, Armenia, Azerbaijan, Belarus, Belize, Bolivia, Brazil, Bulgaria, Chile, China, Colombia, Costa Rica, Cote D'Ivoire, Croatia, Dominican Republic, Ecuador, Egypt, El Savador, Ethiopia, Gabon, Georgia, Ghana, Guatemala, Honduras, Hungary, India, Indonesia, Iraq, Jamaica, Jordan, Kazakhstan, Kenya, Latvia, Lithuania, Malaysia, Mexico, Mongolia, Morocco, Mozambique, Namibia, Nigeria, Pakistan, Panama, Paraguay, Peru, Philipines, Poland, Romania, Russian Federation, Senegal, Serbia, Slovak Republic, South Africa, Sri Lanka, Tanzania, Thailand, Tunisia, Turkey, Ukraine, Uruguay, Venezuela, RB, Vietnam and Zambia

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