From Diaspora Dollars to Default Risk: Remittances and Sovereign Spreads*

Minjie Deng
Simon Fraser University

Armen Khederlarian
CUNY - Hunter College

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Abstract

Most developing countries are characterized by two facts: (1) net emigration, and (2) net remittances received. This paper studies how these two facts interact with the sovereign default risk. In theory, the effect of remittances is ambiguous. On the one hand, they provide additional income that increases the governments ability to repay. On the other hand, they reduce the production share of income and thus undermine the sanctioning mechanisms enforcing repayment available to international lenders. Using a panel of developing countries, we document a positive correlation between spreads and net remittances. We then construct a sovereign default model with emigration and remittances. Critical to the ability of the model to reproduce the positive correlation is the countercyclical nature of emigration and remittances. Because the government internalizes that default leads to an increase in remittances that partially cushions against the default penalties, in equilibrium, countries with a large income share from remittances face a steeper government bond spread schedule and hold less debt. Our model, calibrated to countries' average emigration and net remittances, successfully replicates the observed correlations between emigration, remittances, and spreads.

Keywords: Sovereign default, migration, remittances

JEL classification: F22, F34, F41, F43, J61

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1 Introduction

Since the early 1990s, the World has witnessed a gradual increase in international labor migration. This increase accelerated by the turn of the century and has been dominated by emigration from developing to developed countries. Accompanying the rise in international labor migration there has been a sizeable increase in international remittances sent to developing countries, as depicted in Figure 1. Between 1980 and 2020, global remittances (in 2019 USD) increased eightfold, with more than 80 percent accounted for by developing countries. Thus, as illustrated in Figure 2, by 2019, most developing countries were characterized by two salient features: (1) net labor emigration, and (2) positive net remittances. Remittances received can have a significant impact on the economies of developing countries. In effect, as shown by Panel b, for around 20 percent of developing countries in 2019, net remittances represented more than 10 percent of their GNI.[1]

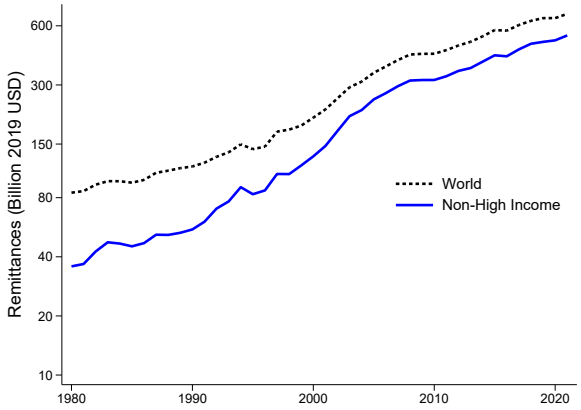


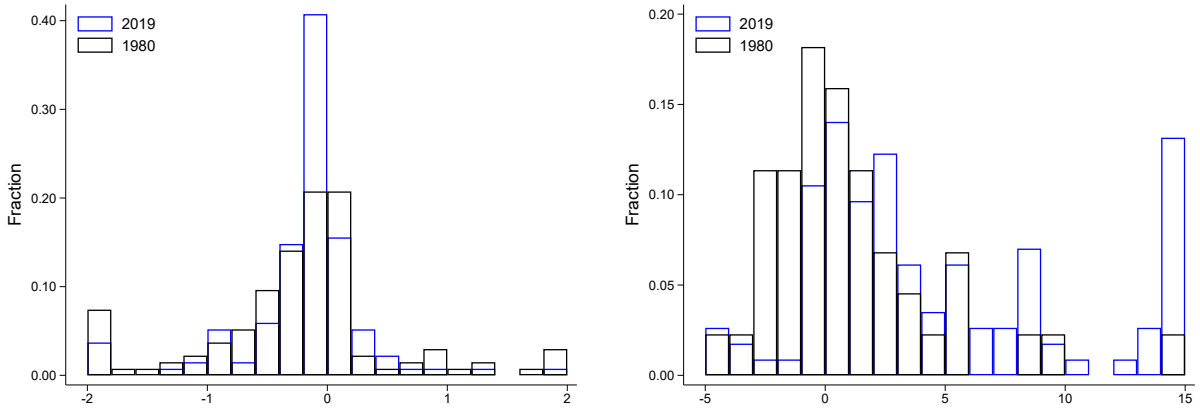
Figure 1: World remittances from 1980–2022

Notes: Remittances are the sum of remittances received in billions of 2019 USD by all countries (black dotted line) and non high-income countries (blue solid line). Data are from the World Bank Database (2023).

In this paper, we study how emigration and received remittances affect a country's government default risk. A long tradition in the sovereign default literature posits that

[1]This includes, for example, El Salvador (21%), Guatemala (14%), Honduras (22%), Nicaragua (14%), Tajikistan (22%), Kyrgyzstan (21%), Uzbekistan (14%), Moldova (14%), Georgia (13%), Ukraine (10%), and Nepal (24%). Other economies with large net remittances to GNI are Albania (9%), Montenegro (8%), Serbia (8%), Croatia (6%), the Dominican Republic (8%), Pakistan (7%), the Philippines (8%), Nigeria (5%), Egypt (9%), Morocco (5%), and Jordan (9%).

governments with limited commitment strategically default in the advent of a negative shock, while internalizing that default penalizes their future endowment or productivity. However, received remittances are neither subject to the same idiosyncratic shock process nor are they affected by the typical default penalties imposed by international lenders. Thus, for countries that generate a large fraction of their income through remittances, default decisions encompass a wider range of incentives. In fact, conditional on the effect of emigration, the impact of remittances on sovereign default risk is potentially ambiguous. On the one hand, remittances offer a steady stream of income that increases the government's ability to repay. On the other hand, given their immunity to the standard default penalties, remittances can potentially increase the government incentives to default. Such effects are compounded by the counter-cyclical nature of net migration, as remittances received tend to increase during economic downturns.



(a) Net Migration per capita (%)

(b) Net Remittances to GNI (%)

Figure 2: Migration and remittances in 1980 & 2019, developing countries

Notes: Net migration per capita is defined as immigration minus emigration divided by the total population of a country. Net remittances to GNI is defined as remittances received minus remittances paid divided by nominal GNI. Both variables are expressed in percent. The sample includes all countries classified as non high-income by the World Bank in 2023. Data are from the World Bank Database (2023).

To make progress, as a first pass, we examine the empirical relationship between economic activity, emigration, remittances, and the government default risk. Focusing on developing countries, we find that net remittances increase significantly with emigration, that emigration increases with sovereign default risk and decreases with output, and that

sovereign default risk correlates positively with net remittances. While the first three facts have been documented previously, the latter constitutes the first contribution of this paper. Guided by these results, we develop a framework that incorporates emigration and remittances into an otherwise standard model of sovereign default. We use the model to study the effect of remittances on the equilibrium bond price schedule and in response to negative shocks. Our key finding is that to reproduce the positive relation between spreads and remittances, the counter-cyclical nature of emigration and remittances is critical. When faced with a negative shock, the government internalizes that, by defaulting on its debt, remittances increase further, mitigating the productivity losses from default and increasing the default value relative to the case without remittances. Thus, remittances lead to increased government bond spreads and lower equilibrium levels of debt.

Our model of sovereign default builds on Alessandria et al. [2020] and incorporates remittances. We consider a consolidated problem in which the government maximizes household utility by making production, borrowing, and default decisions as in the standard sovereign default model [Eaton and Gersovitz, 1981]. Production uses labor as the only input, and the only uncertainty in the economy is regarding productivity, which follows a Markov process.[2] Default entails a period of financial autarky as well as a productivity penalty, as is standard in the literature. While Alessandria et al. [2020] models counter-cyclical emigration as a result of the trade-off between domestic and foreign income and a stochastic migration cost, we formulate emigration in a reduced form as a function of the productivity shock. Every period, a fraction of the labor force leaves the country to work abroad, sends remittances back to their home country, and returns at the end of the period.[3] The main novelty of the model is that the government receives additional income – remittances – that is not subject to the idiosyncratic domestic productivity shock but instead increases with low productivity realizations as more workers emigrate.

Emigration and remittances affect the governments incentives to default in various ways. We distinguish four main channels. First, remittances represent an endowment

[2]Results are similar when the model includes capital and an investment decision. See Section 6.

[3]In Section 6 we develop a version of the model in which there is a stock of emigrants that continues to send remittances while abroad. The results are virtually unchanged.

that increases its ability to repay and lowers the default risk. We call this the endowment channel. On the other hand, three channels raise the government's default risk. First, counter-cyclical emigration reduces the labor force in the face of a negative productivity shock, amplifying the shock as the country's productive capacity is further reduced. We call this the labor channel, first introduced by Alessandria et al. [2020]. Second, since remittances are unaffected by the default penalties, a smaller share of the country's income is subject to the (productivity) penalty from default. We call this the cost channel. Third, in the advent of default, rising emigration increases remittances, cushioning against the losses from default. We call this the cushioning channel. Thus, in theory, the effect of remittances on the sovereign default risk can go in either direction depending on the relative strength of these channels.

We quantify our model by matching some key moments regarding output, spreads, emigration, and remittances of the 73 out of 101 developing countries for which, on average, net migration was negative and net remittances were positive between 1980 and 2021. We then compare our benchmark model to a model with the same emigration rate but without remittances. This allows us to isolate the effects of remittances from the effects of emigration studied in Alessandria et al. [2020], by calibrating both models to have the same labor force. We find that remittances increase the government default risk in comparison to the model without remittances. The key driver of this result is the cushioning effect. International lenders anticipate that the government will receive increased remittances due to the productivity loss from default and thus require a higher spread at every level of debt. In contrast, without counter-cyclical emigration, remittances have no significant effect on the government's default decision relative to a model without remittances, as the endowment and cost channels nearly offset each other.

We also study the response to a negative productivity shock, again comparing our benchmark model to a model without remittances. Although remittances increase the sovereign spread in equilibrium, they provide a buffer during bad times. After experiencing the same productivity shock and corresponding emigration response, the drop in income in the economy without remittances is much larger. This is because remittances rise following

the negative productivity shock. The shock increases default risk in both models, but because the decline in income is smaller with remittances, the increase in the default risk is also smaller compared with the model without remittances. The rise in spreads leads to a large decline in borrowing that is similar in both models. However, the drop in consumption in the model with remittances is only about one-third as large as in the model without remittances. Thus, remittances help the country smooth the adverse effects of a recession, albeit at the cost of higher borrowing costs in normal times.[4]

Next, we assess our model's ability to reproduce the four empirical facts observed in the data: remittances increase with emigration, emigration is countercyclical, emigration rises with sovereign spreads, and spreads increase with remittances. To do so we calibrate and simulate the model for the 73 countries in our sample of countries with negative net migration and positive net remittances, matching their average net remittance received and the average and dispersion of net emigration. When we estimate the analogous regressions with the simulated data from the model we find that the sign of the estimates of the four facts is the same as in the data, even though non of the cross-sectional moments are targeted and countries differ along several key dimensions.

Finally, we show that in our benchmark model, asymmetric default costs arise endogenously. With counter-cyclical emigration and remittances, in good times the default cost is higher than in bad times, since during the former labor supply losses from emigration are relatively costly given the high marginal product of labor, and in the latter, the marginal product of labor is low and remittances cushion against the default penalties. Thus, our mechanism generates negative correlations between output and spreads and debt and spreads, even when the default penalty is modeled as proportional to output. This is unlike the standard quantitative model of sovereign default, which typically assumes asymmetric default costs parametrically in order to match these empirical patterns.

Related Literature Our paper contributes to two main strands of the literature. First, it makes several contributions to the sovereign default literature pioneered by Eaton and

[4]We also show that emigration and remittances increase welfare relative to the case of no emigration nor remittances.

Gersovitz [1981], Aguiar and Gopinath [2006] and Arellano [2008]. Several studies have focused on the consequences of sovereign default on the labor market, particularly its negative impact on unemployment (Balke [2023], Na et al. [2018], Liu and Shen [2024]). In this context, during a sovereign debt crisis, the government faces a trade-off between stimulus and austerity (Bianchi et al. [2023]), as government spending reduces unemployment but inevitably increases the risk of default and sovereign spreads. Using a model of endogenous sovereign default with nominal rigidities, Bianchi and Sosa-Padilla [2024] studies reserve accumulation based on the interaction between macroeconomic stabilization and sovereign risk.

Our focus extends beyond domestic labor market effects to cross-border labor flows, specifically migration and the remittances sent by emigrants. In this regard, the paper most closely related to ours is Alessandria et al. [2020], which incorporates migration decisions into an otherwise standard default model but abstracts from the role of remittances. Other relevant studies include Gordon and Guerron-Quintana [2019], which explores the interaction between local government borrowing, default, and migration, and Deng [2024], which examines how inequality and migration shape government taxation, debt, and default risk. Our study differs in its focus on international migration and the often-overlooked role of remittances. Unlike previous work, we highlight how remittances interact with sovereign default risk. Given the economic significance of remittances in countries prone to debt crises, understanding their role is important for assessing the broader implications of the risk of sovereign default.

Another contribution of our paper to this literature is to highlight a new mechanism driving asymmetric default costs. In order to generate default during downturns and not during economic booms as well as to generate observed default rates, a key assumption of the quantitative sovereign default literature are rather ad-hoc asymmetric default costs, which imply less severe punishment for defaulting when income is low than when income is high [Chatterjee and Eyigungor, 2012, Aguiar and Amador, 2021]. In our framework these arise endogenously due to counter-cyclical remittances and emigration. Other mechanisms that generate endogenous asymmetric default costs are through endogenous TFP dynamics

[Mendoza and Yue, 2012] and the strategic management of oil reserves [Hamann et al., 2023, Esquivel, 2025].

Second, the paper contributes to the literature studying the macroeconomic effects of remittances. The empirical literature has mostly focused on the role of remittances for investment and consumption smoothing during economic downturns [Amuedo-Dorantes, 2006, Yang and Choi, 2007, Yang, 2008].[5] Similarly, the quantitative has explored the role of remittances in business cycle fluctuations. For instance, Mandelman and Zlate [2012] considers a two-country DSGE model with endogenous migration matching cyclical patterns of the U.S. and Mexico to study the insurance role in consumption smoothing of remittances. Mandelman [2013] studies how the business cycle effects differ across exchange rate regimes. Other papers that study the role of remittances in small open economy models include Acosta et al. [2009], Durdu and Sayan [2010], Mandelman and Finkelstein Shapiro [2016], Chatterjee and Turnovsky [2018], Bahadir et al. [2018], Lim and Khun [2022], among others. Our contribution lies in showing that, both, empirically and quantitatively remittances affect the affect government default risk and, thus, government borrowing costs.

The rest of the paper is organized as follows. Section 2 documents the empirical facts regarding output, emigration, remittances, and sovereign default risk. Section 3 presents our benchmark model. Section 4 describes its quantification, the equilibrium bond price schedule, and its response to a productivity shock. Section 5 presents the cross-sectional analysis. Section 6 considers some robustness and extensions of the results and Section 7 concludes.

2 Empirical Evidence

We study the relationship between economic activity, migration, remittances, and sovereign default considering a panel of developing countries between 1980 and 2021. The key variables of our analysis are net migration, net remittances, and the government default

[5] An exception is Machasio [2016] which shows that remittances rise in the aftermath of default episodes.

risk measured by spreads. We obtain economic data from the World Bank Databank and population data from the U.N. Population Database. We measure the government default risk either using the five-year maturity credit default swap (CDS) obtained from Bloomberg or the Emerging Markets Bond Index (EMBI) spread from the Global Economic Monitor, when the latter is unavailable. There are 135 countries classified as non-high income countries according to the World Bank 2020 classification. In the baseline we exclude countries whose income is dominated by oil revenues as well as tax havens. In addition, some countries are dropped because of insufficient data coverage. Our final set of countries is 101.[6] We also report results for the subsample of 73 countries for which average net migration was negative and average net remittances positive over our sample period, and which we label "+R,-M". We are interested in this subsample because we will target the model of Section 3 to each of these countries and then consider its ability to reproduce some of the moments documented here. In what follows, we document four key facts regarding the relation between economic activity, net migration, net remittances, and sovereign default risk.[7]

Fact 1: Net remittances increase with emigration. First, we consider the relation between remittances and migration by estimating the following equation:

$$NR_{it} = \alpha^{RM} NM_{it} + \Gamma' X_{it} + D_t + \varepsilon_{it}, \tag{1}$$

where NR_{it} are net remittances, i.e. remittances received minus remittances paid, as a percentage of GNI, NM_{it} is net migration, i.e. immigration minus emigration, as a percentage of total population, X_{it} is a vector of business cycle controls including output measured by the log Real Gross National Income (RGNI), inflation measured by the log GDP deflator, the log of the real effective exchange rate (REER), as well as the level of debt,

[6] See Table G.2 for the list of all countries. Excluded oil countries are Algeria, Angola, Republic of Congo, Gabon, Iran, Iraq, Nigeria, and Venezuela. Tax havens are Belize, Djibouti, Dominica, Maldives, St. Lucia, and Vanuatu.

[7] Appendix B documents that the results documented here and obtained from cross-country variation are consistent with the impulse response functions estimated by a panel VAR model.

measured by the log debt-to-GNI.[8,9] D_t are year fixed effects that capture global factors such as U.S. GDP and the global finance cycle. Given the relatively small within-country variation in net remittances to GNI over time, α^{RM} is mostly identified off variation in net remittances to GNI across countries.[10] Columns 1 and 2 of Table 1 report the results of (1). Net remittances are negatively related to net migration, indicating that larger emigration flows result in an increased share of a country's income coming from remittances. The relation is virtually unchanged when focusing on the "+R,-M" sample. Table A.2 of the Appendix A reports that the relation is similar when including additional lags of net emigration or net emigration is accumulated, that the magnitude is sizeable as one standard deviation increase in net emigration is associated with an increase of net remittances to GNI by 1.8 percentage points, and that the correlation is almost entirely driven by received remittances as opposed to paid remittances.

Fact 2: Emigration is counter-cyclical. Next we investigate the relation between net migration and economic activity by regressing net migration per capita on the same controls included in (1), which includes RGNI as the measure of fluctuation in the business cycle.[11] In contrast to (1), we include country fixed effects; thus, the covariance between RGNI and net migration is estimated from within-country variation. Columns 3 and 4 indicate a positive and significant relation between net migration per capita and RGNI, i.e. higher economic growth is associated with increased immigration and economic downturns are associated with increased emigration. Table A.3 of the Appendix A indicates that this relation is robust to alternative output measures of the business cycle, the exclusion of country fixed effects, and estimation in differences. It also reports that the magnitude is sizeable: A one standard deviation increase in RGNI is associated with a 1 percentage point increase in net migration per capita.

[8]Note we use GNI instead of GDP to be consistent with our measurement of economic activity in the model of Section 3. All results are robust to using GDP and are available upon request.

[9]For consistency we use the same controls in all four regressions (4 facts). Including debt is particularly important when considering the dynamics of the sovereign default risk given that our most important results in the model refer to spreads conditional on the level of debt.

[10]The adjusted R-square of (1) goes from 0.07 to 0.76 when including country fixed effects and the α^{RM} from -.129 to -0.11 as reported in Table A.2 of the Appendix.

[11]It is well established that emigration is counter-cyclical. See for example Mayda [2010] and Clemens [2011].

Table 1: Economic Activity, Remittances, Migration, and Spreads

Dep. Var.	Net Remitt./GNI		Net Mig. pc				Spreads	
Sample:	Baseline	+R,-M	Baseline	+R,-M	Baseline	+R,-M	Baseline	+R,-M
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Net Mig. pc	-1.27***	-1.36***						
	(0.12)	(0.14)						
RGNI pc	0.23*	0.54***	0.30***	0.27**	0.85**	0.72*	-0.94***	-0.87***
	(0.14)	(0.18)	(0.08)	(0.11)	(0.40)	(0.42)	(0.20)	(0.23)
Spreads					-0.24***	-0.23**		
					(0.09)	(0.10)		
Net Remitt./GNI							0.03**	0.04**
							(0.02)	(0.02)
GDP deflator	-1.39***	-0.32	0.27***	0.19*	-0.35	-0.45	-0.15	-0.43
	(0.48)	(0.55)	(0.09)	(0.11)	(0.37)	(0.42)	(0.21)	(0.27)
REER	0.33	0.09	-0.11***	-0.12***	-0.52	-0.50	0.21	0.34
	(0.39)	(0.44)	(0.04)	(0.04)	(0.34)	(0.38)	(0.21)	(0.28)
Debt/GNI	0.43**	0.28	0.07**	0.04	0.15	0.08	0.71***	0.72***
	(0.17)	(0.22)	(0.03)	(0.05)	(0.15)	(0.19)	(0.08)	(0.11)
Fixed Effects	t	t	i,t	i,t	i,t	i,t	i,t	i,t
Number Countries	101	73	101	73	40	28	39	27
Observations	2844	2049	3524	2508	625	465	559	406
Adjusted R^2	0.07	0.09	0.17	0.14	0.16	0.03	0.80	0.78

Note. Columns labeled "+R,-M" refer to the sample of countries with average positive net remittances and average negative net migration. All variables are in log except net migration per capita and net remittances to GNI, which are in percent. Robust standard errors are in parentheses, * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Fact 3: Emigration increases with the sovereign default risk. Third, we consider the relation between net migration and spreads by extending the regression from fact 2 to include the government spread.[12] Columns 5 and 6 of Table 1 show that net migration is negatively related to sovereign defaults risk, i.e. as spreads increase, net migration decreases. This relation has previously been documented in Alessandria et al. [2020], who study 23 European countries around the 2012 European debt crisis. Column 2 of Table A.4 of the Appendix A shows that the effects are indeed also present for high income countries; however, they are larger for developing countries. This table also shows that the results are robust to our definition of the spread and the exclusion of controls, and that the magnitude of the effect is non-negligible: A one standard deviation increase in the spread is associated with a 0.29 percentage point decrease in net emigration per capita.

[12]Note the country fixed effects account for the differences in spread measures (CDS or EMBI) across countries.

Fact 4: Sovereign default risk increases with net remittances. At last, we consider the relation between spreads and remittances by regressing the log of spreads on net remittances to GNI and the same macro controls as (1). Columns 7 and 8 of Table 1 report the results. The sovereign default risk is significantly and positively related to net remittances; that is, as the share of remittances increases, countries face larger spreads. Table A.5 of the Appendix A shows that this relation is absent in the case of high-income countries, that it is robust to the exclusion of controls, alternative measures of the spread, and the inclusion of net migration; and that the magnitude is non-negligible as a one standard deviation increase in net remittances increases the spread by about one third as much as a one standard deviation increase in debt-to-GNI.

These facts indicate that, especially in developing countries, emigration and remittances play an important role during periods of elevated sovereign default risk. First, remittances increase with emigration. Second, emigration increases during economic downturns and with increases in sovereign default risk. Third, spreads on government debt increase as the income share of remittances increases. In the next section we develop a model that captures these facts.

3 Model

In this section, we present a model of sovereign default with migration and remittances. We consider a small open economy with a production technology, a continuum of workers, and a benevolent government. The aggregate output Y is produced with labor L using production function $Y = zL$, where z is the stochastic productivity.[13] The government borrows state-uncontingent bonds internationally and can default on them at the expense of lower productivity and exclusion from international markets for some periods. Although workers supply work inelastically, the labor supply L in the economy fluctuates due to emigration. At the beginning of each period, a fraction of workers emigrate, work abroad,

[13]The effect of remittances on sovereign default risk is similar in a model that includes capital accumulation. To isolate the role of remittances we present the most simple production economy.

and return at the end of the period. While abroad, emigrants send remittances to their home country, which become available within the same period.[14] Our formulation of the emigration is a reduced form of the discrete emigration choice postulated by Alessandria et al. [2020]. In particular, we specify emigration to be a function of productivity, so that when productivity is low, a larger number of workers emigrate, consistent with fact 2 documented above. Thus, given constant per capita remittances, during economic downturns, remittances sent back to the home country increase. The focus of our analysis here is on how the presence of remittances interact with the sovereign default risk.

3.1 Workers and Government

In our small open economy, every period workers either supply labor inelastically at home or emigrate and obtain income abroad. We set the emigration rate to $m_t = \bar{m}e^{\phi(\bar{z}/z_t - 1)}$, where $\bar{m}$ is the average emigration rate, $\bar{z}$ is the average productivity level, and z_t is the productivity of the economy. When productivity is average, $z_t = \bar{z}$, the emigration rate equals $\bar{m}$, while for lower than average productivity, emigration is higher than $\bar{m}$. This captures the counter-cyclical nature of emigration: during good economic periods, fewer workers migrate abroad for work, whereas during economic downturns, more workers seek higher earnings abroad. The elasticity of emigration to productivity is disciplined by ϕ. Each emigrant sends remittances F back home and returns at the end of the period.[15] We normalize the mass of workers at the end of each period to 1. Within the period, the mass of workers available to produce domestically is given by $L_t = 1 - m_t = 1 - \bar{m}e^{\phi(\bar{z}/z_t - 1)}$. While both, the remaining workforce L and emigration m, are a function of productivity z, for notational simplicity, in the remainder of this section we denote them as L and m. Workers have a discount factor β and a constant relative risk aversion utility function over consumption c, $u(c) = \frac{c^{1-\sigma}}{1-\sigma}$, where σ is the risk aversion parameter.

[14] The assumption that emigrants return at the end of the period and that remittances are received within the same period simplifies the model, as it allows us to abstract from tracking the stock of emigrants. In Section 6, we show that incorporating a stock of emigrants does not alter our main findings.

[15] Empirical evidence from Artal-Tur and Requena-Silvente [2014] suggests that remittances are negatively correlated with the receiving countries' business cycle not only at the aggregate level, but also at the per emigrant level [Artal-Tur and Requena-Silvente, 2014]. Since we only observe aggregate remittances in the data we abstract from this margin.

The government is benevolent and maximizes the welfare of all residents, given by $\mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t Lu(c_t)$. The government can issue state-uncontingent bonds internationally but may default on these obligations. Default involves temporary output loss and exclusion from financial markets. The output loss is modeled as a cut in productivity $z_d(z) \leq z$, which lasts as long as the country's exclusion from international financial markets. With probability λ, a country in default regains good credit standing and access to international borrowing and lending. Following the sovereign default literature, we assume that only the government can borrow and lend internationally and that the government rebates all the proceeds back to the workers in a lump-sum fashion. Note that the fraction of workers that emigrate, m, is determined after the government decides whether to default or not. Thus, in the case of default, $m_t = \bar{m}e^{\phi(\bar{z}/z_d(z_t)-1)}$, and emigration increases relative to the no-default state.

3.2 Recursive Formulation

Each period the economy starts with a given level of productivity, z and public debt, B. In what follows, we omit the time subscript t to simplify notation, and we use x' to denote variable x in the next period. The timing of the model is as follows. At the beginning of each period, the aggregate shock z is realized. If the country is in good financial standing, the government, observing the price of issuing new bonds, then chooses whether or not to default on this period's bond payment obligations. Following the government's default decision, workers emigrate and send remittances back to their home country. Note, given the output cost of default, emigration is higher if the government defaults. If the government fulfills its payment obligations, it chooses new borrowing and consumption. If instead it chooses to default on its debt, the country enters financial autarky and only chooses consumption. At the end of the period all emigrants return.

When not in default, the government chooses whether or not to default to maximize the

workers' welfare:[16]

$$V(z,B) = \max\left\{V^c(z,B), V^d(z)\right\}, \tag{2}$$

where V^c denotes the non-defaulting value and V^d the default value. Let $D(z,B) = 1$ denote default. If the government repays its debt, it issues new bonds, B', by solving the following dynamic programming problem:

$$V^c(z,B) = \max_{C,B'} \quad Lu\left(\frac{C}{L}\right) + \beta\mathbb{E}[V(z',B')] \tag{3}$$

subject to the budget constraint:

$$C + B = zL + mF + Q(z,B')B', \tag{4}$$

where domestic output is produced with post-emigration workers L, C is the aggregate consumption by the post-emigration workers, F are the remittances sent by each emigrant. The total amount of remittances sent back to the home country is given by mF, where m is the emigration rate given by $m = \bar{m}e^{\phi(\bar{z}/z-1)}$. The total income (Gross National Income) is given by $zL + mF$. Finally, $Q(z,B')$ is the bond price, and $Q(z,B')B'$ are the proceeds of government issuing debt.

If the government defaults, the economy suffers a loss in productivity from z to z_d and enters financial autarky that prevents the government from borrowing and lending internationally. With probability λ, the government returns to the international financial market and the productivity cost from default is removed. The default value is given by:

$$V^d(z) = \max_{C} \; Lu\left(\frac{C}{L}\right) + \beta\mathbb{E}[\lambda V(z',0) + (1-\lambda)V^d(z')] \tag{5}$$

subject to the budget constraint

$$C = z_d L + m_d F, \tag{6}$$

where $m_d = \bar{m}e^{\phi(\bar{z}/z_d(z)-1)}$ increases relative to no-default due to the productivity loss z_d.

[16] In Section 6.1 we show that the results of Section 4 are robust to considering alternative government objective functions: (1) when it cares about all its citizen, i.e. including emigrants; and (2) when it cares about the average utility of remaining citizens, i.e. it does not care about the size of the remaining population.

Thus, while default implies an output loss and financial autarky, it also implies increased remittances from increased emigration.

International lenders are competitive and risk neutral. They face a constant world risk free rate r. The break-even condition implies the bond price schedule satisfies

$$Q(z, B') = \frac{1}{1+r}\mathbb{E}[1 - D(z', B')]. \tag{7}$$

Hence the bond price compensates lenders for their expected losses if the sovereign defaults. These prices depend on the country's current productivity, z, and newly issued debt, B'.

The recursive equilibrium of the model is given by (i) the government's choices, $B'(z, B)$, with associated value functions $V(z, B)$, $V^c(z, B)$, $V^d(z)$, consumption rules $C(z, B)$, $C^d(z, B)$, and default probabilities $D(z, B)$; and (ii) an equilibrium pricing function for sovereign bonds $Q(z, B')$ such that: (1) given bond price, the government's choices solve the recursive maximization problem (2); and (2) the consumption rule $C(z, B)$ satisfies the resource constraint of the economy; and (3) the bond pricing function $Q(z, B')$ satisfies the arbitrage condition of international lenders.

3.3 The Mechanism

To highlight the roles of emigration and remittances on the government's default choices, we revisit the government budget constraint (4) in normal times by noting that $L = 1 - m$:

$$C + B = z(1 - m) + mF + Q(z, B')B'.$$

Naturally, without remittances, the second term of the right hand side is eliminated and counter-cyclical emigration unambiguously amplifies negative productivity shocks by lowering L, thus severing the effects of sovereign default risk. As documented in Alessandria et al. [2020], introducing migration into models of sovereign default increases the elasticity of the spread to productivity and amplifies the effects of sovereign default risk. We label this the *labor channel*. While this channel remains operative, with remittances

F, emigration and the accompanying remittances have three additional, albeit ambiguous, effects that are unique to our model. On the one hand, the government now receives a steady stream of income (mF) that increases its ability to repay, thus reducing the sovereign default risk. We label this the *endowment channel*. On the other hand, two effects of remittances increase the default risk. First, remittances are out of reach of the international sanctioning mechanisms, namely the productivity loss under default. Default reduces production by z_d/z relative to no default, while remittances are unaffected by this penalty. Thus, larger remittances reduce the share of GNI affected by the default penalties. We label this the *cost channel*. Second, due to the counter-cyclical nature of net emigration, the potential productivity loss from default leads to an increase in emigration and hence remittances. As the government internalizes that the adverse effects of default are mitigated by increased remittances, it becomes more likely to default. We label this the *cushioning channel*.

To provide further intuition regarding these channels it is helpful to consider how GNI, that is $z(1-m)+mF$, varies with emigration and productivity. For this purpose, we abstract from the effects of debt and fix bond holdings B and the bond price Q. First, consider the partial derivative of GNI with respect to emigration:

$$\frac{\partial GNI}{\partial m} = -z + F.$$

When one additional worker emigrates, the government loses z units of domestic output, but receives F units of remittances. The former captures the labor channel – a smaller domestic output z per emigrant; while the latter captures the endowment channel – additional remittances received F per emigrant.

Next, by considering the partial derivative of GNI with respect to productivity, we provide some intuition regarding the cushioning channel. Taking into account that emigration is a function of productivity, the marginal effect of productivity on GNI can be written as

$$\frac{\partial GNI}{\partial z} = 1 + (\phi\bar{z}/z - 1)m - \phi\frac{\bar{z}}{z^2}mF.$$

Without emigration ($m = 0$), given that $Y = zL$, GNI increases one-to-one with productivity and the first term on then right hand side is 1. In the presence of emigration, the changes in GNI might not be one-to-one with productivity due to the labor channel – captured here by the second term on the right hand side. When $\phi = 0$, i.e. emigration is constant, then the marginal effect of productivity is dampened by $-m$. However, when $\phi > 0$ and emigration is countercyclical, the second term is positive if $\phi\bar{z}/z > 1$ and the marginal effect of productivity is amplified by emigration.[17] The third term on the right hand side captures the cushioning channel: Given the negative sign of this term, for any $\phi > 0$ the marginal effect of productivity is dampened by aggregate remittances, mF. In other words, the effect of productivity on GNI is dampened – *cushioned* – by increases in remittances.

In the full model, the marginal effects of productivity and emigration on GNI also operate through default incentives and equilibrium borrowing terms. Thus, the two expressions above can only be viewed as providing intuition. To study the role of each of these channels requires not only the static effects from these two expressions but also the induced response of spreads and borrowing. In the next section, we study the role of these channels by considering alternative quantifications of the model and show that, on net, remittances tend to increase the sovereign default risk, primarily through the cushioning channel.

4 Quantitative Analysis

In this section, we calibrate the model and evaluate the quantitative properties of the model. First, we study how remittances affect the sovereign default risk in equilibrium. Second, we consider the responses of the key variables to a negative productivity shock. Third, we assess the model's ability to replicate patterns observed in the data. Before proceeding with these analyses, we describe our calibration strategy.

[17] This is the case in most of our quantifications and in Alessandria et al. [2020].

4.1 Parameterization and Moments

The model is calibrated at an annual frequency. We assume that the productivity shock z follows a first-order autoregressive process:

$$\log(z_t) = \rho_z \log(z_{t-1}) + \eta_z \varepsilon_t,$$

where ρ_z captures the persistence of the shock, η_z determines the shock volatility, and the shock ε_t follows a standard normal distribution. If the government defaults, the economy suffers a productivity loss. Following Chatterjee and Eyigungor [2012], the productivity loss takes a quadratic form $z_d(z_t) = z_t - \max\left\{\chi_1 z_t + \chi_2 z_t^2, 0\right\}$ with $\chi_1 < 0 < \chi_2$, so that the default loss is especially large in high productivity states.

Table 2 reports the parameter values of the benchmark economy. Overall, our calibration strategy is to match some key properties of the 73 countries of our sample in Section 2 for which net migration is on average negative and net remittances positive, the sample labeled "+R,-M" in Tables A.2-A.5. There are two groups of parameters. The parameters in the first group (Panel a) are taken directly from the literature or from our data, and those in the second group are chosen to match relevant empirical moments jointly. The first group of parameters includes $\{r, \sigma, \lambda, \rho_z, \bar{m}, \beta\}$. Following convention, we set the risk-free rate r to 4% and the risk aversion σ to 2. The return parameter λ is set to 0.25 so that defaulting countries are excluded from international financial markets for an average of four years, consistent with the findings of Gelos et al. [2011]. The persistence of the productivity process, ρ_z, is set to 0.9, which is similar to the values used in many international real business cycle models. We set the average per period emigration rate to 0.4% as in the data.[18] Following Alessandria et al. [2020], we set the discount factor β to 0.83.[19]

The second group (Panel b) includes five parameters: the standard deviation η_z of the

[18] In Appendix E we show that results are unchanged if we match the average stock of emigrants per capita, i.e. $1/Population_t \times \sum_{h=0}^{t} Immigration_{t-h} - Emigration_{t-h}$, since what matters to the government's default decision are aggregate remittances.

[19] In order to generate reasonable default rates, as is well-known, standard sovereign default models require a low discount factor. We set the same value of discount factor as Alessandria et al. [2020].

Table 2: Parameters

Parameter	Description	Value	Target/Source
Panel a: Assigned parameters			
r	Risk-free interest rate	0.04	Conventional value
σ	Risk aversion	2	Conventional value
λ	Reentry probability	0.25	Gelos et al. [2011]
ρ_z	Productivity persistence	0.90	Conventional value
$\bar{m}$	Avg net migration	-0.4%	Data
β	Discount factor	0.83	Alessandria et al. [2020]
Panel b: Calibrated parameters			
η_z	SD productivity shocks	0.081	SD GNI
χ_1	Default loss	-0.31	Avg spread
χ_2	Default loss	0.35	SD spread
F	Foreign income	8.3	Avg remittances-to-GNI
ϕ	Elasticity of emigration	5.6	SD net migration

productivity process, the default cost parameters χ_1 and χ_2, the foreign income parameter F, and parameter ϕ that disciplines the elasticity of emigration to productivity. We choose these parameters to jointly target the following moments: a standard deviation of (logged) GNI of 13.29%, an average and standard deviation of spreads of 4.08% and 4.75%, an average of net remittance-to-GNI ratio of 5.57%, and a standard deviation of net migration of 1.39%. Even though we chose all these parameters jointly, we can give a heuristic description of how the data moments inform specific parameters. The default cost parameters mostly influence the behavior of spreads. The volatility of productivity shocks affects the volatility of GNI and spreads. The net remittances-to-GNI ratio is largely determined by the foreign income parameter F. And the volatility of net migration informs the elasticity of emigration of productivity ϕ. Table 3 presents the moments generated by the model, demonstrating a good fit with the data.

Table 3: Targeted Moments and Model Fit

	Data	Model
SD GNI (%)	13.29	13.20
Avg spread (%)	4.08	4.38
SD spread (%)	4.75	3.40
Avg remittances-to-GNI (%)	5.57	5.61
SD net migration (%)	1.39	1.33

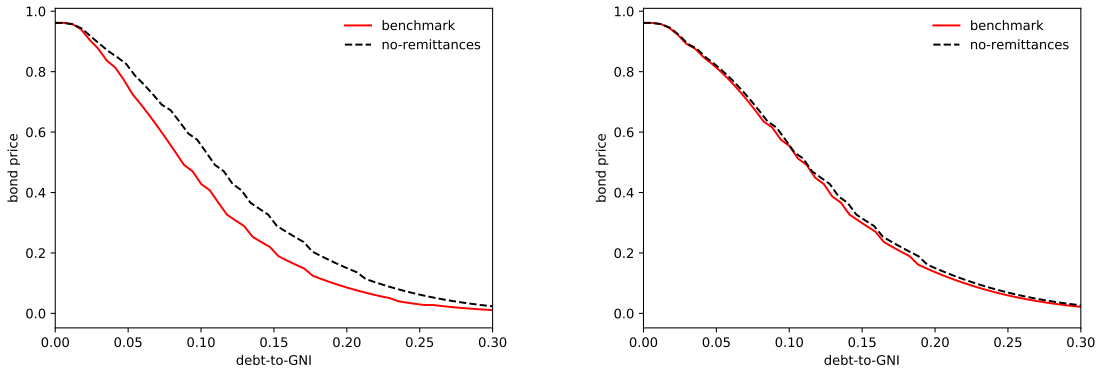
4.2 The Role of Remittances in the Bond Schedule

To examine the effect of remittances on sovereign default risk we compare our benchmark model to an economy with the same fundamentals but without remittances. In particular, the *no-remittances* model sets all parameters values to be the same as in the benchmark, except the foreign income, F, set to zero. This comparison allows us to isolate the role of remittances and control for the labor channel discussed in Section 3.3, since given inelastic labor supply, in both calibrations emigration will be the same in equilibrium and in response to productivity shocks.

Panel a of Figure 3 plots the bond price schedules as the function of debt-to-GNI under the median productivity level z. The bond price schedule in the benchmark model (solid red line) is shifted to the left relative to the no-remittances model (dashed black line), i.e. the government faces a higher spread for the same level of debt-to-GNI. The explanation is that, conditional on the same level of debt, remittances lower the burden of default: For one, the productivity cost of default has a smaller impact on the country's income (cost channel); and, in addition, a lower productivity increases emigration and thus remittances (cushioning channel). Therefore, international lenders respond by requiring a higher bond spread. In equilibrium, this implies that countries with large levels of remittances sustain smaller debt levels. In Appendix D we show that these differences become even more significant when we compare our benchmark economy to two alternative economies without remittances. First we consider a model without remittances and the same fundamentals (parameter values) but also the same GNI (by re-calibrating its average productivity).

Second, we recalibrate the the model to match the same targeted moments. This illustrates that quantitative analysis that match empirical facts but omit modeling remittances may yield very different results if remittances are large.

To further investigate the role of remittances, we turn off the elasticity of emigration to productivity by setting $\phi = 0$. Thus, in both models emigration is constant and the labor force equals $L = 1 - \bar{m}$. In this case, the no-remittance model effectively collapses to the standard sovereign default model without migration. Nevertheless, with remittances, the endowment and cost channels remain, allowing us to assess their relative strength as well as the contribution of the cushioning channel to the previous result. Panel b of Figure 3 plots the bond price schedule as a function of debt-to-GNI, for both models. The two schedules are almost identical, indicating that without counter-cyclical emigration the endowment and cost channels almost entirely offset each other and deliver the same bond schedule as the standard sovereign default model without migration nor remittances.[20] This striking result indicates that the cushioning channel is the key driver of the result that remittances heighten the default risk and the spread, as depicted in Panel a.



(a) Benchmark calibration (b) Constant labor force ($\phi = 0$)

Figure 3: The Bond Price Schedule Comparison

Notes: This figure plots the bond price schedule for a country with median productivity as a function of debt-to-GNI ratio for the model with remittances (solid red lines) and the model without remittances (dashed black lines). Panel a is our benchmark calibration. Panel b corresponds to the case when $\phi = 0$, so that the labor force in both models is constant at $L = 1 - \bar{m}$.

[20] In Appendix F we further illustrate this by separating the endowment and cost channels.

4.3 The Role of Remittances in Response to Shocks

We now explore the effects of a negative productivity shock in our benchmark model and the no-remittances model. To construct the generalized impulse response functions (GIRFs), we simulate 5,000 paths for each model over 500 periods. From periods 1 to 400, the productivity shock follows its underlying Markov chains so that the cross-sectional distribution of debt and credit standing converges to the limiting distribution. In period 401 (period 1 in the plots), we introduce a negative productivity shock of 10 percent in all simulations of both models (Panel a). From period 401 on, productivity follows its Markov process again. We then report the average impulse response over the 5,000 paths of each model. Figure 4 plots the GIRFs of productivity, remittances, GNI, and consumption in percent changes; the spread and debt-to-GNI in levels (unit is percent); and the default rate and net migration in percentage point changes. The solid red lines are for our benchmark model and the dashed black lines are for the no-remittances model.

With the same negative productivity shock (Panel a), both models see an increase in the default rate. Without remittances, the default rate increased by more (Panel b). The increase in the government bond spread are similar (Panel c).[21] This is perhaps surprising given the leftward shift in the bond schedule with remittances depicted in Figure 3, but is explained by the fact that economies with remittances have a lower equilibrium debt level at the time of the shock as can be seen in Panel g. Panel d shows that more workers migrate out of the country during downturns. With more emigrants, remittances increase by 70 percent in the benchmark model following a negative productivity shock (Panel e). In terms of levels, it represents remittances-to-GNI ratio increasing from around 5.6 to 9.9 percent. Panel f illustrates how remittances received generate a gap between the country's income and its domestic production. Even though in both economies the productivity decline is the same (Panel a), the drop in GDP is more than three times as large in the economy without remittances. This is entirely due to the increase in remittances.

Panel g plots the response of debt-to-GNI ratio. In both economies, there is a large

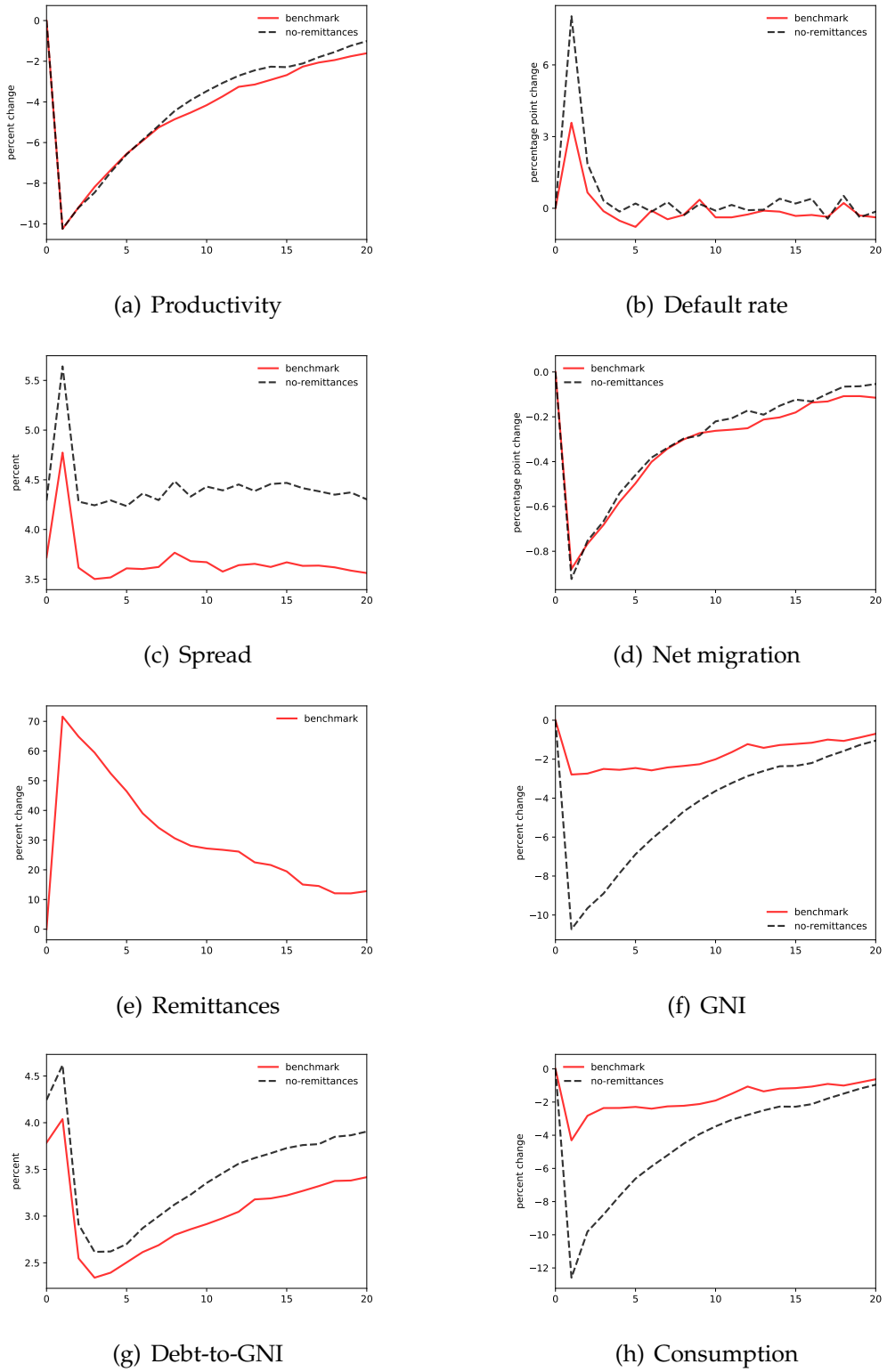
[21] Note that Panel c plots the average spread across the simulations that do not default because spreads are not well defined when government is in default.

drop. Finally, Panel h shows that the consumption drop is around three times as large in the model without remittances than with remittances, illustrating the insurance role of remittances. Note consumption drops by more than GNI in both models due to the decline in the net foreign asset position from the increase in the spreads. The GIRFs show that remittances serve as an important buffer against adverse shocks, even though they undermine the government's borrowing possibilities during normal times by shifting the bond schedule to the left.

5 Cross-sectional Analysis

While in the previous section we studied the effect of remittances on sovereign default risk by comparing it to a model without remittances, in this section we examine whether the benchmark model can reproduce the empirical facts documented in Section 2. To do so, we consider 73 calibrations of the model for each of the country in our "+R,-M" sample of developing countries. Precisely, we vary F, $\bar{m}$, and ϕ to generate the observed net remittances-to-GNI and the average and standard deviation of net migration of each country. The targeted moments of each country are reported in Table G.2 of the Appendix. We then simulate the 73 calibrations of the model to generate a country-year panel that mimics the data and allows us to run four regressions analogous to our empirical analysis, that is controlling for the same aggregate variables (except prices and unemployment) and including the same fixed effects used in the results of Table 1.

Table 4 reports the result. Column 1 reproduces the four coefficients of interest from the data (columns 2, 4, 6, and 8 of Tables 1) and column 2 presents the results of the model simulations. The model successfully replicates the qualitative patterns observed in the data, as the signs of all correlations are consistent across model and data. Quantitatively, the model produces correlations of comparable magnitude in most cases. The relationship between remittances and migration (Fact #1) is negative in both the data (-1.36) and the model (-0.99), while the correlation between migration and income (Fact #2) is positive (0.27 in the data and 0.79 in the model). The correlations between migration and spreads



(a) Productivity

(b) Default rate

(c) Spread

(d) Net migration

(e) Remittances

(f) GNI

(g) Debt-to-GNI

(h) Consumption

Figure 4: GIRFs in Benchmark Model and No-Remittances Model

Notes: This figure plots the generalized impulse response functions (GIRFs) to a negative productivity shock in the benchmark model (solid lines) and no-remittances model (dashed black lines). Productivity, remittances, GNI, and consumption are in percent changes; spread and debt-to-GNI are in levels (unit is percent); and the default rate and net migration rate are in percentage point changes.

(Fact #3) and between spreads and remittances (Fact #4) also have the correctly sign, with the latter also being quite close in magnitude (0.06 in the model and 0.04 in the data), while the former is somewhat weaker in the model (-0.03 versus -0.23). These findings are particularly noteworthy for Facts #3 and #4, as the parameters F, ϕ, and $\bar{m}$ vary across countries and jointly shape the responses of spreads, remittances, and emigration to productivity shocks. These results are not trivial since in the cross-section not necessarily economies with higher remittances also exhibit higher spreads, as possibly lower values of ϕ and $\bar{m}$ could decrease their spread response.

Table 4: Regression with Model-simulated Data

	Data	Model
Net. Rem./GNI on Net. Mig. pc (Fact #1)	-1.36	-0.99
Net. Mig. pc on RGNI pc (Fact #2)	0.27	0.79
Net. Mig. pc on Spreads (Fact #3)	-0.23	-0.03
Spreads on Net Rem./GNI (Fact #4)	0.04	0.06

6 Additional Results and Extensions

6.1 Alternative Government Preferences

In our benchmark model the planner cares about both, the size and the average per capita utility of the remaining workforce. Here, we consider two alternative social welfare functions. First, the government cares only about the average utility of the remaining workers. Second, the government cares about the average utility of remaining workers and emigrants.

Under the first formulation, the repayment value and the default value of the government are given by:

$$V^c(z,B) = \max_{C,B'} \quad u\left(\frac{C}{L}\right) + \beta \mathbb{E}[V(z',B')] \tag{8}$$

and

$$V^d(z) = \max_C \; u\left(\frac{C}{L}\right) + \beta \mathbb{E}[\lambda V(z', 0) + (1-\lambda) V^d(z')]. \tag{9}$$

Under the second formulation, the repayment value and the default value of the government are given by:

$$V^c(z, B) = \max_{C, B'} \quad u\left(C\right) + \beta \mathbb{E}[V(z', B')] \tag{10}$$

and

$$V^d(z) = \max_C \; u\left(C\right) + \beta \mathbb{E}[\lambda V(z', 0) + (1-\lambda) V^d(z')]. \tag{11}$$

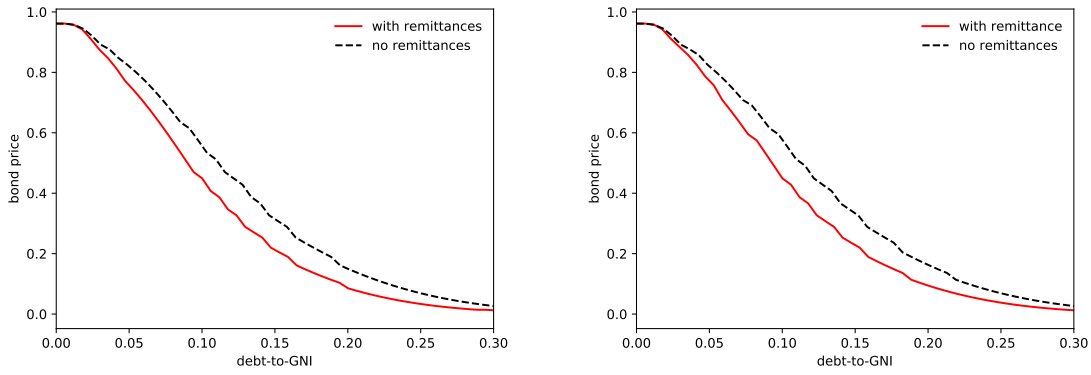
We solve the model under those alternative government preferences. Table G.3 reports the moments generated by the models under alternative social welfare function assumptions. Both models fit the data just as well as our benchmark. Figure 5 plots the bond price schedules as functions of debt-to-GNI ratios for the model with and without remittances under the two alternative welfare functions. Panel (a) considers the case in which the government cares only about the average utility of remaining workers; while Panel (b) considers the case in which it cares about the average utility of remaining workers and emigrants. Both bond schedules are virtually indistinguishable from the benchmark indicating that our results are not sensitive to the choice of the government's welfare function.[22]

6.2 Model with Capital

In this section, we incorporate capital into the model. This extension allows us to study the role of remittances when they can be used for both consumption and investment, and thus can also be used to enhance the country's future production possibilities, an important theme in the macro literature on remittances [Mandelman and Zlate, 2012].[23]

[22] We also examine the case where we eliminate the elasticity of emigration with respect to productivity by setting $\phi = 0$. The findings are consistent with those in the benchmark model — namely, the cushioning channel continues to be the main mechanism through which remittances increase default risk and sovereign spreads. We have done this for all the extensions in this section. The results are available upon request.

[23] Despite the conventional wisdom that remittances are mostly used for consumption, Giuliano and Ruiz-Arranz [2009] provides evidence that remittances are used to finance investment. Here we assume that remittances are used for consumption and investment at the same rate as income from production.



(a) Average Utility (b) All Citizen

Figure 5: Bond Price Schedule Comparison Under Alternative Government Preferences

Notes: This figure plots the bond price schedule for a country with median productivity as a function of debt-to-GNI ratio for the model with remittances (solid red lines) and the model without remittances (dashed black lines). Panel (a) assumes that the government cares about the average utility of the remaining workers. Panel (b) assumes that government cares about both remaining workers and emigrants.

Here, the aggregate output Y is produced with capital K and labor L using a Cobb-Douglas production function $Y = zK^{\alpha}L^{1-\alpha}$. If the government repays its debt, it can choose both investment and new international borrowing, B', by solving the following dynamic programming problem:

$$V^{c}(z,K,B) = \max_{C,B',K'} \quad Lu\left(\frac{C}{L}\right) + \beta\mathbb{E}[V(z',K',B')] \tag{12}$$

subject to the budget constraint:

$$C + B = zK^{\alpha}(L)^{1-\alpha} - K' + (1-\delta)K + mF + Q(z,K',B')B', \tag{13}$$

where output is produced with current capital stock K and post-migration workers L, $Q(z,K',B')$ is the bond price and $Q(z,K',B')B'$ are the proceeds of government issuing debt. The default value is given by:

$$V^{d}(z,K) = \max_{C,K'} \; Lu\left(\frac{C}{L}\right) + \beta\mathbb{E}[\lambda V(z',K',0) + (1-\lambda)V^{d}(z',K')] \tag{14}$$

subject to the budget constraint

$$C = z_d K^{\alpha}(L)^{1-\alpha} - K' + (1-\delta)K + m_d F, \tag{15}$$

During a default, the country cannot engage in international borrowing or saving. However, it can still self-insure through capital accumulation. The bond price schedule is given by:

$$Q(z, K', B') = \frac{1}{1+r}\mathbb{E}[1 - D(z', K', B')], \tag{16}$$

which depends on the country current shock z, level of capital, K', and debt, B'.

Quantitatively, we set the capital depreciation rate δ to 10% and the capital share α to 0.5, following Alessandria et al. [2020]. We recalibrate the model such that the model generates the targeted data moments listed in Table 3. Table 5 presents the parameters in this with-capital model. To study the role of remittances, again, we compare the bond price schedules of the model with remittances and the one in which all else is equal but $F = 0$. Figure 6 plots the bond price schedules for both models. The difference between the two bond schedules is now even more distinct, as the bond schedule with remittances shifts farther left from the model without remittances. This suggests that when remittances can be used to accumulate capital and thus enhance future production possibilities in the case of default, the sovereign default risk increases further and international lenders require a larger spread.

Table 5: Matching Same Moments in Benchmark and Model with Capital

Parameter	Description	Benchmark	With Capital
η_z	Std. productivity shocks	0.081	0.044
χ_1	Default loss	-0.31	-0.31
χ_2	Default loss	0.35	0.34
F	Foreign income	8.3	13
ϕ	Elasticity of emigration	5.6	11.5

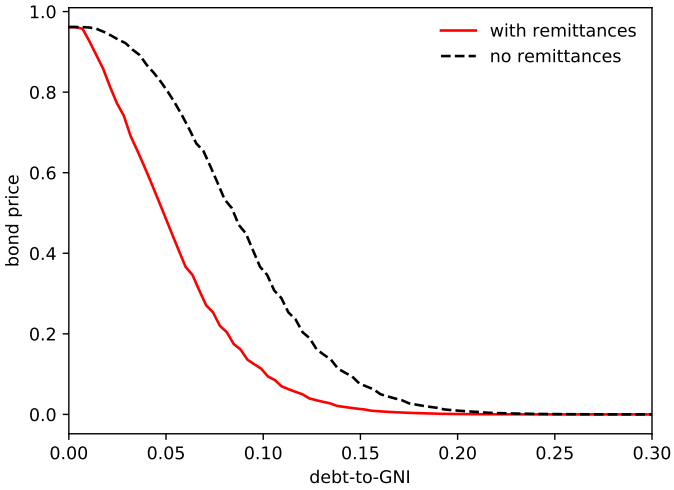


Figure 6: Bond Price Schedule Comparison for Model with Capital

Notes: This figure plots the bond price schedule for a country with median productivity as a function of debt-to-GNI ratio for the with-remittance (solid red line) and the no-remittance model (dashed black line) when we include capital.

6.3 Model with Emigrant Stock

In this section, we incorporate the stock of emigrants into the model. Instead of assuming emigrants return at the end of the period, we assume that a fraction $1-\gamma$ of emigrants remain abroad and continue to send remittances back, while only a fraction γ of emigrants return. The law of motion for the stock of emigrants is given by:

$$E_t = (1-\gamma)E_{t-1} + m_t L_{t-1}, \tag{17}$$

where $m_t = \bar{m}e^{\phi(\bar{z}/z_{t-1})}$ is the emigration rate. The law of motion for the domestic workers is given by:

$$L_t = L_{t-1} + \gamma E_{t-1} - m_t L_{t-1}. \tag{18}$$

With $L_t + E_t = 1$, we have

$$L_t = L_{t-1} + \gamma(1-L_{t-1}) - m_t L_{t-1} = (1-\gamma)L_{t-1} + \gamma - m_t L_{t-1}, \tag{19}$$

$$E_t = (1-\gamma)(1-L_{t-1}) + m_t L_{t-1}. \tag{20}$$

We include the last period labor L_{t-1} as an additional state variable and modify the recursive government problem as follows. If the government repays its debt, it issues new bonds, B', by solving the following dynamic programming problem, where L_{-1} denotes last period's domestic workforce:

$$V^c(z, L_{-1}, B) = \max_{C,B'} \quad Lu\left(\frac{C}{L}\right) + \beta \mathbb{E}[V(z', L, B')] \tag{21}$$

subject to the budget constraint:

$$C + B = zL + [(1-\gamma)(1-L_{-1}) + mL_{-1}]F + Q(z, L_{-1}, B')B', \tag{22}$$

where $(1-\gamma)(1-L_{-1}) + mL_{-1}$ is the stock of emigrants each period, and F are the remittances sent by each emigrant. The law of motion for labor:

$$L = (1-\gamma)L_{-1} + \gamma - mL_{-1}, \tag{23}$$

The default value is given by:

$$V^d(z, L_{-1}) = \max_{C} \; Lu\left(\frac{C}{L}\right) + \beta \mathbb{E}[\lambda V(z', L, 0) + (1-\lambda)V^d(z', L)] \tag{24}$$

subject to the budget constraint and the law of motion for labor:

$$C = z_d L + [(1-\gamma)(1-L_{-1}) + m_d L_{-1}]F, \tag{25}$$

$$L = (1-\gamma)L_{-1} + \gamma - m_d L_{-1}, \tag{26}$$

With higher emigration, the economy has fewer labor but receives more remittances. The bond price schedule is given by:

$$Q(z, L_{-1}, B') = \frac{1}{1+r}\mathbb{E}[1 - D(z', L, B')]. \tag{27}$$

We assume half of the emigrants come back each period, that is $\gamma = 0.5$.[24] Then we recalibrate the model such that the model generates the targeted data moments listed in Table 3. Table 6 presents the parameters in this with-emigrants-stock model. Figure 7 plots the bond price schedules for the model with remittances and the model without remittances. The difference between the two models is very similar to our benchmark model in which $\gamma = 1$, i.e. all emigrants return. The reason is that even though a negative productivity shock now generates a more persistent increase in remittances as emigrants remain abroad for extended periods, in order to match the same moments, the per capita remittances are smaller: F is 8.3 in the benchmark and 5.2 here. This suggests that what matters in terms of the sovereign default risk is the response of aggregate remittances.

Table 6: Matching Same Moments in Benchmark and Model with Emigrant Stock

Parameter	Description	Benchmark	With Emigrant Stock
η_z	Std. productivity shocks	0.081	0.081
χ_1	Default loss	-0.31	-0.31
χ_2	Default loss	0.35	0.36
F	Foreign income	8.3	5.2
ϕ	Elasticity of emigration	5.6	5.6

6.4 Welfare and Policy

In this subsection we study the effect of emigration and remittances as well as policy on welfare. First, we consider welfare in our benchmark in comparison to a model without emigration nor remittances, that is, setting $F = 0$ and $\bar{m} = 0$. Panel a of Figure 8 plots aggregate welfare as a function of debt of the benchmark model and the closed economy. Even though the benchmark model has a smaller effective labor force and the government faces higher spreads, emigration and remittances increase welfare.[25]

[24] Appendix H shows that the same pattern holds when we consider a higher or lower value of γ.
[25] Results are similar if we consider per capita welfare.

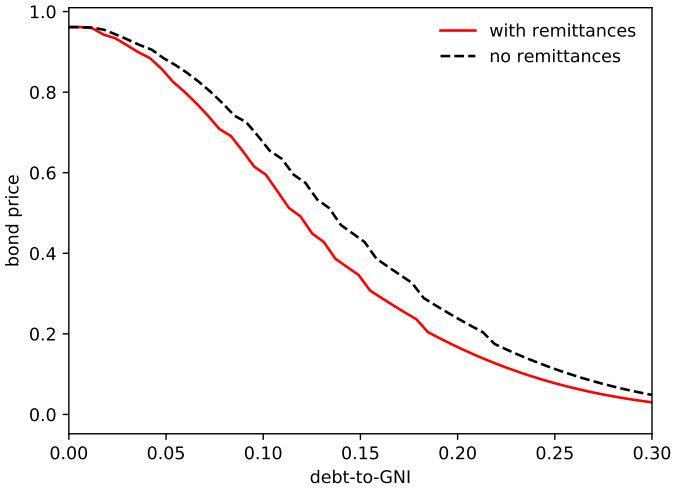


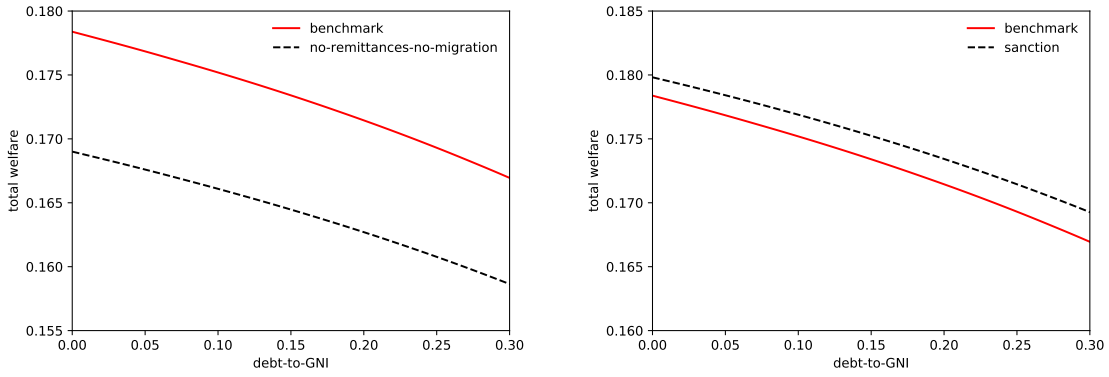
Figure 7: Bond Price Schedule Comparison for Model with Emigrant Stock

Notes: This figure plots the bond price schedule for a country with median productivity as a function of debt-to-GNI ratio for the with-remittance (solid red line) and the no-remittance model (dashed black line) when we include stock of emigrants.

Second, we consider the case when remittances are sanctioned with a tax in the case of default. Precisely, we set the budget constraint to be $C = z_d(z) \cdot L + \frac{z_d(z)}{z} \cdot (m_d F)$ instead of $C = z_d(z) \cdot L + m_d F$, so that only the fraction $\frac{z_d(z)}{z}$ of sent remittances are effectively received when the country is in default. Thus, this formulation eliminates the cost channel from the benchmark model. Also note this sanction may be viewed as a tax, and for simplicity here it is not rebated to international lenders. Panel b of Figure 8 compares the aggregate welfare as a function of government debt-to-GNI of our benchmark to this version with taxes on remittances. Under the latter, the value of default drops, thus lowering the equilibrium default probabilities and sovereign spreads. This raises welfare relative to the benchmark without such sanctions.

6.5 Endogenous Asymmetric Default Costs

A pervasive feature of sovereign default episodes is that they occur during economic downturns [Borensztein and Panizza, 2009, Uribe and Schmitt-Grohé, 2017]. An implication is that spreads and output tend to be negatively correlated. To reproduce this pattern the



(a) Open vs. Closed

(b) Remittances Tax in Default

Figure 8: Welfare and Policy

Notes: This figure plots total welfare with median productivity as a function of debt-to-GNI ratio for the model with remittances. The solid red lines plots the benchmark model and the dashed black lines plot the alternative models. In Panel (a) the closed model is defined by $F = \bar{m} = 0$ and in Panel (b) the Sanction model is defined by the budget constraint under default of $C = z_d(z) \cdot L + \frac{z_d(z)}{z} \cdot (m_d F)$.

standard approach of quantitative models of sovereign default is to assume asymmetric default costs using a cost ceiling as in Arellano [2008] or a quadratic costs as in Chatterjee and Eyigungor [2012], which imply more severe output losses when income is high. In contrast, when the default cost is modeled as a linear function of the country's income, default episodes are at most weakly negatively correlated with the country's business cycle, depending on the quantification; and the negative correlation between spreads and output breaks down [Aguiar and Amador, 2021]. While there is an ongoing debate about the real world nature of the output costs from default, justifying the default cost asymmetry has been mostly neglected by the literature. Here we show that with counter-cyclical emigration and remittances, default episodes and spreads are negatively correlated with output even with linear default costs. The reason is that default costs endogenously become asymmetric: In good times, the marginal product of labor (z) is high relative to the received remittances from emigration, while in bad times the marginal product of labor drops and emigration becomes less costly and comes with increased remittances. Thus, default is more costly in the good state than in the bad state.

Table 7 reports some moments of the ergodic distribution of our benchmark model and the standard model without emigration nor remittances (setting $\phi = 0$ and $F = 0$)

under two parameterizations of the default cost: (1) the quadratic cost used in Section 4, and (2) a linear cost in which $z_d(z_t) = (1-\delta)z_t$ as in Aguiar and Gopinath [2006]. We focus our discussion on the latter, since there are no significant differences between the two models when considering the quadratic cost. Most importantly, in the benchmark model the correlation between GDP and spreads is negative and of similar magnitude to those of the quadratic cost. In contrast, it is positive under the standard model with linear cost. Another important difference is that the benchmark model generates similar default rates and spreads to those under the quadratic costs, while they are negligible under the standard model with linear costs.[26] Finally, it is noticeable that most moments of the benchmark model are very similar under the two cost specifications. This illustrates how remittances and emigration justify the use of asymmetric default costs in the standard quantitative sovereign default models.

Table 7: Model Moments with (A)Symmetric Default Costs

	Quadratic Cost		Linear Cost	
	Benchmark	Standard	Benchmark	Standard
Avg (b'/GNI) (%)	4.44	5.35	10.01	42.50
Default Rate (%)	3.48	4.08	7.76	0.11
Avg spread (%)	4.38	5.41	8.83	0.10
SD spread (%)	3.40	4.72	12.36	0.06
Corr(ln GNI , spread)	-0.46	-0.47	-0.69	-0.05
Corr(b'/GNI , spread)	-0.34	-0.48	-0.72	0.03
Corr(TB, spread)	0.38	0.34	0.21	0.27

Notes: All moments are conditional on not defaulting with exception of the default rate. "Benchmark" is our model, "Standard" is a standard model without emigration nor remittances. The quadratic cost function is $z_d(z_t) = z_t - \max\{\chi_1 z_t + \chi_2 z_t^2, 0\}$ with $\chi_1 = -0.31$ and $\chi_2 = 0.35$ as in our benchmark model calibration. The linear default cost function is $z_d(z_t) = (1-\delta)z_t$ as in Aguiar and Gopinath [2006], where $\delta = 0.1$. b'/GNI is the level of debt issued as a fraction of GNI. TB is trade balance, which is GNI minus consumption.

[26] The moments of the standard model with linear cost are in line with Aguiar and Amador [2021] (Table 5.2).

7 Conclusions

Spurred by rising international migration, in the last three decades, remittances received have become an important fraction of many developing country's income. In this paper, we examine how remittances affect country's sovereign default risk. Remittances received introduce non-trivial effects into the standard sovereign default model since they are neither subject to the same uncertainty as domestic production nor to the typical sanctioning mechanisms enforcing debt repayment. In our data analysis, we show government spreads tend to correlate positively with remittances across developing countries. To reproduce this pattern in a model of sovereign default with emigration and remittances, the counter-cyclical nature of emigration and aggregate remittances is crucial. As the government internalizes that remittances can cushion against the productivity losses from default, the value of default increases relative to a model with the same emigration rate but no remittances and lenders require a higher return on their loans to the sovereign. In equilibrium, this leads to higher spreads and/or lower debt levels. Thus, our paper provides a new mechanism that explains why many developing countries tend to face high borrowing costs even with relatively low levels of debt.

While our analysis provides a clear implication regarding the effects of remittances on sovereign default risk, it abstracts from several potentially important aspects. First, by focusing on the consolidated planner's problem, we implicitly assume that all remittances are immediately available for debt repayment within the same period. In practice, households may allocate remittances differently during economic downturns than in normal times, which may affect when remittances become tax revenue to the government. Second, the model abstracts from explicit exchange rate dynamics, which could influence both emigration incentives and remittance behavior. In our current framework, emigration is linked to productivity in a reduced-form manner, and the elasticity parameter ϕ can be interpreted as capturing exchange rate effects. Nonetheless, explicitly incorporating exchange rate movements–since currency depreciation during downturns could increase both the incentives to emigrate and to send remittances–would be a valuable extension. Finally, while our empirical analysis documents a robust positive association between re-

mittances and sovereign debt spreads, a promising avenue for future research is to explore the idenitifcation of a causal relationship between the two.

References

Pablo Acosta, Emmanuel Lartey, and Federico Mandelman. Remittances and the dutch disease. *Journal of International Economics*, 79(1):102–116, 2009.

Mark Aguiar and Manuel Amador. The economics of sovereign debt and default. *Princeton University Press*, 2021.

Mark Aguiar and Gita Gopinath. Defaultable debt, interest rates and the current account. *Journal of international Economics*, 69(1):64–83, 2006.

George Alessandria, Yan Bai, and Minjie Deng. Migration and sovereign default risk. *Journal of Monetary Economics*, 113:1–22, 2020.

Pozo S. Amuedo-Dorantes, C. Remittances and insurance: Evidence from mexican immigrants. *Journal of Population Economics*, 19:227–254, 2006.

Cristina Arellano. Default risk and income fluctuations in emerging economies. *American Economic Review*, 98(3):690–712, 2008.

Peri G. Artal-Tur, A. and F. Requena-Silvente. The socio-economic impact of migration flows: Effects on trade, remittances, output, and the labour market. 2014.

Berrak Bahadir, Santanu Chatterjee, and Thomas Lebesmuehlbacher. The macroeconomic consequences of remittances. *Journal of International Economics*, 111:214–232, 2018.

Neele Balke. The employment cost of sovereign default. Technical report, Working paper, 2023.

Javier Bianchi and César Sosa-Padilla. Reserve accumulation, macroeconomic stabilization, and sovereign risk. *Review of Economic Studies*, 91(4):2053–2103, 2024.

Javier Bianchi, Pablo Ottonello, and Ignacio Presno. Fiscal stimulus under sovereign risk. *Journal of Political Economy*, 131(9):2328–2369, 2023.

Eduardo Borensztein and Ugo Panizza. The costs of sovereign default. *IMF Staff Papers*, 56 (4):683–741, 2009.

Santanu Chatterjee and Stephen J Turnovsky. Remittances and the informal economy. *Journal of Development Economics*, 133:66–83, 2018.

Satyajit Chatterjee and Burcu Eyigungor. Maturity, indebtedness, and default risk. *American Economic Review*, 102(6):2674–99, 2012.

Michael A Clemens. Economics and emigration: Trillion-dollar bills on the sidewalk? *Journal of Economic perspectives*, 25(3):83–106, 2011.

Minjie Deng. Inequality, taxation, and sovereign default risk. *American Economic Journal: Macroeconomics*, 16:217–49, 2024.

Ceyhun Bora Durdu and Serdar Sayan. Emerging market business cycles with remittance fluctuations. *IMF Staff Papers*, 57(2):303–325, 2010.

Jonathan Eaton and Mark Gersovitz. Debt with potential repudiation: Theoretical and empirical analysis. *The Review of Economic Studies*, 48(2):289–309, 1981.

Carlos Esquivel. The sovereign default risk of giant oil discoveries. *Working Paper*, 2025.

R Gaston Gelos, Ratna Sahay, and Guido Sandleris. Sovereign borrowing by developing countries: What determines market access? *Journal of international Economics*, 83(2): 243–254, 2011.

Paola Giuliano and Marta Ruiz-Arranz. Remittances, financial development, and growth. *Journal of Development Economics*, 90(c):144–152, 2009.

Grey Gordon and Pablo Guerron-Quintana. On regional borrowing, default, and migration. *Federal Reserve Bank of Richmond Working Paper*, 2019.

Franz Hamann, Enrique G. Mendoza, Juan Camilo Mendez-Vizcaino, and Paulina Restrepo-Echavarria. Natural resources and sovereign risk in emerging economies: A curse and a blessing. *NBER Working Paper*, 31058, 2023.

Sokchea Lim and Channary Khun. Macroeconomic impacts of remittances: A two-country, two-sector model. *Journal of Macroeconomics*, 73:103443, 2022.

Siming Liu and Hewei Shen. Sovereign default and labor market dynamics. *Available at SSRN 3785746*, 2024.

Immaculate Machasio. Do remittance flows stabilize developing countries in the aftermath of sovereign defaults? Unpublished manuscript, 2016.

Federico Mandelman. Monetary and exchange rate policy under remittance fluctuations. *Journal of Development Economics*, 102(c):128–147, 2013.

Federico Mandelman and Alan Finkelstein Shapiro. Remittances, entrepreneurship and employment dynamics over the business cycle. *Journal of International Economics*, 103: 184–199, 2016.

Federico S Mandelman and Andrei Zlate. Immigration, remittances and business cycles. *Journal of Monetary Economics*, 59(2):196–213, 2012.

Anna Maria Mayda. International migration: A panel data analysis of the determinants of bilateral flows. *Journal of population economics*, 23:1249–1274, 2010.

Enrique G Mendoza and Vivian Z Yue. A general equilibrium model of sovereign default and business cycles. *The Quarterly Journal of Economics*, 127(2):889–946, 2012.

Seunghoon Na, Stephanie Schmitt-Grohé, Martín Uribe, and Vivian Yue. The twin ds: Optimal default and devaluation. *American Economic Review*, 108(7):1773–1819, 2018.

Martín Uribe and Stephanie Schmitt-Grohé. Open economy macroeconomics. *Princeton University Press*, 2017.

Dean Yang. International migration, remittances, and household investment: Evidence from philippine migrants' exchange rate shocks. *The Economic Journal*, 118:591–630, 2008.

Dean Yang and HwaJung Choi. Are remittances insurance? evidence from rainfall shocks in the philippines. *World Bank Economic Review*, 21:219–248, 2007.

Appendix

A Robustness Empirical Evidence

In this section we provide some robustness and extensions to the relation between migration, remittances, output, and spreads documented in Section 2.

A single regression with remittances, migration, output, and spreads

In our baseline estimation of the 4 facts we consider 4 separate regressions by considering the relation between the two variables of interest and maintaining the same set of control variables throughout. However, given the obvious endogeneity between the 4 variables, a reasonable concern is that some effects may dissipate if one was to control for the other two variables of interest as well. For instance, the relation between remittances and spreads may be driven by migration, or vice-versa. Here we show that if one consider a single regression including all 4 variables of interest (and the same controls), the documented facts remain significant. In particular, we consider net remittances as the dependent variable and regress it on net migration, RGNI pc, spreads, and the 3 control variables, namely the GDP deflator, the REER, and debt-to-GNI. Note this approach allows to only consider 3 of the 4 facts as we omit the relation between net migration and spreads.

The results are reported in Table A.1 under our baseline sample and the "+R,-M" sample, and for year and country and year fixed effects. We also include consider the case of accumulated net migration per capita, i.e. $\frac{1}{Population_t} \times \sum_{h=0}^{t} Immigration_{t-h} - Emigration_{t-h}$, a measure close to that of a diaspora. The results indicate that our estimated effects are robust to this approach. First, across countries, net remittances and net migration are negatively correlated. Second, net remittances are counter-cyclical, both across and within countries. Third, spreads and net remittances are positively correlated, across and within countries.

Table A.1: Remittances, Migration, Output, and Spreads

Dep. Var.:	Net Remitt./GNI							
Sample:	Baseline (1)	+R,-M (2)	Baseline (3)	+R,-M (4)	Baseline (5)	+R,-M (6)	Baseline (7)	+R,-M (8)
Net Mig. pc	-0.41*	-1.05***			0.18***	0.01		
	(0.21)	(0.25)			(0.06)	(0.08)		
RGNI pc	-1.84***	-2.20***	-1.34***	-1.75***	-0.97	-2.72***	-1.02*	-2.74***
	(0.37)	(0.42)	(0.31)	(0.34)	(0.60)	(0.73)	(0.60)	(0.72)
Spreads	0.50*	0.50	0.63***	0.89***	0.32**	0.37**	0.23*	0.33**
	(0.28)	(0.33)	(0.23)	(0.27)	(0.13)	(0.17)	(0.13)	(0.16)
Accum. Net Mig. pc			-0.21***	-0.24***			-0.10***	-0.09**
			(0.01)	(0.02)			(0.03)	(0.03)
GDP deflator	-3.63***	-2.66**	-3.31***	-2.58**	-0.36	1.32	-0.17	1.32
	(1.29)	(1.34)	(1.10)	(1.06)	(0.61)	(0.83)	(0.61)	(0.83)
REER	6.23***	3.92***	6.53***	3.80***	-0.67	-1.15	-0.83	-1.12
	(1.15)	(1.22)	(0.98)	(0.97)	(0.61)	(0.87)	(0.61)	(0.86)
Debt/GNI	1.61***	2.83***	0.57*	1.11***	0.20	1.44***	0.39	1.50***
	(0.35)	(0.40)	(0.31)	(0.34)	(0.24)	(0.34)	(0.24)	(0.34)
Fixed Effects	t	t	t	t	i,t	i,t	i,t	i,t
Number Countries	40	28	40	28	39	27	39	27
Observations	560	407	560	407	559	406	559	406
Adjusted R^2	0.14	0.23	0.48	0.63	0.94	0.93	0.94	0.93

Note. Estimates in odd columns are obtained using the baseline sample of non-high income countries. Even columns report the same estimates using the $+R, -M$ sample. All variables are in log except net migration per capita, accumulated net migration per capita, and the dependent variable, net remittances to GNI, which are in percent. In columns 3,4, 7 and 8 accumulated net migration per capita is calculated as $\frac{1}{Population_t} \times \sum_{h=0}^{t} Immigration_{t-h} - Emigration_{t-h}$. Robust standard errors are in parentheses, * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Fact 1: Net remittances increase with emigration.

Table A.2 reports several robustness checks to the estimated conditional covariance between net remittances and net migration documented in column 1 of Table 1. First, column 1 shows that the estimate of α^{RM} increases slightly when excluding macro controls. Column 2 shows that the estimate decreases significantly from -1.45 to -0.14 when country fixed effects are included, while the adjusted R-square increases from 0.07 to 0.76. This indicates that the estimate is mostly identified off cross-country variation. The next two columns show that there are lagged effects of net emigration on net remittances. In column 4, three lags are added to (1) and the accumulated effect increases by more than a factor of three. Next, we consider the accumulated net migration since our first observation divided by

current population, i.e. $\frac{1}{Population_t} \times \sum_{h=0}^{t} Immigration_{t-h} - Emigration_{t-h}$, a measure close to that of a diaspora. The estimate is large and significant. Column 5 provides insight into the magnitude of the covariance by using standardized regressors. The covariance of net migration and net remittances is larger than that of any other covariate, and a one standard deviation increase of net migration is associated with a 1.8 percentage point increase in net remittances to GNI. Finally, columns 6 and 7 use remittances recived to GNI and remittances paid to GNI as the dependent variable. As expected, the positive relation between emigration and net remittances is driven by increases in received remittances, as opposed to a decline in paid remittances.

Table A.2: Remittances and Migration

Dep. Var.: NR_{it}	No controls		Lags	Cum. NM_{it}	Developed Countries	Std.	Remitt. Rec.	Remitt. Paid
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Net Mig. pc	-1.29***	-0.11			-0.74***	-2.10***	-1.45***	-0.02
	(0.11)	(0.06)			(0.13)	(0.20)	(0.13)	(0.03)
$\sum_{h=0}^{3} NM_{i,t-h}$			-3.13***					
			(0.18)					
Accum. Net Mig. pc				-0.23***				
				(0.01)				
RGNI pc			0.18	-0.18	-1.03***	0.33*	0.01	0.03
			(0.13)	(0.13)	(0.11)	(0.20)	(0.15)	(0.04)
GDP Deflator			-1.20***	-2.09***	1.58***	-0.99***	-1.07**	0.12
			(0.47)	(0.45)	(0.30)	(0.34)	(0.52)	(0.12)
REER			0.37	0.67*	-0.92**	0.15	0.84**	-0.17*
			(0.38)	(0.36)	(0.40)	(0.17)	(0.42)	(0.10)
Debt/GNI			0.41**	-0.15	0.00	0.41**	0.67***	0.42***
			(0.16)	(0.16)	(0.08)	(0.17)	(0.19)	(0.04)
Fixed Effects	t	i,t	t	t	t	t	t	t
Number Countries	119	116	101	101	40	101	101	101
Observations	3257	3254	2844	2844	689	2844	3140	2950
Adjusted R^2	0.06	0.76	0.13	0.17	0.31	0.07	0.06	0.03

Note. All estimates are obtained using the baseline sample of non-high income countries, except column 5 which uses high income countries only. All variables are in log except net migration per capita, accumulated net migration per capita, and the dependent variable, net remittances to GNI, which are in percent. In column 4 accumulated net migration per capita is calculated as $\frac{1}{Population_t} \times \sum_{h=0}^{t} Immigration_{t-h} - Emigration_{t-h}$. In the column labeled as "Std." all variables are standardized. In the column labeled as "Remitt. Rec." the dependent variable is remittances received to GNI. Column 7 follows the same logic. Robust standard errors are in parentheses, * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Fact 2: Emigration is counter-cyclical.

Table A.3 reports several robustness checks to the estimated conditional covariance between net migration per capita and RGNI documented in column 3 of Table 1. First, column 1 shows that the estimate is unchanged when other controls are excluded. Second, it shows that when country fixed effects are dropped the relation remains positive but is significantly smaller, illustrating that within-country variation is critical to the relation. Columns 3 and 4 use RGNI per capita and RGDP per capita instead of RGNI to demonstrate robustness to alternative output measures of the business cycle. Column 5 uses standardized regressors to consider the magnitude of the strength of the covariance: A one standard deviation increase in RGNI is associated with a 1 percentage point increase of net migration per capita. Finally, column 6 provides the estimates of the analogous regression in differences (thus eliminating the country fixed effects).

Table A.3: Migration and the Business Cycle

Dep. Var.: NM_{it}	No Controls	Alternative Incomes		Developed	Std.	ΔNM_{it}
	(1)	(2)	(3)	(4)	(5)	(6)
RGNI pc	0.23***			0.57***	0.43***	
	(0.06)			(0.16)	(0.12)	
RGNI		0.19**				
		(0.09)				
RGDP pc			0.26***			
			(0.09)			
GDP Deflator		0.30***	0.26***	0.36**	0.19***	
		(0.09)	(0.09)	(0.16)	(0.06)	
REER		-0.11***	-0.11***	-0.45**	-0.05***	
		(0.04)	(0.04)	(0.20)	(0.02)	
Debt/GNI		0.09***	0.07*	-0.09	0.07**	
		(0.03)	(0.03)	(0.06)	(0.03)	
Δ RGNI pc						3.80***
						(0.38)
Δ GDP Deflator						0.37*
						(0.19)
Δ REER						-0.29***
						(0.10)
Δ Debt/GNI						0.03
						(0.07)
Fixed Effects	i,t	t	i,t	i,t	i,t	t
Number Countries	120	101	101	43	101	101
Observations	4360	3524	3524	784	3524	3460
Adjusted R^2	0.21	0.17	0.17	0.63	0.17	0.02

Note. All estimates are obtained using the baseline sample of non-high income countries, except column 4 which uses high income countries only. All variables are in log except the dependent variable, net migration per capita, which is in percent. Δ indicates the one-period change. In column 5 all variables are standardized. Robust standard errors are in parentheses, * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Fact 3: Emigration increases with the sovereign default risk.

Table A.4 reports several robustness checks to the estimated conditional covariance between net migration per capita and spreads documented in column 5 of Table 1. First, column 1 shows that the estimate increases slightly when other macroeconomic controls are excluded. Column 2, in turn, shows that the association between spreads and migration is also negative in the case of high income countries, as previously documented by Alessandria et al. [2020]. However, the coefficient is less than half of the one estimated for our sample of non-high income countries. Columns 3 to 5 consider 3 alternative measures of the sovereign

default risk. Recall that in the baseline we consider the log of the CDS or EMBI depending on which one has the longest coverage for each country. Here instead we consider (1) the non-logged version of spreads, (2) one in which the CDS is only used when EMBI is not available, and (3) one in which the EMBI is only used when the CDS is not available. Finally, column 6 provides insights to the magnitude of the association by considering the standardized version of all regressors. The association between spreads and net migration is non-negligible: One standard deviation increase increase in spreads is associated with a 0.29 percentage point decrease in net migration.

Table A.4: Migration and Spreads

Dep. Var.: NM_{it}	No controls	No t FEs	Developed	Alternative Spreads		Std.
	(1)	(2)	(3)	(4)	(5)	(6)
Spreads	-0.23***	-0.14***	-0.03			-0.35***
	(0.08)	(0.05)	(0.03)			(0.13)
EMBI if missing				-0.23***		
				(0.07)		
EMBI or CDS					-0.22***	
					(0.08)	
RGNI pc		0.10	0.74***	0.53*	0.62**	1.23**
		(0.07)	(0.28)	(0.29)	(0.31)	(0.57)
GDP Deflator		-0.46**	0.21	-0.43	-0.44	-0.25
		(0.23)	(0.36)	(0.30)	(0.31)	(0.26)
REER		-0.12	-0.25	-0.30	-0.27	-0.23
		(0.21)	(0.38)	(0.25)	(0.26)	(0.15)
Debt/GNI		0.07	-0.45***	0.13	0.14	0.15
		(0.07)	(0.08)	(0.13)	(0.14)	(0.15)
Fixed Effects	i,t	t	i,t	i,t	i,t	i,t
Number Countries	40	40	18	40	40	40
Observations	627	625	277	702	678	625
Adjusted R^2	0.15	0.02	0.74	0.17	0.16	0.16

Note. All estimates are obtained using the baseline sample of non-high income countries, except column 2 which uses high income countries only . All variables are in log except the dependent variable, net migration per capita, which is in percent. The spread measure labeled "EMBI" ("CDS") uses EMBI as the spreads unless only the CDS (EMBI) measure is available. In the column labeled as "Std." all variables are standardized. Robust standard errors are in parentheses, * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Fact 4: Sovereign default risk increases with net remittances.

Table A.5 reports several robustness checks to the estimated conditional covariance between spreads and net remittances to GNI documented in column 5 of Table 1. Column 1 shows that the estimate is unchanged when other macroeconomic controls are excluded. Column 2 illustrates the relation becomes insignificant and changes its sign when considering the sample of high income country. Columns 3 to 5 demonstrate that the estimated association between spreads and remittance is robust to the three alternative definitions of the spread described above. Column 6 shows that the magnitude of the association is non-negligible, at around a third of the association between spreads and debt-to-GNI. Finally, column 7 show that the association is robust to the inclusion of net migration per capita, which consistent with fact 3 is negatively associated with spreads.

Table A.5: Spreads and Remittances

Dep. Var.: S_{it}	No Controls	No i FEs	Developed Countries	Alternative Spreads		Std.	Incl. NM_{it}	ΔS_{it}
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
NR_{it}	0.06***	0.01**	-0.08	0.03**	0.02	0.20**	0.04**	
	(0.02)	(0.01)	(0.07)	(0.01)	(0.01)	(0.10)	(0.02)	
RGNI pc		-0.41***	-2.81***	-0.87***	-0.60***	-1.36***	-0.87***	
		(0.06)	(0.52)	(0.17)	(0.15)	(0.29)	(0.20)	
Debt/GNI		0.46***	0.23	0.62***	0.74***	0.69***	0.71***	
		(0.05)	(0.17)	(0.07)	(0.06)	(0.08)	(0.08)	
REER		-0.55***	0.92	-0.09	0.27*	0.09	0.16	
		(0.18)	(0.76)	(0.17)	(0.16)	(0.09)	(0.21)	
GDP Deflator		-0.85***	-1.99***	-0.41**	-0.45***	-0.11	-0.16	
		(0.20)	(0.72)	(0.18)	(0.17)	(0.15)	(0.21)	
Net Mig. pc							-0.06***	
							(0.02)	
ΔNR_{it}								0.11**
								(0.05)
Δ RGNI pc								-6.40***
								(1.08)
Δ Debt/GNI								-1.06***
								(0.33)
Δ REER								-0.10
								(0.76)
Δ GDP Deflator								-0.49
								(0.82)
Fixed Effects	i,t	t	i,t	i,t	i,t	i,t	i,t	t
Number Countries	39	40	18	39	39	39	39	39
Observations	561	560	273	622	604	559	559	548
Adjusted R^2	0.742	0.360	0.880	0.789	0.777	0.799	0.802	0.205

Note. All estimates are obtained using the baseline sample of non-high income countries, except column 3 which uses high income countries only. All variables are in log except net remittances to GNI, which is in percent. In columns 4 the spreads are measured using EMBI unless only the CDS measure is available, while column 5 considers the opposite case. In the column labeled as "Std." all variables are standardized. Robust standard errors are in parentheses, * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

B VAR Evidence

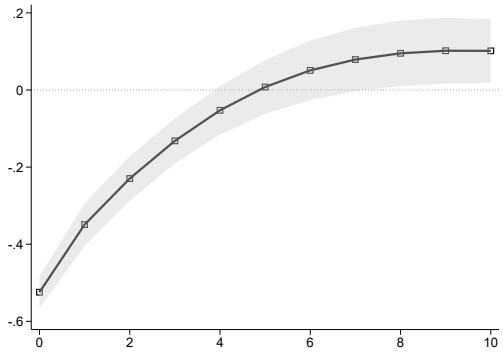
Here we show that the four facts established in Section 2 are also found when considering the impulse response functions to orthogonalized shocks from a 1-lag panel VAR model.[27] To ensure the stability of the model, we exclude the GDP deflator and the REER from the

[27]We use the forward mean-differencing (Helmert) transformation to remove country level fixed effects without serial correlation of the error term.

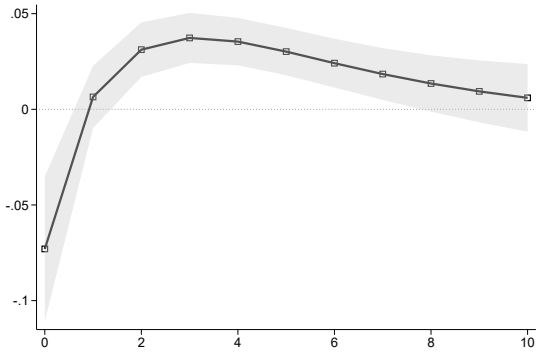
model and include all variables of interest and debt-to-GNI. We order them as follows: First, GNI per capita, then spreads, debt-to-GNI, net migration per capita, and finally net remittances-to-GNI. We de-trend all variables using a HP filter with $\lambda = 100$.[28]

Figure B.1 reports the results. Panel a shows that one standard deviation shock to net migration leads to reduction in net remittances of -0.5 percentage points. This effect persists for around 5 periods. Panel b shows that, while on impact a shock to GNI lowers net migration, perhaps due to a decline in emigration, after the second period net migration increases significantly and remains positive and significant for the next seven periods. Panel c indicates that shocks to spreads are associated with an reductions of net migration, that is, as spreads increase on net emigration increases. Panel d illustrates that an increase in remittances is associated with significant increases in spreads in the following three periods. Panel e also confirms that net remittances respond negatively to GNI shocks, as on net remittances received increase during economic downturns. Finally, panel f reports the autocorrelations of the different shock processes.

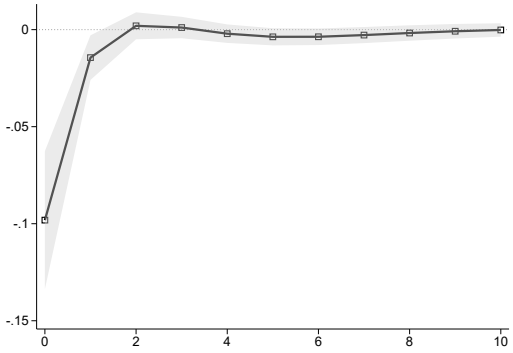
[28]The results reported here are similar if we consider several alternatives. Namely, if we consider the sample of all non-high income countries; if we de-trend with an HP-filtered setting $\lambda = 1,600$ or a cubic polynomial filter; and if we order debt shocks before spread shock or migration and remittances shock preceding spreads and debt shocks. These results are available upon request.



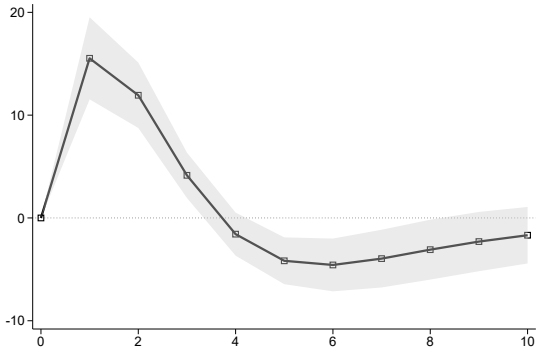
(a) Fact #1: Net Mig. on Net Remitt.



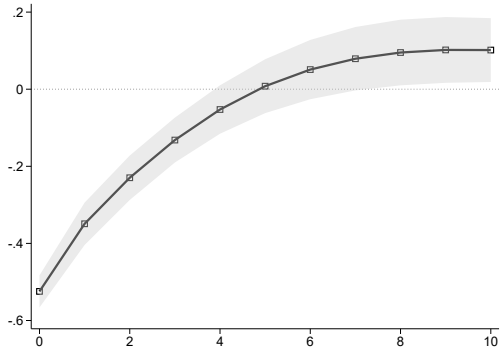
(b) Fact #2: GNI on Net Mig.



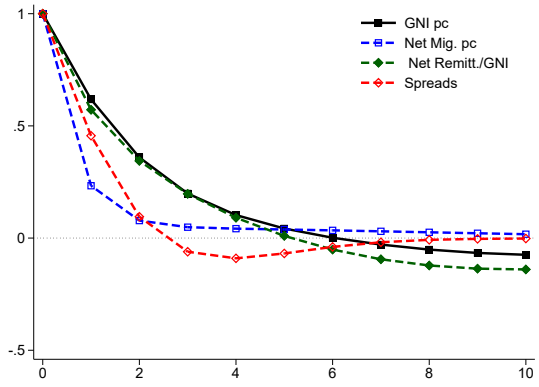
(c) Fact #3: Spread on Net Mig.



(d) Fact #4: Net Remitt. on Spread



(e) GNI on Net Remitt.



(f) Autocorrelations

Figure B.1: IRFs in Estimated VAR Model

Notes: This figure plots the orthgonalized impulse response functions. The first variable in the subtitle is the impulse (shock) variable and the second variable is the response variable, e.g. panel (a) plots the response of net remittances to a one standard deviation shock to net migration pc. The VAR includes GNI per capita, spreads, net migration per capita, net remittances-to-GNI, and debt-to-GNI. The shaded area represents the 68 percent confidence interval.

C Model sensitivity to F and ϕ

To provide some more intuition regarding the parameters specific to our model, namely F and ϕ, we conduct the following comparative analysis: we vary F and ϕ, respectively, while keeping all other parameters constant, and then consider the five targeted moments from Table 3. Table C.1 illustrates how changes in the parameters F and ϕ influence the behavior of GNI volatility, spreads, debt, remittances, and emigration.

The size of remittances F mostly affects the average remittances-to-GNI. As expected higher values of F increase the average remittances-to-GNI. However, F also affects other important moments. For instance, the standard deviation of GNI is decreasing in F, as the lack of volatility of remittances, higher values of F undermine the share of GNI affected by the productivity shocks. F is also negatively related to average spreads and the average debt-to-GNI. This is because the bond schedule of countries with larger remittances is shifted to the left and thus borrow less and at lower rates.

The elasticity of emigration to productivity plays an important role for almost all moments. Most importantly and, as expected, it affects the standard deviation of net migration. It also has an important impact on average remittances-to-GNI. This is explained by the exponential characterization of emigration m. Higher values of ϕ also exacerbate the volatility of GNI, as productivity shocks under high values of ϕ imply larger emigration and larger fluctuations in output. Finally, higher values of ϕ are associated with lower average spreads and lower values of debt, as larger values of ϕ shift the bond schedule to the left and countries hold lower levels of debt in equilibrium, albeit at smaller spread levels.

D Alternative No-Remittances Calibrations

In Section 4 we quantified the no-remittances model by using the same fundamentals as in our benchmark model, with the exception of the foreign income F, set to zero. The main

Table C.1: Changing Values for Parameter F and ϕ

	changing F					changing ϕ				
	2	4	6	8	10	2	4	6	8	10
SD GNI	15.86	14.53	13.73	13.23	13.17	15.40	13.70	13.70	17.44	22.22
Avg spread	5.14	4.86	4.68	4.43	3.44	5.21	4.89	3.43	3.45	2.86
SD spread	4.27	3.95	3.70	3.46	3.02	4.37	3.92	3.04	2.92	3.36
Avg debt-to-GNI	4.95	4.72	4.57	4.37	4.10	4.90	4.59	4.20	3.92	3.67
Avg remittances-to-GNI	1.62	3.01	4.24	5.42	7.24	3.47	4.39	6.68	8.56	10.86
SD net migration	1.32	1.33	1.33	1.31	1.51	0.17	0.54	1.91	4.39	6.81

Note. This table reports the comparative statistics under different values of F and ϕ. All statistics are in percent (%).

advantage of this choice is that it allows us to control for the labor channel, as both in equilibrium and in response to shocks, both models deliver the same net migration. In this section we compare our benchmark model to two alternative versions of economies for which foreign income, F, is zero.

The first alternative no-remittances economy, which we call *same GNI*, considers the same parameter values as our benchmark economy with remittances except that the the average productivity, $\bar{z}$, is set to match the benchmark's equilibrium GNI. Note that we need a higher $\bar{z}$ to match the same GNI due to the lack of remittances contributing to GNI in this economy. While this economy allows us to fix in the two country's gross income to be the same, it no longer implies the same emigration flows as the benchmark. Our second alternative no-remittances economy, labeled *same moments*, recalibrates the parameters listed in Panel b of Table 2, except foreign income, to match the moments in Table 3, except average remittances-to-GNI. The resulting parameter values are reported in Table D.1. To generate the same moments, the no-remittances model requires lower productivity shock volatility (η_z), a smaller default loss parameter (χ_2), and a higher elasticity of emigration to productivity (ϕ). The intuition is as follows: without remittances, the model produces greater GNI volatility since in the limiting distribution foreign income is less volatile than domestic output. Therefore, to match the same GNI volatility, a lower productivity shock volatility (η_z) is required. With smaller productivity shocks, a lower default penalty (χ_2) is necessary to obtain the same spread level, as reduced punishment increases the default

risk and the spread. Finally, lower productivity volatility decreases migration volatility, so a larger elasticity (ϕ) is required to match the volatility of net migration.

Table D.1: Matching Same Moments in Benchmark and No-remittances Model

Parameter	Description	Benchmark	No-Remittances
η_z	Std. productivity shocks	0.081	0.059
χ_1	Default loss	-0.31	-0.31
χ_2	Default loss	0.35	0.34
F	Foreign income	8.3	0
ϕ	Elasticity of emigration	5.6	11.5

Note. This table reports the parameters used in benchmark model and the *same moments, no-remittances* reference model. Both calibrations target the moments listed in Table 3, except for the average remittances-to-GNI which is zero in the no-remittances model.

Next we consider their bond price schedule in comparison to the benchmark model. Figure D.1 plots the schedules of all four calibrations of the model. When the no-remittances model is characterized by the same fundamentals, same GNI (blue dashed line) or same moments (gray dash-dotted line), the bond price schedule shifts further to the right in comparison the no-remittances model presented in the main article. Thus, the spread differential caused by remittances increases even further.

We now turn to the comparison of the response to a negative productivity shocks. Figure D.2 presents the results. First, we discuss the response of the "same GNI" economy. They are plotted with blue dotted lines and labeled as "no-remittances: same fundamental, same GNI" in the figures. Following a negative productivity shock (Panel a), the default rate increases and also the spread. The declines in GNI and consumption are similar to the no-remittances model with same fundamentals (Panels f and h). Note that before the shock, this economy has higher debt-to-GNI (Panel g) due to the fact that this economy has higher equilibrium productivity level (to match the same level of GNI).

Next, we discussion the response of the "same moments" economy. They are plotted with gray dash-dotted lines and are labeled as "no-remittances: same moments" in the figures. The response to a negative productivity shock in the "same moments" no-remittances

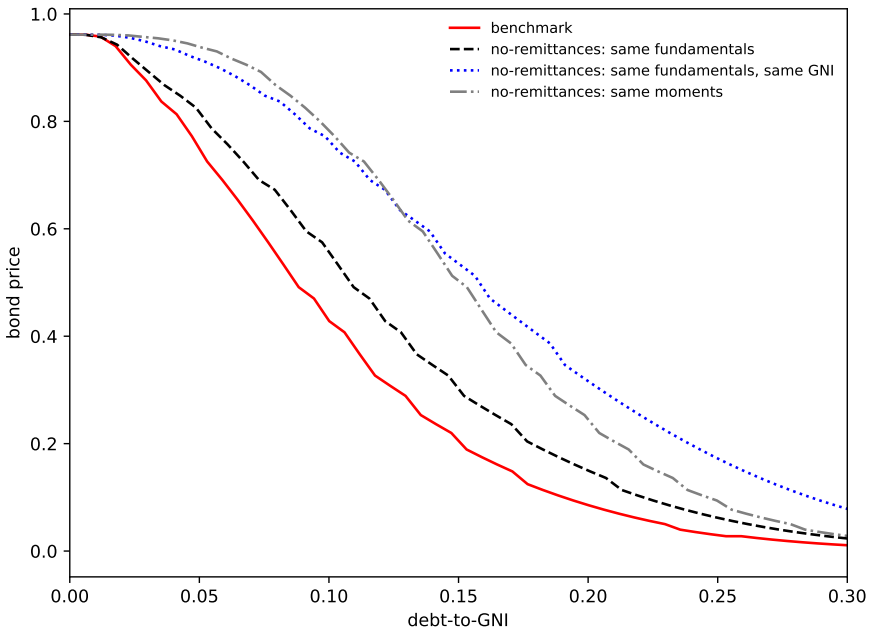
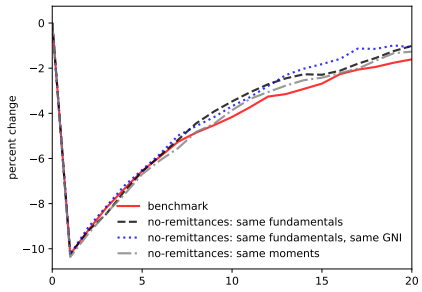


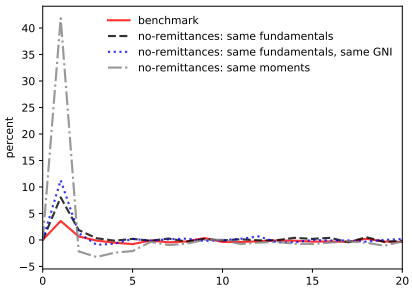
Figure D.1: Bond Price Schedule with Alternative No-Remittances Calibrations

Notes: This figure plots the bond price schedule as a function of debt-to-GNI ratio for the benchmark model with remittances (solid red line) and the three calibrations of the model without remittances.

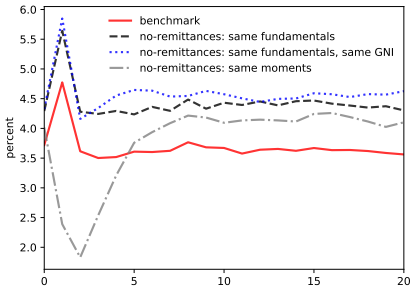
model is markedly different than the no-remittances model with the same fundamentals as our benchmark. The default rate is significantly larger (Panel b). More workers emigrate (Panel d) because of high default rate and the elasticity of emigration to productivity is higher in this recalibrated economy (see higher ϕ in Table D.1). With more emigrants and thus smaller working population, the decline in GNI is larger (Panel f). In terms of spread (Panel c), since the parameters are recalibrated to match equilibrium spread, unlike the "same GNI" no-remittances model, the equilibrium spread before the shock is the same as other models and higher than that in "same GNI" no-remittances model. Following the negative productivity shock, the spread declines because the default rate is very high, meaning that the paths plotted for the spread correspond to selectively better economic conditions. In addition, the debt-to-GNI ratio declines more compared to the no-remittances model with the same fundamentals. With lower debt, the spread also tends to decline. The comparison between the benchmark model and this alternative remittances model is complicated by the fact that, besides remittances, other factors determining sovereign default risk also differ significantly from those in the benchmark model with remittances. In particular, the level of debt is higher at the time of the shock, and the increase in emigration is substantially larger.



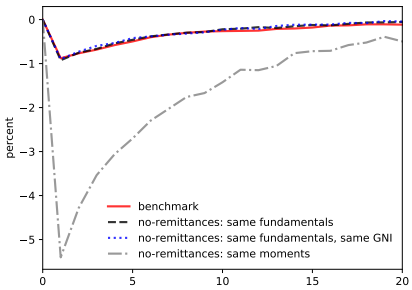
(a) Productivity



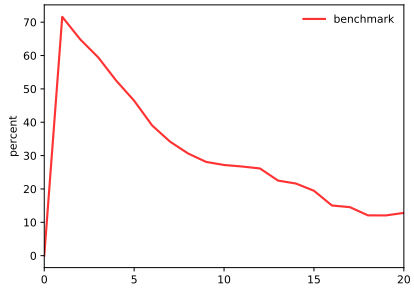
(b) Default rate



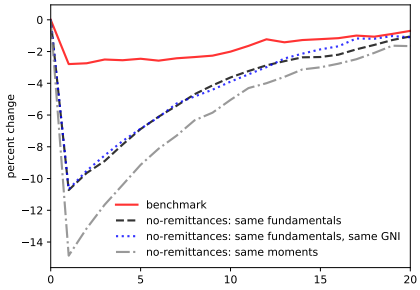
(c) Spread



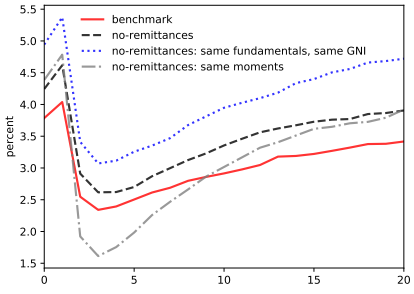
(d) Net migration



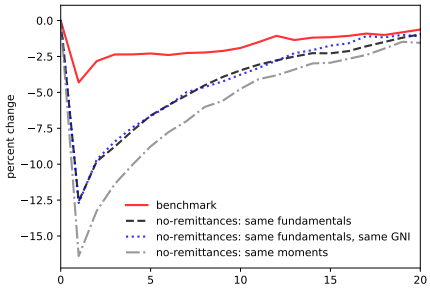
(e) Remittances



(f) GNI



(g) Debt-to-GNI



(h) Consumption

Figure D.2: GIRFs in Benchmark and Alternative No-Remittances Models

Notes: This figure plots the generalized impulse response functions (GIRFs) to a negative productivity shock in the benchmark model (solid lines) and all three no-remittances models. Productivity, remittances, GNI, and consumption are in percent changes; spread and debt-to-GNI are in levels (unit is percent); and the default rate and net migration rate are in percentage point changes.

E Alternative Emigration and Remittances Calibration

In our benchmark calibration emigrants are assumed to work abroad for one period and return at the end of the period. Because of this timing assumption, we consider the observed average annual emigration rate to inform $\bar{m}$ in the model. One concern with this approach, is that if emigrants remain abroad for several periods, the relevant empirical counterpart becomes the stock of nationals living abroad, which is larger than the annual flow. To address this concern, we consider the accumulated net migration measure, i.e. $1/Population_t \times \sum_{h=0}^{t} Immigration_{t-h} - Emigration_{t-h}$, also used in some of the robustness checks of the empirical analysis. The average stock of emigrants per capita is 8.52 percent. We then set $\bar{m}$ to this number and recalibrate the model to match the same moments as in Table 3. The recalibrated parameter values are reported in Table E.1. As expected, the higher value of $\bar{m}$ results in a substantially lower F. To match the same volatility of GNI and net migration, it also results in lower values of the elasticity of emigration (ϕ) and the standard deviation of productivity shocks (η_z).

Nevertheless, Figure E.1 indicates that the quantitative implications of the model are essentially unchanged with respect to the benchmark. The bond price schedule with remittances is well below that of the no-remittances calibration. The main intuition for this result is that what matters in terms of the government's default decision are not per-capita remittances or how many citizen emigrate, but how aggregate remittances, i.e. $\bar{m}F$, respond to the default decision, and this is informed by data moments: average aggregate remittances and the standard deviation of emigration. In other words, a small F and a large $\bar{m}$ affect the bond schedule similarly to a large F and a small $\bar{m}$.

Table E.1: Parameters recalibrated

Parameter	Description	Benchmark	Target accumulated emigration
η_z	Std. productivity shocks	0.081	0.065
χ_1	Default loss	-0.31	-0.31
χ_2	Default loss	0.35	0.37
F	Foreign income	8.3	0.64
ϕ	Elasticity of emigration	5.6	1.2

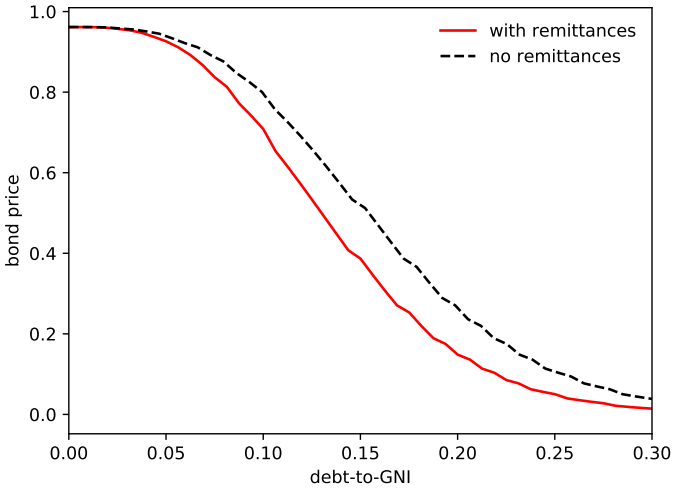


Figure E.1: Bond Price under Recalibration

F Decomposition of Channels

In Section 3.3 we highlight four channels that determine the effect of remittances on the sovereign default risk, namely the labor, endowment, cost, and cushioning channel. In Section 4.2 we evaluate the relative importance of each of these channels by considering various calibrations of the model. Here we describe them in Table F.1. Our main result is that remittances shift the bond schedule leftward in comparison to a model with emigration but without remittances (calibration 1 vs. calibration 2). Thus, the comparison is conditional on the same behavior of labor and separates the effects of remittances from the labor channel studied by Alessandria et al. [2020]. We then argue that the cushioning channel is critical to obtain this result. We do this by illustrating that when we shut off the cushioning channel ($\phi = 0$), which implies that labor is constant, the model with remittances yields virtually the same bond schedule as the model without remittances (calibration 3 vs. calibration 4). Thus, remittances only become relevant to the sovereign default risk due to the counter-cyclical nature of emigration and remittances.

One implication is that, without counter-cyclical emigration, the cost and endowment channels cancel each other out. Here we further investigate this by considering an addi-

tional version of the model in which remittances are also affected the default penalty.[29] We do this by setting the budget constraint during default as $C = z_d(z)L + \frac{z_d(z)}{z}(m_d F)$ instead of $C = z_d(z)L + m_d F$. Again, we consider the case in which labor is constant, i.e. $\phi = 0$. Thus, in this case, the government still receives a steady stream of income from remittances (endowment channel), but this income will be subject to punishment in case of default, shutting down the cost channel.

Table F.1: Model Calibrations Informing the 4 Channels

		Labor	Endowment	Cost	Cushioning
1	Benchmark	yes	yes	yes	yes
2	$F = 0$	yes	no	no	no
3	$\phi = 0$	no	yes	yes	no
4	$\phi = F = 0$	no	no	no	no
5	$\frac{z_d(z)}{z} mF$, $\phi = 0$	no	yes	no	no

First, to assess the role of the endowment channel we can then compare this version to calibration 4, in which there are no remittances. Figure F.1 plots the bond schedule of the two models. As expected, the endowment effect of remittances shifts the bond schedule rightwards (red solid vs. black dashed), consistent with a reduction in the sovereign default risk. Perhaps interestingly, the bond price becomes less elastic to debt, as the difference narrows for higher debt levels. Second, by comparing calibration 3, which includes the cost and endowment channel, to calibration 5, which only includes the endowment channel, we can assess the role of the cost channel. Again, as expected, when remittances are no longer subject to the costs of default, the sovereign default risk increases and the bond schedule shifts to the left (from solid red to dashed-dotted blue). Thus, these two decompositions confirm that the cost and endowment channels nearly cancel each other out, as indicated by the comparison between calibration 3 and 4 (black dashed and blue dashed-dotted lines).

[29] We thank an anonymous referee for highlighting the assessment of the cost channel.

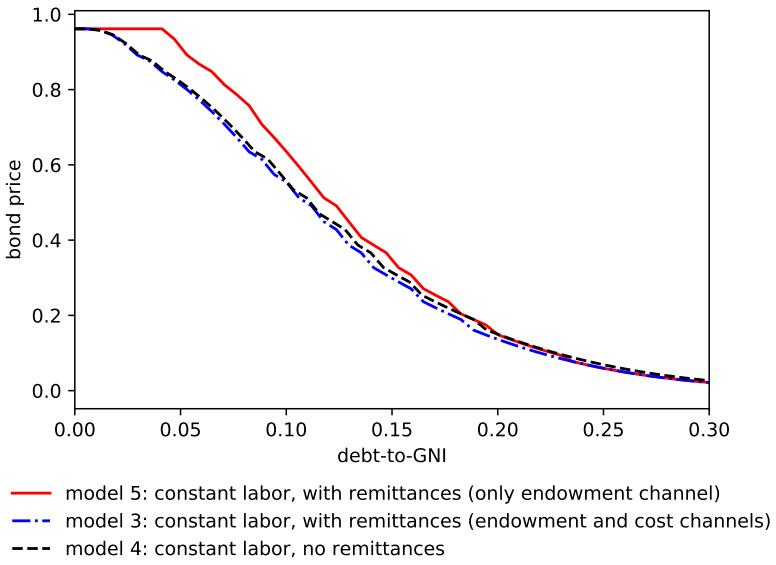


Figure F.1: Decomposing Endowment and Cost Channels

Notes: This figure plots the bond price schedule for a country with median productivity as a function of debt-to-GNI ratio under different reformulations of the benchmark model. Model 3 (blue dash-dotted) considers $\phi = 0$ and thus eliminates the labor and cushioning channel. Model 5 (red solid) also eliminates the cost channel by considering the budget constraint under default as $C = z_d(z)L + \frac{z_d(z)}{z}(m_d F)$. Model 4 (black dashed) eliminates all channels by also setting $F = 0$.

G Additional Tables

Table G.1: Target Moments from the Data by Countries

	Targeted Moments								
	SD	Spreads		Net Mig. pc		Net Rem./GNI		Debt/GNI	In sample
Country	RGNI pc	Avg	SD	Avg	SD	Avg	SD	Avg	"+R,-M"
Afghanistan	11.73			-0.50	4.89	0.32	2.49	14.45	✓
Albania	18.14			-1.19	0.64	11.25	2.56	45.53	✓
Argentina	10.91	12.84	13.05	0.00	0.06	-0.02	0.05	55.49	
Armenia	21.39			-1.12	1.13	11.48	2.81	56.83	✓
Azerbaijan	22.16	3.09	0.79	-0.17	0.32	0.66	1.21	22.27	✓
Bangladesh	9.65			-0.29	0.19	5.31	2.43	26.73	✓
Belarus	16.93	6.34	2.43	0.02	0.09	0.88	0.66	39.04	
Benin	5.37			0.02	0.50	2.30	1.59	43.79	
Bhutan	9.45			-0.25	1.92	-2.47	2.71	63.29	
Bolivia	10.36			-0.20	0.09	1.81	2.05	68.15	✓
Bosnia and Herzegovina	29.75			-0.82	2.11	13.89	4.94	61.53	✓
Botswana	26.61			0.31	0.23	-0.14	1.79	15.27	
Brazil	6.45	3.73	4.83	0.00	0.02	0.18	0.12	29.85	✓
Bulgaria	12.84	1.38	1.02	-0.21	0.11	3.17	2.07	72.82	✓
Burkina Faso	6.94			-0.18	0.17	1.92	1.95	46.35	✓
Burundi	14.46			-0.33	2.65	0.87	0.73	73.79	✓
Cabo Verde	15.50			-0.76	0.61	13.02	4.11	62.28	✓
Cambodia	5.03			0.06	0.71	2.79	3.08	55.10	
Cameroon	18.21			-0.07	0.30	-0.20	0.71	51.61	
Central African Repiblic	9.54			-0.89	0.92	-2.44	0.26	57.44	
Chad	20.03			0.07	1.36	-1.97	0.64	38.57	
China	11.00	0.68	0.35	-0.03	0.02	0.12	0.09	12.11	✓
Colombia	5.60	1.89	1.14	0.00	0.28	1.38	0.82	35.47	✓
Comoros	5.70			-0.37	0.17	6.44	6.39	41.28	✓
Congo, DR	11.22			0.04	0.60	0.67	0.78	104.82	
Costa Rica	7.96	4.72	1.08	0.20	0.14	0.43	0.38	61.91	
Cote d'Ivoire	30.29	14.28	10.39	-0.11	0.42	-3.08	1.68	133.47	
Dominican Republic	8.09	4.81	2.35	-0.33	0.06	7.57	1.71	40.43	✓
Ecuador	7.17	11.73	7.44	-0.08	0.25	2.88	2.41	59.38	✓
Egypt	6.53	3.34	1.82	-0.01	0.06	6.37	2.75	55.44	✓
El Salvador	12.14	4.00	1.40	-1.05	0.43	13.96	7.02	55.53	✓
Eswatini	4.20			-0.59	0.94	3.15	2.12	19.02	✓
Ethiopia	23.58			0.16	0.59	0.63	0.69	58.52	
Fiji	7.14			-1.00	0.49	2.88	2.87	22.99	✓
Gambia	6.67			0.18	0.52	7.02	7.01	71.07	
Georgia	12.16	4.62	2.59	-1.13	1.07	9.29	2.42	68.46	✓
Ghana	21.38	5.94	1.84	-0.12	0.25	1.40	2.04	61.49	✓
Grenada	8.68			-0.75	0.81	3.93	2.49	55.86	✓
Guatemala	6.26	2.50	0.51	-0.37	0.12	6.24	5.52	30.46	✓
Guinea	4.23			-0.22	0.54	0.01	0.70	72.84	✓
Guinea-Bissau	9.24			-0.38	0.46	1.07	4.19	208.35	✓
Haiti	10.11			-0.34	0.04	9.87	5.40	24.64	✓
Honduras	4.83			-0.18	0.11	15.45	6.84	61.12	✓
India	13.24	1.60	0.40	-0.02	0.02	2.20	0.93	20.96	✓
Indonesia	7.09	1.91	0.90	-0.01	0.02	0.66	0.34	55.70	✓
Jamaica	10.13	4.86	1.53	-0.69	0.27	9.76	5.41	106.26	✓
Jordan	14.76	3.95	0.74	1.14	2.54	14.92	3.87	99.56	
Kazakhstan	9.50	1.81	1.23	-0.44	0.97	-1.60	1.23	81.89	
Kenya	9.35			-0.12	0.12	1.76	1.02	53.10	✓
Kyrgyz Republic	14.76			-0.58	0.40	13.50	11.78	97.89	✓
Laos	7.70			-0.31	0.22	0.43	0.45	125.16	✓
Lebanon	17.91	7.19	12.90	-0.08	2.61	6.93	3.98	105.59	✓

Table G.2: Target Moments from the Data by Countries, continued

	Targeted Moments								
	SD	Spreads		Net Mig.pc		Net Rem./GNI		Debt/GNI	In sample
Country	RGNIpc	Avg	SD	Avg	SD	Avg	SD	Avg	"+R,-M"
Lesotho	11.47			-0.52	0.46	46.62	16.46	30.46	✓
Liberia	12.49			-0.20	5.63	4.85	3.14	230.08	✓
Madagascar	9.84			-0.01	0.01	0.96	1.37	66.74	✓
Malawi	8.47			0.05	1.21	0.38	0.65	74.81	
Malaysia	7.45	0.94	0.47	0.47	0.28	-1.87	1.29	53.91	
Mali	4.94			-0.42	0.31	3.02	1.42	67.66	✓
Mauritania	7.27			-0.20	0.44	-1.02	1.25	102.25	
Mauritius	6.11			-0.16	0.10	-0.46	3.17	54.89	
Mexico	8.45	1.36	0.55	-0.33	0.25	2.21	1.22	40.26	✓
Moldova	6.97			-0.99	0.77	16.93	7.00	67.41	✓
Mongolia	17.97	5.20	1.80	-0.18	0.24	1.67	2.20	126.89	✓
Morocco	4.45	3.05	1.67	-0.29	0.12	6.02	0.90	57.32	✓
Mozambique	8.75			-0.23	0.89	0.43	0.82	192.22	✓
Myanmar	31.21			-0.18	0.12	1.77	1.22	116.02	✓
Namibia	9.54	3.10	0.79	0.01	1.05	-0.10	0.17	13.40	
Nepal	10.76			-0.43	0.55	14.40	10.06	33.07	✓
Nicaragua	8.70			-0.56	0.17	11.23	2.31	304.04	✓
Niger	15.16			-0.04	0.06	-0.40	1.35	45.68	
North Macedonia	7.51			-0.32	0.51	2.97	0.90	55.16	✓
Pakistan	6.02	6.18	3.58	-0.15	0.54	5.15	2.41	38.92	✓
Papua NewGuinea	10.85			0.28	0.62	-1.27	1.09	70.44	
Paraguay	9.86			-0.30	0.25	1.44	0.17	56.69	✓
Peru	19.67	1.47	0.73	-0.22	0.37	1.04	0.44	57.89	✓
Philippines	11.86	1.92	1.47	-0.20	0.13	6.71	3.23	46.18	✓
Russia	18.57	2.36	0.98	0.22	0.10	-0.57	0.60	37.49	
Rwanda	24.96			-0.20	6.11	0.04	1.20	45.15	✓
Samoa	4.83			-1.88	0.57	22.49	12.16	79.17	✓
Sao Tome and Principe	6.32			-0.85	0.33	2.66	2.95	154.42	✓
Senegal	6.40	4.77	0.81	-0.31	0.13	3.81	3.37	55.95	✓
Sierra Leone	20.51			-0.22	1.57	1.20	1.39	106.53	✓
Solomon Islands	10.82			-0.25	0.23	-1.59	1.96	34.65	
South Africa	11.46	1.79	0.70	0.11	0.41	-0.39	0.41	30.11	
Sri Lanka	7.29	5.70	3.21	-0.31	0.17	6.80	0.48	59.19	✓
St.Vincent and the Grenadines	6.26			-1.40	0.33	4.30	1.40	36.41	✓
Sudan	18.80			-0.35	0.55	2.31	1.82	89.05	✓
Syria	16.64			-0.46	2.35	0.48	0.26	17.40	✓
Tajikistan	32.86			-0.48	0.51	22.49	8.04	60.41	✓
Tanzania	5.83			-0.12	0.42	0.23	0.33	70.84	✓
Thailand	12.13	0.87	0.47	0.16	0.08	0.95	0.63	43.12	
Togo	9.75			-0.02	1.20	2.97	2.60	102.27	✓
Tonga	4.56			-2.02	0.44	22.19	6.54	35.84	✓
Tunisia	6.54	3.08	2.02	-0.11	0.13	4.36	0.68	65.44	✓
Turkiye	6.90	3.73	2.42	-0.01	0.24	0.15	0.11	43.51	✓
Uganda	6.57			-0.25	0.32	1.70	1.10	47.16	✓
Ukraine	24.93	8.15	5.86	-0.04	0.14	4.58	3.42	62.19	✓
Uzbekistan	9.80			-0.15	0.07	8.55	2.87	25.97	✓
Vietnam	3.40	2.09	0.91	-0.05	0.08	5.32	0.00	88.40	✓
Yemen	32.43			-0.22	0.15	7.88	3.72	37.53	✓
Zambia	20.40	11.91	8.16	-0.11	0.30	-0.19	0.30	148.96	
Average	13.29	4.08	4.75	-0.40	1.39	5.57	7.25	66.31	
United States	4.42			0.43	0.14	-0.25	0.07	67.20	

Note. All variables except Real Gross National Income per capita (column 1) are in percent. Net remittances are defined as remittances received minus remittances paid as percentage of GNI; net migration is immigration minus emigration over total population. The last column, labeled "+R,-M" is 1 when the country is characterized by average positive net remittance and average negative net migration, and 0 otherwise.

Table G.3: Moments with alternative social welfare functions

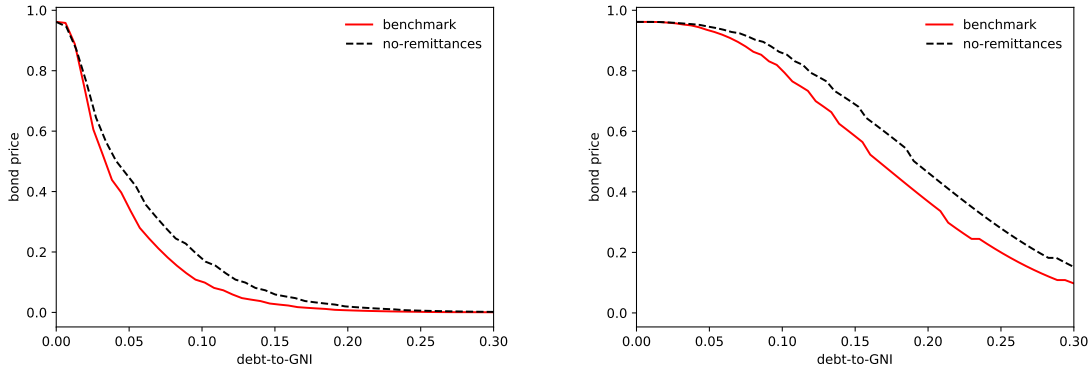
	Benchmark	Average Utility	All Citizen
SD GNI (%)	13.20	13.20	13.20
Avg spread (%)	4.38	4.45	4.47
SD spread (%)	3.40	3.41	3.48
Avg remittances-to-GNI (%)	5.61	5.57	5.59
SD net migration (%)	1.33	1.31	1.33

Note. This table reports the simulated moments for the alternative social welfare functions. "Benchmark" refers to our benchmark model, where the government maximizes the aggregate utility of all staying workers. "Average Utility" refers to an alternative assumption that the government maximizes the average utility of all staying workers. "All Citizen" refers to an alternative assumption that the government maximizes the aggregate utility of all citizen, including both the staying workers and the emigrants.

H Additional Figures

H.1 Different Levels of Productivity

Figure H.1 plots the bond price schedules when we use different levels of productivity instead of the median productivity level. As shown, despite varying productivity levels, the bond price schedules follow a consistent pattern as in Figure 3(a): in the benchmark model with remittances, the government faces lower bond price schedule, i.e., a higher spread for the same level of debt-to-GNI than in the no-remittances model.



(a) Low z (b) High z

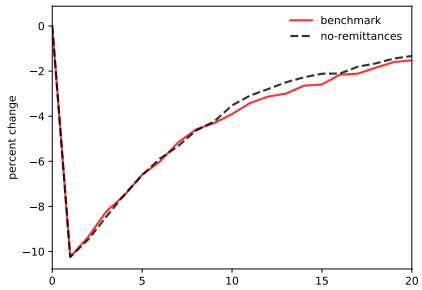
Figure H.1: Bond price schedule for different levels of productivity

Notes: This figure plots the bond price schedule as a function of debt-to-GNI ratio for the model with remittances (solid red lines) and the model without remittances (dashed black lines) with different productivity levels.

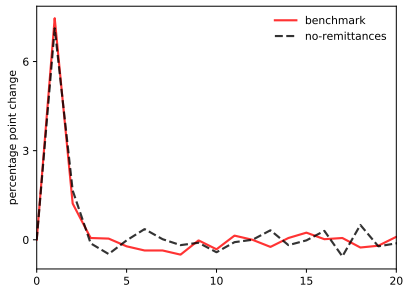
H.2 IRFs in Benchmark and No-remittances under Constant Labor

Figure H.2 plots the impulse response functions to a negative productivity shock in the benchmark model (solid lines) and no-remittances model (dashed black lines) when we have a constant labor force ($\phi = 0$). The method of shutting down remittances here follows the main article, i.e., set foreign income F to 0, while keeping other parameters the same. With constant labor force, remittances do not play a significant role in the responses of the economy. With a negative productivity shock, migration (Panel d) and remittances

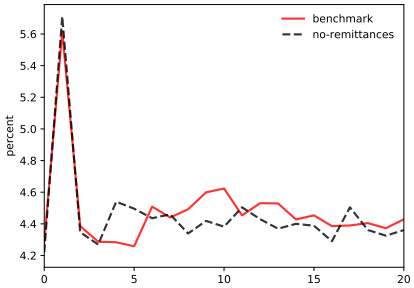
(Panel e) do not change. The default rate (Panel b) and spread (Panel c) increase are of the similar magnitude. The declines in GNI (Panel f), debt-to-GNI (Panel g) and consumption (Panel h) are similar as well. This is consistent with Figure 3(b), which highlights that countercyclical emigration and remittances are key features of the model that allow us to replicate the pattern in the data.



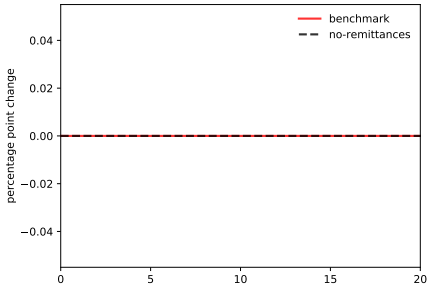
(a) Productivity



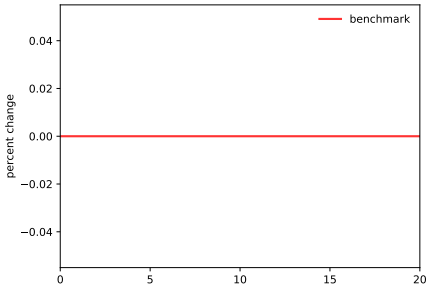
(b) Default rate change



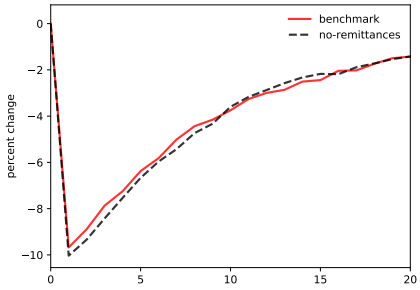
(c) Spread



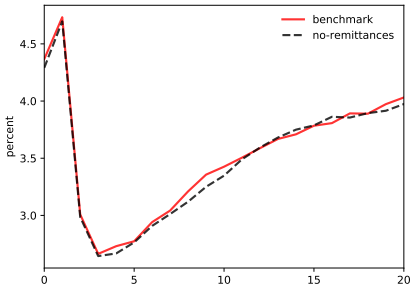
(d) Net migration change



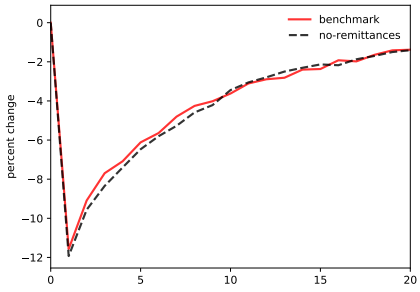
(e) Remittances



(f) GNI



(g) Debt-to-GNI



(h) Consumption

Figure H.2: GIRFs in Benchmark Model and No-Remittances Model under Constant Labor

Notes: This figure plots the generalized impulse response functions (GIRFs) to a negative productivity shock in the benchmark model (solid lines) and no-remittances model (dashed black lines) when labor is constant. Productivity, remittances, GNI, and consumption are in percent changes; spread and debt-to-GNI are in levels (unit is percent); and the default rate and net migration rate are in percentage point changes.

H.3 Model with Emigrant Stock

Figure H.3 plots the bond schedule comparison when we assume an alternative return rate for the emigrants.

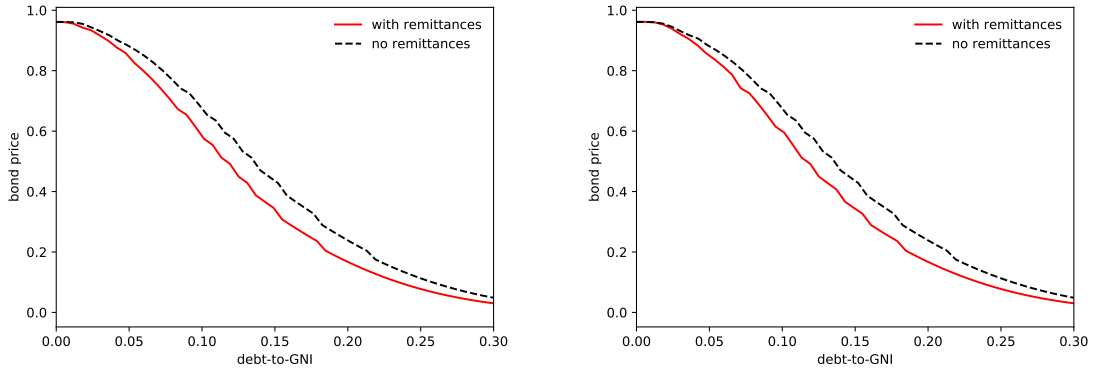


Figure H.3: Bond Price Schedule Comparison for Model with Emigrant Stock

Notes: This figure plots the bond price schedule as a function of debt-to-GNI ratio for the model with remittances (solid red lines) and the model without remittances (dashed black lines) when we include stock of emigrants. Panel (a) uses return rate of emigrants $\gamma = 0.2$ and Panel (b) uses $\gamma = 0.8$.