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

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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 GDP.[1]

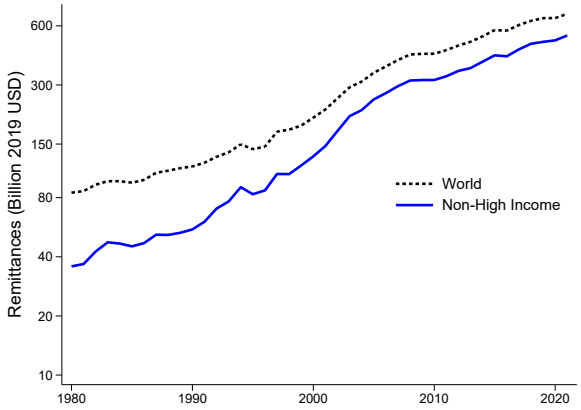


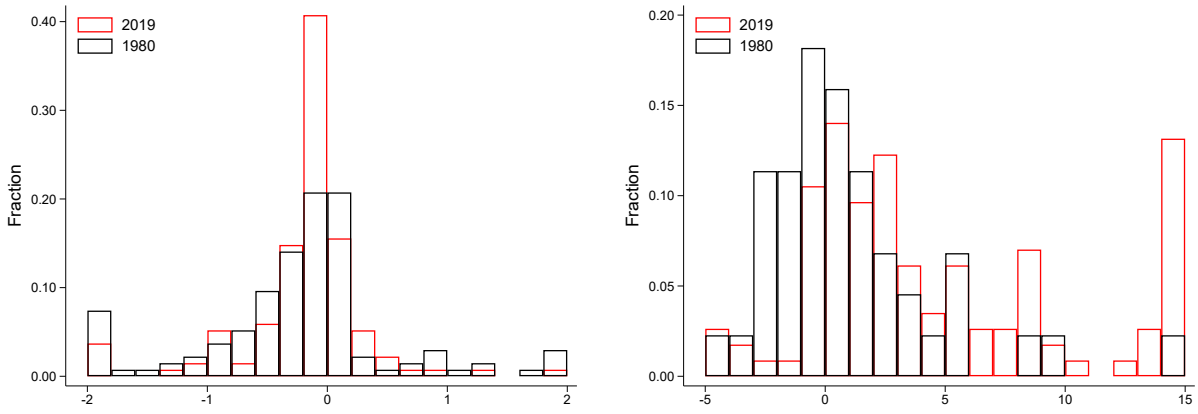

Figure 1: World remittances from 1980–2022

*Notes:* Remittances are measured as the sum of remittances received in billions of 2019 USD by all countries (black dotted line) and non high-income countries (red 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 gov-

[1]This includes, for example, the Dominican Republic, El Salvador, Guatemala, Honduras, Nicaragua, Tajikistan, Kyrgyzstan, Uzbekistan, Moldova, Georgia, Montenegro, Ukraine, and Nepal. Other relatively large economies for which net remittances to GDP are considerable include Albania (9%), Serbia (8%), Croatia (6%), Mexico (3%), Pakistan (7%), the Philippines (9%), Nigeria (5%), Egypt (8%) and Jordan (9%).

ernments with limited commitment strategically default in the advent of a negative shock, all the 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 receive a large fraction of their income in the form of remittances, default decisions encompass a wider range of incentives. In fact, the effect of emigration and 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 and the associated outflow of the working population.




(a) Net Migration per capita

(b) Net Remittances to GDP

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 GDP is defined as remittances received minus remittances paid divided by nominal GDP. 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 emigration, remittances and government default risk. Focusing on developing countries, we find that net remittances increase significantly with emigration, that emigration increases with sovereign default risk, and that sovereign default risk correlates positively with net remit-

tances. While the first two 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 then 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 due to the counter-cyclical nature of emigration and remittances, government internalizes that, by defaulting on its debt, remittances offer a partial compensation for the productivity losses and therefore increase the default value. Thus, remittances lead to increased government bond spreads and lower equilibrium levels of debt. We also test the model's ability to reproduce some untargeted moments of our cross-country panel analysis.

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. 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. On the one hand, remittances offer an increased endowment that increases its ability to repay and lowers the default risk. On the other hand, three channels raise the government's default risk. First, counter-cyclical emigration reduces the labor force in the

[2]All results are similar when we extend the model to include capital and an investment decision. See Section 6 for this model extension.

face of a negative productivity shock, thus amplifying its effect as the country's productive capacity is further reduced. This is the main channel in Alessandria et al. [2020]. Second, the scope of the default penalty in terms of the country's income is effectively smaller, as remittances are unaffected by the available default penalties. Third, in the advent of default, the increase in emigration increases remittances effectively cushioning against the productivity losses of default. Thus, in theory, the effect of remittances on sovereign default risk can go in either direction depending on the 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 net migration was negative and net remittances were positive on average between 1980 and 2021. We then compare our benchmark model with remittances 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 of remittances in the face of productivity losses from default. 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.

Next, we 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 output in the economy without remittances is much larger. This is because output in the benchmark model includes remittances, which rise following the negative productivity shock. The shock increases default risk in both models, but because the decline in output is smaller with remittances, the increase in 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.

At last, 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 with remittances and migration, asymmetric default costs arise endogenously, even when the default penalty is modeled as proportional to output. In good times the default cost is higher than in bad times, since during the former labor supply losses from emigration are relatively costly, and in the latter, remittances cushion against the default penalties. More broadly, when a fraction of a country's income is exempt from the default penalties, and this fraction increases during downturns, the government's incentives to default increase. Thus, our mechanism provides a justification for the commonly assumed asymmetric default costs in the quantitative sovereign default literature, a feature introduced to improve quantitative performance, but rarely grounded in underlying economic behavior.

**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 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 neg-

ative 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, a major source of income for many developing countries, 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 sovereign risk.

Another contribution of our paper to this literature is to highlight a new mechanism justifying 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].[3] 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 emigration, remittances, and sovereign default risk. Section 3 presents our benchmark model. Section 4 lays out 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 extensions of the model 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 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

[3]One exception is Machasio [2016] which documents that remittances increase in the aftermath of default episodes.

default risk either using the Emerging Markets Bond Index (EMBI) spread from the Global Economic Monitor or using the five-year maturity credit default swap (CDS) obtained from Bloomberg, depending on country-level data availability. 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.[4] In addition, some countries are dropped because of insufficient data coverage. Our final set of countries is 101. 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.[5]

**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, measured by the log debt to GNI.[6,7] $D_t$ are year fixed effects that capture global factors

[4] See Table D.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.

[5] 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.

[6] 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.

[7] 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.

such as U.S. GDP and the global finance cycle. Given the relatively small within-country variation in net remittances to GNI over time, $\alpha^{RM}$ is mostly identified off variation in net remittances to GNI across countries.[8] 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 becomes stronger 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.[9] 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 percentage point increase in net migration per capita.

**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. Note that for each country we measure the spread using either EMBI or CDS data depending on which one has the longest coverage over our sample

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

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

period. Thus, we continue to include country fixed effects to account for the differences in spread measures across countries. 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.

**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 to GNI 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 control, alternative measures of the spread, and the inclusion of net migration; and that in terms of magnitude it the association is non-negligible as one standard deviation increase in net remittances to GNI increases the spread by about one third as much as one standard deviation increase in debt to GNI.

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. Robust standard errors are in parentheses, * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

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 the more countries rely on remittances to finance their expenditures. 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.[10] The government borrows state-uncontingent bonds internationally and can default on them with the punishment of lower productivity and exclusion from international markets for some periods. The labor supply $L$ in the economy fluctuates due to emigration. At the beginning of each period, a fraction of workers emigrate, work abroad, and return at the end of the period. While abroad, emigrants send remittances to their home country, which become available within the same period.[11] 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 negative 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

[10] 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.

[11] 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.

$\phi$. Each emigrant sends remittances $F$ back home and returns at the end of the period.[12] 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 $L_t = 1 - m_t = 1 - \bar{m}e^{\phi(\bar{z}/z_t - 1)}$. Workers staying at home country supply one unit of labor inelastically, and receive or pay a lump-sum transfer from or to the government. Workers have a discount factor $\beta$ and a constant relative risk aversion utility function over consumption $c$, $u(c) = \frac{c^{1-\sigma}}{1-\sigma}$, where $\sigma$ is the risk aversion parameter.

The government is benevolent and maximizes the welfare of all residents, given by $\mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t L u(c_t)$. 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 modelled 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 $\lambda$, the country in default regains a 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.

## 3.2 Recursive Formulation

Each period the economy starts with a 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

[12] 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, but also at the per emigrant level [Artal-Tur and Requena-Silvente, 2014]. Since we focus on the sovereign's default problem we abstract from this margin.

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:

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

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 $\lambda$, 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 $m_d = \bar{m} e^{\phi(\bar{z}/z_d - 1)}$ increases relative to no-default due to the productivity loss $z_d$. 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 during sovereign default. These prices depend on the country current productivity shock, $z$, 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 $C(z, B)$ satisfy 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:

$$C + B = zL + mF + Q(z, B')B'.$$

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 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 and financial autarky. Thus, remittances reduce the share of national income 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*. In the next section, we quantify these channels and show that, on net, remittances tend to increase 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.

## 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 $\rho_z$ captures the persistence of the shock, $\eta_z$ determines the shock volatility, and the shock $\varepsilon_t$ 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 labelled "+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 $\sigma$ to 2. The return parameter $\lambda$ 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, $\rho_z$, is set to 0.9, which is similar to the values used in many international real business cycle models. We set the average emigration rate to 0.4% as in the data. Following Alessandria et al. [2020], we set the discount factor $\beta$ to 0.83.[13]

The second group (Panel b) includes five parameters: the standard deviation $\eta_z$ of the productivity process, the default cost parameters $\chi_1$ and $\chi_2$, the foreign income parameter $F$, and parameter $\phi$ that disciplines the elasticity of emigration to productivity. We choose

[13] 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 |
| $\sigma$ | Risk aversion | 2 | Conventional value |
| $\lambda$ | Reentry probability | 0.25 | Gelos et al. [2011] |
| $\rho_z$ | Productivity persistence | 0.90 | Conventional value |
| $\bar{m}$ | Avg net migration | -0.4% | Our sample |
| $\beta$ | Discount factor | 0.83 | Alessandria et al. [2020] |
| *Panel b: Calibrated parameters* | | | |
| $\eta_z$ | SD productivity shocks | 0.081 | SD GNI |
| $\chi_1$ | Default loss | -0.31 | Avg spread |
| $\chi_2$ | Default loss | 0.35 | SD spread |
| $F$ | Foreign income | 8.3 | Avg remittances-to-GNI |
| $\phi$ | Elasticity of emigration | 5.6 | SD net migration |

these parameters to jointly target the following moments: the volatility of (logged) GNI of 13.29%, the average and volatility of spreads of 4.08% and 4.75%, the mean of net remittance-to-GNI ratio of 5.57%, and the volatility 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 average and volatility 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 $F$. Lastly, the volatility of net migration informs the elasticity of emigration of productivity $\phi$. Table 3 presents the moments generated by the model, demonstrating a good fit with the data.

## 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,

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 |

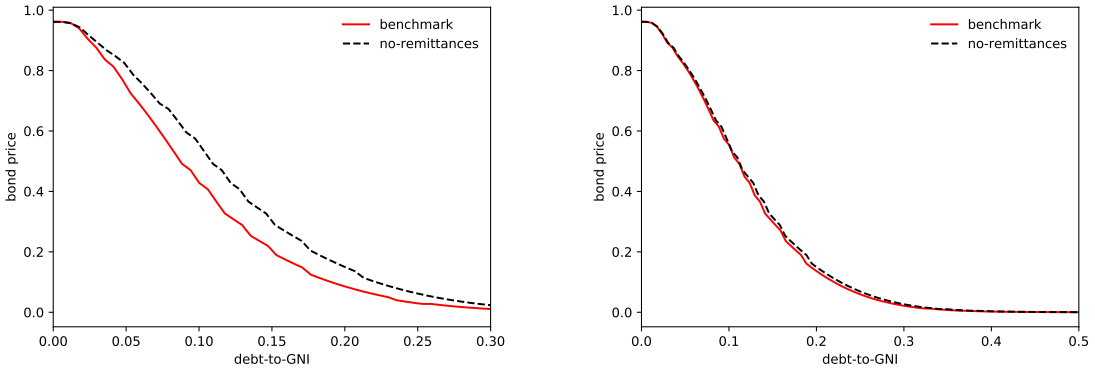
the *no-remittances* model sets all parameters values to be the same as in the benchmark, as reported in Table 2, except setting the foreign income, $F$, to zero.[14] This comparison allows us to isolate the role of remittances and control for the labor channel discussed in section 3.3, since given inelastic 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 $z$. In the benchmark model (solid red line), 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 (dashed black line). 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.

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 ratio, for both models. The

[14] In Appendix C we compare our benchmark economy to two alternative economies without remittances and: (1) the same fundamentals and GNI level, and (2) that matches the same targeted moments.

two schedules are almost identical, indicating that without counter-cyclical emigration the two opposing effects of remittances almost entirely offset each other and deliver the same bond schedule as the standard sovereign default model without migration nor remittances. 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 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 $L = 1 - \bar{m}$.

## 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 impulse response functions (IRFs), 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 IRFs of productivity, remittances, GNI, and consumption in percent changes; the

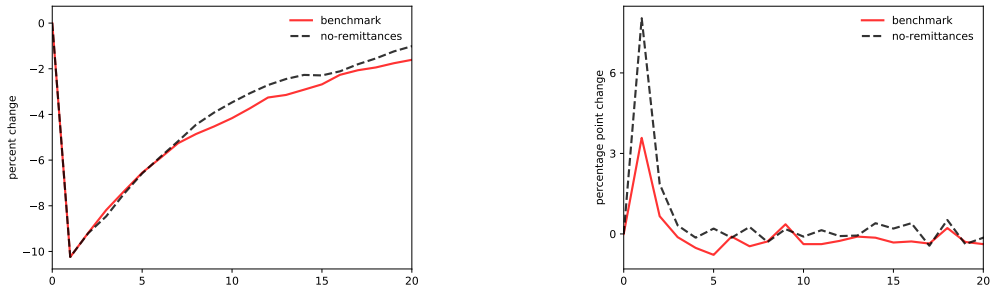
spread and debt-to-GNI in levels (unit is percent); and the default rate and net migration in percentage point changes. The solid red lines are for our benchmark model and the dashed black lines are for the no-remittances model.

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). 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. 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 drop. Note before the shock, the equilibrium level of debt is smaller in the benchmark economy, consistent with the higher spread schedule in Figure 3. 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 GDP in both models due to the decline in the net foreign asset position from the increase in the spreads. The IRFs show that remittances serve as an important buffer against adverse shocks, even though they increase the default risk and bond spread during normal times.

# 5 Cross-sectional Analysis

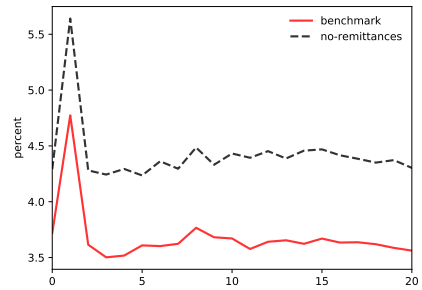
While in the previous section we studied the effect of remittances on sovereign default risk by comparing it to a model without remittances, in this section we examine whether



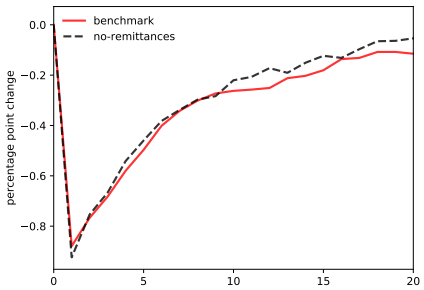

(a) Productivity



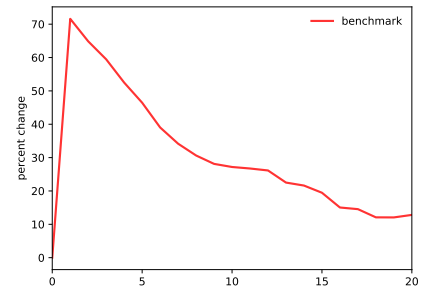

(b) Default rate



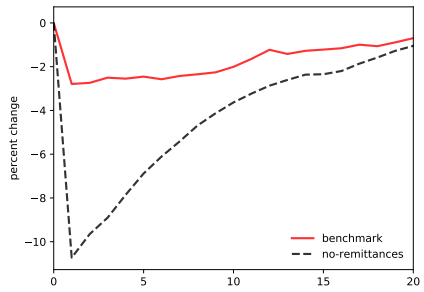

(c) Spread



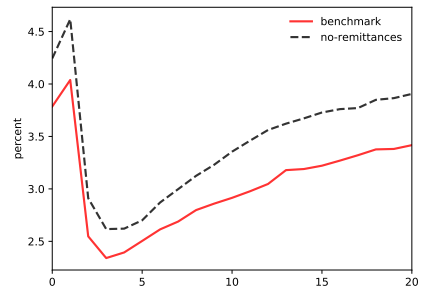

(d) Net migration



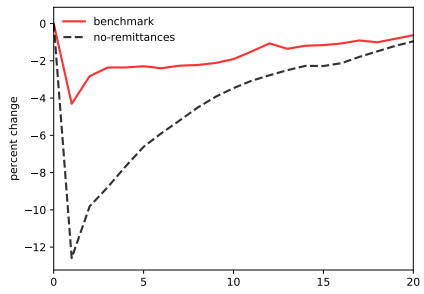

(e) Remittances




(f) GNI




(g) Debt-to-GNI




(h) Consumption

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

*Notes:* This figure plots the impulse response functions 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.

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 $\phi$ 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 D.2 of the Appendix. We then simulate the 73 calibrations of the model to generate a simulated country-year panel that mimics the data and allows us to run analogous four regressions of our empirical analysis, that is controlling the same aggregate variables (except prices and unemployment) and including country fixed effects.

Table 4 reports the result. Column 1 reproduces the four coefficients of interest from the data (column (2)(4)(6)(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 (Fact #3) and between spreads and remittances (Fact #4) are also correctly signed, with the latter being close in magnitude between the model (0.06) and the data (0.04), 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 $F$, $\phi$, and $\bar{m}$ vary across countries and jointly shape the responses of spreads, remittances, and emigration to productivity shocks. Consequently, it is not trivial that economies with higher remittances also exhibit higher spreads, as possibly lower values of $\phi$ 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 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 standard approach of quantitative models of sovereign default is to assume asymmetric default costs in the tradition of Arellano [2008] with a cost ceiling or Chatterjee and Eyigungor [2012] with quadratic costs that 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, maintaining high labor force is more productive than remittances while in bad times income from remittances outweigh those from labor. Thus, default is more costly in the good state than in the bad as is the case with the typically assumed asymmetric default costs.

Table 5 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.[15] 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 5: 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 $z_d(z_t) = z_t - \max\left\{\chi_1 z_t + \chi_2 z_t^2, 0\right\}$ 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.

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

## 6.2 Alternative Government Preferences

We consider two alternative assumptions related to social welfare function. First, the government cares about average utility of the staying workers. Second, the government cares about both, the staying workers and the emigrants. Under the first assumption, 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

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

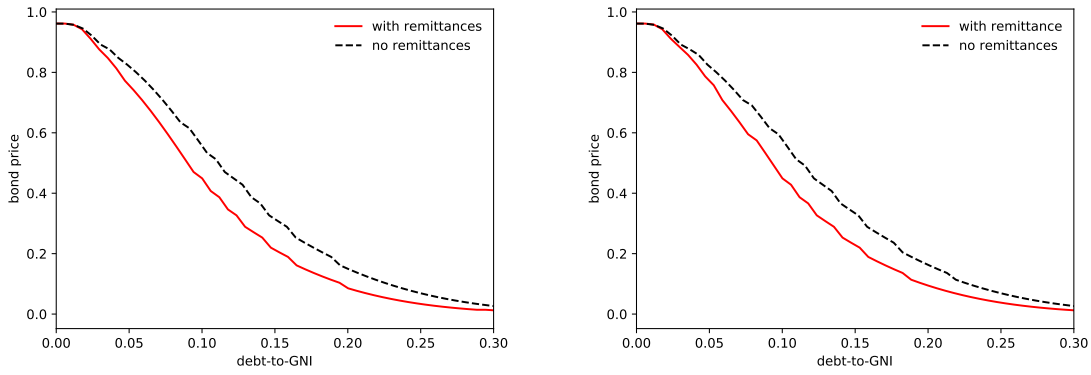
Under the second assumption, the repayment value and the default value of the government are given by:

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

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 resolve the model under those alternative government preferences. Table D.3 reports the moments generated by the models under alternative social welfare function assumptions. With alternative assumptions, the models generate similar moments as in the benchmark. Figure 5 plots the bond price schedules as functions of debt-to-GNI ratios for the model with and without remittances under the alternative assumption that government cares about the average utility of the staying workers (Panel (a)) and alternative assumption that government cares about both staying workers and emigrants (Panel (b)). Consistent with our benchmark model, remittances are associated with lower bond prices, i.e., higher levels of bond spreads.




(a) Average Utility (b) All Citizen

Figure 5: Bond Price Schedule Comparison Under Alternative Government Preferences

*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). Panel (a) assumes that the government cares about the average utility of the staying workers. Panel (b) assumes that government cares about both staying workers and emigrants.

## 6.3 Model with Capital

In this section, we incorporate capital into the model. In particular, 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

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

where $m = \bar{m}e^{\phi(\bar{z}/z_d - 1)}$ increases relative to no-default due to the productivity loss $z_d$. During a default, the country cannot engage in international borrowing or saving. However, it can still self-insure through capital accumulation.[16] 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 $\delta$ to 10% and the capital share $\alpha$ to 0.5, following Alessandria et al. [2020]. We recalibrate the model such that the model generates the targeted data moments as listed in Table 3. Table 6 presents the parameters in this with-capital model. With the recalibrated model, we shut down remittances by setting $F = 0$ and compare the bond price schedules. Figure 6 plots the bond price schedules for the model with remittances and the model without remittances. It indicates that the inclusion of capital into the model does not change our baseline results.

Table 6: Matching Same Moments in Benchmark and Model with Capital

| Parameter | Description | Benchmark | With Capital |
|---|---|---|---|
| $\eta_z$ | Std. productivity shocks | 0.081 | 0.044 |
| $\chi_1$ | Default loss | -0.31 | -0.31 |
| $\chi_2$ | Default loss | 0.35 | 0.34 |
| $F$ | Foreign income | 8.3 | 13 |
| $\phi$ | Elasticity of emigration | 5.6 | 11.5 |

[16] Note that this formulation implicitly assumes that remittances are used for consumption and investment at the same rate as income from production. 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.

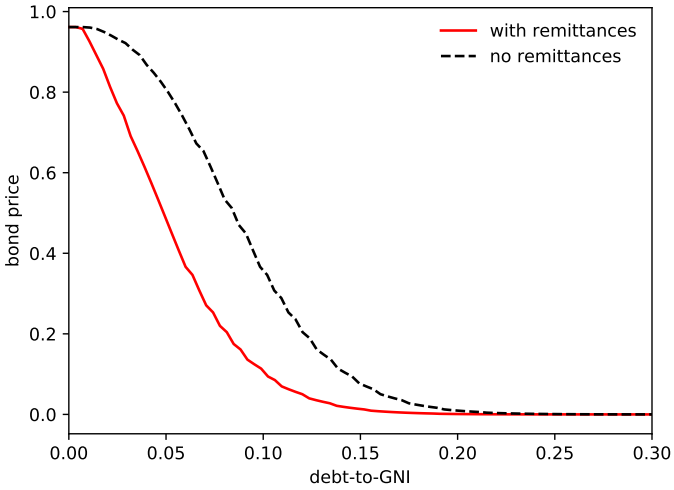



Figure 6: Bond Price Schedule Comparison for Model with Capital

*Notes:* This figure plots the bond price schedule 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.

## 6.4 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 some emigrants stay abroad and keep sending remittances back. Denote a fraction $\gamma$ 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. Denote the last period labor as $L_{-1}$. If the government repays its debt, it issues new bonds, $B'$, by solving the following dynamic programming problem:

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

subject to the budget constraint:

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

and the law of motion for labor:

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

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 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:

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

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

where emigration $m_d = \bar{m}e^{\phi(\bar{z}/z_d - 1)}$ increases relative to no-default due to the productivity loss $z_d$. 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 $\gamma = 0.5$. Then we recalibrate the model such that the model generates the targeted data moments as listed in Table 3. Table 7 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. Appendix E provides results when we set alternative values for $\gamma$, the same pattern holds.

Table 7: Matching Same Moments in Benchmark and Model with Emigrant Stock

| Parameter | Description | Benchmark | With Emigrant Stock |
|---|---|---|---|
| $\eta_z$ | Std. productivity shocks | 0.081 | 0.081 |
| $\chi_1$ | Default loss | -0.31 | -0.31 |
| $\chi_2$ | Default loss | 0.35 | 0.36 |
| $F$ | Foreign income | 8.3 | 5.2 |
| $\phi$ | Elasticity of emigration | 5.6 | 5.6 |

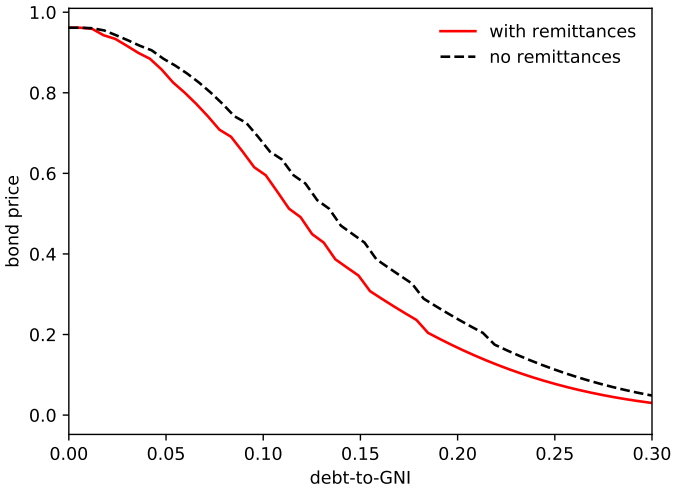



Figure 7: Bond Price Schedule Comparison for Model with Emigrant Stock

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

# 7 Conclusions

Spurred by rising international migration, in the last three decades, remittances received have become an important fraction of many developing country's national 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 thus 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. Our paper also provides a microfoundation for the commonly assumed asymmetric default costs in the quantitative sovereign default literature.

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. 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 $\phi$ 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, a promising avenue for future research is to explore policies that could mitigate the higher borrowing costs associated with remittance inflows.

# 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.

### Unified framework with remittances, migration, output, and spreads

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

| Dep. Var.: | Net Remitt./GNI | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Sample: | Baseline | +R,-M | Baseline | +R,-M | Baseline | +R,-M | Baseline | +R,-M |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (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*** | -1.33*** | -1.84*** | -0.97 | -2.72*** | -1.04* | -2.75*** |
| | (0.37) | (0.42) | (0.28) | (0.29) | (0.60) | (0.73) | (0.60) | (0.72) |
| Spreads | 0.50* | 0.50 | 0.66*** | 1.00*** | 0.32** | 0.37** | 0.22* | 0.32* |
| | (0.28) | (0.33) | (0.21) | (0.23) | (0.13) | (0.17) | (0.13) | (0.16) |
| Cum. Net Mig. pc | | | -22.93*** | -25.61*** | | | -10.79*** | -8.69** |
| | | | (1.22) | (1.23) | | | (2.70) | (3.37) |
| GDP deflator | -3.63*** | -2.66** | -3.11*** | -2.29** | -0.36 | 1.32 | -0.17 | 1.28 |
| | (1.29) | (1.34) | (1.00) | (0.93) | (0.61) | (0.83) | (0.60) | (0.83) |
| REER | 6.23*** | 3.92*** | 6.31*** | 3.51*** | -0.67 | -1.15 | -0.80 | -1.11 |
| | (1.15) | (1.22) | (0.89) | (0.85) | (0.61) | (0.87) | (0.60) | (0.86) |
| Debt/GNI | 1.61*** | 2.83*** | 0.49* | 0.80*** | 0.20 | 1.44*** | 0.43* | 1.49*** |
| | (0.35) | (0.40) | (0.28) | (0.30) | (0.24) | (0.34) | (0.25) | (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 and the dependent variable, net remittances to GNI. 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 $\alpha^{RM}$ 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) | (0.12) | | (0.13) | (0.20) | (0.13) | (0.03) |
| $\sum_{h=0}^{3} NM_{i,t-h}$ | | | -3.13*** | | | | | |
| | | | (0.18) | | | | | |
| Cumulative $NM_{it}$ | | | | -15.68*** | | | | |
| | | | | (0.72) | | | | |
| RGNI pc | | | 0.18 | -0.31** | -1.03*** | 0.33* | 0.01 | 0.03 |
| | | | (0.20) | (0.13) | (0.13) | (0.11) | (0.15) | (0.04) |
| GDP Deflator | | | -1.20*** | -2.10*** | 1.58*** | -0.99*** | -1.07** | 0.12 |
| | | | (0.47) | (0.46) | (0.30) | (0.34) | (0.52) | (0.12) |
| REER | | | 0.37 | 0.42 | -0.92** | 0.15 | 0.84** | -0.17* |
| | | | (0.17) | (0.38) | (0.37) | (0.40) | (0.42) | (0.10) |
| Debt/GNI | | | 0.41** | 0.06 | 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 and the dependent variable, net remittances to GNI. 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. | $\Delta NM_{it}$ |
|---|---|---|---|---|---|---|
| | (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 net migration per capita. 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-negligibel: 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 useshigh income countries only . All variables are in log except net migration per capita and spreads in column 3, as indicated by the non-logged in parenthesis. 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

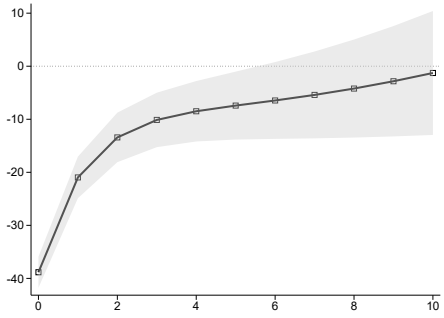
| Dep. Var.: $S_{it}$ | No Controls | No $i$ FEs | Developed Countries | Alternative Spreads | | Std. | Incl. $NM_{it}$ | $\Delta S_{it}$ |
|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| $NR_{it}$ | 0.06*** | 0.01** | -0.08 | 0.03** | 0.02 | 0.20** | 0.04** | |
| | (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) | |
| $\Delta NR_{it}$ | | | | | | | | 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 2 which uses y high income countriesonl. All variables are in log except net remittances to GNI, net migration per capita, and spreads in column 3, as indicated by the non-logged in parenthesis. 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, * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

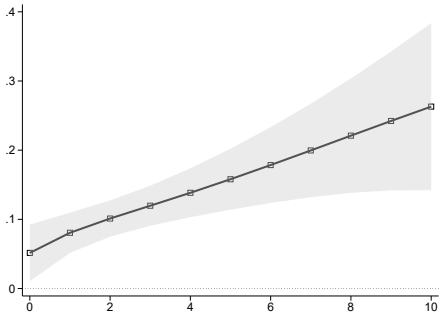
# B VAR Evidence

Here we provide further evidence of the four facts established in section 2 by considering the responses to orthogonalized shocks from a panel VAR model that includes all variables of interest. Precisely, we estimate a panel VAR model of our baseline sample including GNI per capita, spreads, net migration per capita, net remittances-to-GNI, and debt-to-GNI. We

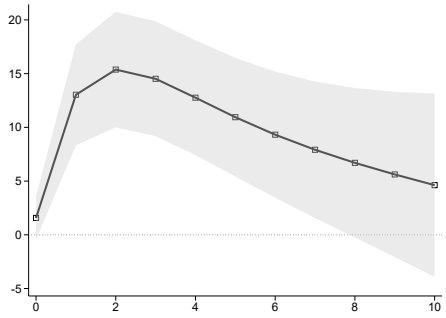
de-trend all variables using an HP-filter for which we set $\lambda = 1,600$.[17]



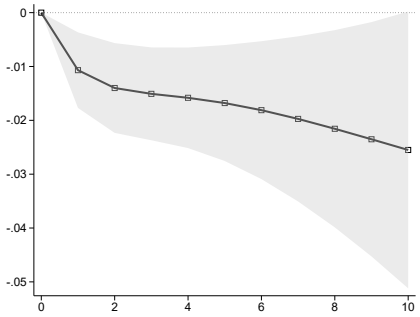

(a) GNI Shock on Spread



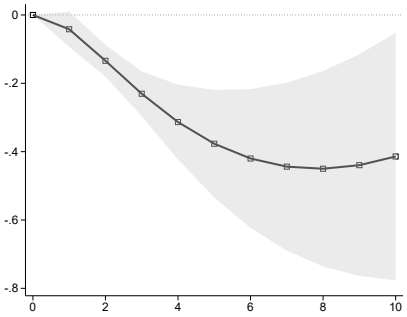

(b) GNI Shock on Net Mig. pc




(c) Net Remitt./GNI Shock on Spread




(d) Spread Shock on Net Mig. pc




(e) Net Mig. pc Shock on Net Remitt./GNI

Figure B.1: IRFs in Estimated VAR Model

# C 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

[17] Results are similar if we use a cubic or linear trend, include all countries, and consider a model that also includes the exchange rate and inflation.

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 C.1. To generate the same moments, the no-remittances model requires lower productivity shock volatility ($\eta_z$), a smaller default loss parameter ($\chi_2$), and a higher elasticity of emigration to productivity ($\phi$). 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 ($\eta_z$) is required. With smaller productivity shocks, a lower default penalty ($\chi_2$) 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 ($\phi$) is required to match the volatility of net migration.

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

| Parameter | Description | Benchmark | No-Remittances |
|---|---|---|---|
| $\eta_z$ | Std. productivity shocks | 0.081 | 0.059 |
| $\chi_1$ | Default loss | -0.31 | -0.31 |
| $\chi_2$ | Default loss | 0.35 | 0.34 |
| $F$ | Foreign income | 8.3 | 0 |
| $\phi$ | 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 C.1 plots the schedules of all four calibrations of the model. When the no-remittances model is characterized by the same fundamentals and same GNI as the benchmark economy, 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. The reason is that although both economies have the same income, the default penalty is effectively smaller in the economy with remittances, inducing lenders to require a higher spread at each level of debt. In the case of the "same moments" no remittances economy, the effect of remittances on the spread becomes ambiguous. At low levels of debt-to-GNI the spread is higher, while at high levels of debt-to-GNI the spread with remittances is smaller. This may be explained by the additional differences in parameter values other than $F$: A smaller productivity shock volatility ($\eta_z$) decreases the sovereign default risk, while a slightly smaller default loss ($\chi_2$) a substantially larger elasticity of emigration ($\phi$) increase the sovereign default risk.

We now turn to the comparison of the response to a negative productivity shocks. Figure C.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 increase in default rate is significantly larger as it goes from around 15 to around 35 percent. This translates into an observed reduction in spreads – as observing spreads is conditional on

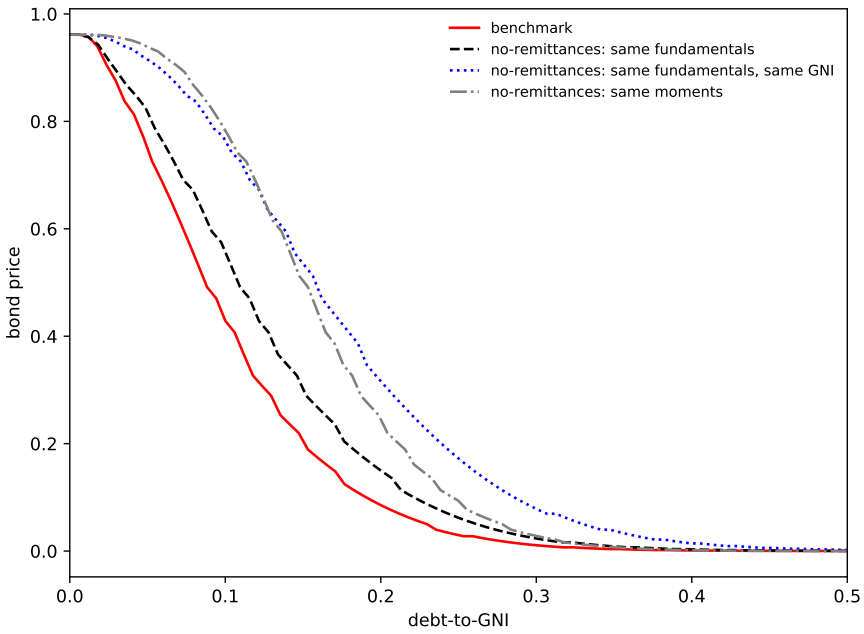
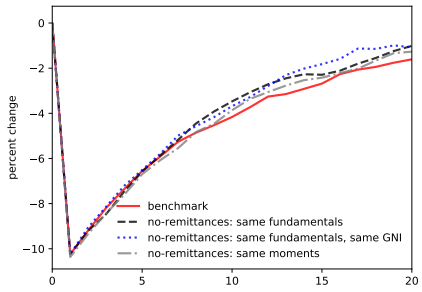



Figure C.1: Bond Price Schedule with Alternative No-Remittances Calibrations

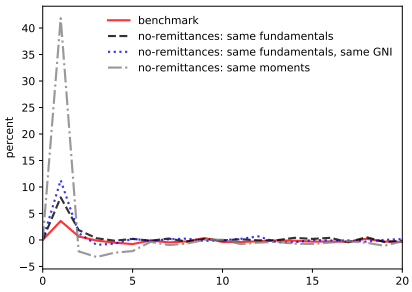
*Notes:* This figure plots the bond price schedule as a function of debt-to-GNI ratio for the benchmark model with remittances (solid red line) and the three calibrations of the model without remittances.

no default, and those simulations of the "same GNI" economy that didn't default have relatively high productivity at the time of the shock. Also, as shown in Panel g, the decline in the debt-to-GNI ratio is large, contributing to a lower spread in response. The decline in GNI is also larger than the no-remittances model with same fundamentals. This is because with higher default rate, the effective productivity is lower, leading to lower GNI (Panel f) and lower consumption (Panel h). Note that before the shock, this economy has lower equilibrium spread (Panel c) and 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).

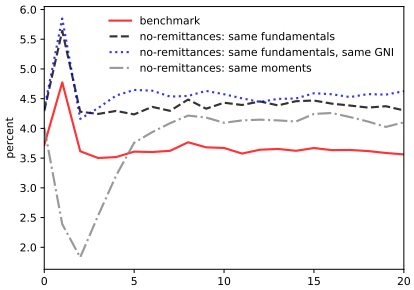
Next, we discussion the response of the "same moments" economy. They are plotted with gray dash-dotted lines and are labeled as "no-remittances: same moments" in the figures. The response to a negative productivity shock in the "same moments" no-remittances model is again markedly different than the no-remittances model with the same fundamentals as our benchmark. Similar to the case of the "same GNI" no-remittances model, the default rate is significantly larger. However, more workers emigrate (Panel d) because the elasticity of emigration to productivity is higher in this recalibrated economy (see higher $\phi$ in Table C.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.



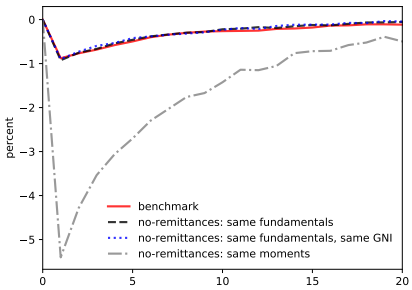

(a) Productivity



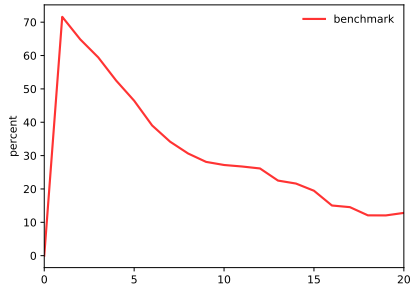

(b) Default rate



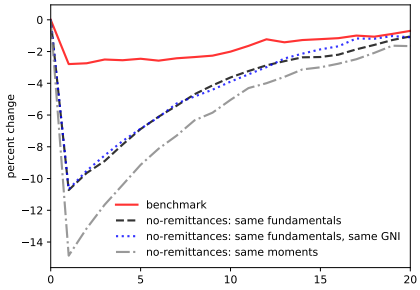

(c) Spread



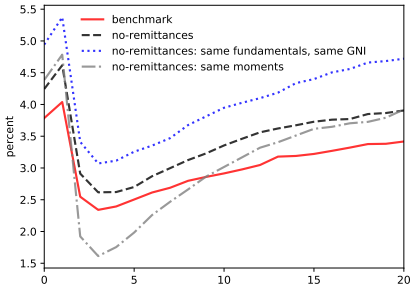

(d) Net migration



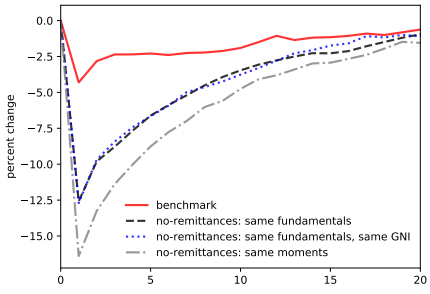

(e) Remittances




(f) GNI




(g) Debt-to-GNI




(h) Consumption

Figure C.2: IRFs in Benchmark and Alternative No-Remittances Models

*Notes:* This figure plots the impulse response functions 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.

# D Additional Tables

Table D.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 | 1 |
| Lebanon | 17.91 | 7.19 | 12.90 | -0.08 | 2.61 | 6.93 | 3.98 | 105.59 | 1 |

Table D.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 +R,-M | 11.65 | 3.93 | 2.39 | -0.40 | 0.68 | 6.07 | 2.97 | 67.67 | 73 |
| Total +R,-M | 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.

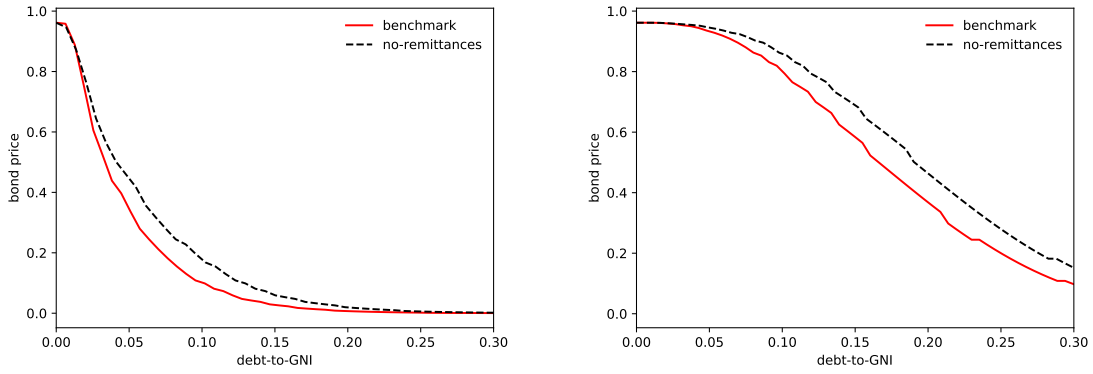
Table D.3: Moments with alternative social welfare functions

| | 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.

# E Additional Figures

Figure E.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.

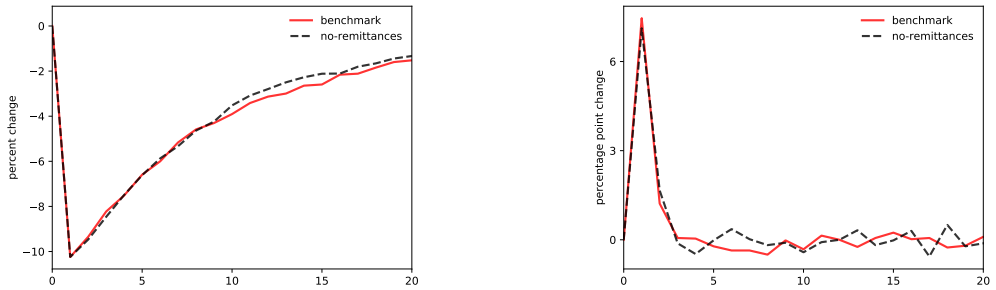



(a) Low $z$ (b) High $z$

Figure E.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.

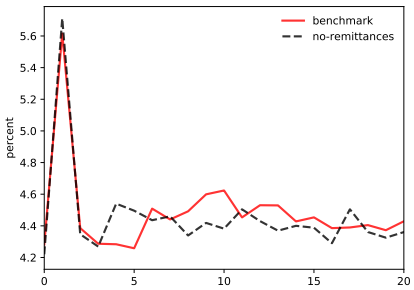
Figure E.2 plots the impulse response functions to a negative productivity shock in the benchmark model (solid lines) and no-remittances model (dashed black lines) when we have a constant labor force ($\phi = 0$). The method of shutting down remittances here follows the main article, i.e., set foreign 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.



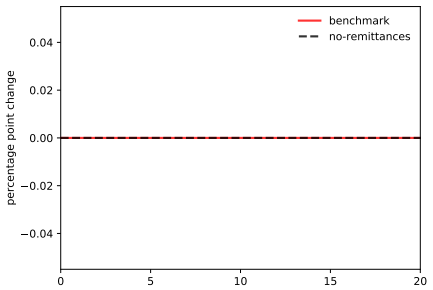

(a) Productivity



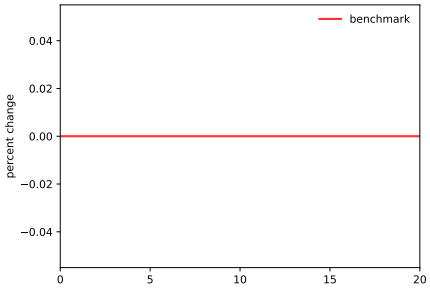

(b) Default rate change



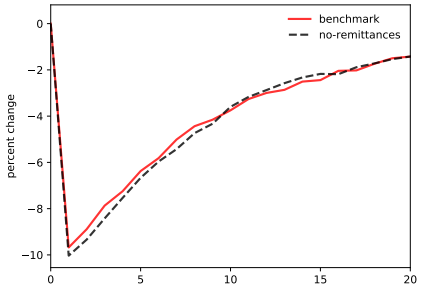

(c) Spread



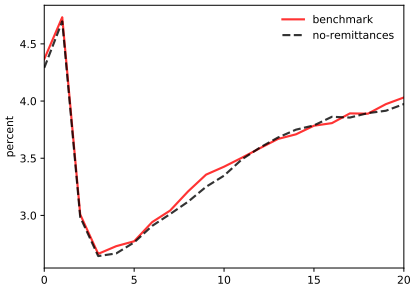

(d) Net migration change



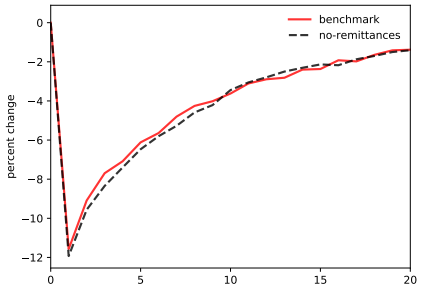

(e) Remittances




(f) GNI




(g) Debt-to-GNI




(h) Consumption

Figure E.2: IRFs in Benchmark Model and No-Remittances Model under Constant Labor

*Notes:* This figure plots the impulse response functions 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.

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

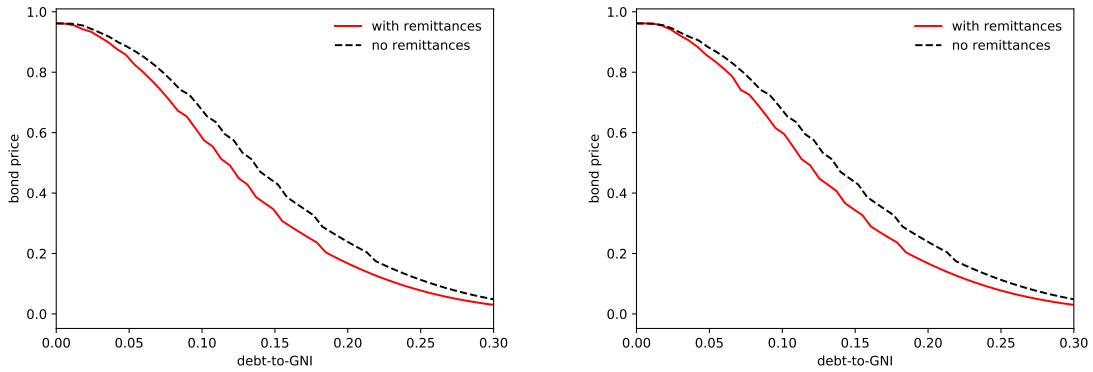



Figure E.3: Bond Price Schedule Comparison for Model with Emigrant Stock

*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 $\gamma = 0.8$.