Your Cheque is in the Mail: Remittances and Macroeconomic Fluctuations in Honduras

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Abstract

Using data for Honduras from 1974 to 2016, this paper develops and estimates a Real Business Cycle (RBC) model with financial frictions to analyze the effects of remittances on macroeconomic fluctuations in Honduras. The results are consistent with the business cycle stylized facts: remittances are highly volatile, consumption is more volatile than output, and investment is more volatile than consumption and output. The growth rate of output is positively correlated with the growth rate of remittances, while the change in trade balance-to-output ratio is negatively correlated with the growth rate of remittances. I report the relative role of each structural shock in explaining macroeconomic fluctuations: remittance shocks, a shock to world interest rates, shocks to total factor productivity and to stochastic trend productivity. Remittances account for 44.10% of volatility in consumption growth, 27.14% of the volatility in the change in trade balance-to-output ratio, and 15.34% of volatility in investment growth.

Keywords: remittances, business cycle, financial frictions, shocks, Honduras

1. Introduction

Foreign workers contribute to poverty reduction in their country of origin by sending money (remittances) home to their family members. According to the World Bank, worldwide remittances to low and middle-income countries reached approximately US$441 billion in 2015, a figure three times the volume of official aid flows. These inflows constitute more than 10 percent of GDP in certain developing countries. For example, remittances to Honduras accounted for 18.8% of its GDP in 2017. Honduras is a country with high incidence of poverty and it is subject to frequent natural calamities such as hurricanes and droughts. More than 64.5% of the Honduran population was living in poverty in 2017. Remittances can help to increase the standard of living of the families that receive them. Yet, remittances do not necessarily lead to economic growth. They may reduce employment and introduce a culture of dependency, inhibiting economic growth.

My study builds on research by Neumeyer and Perri (2005), Uribe and Yue (2006), García-*Cicco et al.* (2010) and Chang & Fernández (2013), who have highlighted the role of both interest rates and stochastic trend productivity shocks in explaining business cycles in emerging economies. In this paper, I augment their models by incorporating a transfer of wealth (remittances) to explain the role of remittances on the Honduran business cycle.

While foreign aid requires the coordination of government agencies from many countries, remittances do not face that same constraint. The Honduran government would have discretion over how to spend foreign aid. For these reasons, remittances can be an appealing alternative; they can move directly to the families of the workers who send them. If a government is highly ineffective, remittances might have a higher impact on poverty reduction than foreign aid at the

same level of funding. On the other hand, well-designed spending programs using foreign aid can take advantage of economies of scale and subsidize goods with positive externalities.

Remittances represent a flow of financial resources to a country, and affect the macroeconomic activity through various channels, such as investment and consumption. These effects can be particularly significant if remittances are large compared to the size of the economy and other financial flows. Using Honduran data from 1974 to 2016, I analyse how remittances affect macroeconomic aggregates (output, consumption, investment, and trade balance) over the business cycle. Through Real Business Cycle (RBC) models, it is possible to analyse the macroeconomic effect of remittances, because the model teases out the economic impact of worker remittances to GDP per capita from other factors that affect the economy.

RBC theory sees business cycle fluctuations as the response to exogenous shocks in the real economic environment (Kydland & Prescott, 1982). Through RBC models, it is possible to study how real shocks to the economy might affect the decisions of individuals and firms, who in turn change what they buy and produce and thus eventually affect output. The RBC model is often used when analyzing the implications of capital inflows, such as remittances, in a country's economic fluctuations. That is because the model can predict how agents respond to remittance shocks, in terms of consumption, employment, and investment decisions. The model assumes that individuals decide how to allocate their income between savings and consumption, and they choose how to allocate their time between leisure and labour. I augment this model by incorporating a transfer of wealth (remittances) from abroad.

Moreover, I also include stochastic trend productivity shocks and a random world interest rate that interacts with financial frictions. Recent research on macroeconomic fluctuations in emerging economies has resulted in two leading approaches which I combine in this model. The

first approach, used in Aguiar & Gopinath (2007), argues that stochastic trend productivity shocks explain business cycles in emerging markets because these shocks capture frequent changes in economic policies, which are common in emerging countries.

In this model, I also include world interest rates that interact with financial frictions to capture the effect of remittances. In this respect, I build on the other approach in RBC modelling that shows that financial frictions are better suited to capture the different dynamics in business cycles. Financial frictions arise out of asymmetric information on the part of lenders and enforcement of contracts in international financial markets. The risk international lenders face depends on the country's level of indebtedness and its repayment capacity. In that sense, remittances boost the repayment capacity of Honduras because they are an additional source of income. In developing countries, where credit markets are not well developed, and recipients have limited access to such markets, these capital inflows are particularly important. Moreover, remittances also increase the availability of foreign exchange, which allows borrowing countries to repay international loans denominated in foreign currency.

My results are consistent with the business cycle stylized facts: remittances are highly volatile, consumption is more volatile than output, and investment is more volatile than consumption and output. Furthermore, remittance shocks play an important role in explaining volatility in consumption growth (44.10%). They also account for 27.14% of the volatility in the change in trade balance-to-output ratio, and 15.34% of volatility in investment growth.

The remainder of the paper is organized as follows. Section 2 summarizes the existing literature on remittances and RBC models. Section 3 describes the data and the stylized business cycle facts. Section 4 presents the model with remittance shocks. Section 5 describes the calibrated and estimated parameters. Section 6 presents the results. Section 7 concludes.

2. Literature Review

The idea to utilize RBC models to study the relationship between remittances and macroeconomic fluctuations is not new. For example, Batu (2017) develops a standard small open economy RBC model, which includes remittance shocks. To calibrate the model, Batu uses data for 81 countries over a long time horizon (1970–2012) and finds that only worker remittances that are temporary in nature have an impact on GDP per capita in the short run, while permanent increases do not affect GDP growth. Overall, the basic RBC model predicts that given a temporary shock to productivity, endogenous variables (output, consumption, investment and labour) rise above their long-term trends. In the case of remittances, only those that are temporary in nature should have an impact on GDP per capita growth in the short run. This is because when agents face a temporary remittance shock, they save to smooth their consumption profiles, leading to an increase in investment and, consequently, output (Batu, 2017). A permanent change in worker remittances, on the other hand, leads to a positive income effect. Since leisure is a normal good, hours worked fall, leading to a reduction in output. Batu's results are supported by Annen *et al.* (2016), who also calibrate and simulate an RBC model and find that a temporary change in inflows results in positive effects on economic growth.

The statistics generated by Batu (2017) are consistent with business cycle stylized facts: investment is procyclical and more volatile than output and consumption, trade balance is countercyclical, and consumption is procyclical. Remittance is acyclical, which is consistent with the data for remittance recipients. However, the model does not accurately match consumption volatility in the data. Batu also assesses the role of remittance shocks in the volatility of macroeconomic aggregates. Similar to Annen *et al.* (2016), he finds that most of the volatility in aggregate variables (other than remittances) is explained by productivity shocks, not remittance

shocks. According to Annen *et al.*, wealth transfer shocks would have to be approximately nine times as large in order to produce the same GDP volatility created by productivity shocks.

Chami *et al.* (2006) also use an RBC model to analyze the effects of exogenous remittances on output growth. They assume remittances to be countercyclical: a drop in domestic output results in higher remittance transfers. The authors find that remittances raise household welfare by increasing disposable income and consumption. In this way, households are able to insure consumption against income shocks. This also means that households have more resources, leading to a reduction in the supply of labour. They conclude that countercyclical remittances increase the correlation between labour and output, raising business cycle volatility.

One challenge that remittances might pose to the receiving country is what is known as the Dutch disease phenomenon. The idea is that remittances raise households' disposable income, which triggers an expansion in aggregate demand, and culminates in higher relative prices of non-tradable goods (spending effect), leading to a real exchange rate appreciation. Acosta *et al.*, (2009) investigate the effects of remittance inflows on labour supply and output, particularly in terms of trade balance. They develop a general equilibrium model and examine whether an increase in remittances led to the Dutch disease phenomenon in El Salvador. The authors find that the higher prices of non-tradable goods lead to an expansion of the non-tradable sector, and consequently a further reallocation of resources toward the non-tradables (Acosta *et al*., 2009).

The paper by Acosta *et al*. (2009) is particularly relevant to my research because it uses a combination of calibration methods and Bayesian estimation. One advantage of Bayesian estimation is that given the predictive densities for the parameters, one can check the empirical validity of RBC models. Researchers such as García-*Cicco et al.* (2010) and Chang & Fernández (2013), have turned to Bayesian methods to estimate their models and simulate them at the

parameter values which are supported by the data. These authors are particularly interested in the roles of various types of shocks in explaining business cycles in emerging economies. They do not include remittance shocks, but provide a solid background for my model development and explain why observed aggregate fluctuations in emerging economies differ from those in developed economies.

García-Cicco *et al.* (2010) test whether an RBC model driven by trend shocks to productivity can explain business cycles in Argentina and Mexico over the period 1900-2005. The authors find that the role of trend shocks in explaining business cycles is negligible. In fact, they augment the RBC model to incorporate preference shocks, country-premium shocks, and a realistic debt elasticity of the country premium. They base their methodology on Neumeyer & Perri (2005), who use a model with interest rate shocks to capture the different dynamics in business cycles. It is argued that business cycles in emerging market economies are correlated with the cost of borrowing that these countries face in international financial markets (Uribe & Yue, 2006). When interest rates are low, the economy typically expands, and in times of high interest rates, the economy is often characterized by lower levels of aggregate activity.

Neumeyer & Perri (2005) show that business cycles in emerging countries are more volatile than in developed countries, real interest rates are countercyclical, consumption is more volatile than output, and net exports are countercyclical. They find that interest rate shocks explain 50% of output fluctuations in Argentina, and are therefore an important factor for explaining aggregate volatility in emerging markets. García-Cicco *et al.* (2010) find that their model with interest rate shocks and financial frictions mimics remarkably well the observed business cycles in Argentina. They thus refute the argument by Aguiar & Gopinath (2007), who have suggested

that an RBC model driven primarily by trend shocks to productivity can explain business cycles in emerging countries.

Chang & Fernández (2013) compared the approaches by Aguiar & Gopinath (2007) and García-Cicco *et al.* (2010) empirically by pairing them against each other and also against an encompassing model embedding trend productivity shocks, interest rate shocks and financial frictions. Overall, their results support the view that financial imperfections should be considered when explaining fluctuations in emerging economies, because they amplify conventional productivity and interest rate shocks. Their analysis provides useful information as to whether and how financial frictions can enhance the performance of business cycle models in emerging economies (Chang & Fernández, 2013). My study adds to the literature in the sense that it incorporates the approach used by Chang & Fernández, with the addition of remittance shocks in Honduras, a country highly dependent on remittance inflows.

3. Data and Business Cycles

3.1. Business Cycle Data

I use data from the United Nations Department of Economic and Social Affairs (UN DESA) and the World Bank for the time period 1974-2016. I construct the time series of nominal and real GDP (constant 2010 prices) by adding up the GDP components (Consumption, Government Expenditure, Investment, and Net Exports). Household final consumption expenditure consists of the expenditure incurred by households on individual consumption goods and services, including those sold at prices that are not economically significant. Government final consumption expenditure is the expenditure incurred by general government on individual consumption goods and services and collective consumption services. Investment is gross fixed capital formation. I construct net exports from the difference between exports and imports.

I deflate the UN DESA series using the GDP deflator, and convert it into per capita real terms using the population data. I retrieved data on remittances, official exchange rate and population data from the World Bank database for the period 1974-2016. I convert remittances to local currency (Lempira) using official exchange rate data and deflate using the GDP deflator. I take the log of the variables and then subtract from the previous year to calculate the growth rate of output, consumption, investment, and remittances per capita. I subtract the trade balance-to-output ratio from the previous year to obtain the change in trade balance-to-output ratio.

Figure 1 plots growth rates of output, consumption, investment, remittances and the change in trade balance-to-output ratio over 1974-2016. It shows that remittances growth rate fluctuates much more than other macroeconomic aggregates.

Figure 1: Macroeconomic Fluctuations (including Remittances)

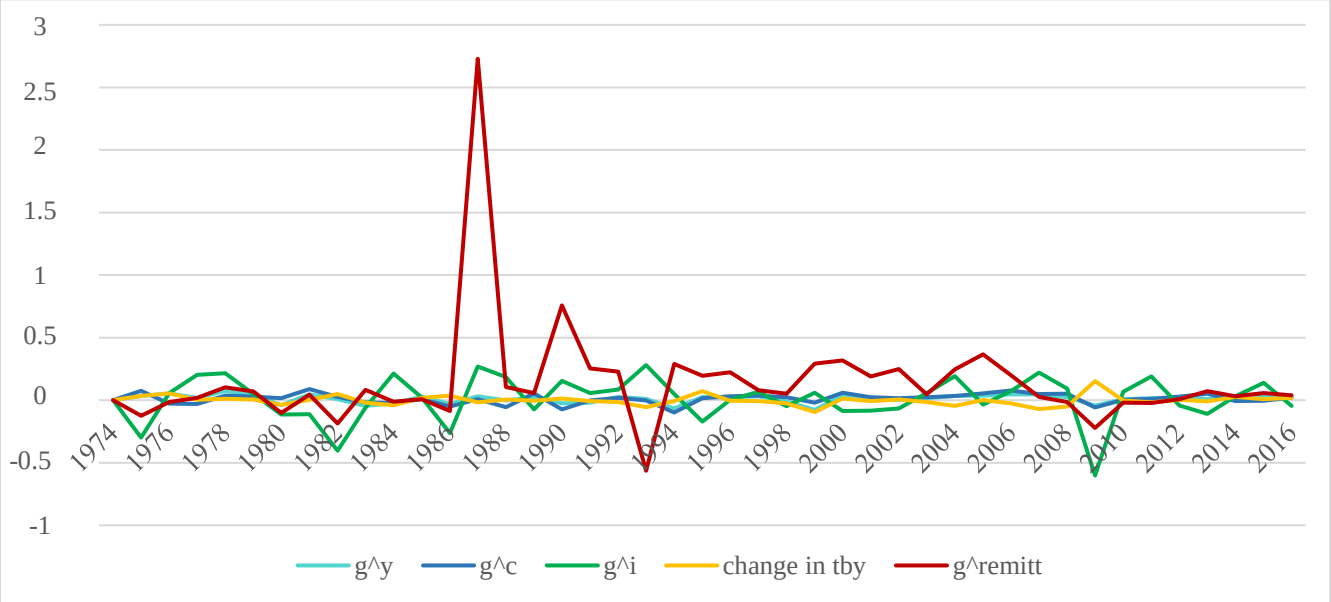
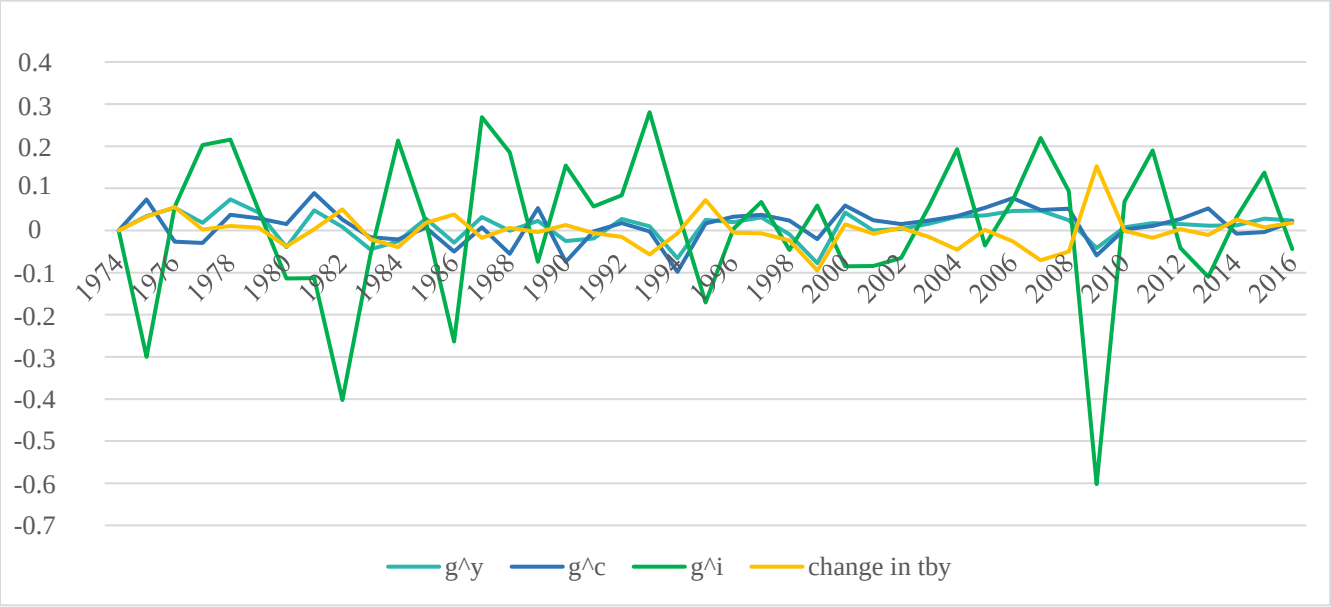


Figure 2 plots the macroeconomic aggregates other than remittances growth rate. It shows that consumption growth, investment growth and change in trade balance-to-output ratio move in the same direction as output growth. Investment growth is the most volatile macroeconomic variable, followed by consumption growth and change in trade balance-to-output ratio.

Figure 2: Macroeconomic Fluctuations (excluding Remittances)



3.2. Stylized Facts

This paper uses growth rates because they show us the incremental effects of changes in remittances (e.g., if a household receives an additional amount of remittances, we can see how that affects their growth rate of consumption).

In describing the behaviour of key economic variables, I follow the literature and use terms such as volatility, co-movement and persistence. Statistics such as these constitute the "stylized facts" of the business cycle. My analysis also includes statistical properties of workers' remittances. It is common practice to detrend the time series data by using filters (e.g., HP Filter). They eliminate the long-term trend and any rapidly changing irregular components, leaving only the business cycle variation of the series. Cyclicality is defined as the correlation between the detrended series of output and another variable. I do not detrend the time series because in emerging markets, shocks to trend productivity growth are considered one of the primary sources of fluctuations, as opposed to transitory fluctuations around the trend.

The standard deviation measures the volatility of a series; a series with a high standard deviation is very volatile. Evidence from developed countries shows that consumption is smoothed across periods and its volatility is low; consumption does not vary significantly even if income fluctuates across periods. Furthermore, investment spending is usually more volatile than consumption and output: individuals try to smooth out their consumption levels over time, and thus current investment reacts much more dramatically to changes in economic conditions than current consumption does. As shown in Table 1, investment in Honduras is approximately five times more volatile than output. However, in developing countries, consumption is more volatile than output (García-Cicco *et al.*, 2010), which is also the case for Honduras. When households anticipate a higher growth rate of income, which eventually leads to a rise in future income, they

increase current consumption more than the rise in current income by borrowing against the future income or reducing current savings. As a result, consumption fluctuates more than output in Honduras, which is a common feature of emerging countries.

As shown in Table 1, remittances growth rate is approximately 14 times more volatile than output growth, about 11 times more volatile than consumption growth, approximately 3 times more volatile than investment growth and 11 times more volatile than change in trade balance-to-output ratio.

Correlation is another measure I use to describe stylized facts. It measures the co-movement of two series. The direction of the relationship is indicated by the sign of the coefficient; a positive sign indicates a positive relationship and a negative sign indicates a negative relationship. In Honduras, consumption growth and investment growth are positively correlated with output growth. Moreover, the growth rate of remittances is positively correlated with the growth rates of output and investment and negatively correlated with the growth rate of consumption and the change in the trade balance-to-output ratio.

Another measure I use to describe stylized facts is persistence. One way to measure persistence is to correlate a series with itself, but lagged by one period. I find that macroeconomic aggregates in Honduras are not characterized by high persistence.

Table 1: Business Cycle Moments

Statistic	$\boldsymbol{g^y}$	$\boldsymbol{g^c}$	$\boldsymbol{g^i}$	$\boldsymbol{\Delta tby}$	$\boldsymbol{g^{remitt}}$
Standard deviation	0.032	0.0403	0.177	0.040	0.450
Correlation with g^y	1.000	0.676	0.235	0.076	0.061
Correlation with g^{remitt}	0.0612	-0.047	0.291	-0.108	1.000
Serial correlation	0.009	0.027	0.035	0.001	-0.034

Notes: $\boldsymbol{g^y}$, $\boldsymbol{g^c}$, $\boldsymbol{g^i}$, $\boldsymbol{g^{remitt}}$ *denote the growth rates of output per capita, consumption per capita, investment per capita, and remittances per capita, and* $\boldsymbol{\Delta tby}$ *is the change in the trade balance-to-output ratio.*

4. Theoretical Framework and Derivation of Results

This section builds on a one sector representative agent small open economy that consists of a number of identical households who consume, save, and invest. Firms hire labour and capital, and produce goods. The labour, output and capital markets are competitive. Households receive remittances and pay lump-sum taxes to the government. Time is discrete and indexed by $t = 0,1,2, \dots, \infty$. This model includes shocks to total factor productivity, to stochastic trend productivity, remittance shocks, random world interest rates that interact with financial frictions, and government expenditure shocks. The only debt traded in the international financial markets is a one-period non-contingent real bond. The model builds on those developed by Neumeyer and Perri (2005), Aguiar and Gopinath (2007), García-Cicco *et al.* (2010) and Chang & Fernández (2013).

The production function is given by:

$$Y_t = a_t K_t^{\alpha} (X_t h_t)^{1-\alpha} , \tag{1}$$

where t denotes the time period, Y_t denotes output, K_t denotes capital, h_t denotes hours worked, a_t represents total factor productivity, X_t represents the stochastic trend productivity (labour augmenting productivity), and α is labour share of income. Upper case letters denote non-stationary variables, and lower case letters denote stationary variables.

Following García-Cicco *et al.* (2010), total factor productivity a_t follows the process:

$$lna_{t+1} = \rho_a lna_t + \epsilon_{t+1}^a; \quad \epsilon_{t+1}^a \sim N(0, \sigma_a^2) ,$$

where ϵ_{t+1}^a is the structural shock and the parameter $\rho_a \in [0, 1)$ governs the persistence of a_t.

The stochastic trend productivity X_t increases the effective labour input. It is non-stationary and g_t denotes the gross growth rate of X_t:

$$g_t \equiv X_t / X_{t-1}$$

The logarithm of g_t follows a first-order autoregressive process of the form:

$$\ln(g_{t+1}/g) = \rho_g \ln(g_t/g) + \epsilon^g_{t+1}; \quad \epsilon^g_{t+1} \sim N(0, \sigma_g^2)$$

where g is the steady-state growth rate of the trend productivity factor X_t. The shock is given by ϵ^g_{t+1} and the parameter $\rho_g \in [0, 1)$ governs the persistence of g_t. As noted in Chang & Fernández (2013), a positive ϵ^g_t implies that the growth of labour productivity is temporarily above its long run mean. This shock will be incorporated in g_t and result in a permanent improvement in productivity and income. Thus, consumption can increase more than current income, which explains why consumption is usually more volatile than income in emerging economies.

The investment constraint is given by:

$$I_t = K_t X_{t+1} - (1-\delta)(K_t) + \frac{\varphi_k}{2} K_t \left(\frac{K_{t+1}}{K_t} - g\right)^2 \quad (2)$$

In the function above, δ is the depreciation rate and φ_k is the capital adjustment costs. The last term introduces quadratic capital adjustment costs. The literature usually assumes convex adjustment costs that are quadratic. This implies that the cost of adjusting capital increases disproportionally faster than the amount of capital to be adjusted. It also implies that marginal adjustment costs are linear.

Interest rates and bond prices have an inverse relationship; so when one goes up, the other goes down. Investors constantly compare the returns on their current investments to what they could get elsewhere in the market. As market interest rates change, a bond's coupon rate is more or less attractive to investors, who are therefore willing to pay more or less for the bond itself.

$$qd_t = \frac{1}{1 + r_t}$$

Given this is a small-open economy, households and firms take the world interest rate (r_t) as given.

The country-specific international interest rate is given by:

$$\ln\left(\frac{1+r_t}{1+\bar{r}}\right) = \rho_r \ln\left(\frac{1+r_{t-1}}{1+\bar{r}}\right) + \eta_D \ln\left(\frac{\frac{D_{t+1}}{X_t}}{\bar{d}}\right) - \eta_{GDP} \ln\left[\frac{\frac{(PriGDP_{t+1})+(Rem_{t+1})}{X_t}}{\overline{prigdp}+\overline{rem}}\right] + \epsilon^r_{t+1} \ ,$$

where $PriGDP$ is private GDP, η_D is the elasticity of debt and η_{GDP} is the elasticity of GDP. The shock is given by ϵ^r_{t+1}, which has mean zero and variance σ_r^2. The parameter $\rho_r \in [0, 1)$ governs the persistence of r_t. The values are divided by X_t to make them stationary. Due to asymmetric information in international capital markets, the country-specific interest rate depends on the level of indebtedness and the repaying capacity of the country. These two then capture the financial frictions. Remittances boost up the repaying capacity, and thus reduce the borrowing costs of a country.

The economy faces a period-by-period resource constraint, described below:

$$Y_t + \frac{D_{t+1}}{1+r_t} + Rem_t = I_t + C_t + D_t + Gov_t + (\, r_t \varphi_{wk} W_t h_t) \qquad (3)$$

The left-hand side describes the total resources available in period t, given by output (Y_t), the stock of debt acquired in the previous period (D_{t+1}), and remittances (Rem_t). The right-hand side describes the expenditure in period t, given by consumption (C_t), investment (I_t), debt payments (D_t), and government final consumption expenditure (Gov_t), which is funded by lump-sum taxes. The last term introduces the working capital requirement, a friction developed by Neumeyer and Perri (2005) and Uribe and Yue (2006) given by the parameter φ_{wk}, where $\varphi_{wk} \in (0,1)$. Firms are assumed to borrow from international markets for a fraction φ_{wk} of the wage bill in advance of production to pay workers. Since firms have to borrow to pay for inputs, the demand for labour becomes sensitive to the interest rate: increases in the interest rate make

their effective labour cost higher and reduce their labour demand for any given real wage (W_t). The economy typically expands when interest rates are low, and there are lower levels of aggregate activity when interest rates are high.

The law of motion for remittances is given by:

$$\ln\left(\frac{\frac{Rem_{t+1}}{X_t}}{\overline{rem}}\right) = \rho_{Rem}\ln\left(\frac{\frac{Rem_t}{X_t}}{\overline{rem}}\right) + \epsilon_{t+1}^{Rem}; \quad \epsilon_{t+1}^{Rem} \sim N(0, \sigma_{Rem}^2)$$

The parameter $\rho_{\text{Rem}} \in [0, 1)$ governs the persistence of Rem_t. In the steady-state, the LHS and RHS are zero. Now suppose that in time period 1, a positive shock of 1% in remittances is realized. Assume that it is entirely temporary. Suppose that ρ_{Rem} = 0.9. The 1% positive shock is equal to $1/100 = 0.01$. Then in period 1, the LHS $= 0.01$. In the second period, LHS $= 0.9 * 0.01 = 0.009$. In the third period, the LHS will be $0.9 * 0.009 = 0.0081$. In the fourth period, $0.9 * 0.0081$ and so on.

The law of motion for government expenditure is guided by:

$$\ln\left(\frac{\frac{Gov_{t+1}}{X_t}}{\overline{gov}}\right) = \rho_{Gov}\ln\left(\frac{\frac{Govt_t}{X_{t-1}}}{\overline{gov}}\right) + \eta_{Gov} ln\left[\frac{\frac{(PriGDP_{t+1})}{X_t}}{\overline{prigdp}}\right] + \varepsilon_{t+1}^{Gov}; \quad \epsilon_{t+1}^{Gov} \sim N(0, \sigma_{Gov}^2)$$

The parameter $\rho_{\text{Gov}} \in [0, 1)$ governs the persistence of $Govt_t$.

The social planner maximizes the utility function choosing $c_t, h_t, i_t, d_{t+1}, k_{t+1}$, subject to (1)-(3), taking as given the processes a_t, X_t, and r_t and the initial conditions K_0 and D_{-1}.

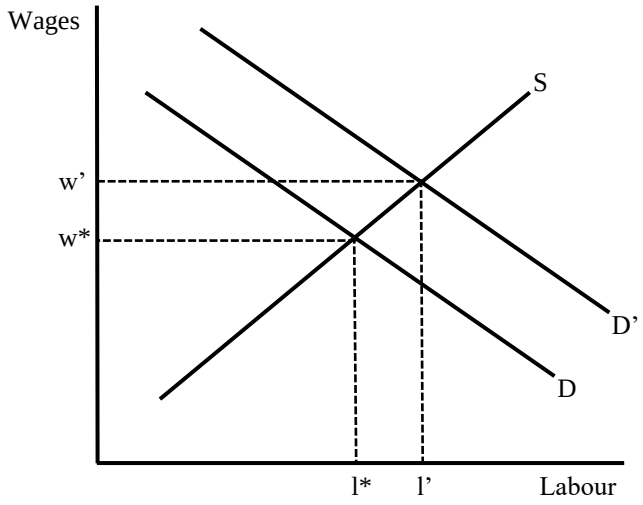
$$E_0 \sum_{t=0}^{\infty} \beta^t \frac{\left[C_t - \frac{\mu}{\omega} X_{t-1} h_t^{\omega}\right]^{1-\sigma}}{1-\sigma},$$

where β^t is the discount factor, ω is the labour supply elasticity, μ determines the value of labour related to consumption, and σ is the intertemporal elasticity of substitution. X_{t-1} is included in the utility function to allow for a balanced growth path. The utility function assumes Greenwood–Hercowitz–Huffman (GHH) preferences. This type of utility function allows the

labour supply to be independent of consumption. This leads to low income effects on labour supply, and large fluctuations in consumption due to positive shocks, which help to explain why consumption is more volatile in emerging countries. With Cobb-Douglas preferences, on the other hand, leisure and consumption are not easily substitutable because the income effect is strong. Consequently, agents will smooth consumption, in response to a positive shock.

In the long-run, the model comes back to the steady state (balanced growth path). We want to evaluate what occurs after a shock and the path followed by the variables after the shock. The model can be solved numerically once we choose and estimate our parameter values and derive the first order conditions. Figure 3 illustrates the adjustment in the labour market following a total factor productivity shock to better explain the mechanism of the model. As we introduce a one time positive shock to total factor productivity, labour becomes more productive and the demand for labour increases in the short-run. Wage and labour depart from their original equilibrium values (w* and l*). However, in the long-run, wages and labour will return to their steady-state values. This logic follows to all the shocks: they will cause temporary disturbances in the endogenous variables, but will return to the long-run equilibrium values.

Figure 3: Illustration of Shock Process



5. Empirical Approach

5.1. Estimated and Calibrated Parameters

Values to the structural parameters are assigned using a combination of calibration and Bayesian methods. Table 2 describes all the parameters that were calibrated. The parameters α, σ and ω are taken from Chang & Fernández (2013). The parameter μ is chosen so that the model generates labour supply of 0.33 in the long-run. β is chosen to be consistent with long-run annual interest rate of 6% as in Chang & Fernández (2013). The elasticity of debt, η_D, is fixed at a very low value as in Chang & Fernández (2013). Furthermore, $\delta, \overline{rem}$ and $\overline{gov}$ are chosen to match long-run values of investment to GDP ratio, government expenditure to GDP ratio, and remittances to GDP ratio. The calibration targets are given in Table 3.

Table 2: Calibrated Parameters

Parameter	α	δ	β	σ	μ	ω	η_D
Value	0.33	0.125	0.96	2.00	1.55	1.60	0.0001

Table 3: Calibration Targets

Consumption/GDP	0.72
Investment/GDP	0.24
Government Expenditure/ GDP	0.14
Remittances/GDP	0.068
Debt/GDP	0.36
Labour share in GDP	0.67
Fraction of time spent working	0.33

The remaining parameters of the model are estimated using Bayesian methods and Honduran data on output growth, consumption growth, investment growth, and the change in trade balance–to-output ratio over the period 1974-2016 as observable variables. The Bayesian framework is used to update our views about the model and its parameters in light of observed data. Bayesian inference derives the posterior probability as a product of a prior probability and a likelihood function, which is the probability of observing A given B. Prior beliefs about the

parameters of a model are given by a prior probability distribution, which is denoted by $P(B)$. $P(A)$ is known as marginal density. After observing the data A, the Bayes Theorem implies that posterior beliefs about B, denoted by $P(B|\mathrm{A})$, must respect:

$$P(B|A) = \frac{P(A|B)P(B)}{P(A)}$$

The prior mean and standard deviation of estimated parameters are given in Table 4, columns 2 and 5. The mean and standard deviation of the parameters are taken from Chang & Fernández (2013) and García-Cicco *et al.* (2010). The estimated posterior mean, along with the 95% highest posterior density interval of the structural parameters are reported in columns 3 and 4. For estimating the model, model equations are log-linearized in the neighborhood of steady-state values of endogenous variables. The model likelihood is obtained by using Kalman filter. For posterior simulations, the Markov Chain-Monte Carlo (MCMC) method is used. The posterior distributions are based on three Markov chains, each with one million draws. To minimize the impact of initial values, first 50% of draws are discarded. The variance of candidate distribution from which simulations are drawn is set to achieve the acceptance rate of around 30%. The model is solved numerically using Dynare software.

Table 4: Prior and Posterior Distributions

Parameter	Prior Mean	Posterior Mean	95% HPD Interval	Prior Std. Dev.
g	1.011	1.0109	(1.0109, 1.0109)	0.0500
φ_k	17.00	16.8009	(13.5225, 20.2732)	1.7000
φ_{wk}	0.250	0.2483	(0.2005, 0.2971)	0.0250
ρ_g	0.010	0.0099	(0.0016, 0.0197)	0.0050
ρ_a	0.800	0.8308	(0.7645, 0.8936)	0.0400
ρ_{gov}	0.800	0.7819	(0.7035, 0.8591)	0.0400
ρ_{Rem}	0.800	0.8297	(0.7538, 0.8999)	0.0400
ρ_r	0.200	0.2000	(0.1979, 0.2020)	0.0010
η_{GDP}	0.100	0.0607	(0.0148, 0.1113)	0.0500
η_{Gov}	0.600	0.6943	(0.1660, 1.2980)	0.3000

6. Results

6.1. Estimated Business Cycle Moments

The RBC model sets itself the task of trying to explain the observations in Table 1. In other words, the accuracy of the model is assessed by its ability to mimic the observed variability of macroeconomic variables and their co-movements.

Table 5 reports the estimated business cycle statistics. The results are consistent with business cycle stylized facts: remittances are very volatile, growth rates of investment and remittances are positively correlated with the growth rate of output, and investment is more volatile than output and consumption. Consumption is also more volatile than output. However, the model does not do a good job in matching the correlation between the growth rates of remittances and consumption. The estimated moments tell us that they are positively correlated, while they are in fact negatively correlated in the data. Furthermore, the correlation between the growth rate of remittances and investment is stronger in the data, while in the estimated economy they are weakly correlated.

Table 5: Estimated Business Cycle Moments

Statistic	g^y	g^c	g^i	Δtby	g^{remitt}
Standard deviation	0.032	0.042	0.150	0.037	0.600
Correlation with g^y	1.000	0.676	0.078	0.253	0.074
Correlation with g^{remitt}	0.074	0.655	0.0315	-0.520	1.000
Serial correlation	-0.149	-0.127	0.020	-0.120	-0.100

Notes: g^y, g^c, g^i, g^{remitt} denote the growth rates of output per capita, consumption per capita, investment per capita, and remittances per capita, and Δtby is the change in the trade balance-to-output ratio.

Table 6 reports the relative role of each structural shock in explaining macroeconomic fluctuations: remittance shocks, a random shock to world interest rates that interact with financial frictions, changes to government expenditure, shocks to total factor productivity and shocks to

stochastic trend productivity. The most remarkable result is the role that shocks to total factor productivity play, which explain 70.34% of the volatility in output growth. Remittances explain 44.10% of volatility in consumption growth, 27.14% of the volatility in the change in trade balance-to-output ratio, and 15.34% of volatility in investment growth and 0.98% of volatility in output growth. World interest rate shocks play a non-trivial role, particularly when explaining the volatility in investment growth (25.15%), and to a lesser extent in consumption growth (15.10%), in the change in trade balance-to-output ratio (6%) and output growth (9.89%). Shocks to government expenditure play a significant role in accounting for changes in the trade balance-to-out ratio (56.23). Stochastic trend productivity shocks do not lead the changes of any particular macroeconomic variable, but can explain 18.08% of volatility in output growth.

Table 6: Variance Decomposition Predicted by the Model (in percent)

	σ_a	σ_g	σ_r	σ_{Rem}	σ_{Gov}
g^y	70.34	18.08	9.89	0.98	0.19
g^c	20.60	8.22	15.10	44.10	5.27
g^i	40.36	7.25	25.15	15.34	8.03
Δtby	9.63	0.82	0.60	27.14	56.23

Notes: $\sigma_a, \sigma_g, \sigma_r, \sigma_{Rem}, \sigma_{Gov}$ *represent the standard deviations of i.i.d. measurement errors on the observables (total factor productivity, stochastic trend productivity, interest rates, remittances and government expenditure, respectively). Numbers do not add up to 100 due to non-zero correlation of estimated shocks in small samples. Measurement errors contribute less than 5% in the variance decomposition.*

7. Conclusion

Remittances in Honduras are important because they constitute 18.8% of the Honduran GDP and represent one of the largest capital flows into the country. Remittances growth rate is much more volatile than the growth rates of consumption, output, investment and the change in trade balance-to-output ratio. Thus, fluctuations in remittances might trigger fluctuations in macroeconomic aggregates. Using a Real Business Cycle framework to analyse the effects of remittances on macroeconomic aggregates over the Honduran business cycle, I find that remittance shocks play an important role in explaining volatility in consumption growth in Honduras. Almost half of the volatility in consumption is in response to fluctuations in remittances. Research on macroeconomic fluctuations in emerging economies has found that most of the fluctuations in consumption are explained by shocks to total factor productivity and to stochastic trend productivity. However, once I introduce remittance shocks to the model, I find that they are actually the main driver of fluctuations in consumption in Honduras.

Furthermore, remittance shocks account for 27.14% of the volatility in the change in trade balance-to-output ratio, 15.34% of volatility in investment growth and 0.98% of volatility in output growth. Their role in explaining the volatility in output growth is crowded out by shocks to total factor productivity (70.34%). Moreover, the results from the simulations are consistent with business cycle stylized facts: remittances are highly volatile, consumption is more volatile than output, and investment is more volatile than consumption and output. The growth rate of output is positively correlated with the growth rate of remittances, while the change in trade balance-to-output ratio is negatively correlated with the growth rate of remittances. However, the model does not do a good job in matching the correlation between the growth rates of remittances and consumption. This could be because the model assumes homogenous households

when in fact, the heterogeneity of households might affect how the economy responds to remittance shocks. For example, Bahadir *et al.* (2018) analyze the dynamic absorption of remittances in the Philippines. They argue that the effects on economic activity will depend on who receives remittances: hand-to-mouth wage earners or credit-constrained entrepreneurs. Further research could account for the internal distribution of remittances to improve the model's fit to the data.

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