Emerging Market Business Cycles with Remittance Fluctuations*

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Abstract

This paper analyzes the implications of remittance fluctuations for various macroeconomic variables and Sudden Stops. The paper employs a quantitative two-sector model of a small open economy with financial frictions calibrated to Mexican and Turkish economies, two major recipients, whose remittance receipts feature opposite cyclical characteristics. We find that remittances dampen the business cycles in Mexico, whereas they amplify the cycles in Turkey. Their quantitative effects in the long run, approximated by the stochastic steady state are mild. In the short run, however, remittances have quantitatively large impacts on the economy, when the economy is borrowing constrained. This is because agents in the economy cannot adjust their precautionary wealth to sudden tightening in credit, hence, fluctuations in remittances get magnified through an endogenous debt-deflation mechanism. Our findings suggest that procyclical (or countercyclical) remittances can play a significant deepening (or mitigating) role for Sudden Stops.

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1 Introduction

Officially recorded migrant remittances received by developing countries increased from $160.4 billion in 2004 to $166.9 billion in 2005, representing a 95 percent increase over 2000 by the World Bank estimates.[1] Thanks to this fast growth, the total amount officially received by the developing world has almost tripled in nominal terms over the last decade. Perhaps more impressively, this growth has been visibly faster than the growth of private capital flows and official development assistance (ODA), enabling remittances to eventually surpass non-FDI (private debt and portfolio equity) and ODA flows, and to almost catch FDI receipts in magnitude as of 2004. During the same year, remittance receipts exceeded combined public and private capital inflows in 36 developing countries and were larger than total merchandise exports in 12 others. In some countries such as Mexico, FDI receipts often fall short of remittances (World Bank, 2006a). As a result, remittances have become a more important source of foreign exchange than private capital flows, ODA and even FDI for many developing countries. Popular stance in the policy circles and among many of the scholars studying remittances is to view this rapid growth as a generally positive development for developing economies on account of the following:

1. As differently from other private capital inflows, remittances do not create any liabilities such as debt servicing or profit transfers in the future.

2. Remittance flows are usually more stable than private capital flows including FDI (Ratha, 2003; Buch and Kuckulenz, 2004).

3. Remittances are likely to serve as macroeconomic stabilizers, since migrant workers are expected to increase the amounts transferred to help family members left behind compensate for the resulting drops in household income, whenever the economic activity back home slows down or falls (UNCTAD, 2006; World Bank, 2006a and b).

Yet, whether high remittance receipts are always a blessing depends on the nature of comovements, if any, between business cycles in the home countries of migrants and cyclical fluctuations in the remittance flows. The findings of Sayan (2004, 2006) indicate that remittance fluctuations may well be procyclical in individual countries and our results confirm that (see Figures 1 and 2, Table 1). How much to remit is a complex decision, as Sayan (2006) points

[1] By the definition in the World Bank's Global Development Finance 2003, migrant remittances are made up of workers' remittances, compensation of employees, and migrants' transfers.

out, involving many other factors than the migrants' altruistic desire to help family members smooth their consumption, and different variables driving remittance behavior might be differently affected by the state of economic activity over home country business cycles. Returns to savings at home, for example, may converge to or diverge from those in the host countries, as home economies go through cyclical downturns and upturns, affecting the remittance behavior in turn (Sayan and Tekin-Koru, 2007).

Remittances could be a blessing indeed if they move counter to home country business cycles, as they will then serve as macroeconomic stabilizers that boost the recipient economy's capacity to cope with recessions and Sudden Stops (see, for example, Bugamelli and Posternò, 2005). If they are procyclical, on the other hand, they could be a setback as the drops in remittance receipts observed right before, during or shortly after cyclical contractions of economic activity or Sudden Stops would magnify the damage resulting from such contractions or stops. Answers to how effective countercyclical or procyclical remittance flows could be in lowering or inceasing the amplitude of macroeconomic fluctuations in the recipient economies depend on several factors and hence are less obvious. In addition to the nature of co-movements between remittance fluctuations and business cycles, the response time of remittances to business cycle movements, and the share of remittances in GDP need to be taken into consideration while answering this question. Likewise, identifying the quantitative effects that remittance fluctuations could have on different macroeconomic variables during Sudden Stops experienced by the recipient economies need to be investigated quantitatively, using an appropriate model that captures general equilibrium interactions between key macroeconomic variables.

Despite their significance, the existing literature lacks studies investigating these issues except through cross-country regressions (see, for example, Bugamelli and Paternò, 2006). Especially, there are only few studies that discusses the effects of remittance fluctuations on the cyclical behavior of different macroeconomic variables based on results obtained from a DSGE model so as to take various interactions between different macroeconomic variables into account (Acosta, Lartey, and Mandelman, 2007 and Chami, Cosimano, and Gapen, 2006). Furthermore, the existing literature focuses almost exclusively on the effects of countercyclical remittances on volatility of output, consumption and investment in the recipient countries (see, for example, IMF, 2005), overlooking the macroeconomic effects of procyclical remittance flows that individual countries such as Turkey may receive.

This paper aims to fill the gap in the existing literature by comparing the effects of remittance flows with opposite cyclical characteristics on different macroeconomic aggregates and Sudden Stops.[2] For this purpose, we introduce remittances to the small open economy model of Mendoza (2005) and calibrate it to the data for Mexican and Turkish economies, two major recipients which differ with respect to the way remittance receipts respond to respective home country business cycles. Remittances are procyclical in Turkey, whereas they are countercyclical in Mexico, as thoroughly discussed by Sayan and Tekin-Koru (2007).

The model features a tradable sector and a nontradable sector in which the liabilities are denominated in units of tradable goods, (i.e., liabilities are dollarized), and agents face a borrowing constraint in international capital markets. Foreign debt is partially leveraged through income generated in nontradable sector. Interaction of these two frictions, i.e., liability dollarization and the borrowing constraint partially-leveraged by nontradable income, creates a debt deflation mechanism that realistically mimics the key features of Sudden Stops experienced by both Mexico and Turkey. A shock to the economy making the borrowing constraint binding leads to a decline in tradable consumption and relative price of nontradables. The decline in relative price of nontradables tightens the constraint even further because the collateral value of nontradable income becomes lower. Further tightening of the borrowing constraint results in further declines in tradable consumption creating a feedback mechanism, which eventually leads to a collapse in consumption and relative price of nontradables and reversals in current account. Various studies (Caballero and Krishnamurthy, 2001; Calvo, Izquierdo and Mejía, 2005; Mendoza 2002, among others) showed that such credit crunches amplified by highly dollarized liabilities were the main driving force of the Sudden Stops that emerging markets like Mexico and Turkey faced during the last decade and a half. It is merely this mechanism in the model that generates Sudden Stop-like crises dynamics. Using this model, we quantitatively explore how important the remittance fluctuations are to countries where they move countercyclically and procyclically to domestic business cycles, and investigate possible effects of these fluctuations on Sudden Stops experienced by such countries.

Our results indicate that remittances dampen the business cycles in the Mexican economy, whereas they deepen the cycles in the Turkish economy as expected. Their quantitative effects in the long run approximated by the stochastic steady state are somewhat mild, and do not

[2]In a recent, cross-country study, Bugamelli and Paternòl (2005) find that as cheap inflows of foreign currencies, remittances might reduce the probability that foreign investors suddenly flee out of emerging markets and developing economies and trigger a dramatic current account adjustment.

significantly depend on whether the economy is borrowing constrained or not. This result mimics the findings of Mendoza (2002), who finds that imposition of borrowing constraints do not alter the long run business cycles quantitively, because agents engage in precautionary savings and minimize the impacts of borrowing constraints on the macroeconomy in the long-run. In the short run, however, remittances can have quantitatively large impacts on the macroeconomy, if the borrowing constraints are in place. In the short run, agents in the economy cannot adjust their precautionary wealth to sudden tightening in their credit, hence, small remittance shocks to the economy gets magnified through the endogenous debt-deflation mechanism.

We quantify the short-run impact effects of remittance fluctuations using forecasting functions, i.e., impulse response functions, which are derived by setting the initial conditions of the economy to a state where the economy is prone to a Sudden Stop. Then, we compare the impact effect of income shocks with and without accompanying remittance shocks. In the Turkish case, one-standard-deviation negative remittance shock that accompanies a one-standard-deviation income shock magnifies the decline in tradable consumption by 2 percent and the reversal in current account-GDP ratio by 3 percentage points. In the Mexican case, a one-standard deviation positive remittance shock that follows the negative income shock smoothes the decline in tradable consumption by 1.4 percent and decreases the reversal in the current account-GDP ratio by 2 percentage points. These results suggest that remittances can have significant amplifying, in the case of procyclical remittances, or smoothing, in the case of countercyclical remittances, effects on Sudden Stops.

Our findings provide important lessons about crises-mitigation or crises-deepening role of remittances as well as their impact on long run business cycles. We can relate our findings to two strands of the macroeconomic literature. One strand analyzes the dynamics of business cycles and Sudden Stops in small open economies, as exemplified by the works of Durdu, Mendoza and Terrones (2007), Durdu (2006), Durdu and Mendoza (2006), Neumeyer and Perri (2005), Oviedo (2005), Kose (2002) and Mendoza (1991, 2002, 2005), among others. The second strand focuses on remittances and explores their empirical characteristics, their effects as well as the driving forces behind them (see Aguinas, 2006 for a rather comprehensive review of this literature).

Mendoza (1991) provides a workhorse quantitative small open economy model that accounts for the aggregate fluctuations in small open economies. Kose (2002) extends this model to explore the importance of world price shocks and fluctuations in world interest rates on business cycles of small open economies. Neumeyer and Perri (2005) and Oviedo (2005) focus on the importance

of world interest rates in driving business cycles. Our paper relates to this first group of paper by shedding some light at the business cycle implications of remittance fluctuations. Mendoza (2002, 2005), among others emphasized the role of frictions in the world capital markets and accounts for the observed features of Sudden Stops by introducing frictions to the workhorse model of Mendoza (1991). Durdu (2006) examines how hedging and self-insurance options and their implications on Sudden Stops are affected if the agents have access to GDP-indexed credit contracts. This paper contributes to this literature by looking at the quantitative importance of remittance fluctuations on Sudden Stops by employing the features used in those studies.

Chami, Fullenkamp, and Jahjah (2003) used a model with micro foundations to formalize the argument about the altruism of migrants as the underlying reason for this expected response of remittances to home country output shocks. They also backed their theoretical result with panel data evidence indicating that remittances do respond to changes in output negatively. Later, other studies such as IMF (2005), Mishra (2005) and World Bank (2006a and b) all presented additional evidence indicating a negative relationship between output and remittance receipts. Yet, the first look in the literature by Sayan (2004) at the co-movements between the cyclical components (defined as deviations from trend) of home country output and remittances series produced different results. Using quarterly time series data on remittances sent home by Turkish workers in Germany, Sayan (2004) found that remittance receipts of Turkey from Germany were procyclical to Turkish output. The sharp drop in total remittance receipts of Turkey after the severe crisis of the Turkish economy in 2001 conformed to these findings, with the country suffering an additional blow due to the decline in remittance receipts (Ratha, 2003). Sayan (2006) repeated the analysis in Sayan (2004) using annual data for 12 countries that receive significant amounts of remittances, including Turkey. Findings from this analysis provided additional support to the view that non-altrusitic considerations may dominate the remittance behavior, leading to procyclicality of remittances as in the case of Turkey. These studies provided the concrete evidence to back the intuition of such authors as Buch, Kuckulenz and Le Manchec (2002) and Ratha (2003), who previously pointed out the potential impact of the cyclical ups and downs in remittance flows on the intensity of recession or expansion phases of home country business cycles. More recently, Sayan and Tekin-Koru (2007) considered the cyclical behavior of Turkish remittances from Germany and Mexican remittances from the US in a comparative study. Using quarterly data covering the 1980s onwards, they found that remittance receipts of Mexico from the US were synchronously countercyclical to the business

cycle in Mexico, whereas Turkish remittances were again procyclical and followed the business cycle in Turkey with a one-quarter lag.[3]

As interesting as they are, the evidence presented by Sayan (2004) and Sayan and Tekin-Koru (2007) concerning cyclical characteristics of Turkish and Mexican remittances do not reveal anything about the size of respective business cycle-deepening or -dampening effects of procyclical and countercyclical remittances flowing into these countries. As far as we know, nor does the previous literature have any answer to this question within the context of individual countries that receive sizable amounts of remittances. The discussion in the rest of the paper serves to fill this gap in the literature and is organized as follows. Section 2 describes the model, Section 3 presents the results of the quantitative exercises, and Section 4 concludes.

2 Model

We introduce remittances to the two sector small open economy model of Mendoza (2005). Foreign debt is denominated in units of tradables and imperfect credit markets impose a borrowing constraint that limits external debt to a share of the value of total income in units of tradables.

Representative households receive stochastic exogenous remittances denoted $(1+\varepsilon_t^R)Rem$; a stochastic endowment of tradables and a nonstochastic endowment of nontradables, which are denoted $(1+\varepsilon_t^y)y^T$ and y^N, respectively. ε_t^R and ε_t^y are respective shocks to the remittances and tradables endowments. Households derive utility from aggregate consumption (c), and they maximize Epstein's (1983) stationary cardinal utility function:

$$U = E_0 \left\{ \sum_{t=0}^{\infty} \exp\left[-\sum_{\tau=0}^{t-1} \gamma \log(1+c_t) \right] u(c_t) \right\}. \tag{1}$$

Functional forms are given by:

$$u(c_t) = \frac{c_t^{1-\sigma} - 1}{1-\sigma}, \tag{2}$$

$$c_t(c_t^T, c_t^N) = \left[\omega (c_t^T)^{-\mu} + (1-\omega)(c_t^N)^{-\mu} \right]^{-\frac{1}{\mu}}. \tag{3}$$

The instantaneous utility function is in constant relative risk aversion (CRRA) form with

[3]Sayan and Tekin-Koru (2006) offered the stagnation of Turkish migration to Germany in the 1980s after family reunifications as the most plausible explanation for the procyclicality of remittances. Turkish migrants' ties with the family members remaining in Turkey weakened, they argued, with the passage of time, causing altruism motive to lose its strength. For Mexico, on the other hand, this motive must remain strong as migration of Mexican workers to the US continues, albeit mostly illegally.

an inter-temporal elasticity of substitution value of $1/\sigma$. Aggregate consumption is given by a constant elasticity of substitution (CES) function, where $1/(1+\mu)$ is the elasticity of substitution between consumption of tradables and non-tradables and where ω is the CES weighing factor. $\exp\left[-\sum_{\tau=0}^{t-1}\gamma\log(1+c_t)\right]$ is an endogenous discount factor that is introduced to induce stationarity in consumption and asset dynamics. γ is the elasticity of the subjective discount factor with respect to consumption.[4]

The households' budget constraint is:

$$c_t^T + p_t^N c_t^N = (1+\varepsilon_t^R)Rem + (1+\varepsilon_t^y)y^T + p_t^N y^N - b_{t+1} + (1+r)b_t \tag{4}$$

where b_t is current bond holdings, $(1+r)$ is the gross return on bonds, and p_t^N is relative price of non-tradables. Notice that bond returns are denominated in units of tradables whereas they are partially financed by income earned in nontradable sector, i.e., liabilities are dollarized.

In addition to the budget constraint, foreign creditors impose the following borrowing constraint, which limits debt issuance as a share of total income at period t not to exceed κ up to a maximum Ω:[5]

$$b_{t+1} \geq -\kappa\left[(1+\varepsilon_t^R)Rem + (1+\varepsilon_t)y^T + p_t^N y^N\right] \geq \Omega. \tag{5}$$

The borrowing constraint takes a similar form to those used in the Sudden Stops literature (see for example, Mendoza, 2005; Caballero and Panageas, 2003; among others). The interaction of the borrowing constraint with the liability dollarization induces a debt deflation mechanism that amplifies the shocks to the economy. (See Mendoza, 2005 for further details.)

The optimality conditions can be summarized as follows:

$$U_c(t)\left(1-\frac{\nu_t}{\lambda_t}\right) = \exp\left[-\gamma\log(1+c_t)\right]E_t\left\{\frac{(1+r)p_t^c}{p_{t+1}^c}U_c(t+1)\right\}, \tag{6}$$

$$\frac{1-\omega}{\omega}\left(\frac{c_t^T}{c_t^N}\right)^{1+\mu} = p_t^N, \tag{7}$$

along with the budget constraint (Equation 4), the borrowing constraint (Equation 5), and the standard Kuhn-Tucker conditions. ν and λ are the Lagrange multipliers of the borrowing

[4]Mendoza, 1991 first introduced preferences with endogenous discounting to quantitative small open economy models. See Schmitt-Grohé and Uribe, 2003; and Kim and Kose, 2003 for alternative specifications used for this purpose.

[5]This upper bound is introduced to rule out equilibria in which the constraint is satisfied at very high levels of debt that increase c^T and p^N. See Mendoza (2005) for further details.

constraint and the budget constraint, respectively. U_c is the derivative of lifetime utility with respect to aggregate consumption. p_t^c is the CES price index of aggregate consumption in units of tradable consumption, which equals $\left[\omega^{\frac{1}{\mu+1}} + (1-\omega)^{\frac{1}{\mu+1}}(p^N)^{\frac{\mu}{\mu+1}}\right]^{\frac{1+\mu}{\mu}}$. Equation (6) is the standard Euler equation equating marginal utility at date t to that of date $t+1$. Equation (7) equates the marginal rate of substitution between tradables consumption and non-tradables consumption to the relative price of non-tradables.

We conduct a series of numerical exercises to explore the implications of remittance fluctuations on macroeconomic variables and Sudden Stops. These results are presented in the next section.

3 Quantitative Analysis

The recursive representation of the households' problem can be formulated as follows:

$$\begin{aligned} V(b,\varepsilon) &= \max_{b'} \left\{u(c) + (1+c)^{-\gamma} E\left[V(b',\varepsilon')\right]\right\} \quad s.t. \\ c^T &= (1+\varepsilon^R)Rem + (1+\varepsilon^y)y^T - b' + Rb, \\ c^N &= y^N, \\ b' &\geq -\kappa\left[(1+\varepsilon^R)Rem + (1+\varepsilon^y)y^T + p^N y^N\right] \geq \Omega. \end{aligned} \tag{8}$$

Here $\mathcal{B} = \{b_1 < ... < b_{NB}\}$ is the endogenous state space. $\mathcal{E} = \{\varepsilon^R, \varepsilon^y\}$ is the exogenous state space, which follows a joint Markov process with known vectors of realization. To approximate the Markov process for those exogenous shocks, we, first, estimate a vector-autoregression (VAR) of tradable output and remittance series. Then we estimate the Markov transition matrix using Tauchen and Hussey's (1991) quadrature procedure. The VAR representation of the system can be summarized as follows:

$$\xi_t = RHO \cdot \xi_{t-1} + e_t \tag{9}$$

where

$$\xi_t \equiv \begin{bmatrix} \varepsilon^y \\ \varepsilon^R \end{bmatrix}, \quad RHO = \begin{bmatrix} \rho_y & \rho_{y,R} \\ \rho_{R,y} & \rho_R \end{bmatrix}, \quad e_t \equiv \begin{bmatrix} e_t^y \\ e_t^R \end{bmatrix}.$$

We calibrate the model to both Turkish and Mexican economies. Table 1 suggest that the

remittance fluctuations are procyclical in Turkey where as they are countercyclical in Mexico. The parameter values are summarized in Table 2. Parameters common for both countries are relative risk aversion parameter, which is set to 2; world interest rate, which is set to the quarterly equivalent of 6.5 percent; the elasticity of substitution between tradable and nontradable good, which is set to 0.316 following the estimates of Ostry and Reinhart (1992). The relative price of nontradables and mean tradable endowments are normalized to 1 for both countries. The rest of the parameters are country specific as summarized in the Table. The estimated VAR coefficients for Turkey are

$$RHO = \begin{bmatrix} 0.58047 & 0.016397 \\ 1.48436 & 0.36511 \end{bmatrix}$$

with the standard deviation of the endowment shock equals 0.0351 and of the remittance shock equals 0.20671. The VAR coefficients for Mexico are

$$RHO = \begin{bmatrix} 0.68662 & -0.022866 \\ -1.06992 & 0.19940 \end{bmatrix}$$

with the standard deviation of the endowment shock equals 0.02681 and of the remittance shock equals 0.1238.

We solve the stochastic simulations using value function iteration over a discrete state space. The state space spans [-5.0, 3.0] interval with 1,000 grid points for both calibrations to Mexico and Turkey. We employ the solution procedure described in Durdu (2006) and Mendoza (2002). We start with an initial conjecture for the value-function and solve the model without imposing the borrowing constraint. We then check whether the bond decision satisfies the borrowing constraint. If so, the solution is found and we calculate the implied value-function, which is then used as a conjecture for the next iteration. If not, we impose the borrowing constraint with equality and resolve it. Then, we calculate the implied value-function using the optimal bond holdings and iterate to convergence.

We divide the stochastic simulations in to four sets. In the first set, which we call *Baseline NB* (for "no borrowing contraint"), the borrowing constraint does not bind and the economy is hit by both endowment and remittance shocks. In the second set, which is labeled as *Baseline B*, the economy is hit by both the endowment and remittance shocks again, but it, now, faces a borrowing constraint. In the third set, the economy is hit by an endowment shock only, and the borrowing constraint does not bind. This set is labeled *End. Shock NB*, accordingly.

In the last set, called *End. Shock B*, the economy is hit by endowment shock only, and the borrowing constraint binds. These simulation exercises aim to shed light on how significant a role remittances play in macroeconomic fluctuations and Sudden Stops.

Figures 3 and 4 show the ergodic distribution of bond holdings in the baseline economies for Turkey and Mexico, respectively. Those figures, first, illustrate how solutions capture the ergodic distribution in each of the simulation exercises as well as how the imposition of the borrowing constraint sharply strengthens the precautionary savings motive, which in turn leads to a strong shift of the distribution to the right. Both figures are in line with the findings of the studies in the Sudden Stops literature such as Mendoza (2002), among others.

Table 3 summarizes the long run business cycle statistics for Turkey. In the nonbinding case, the elimination of procyclical remittance fluctuations reduces the volatility of consumption from 1.77 percent to 1.51 percent. In line with this change, the volatility of aggregate consumption, the volatility of relative price of nontradables, and the volatility of savings also decline. Procyclical remittance fluctuations lead to stronger comovement of consumption with income (compare, for instance, the correlation of tradable consumption with GDP standing at 0.72 in the baseline case with the respective correlation of 0.67 in the endowment shock only case). Remittance fluctuations also strengthen the precautionary savings behavior, since they reduce the catastrophic income levels.

Aiyagari (1994) shows the relationship between the catastrophic income levels and precautionary savings behavior. In his analysis, he establishes that risk averse agents have strong incentives to build up precautionary wealth to insure against the risk of state of natures in which the income stays its lowest level forever, i.e., income is at its catastrophic level. He also shows that if a structural change in the economy such as more volatile and/or more persistent income shocks reduces the catastrophic income levels, precautionary savings that agents in the economy engage in would increase (see Aiyagari, 1994, Durdu, 2006 and Durdu et. al., 2007 for further analysis on the relationship between catastrophic income levels and precautionary savings).

To generalize, the results in Table 3 indicate, in line with the findings of Mendoza (2002), that the imposition of the borrowing constraint reduces volatilities of all key variables below the levels observed in the nonbinding economies, by strengthening the precautionary savings motive. Further, eliminating remittance fluctuations reduces the volatilities in the case of Turkey.

Table 4 summarizes the long run business cycle statistics for Mexico. Contrary to the Turkish

case, remittance fluctuations dampen the cycles in the Mexican economy because of their countercyclical nature. In the nonbinding case, volatility of consumption falls to 1.18 percent in the baseline case compared to the high of 1.40 percent in the economy with endowment shock only. In line with that result, correlation of tradable consumption with GDP increases from 0.74 in the baseline case to 0.78 in the economy with endowment shock only. As in the simulation exercises with parameter values calibrated to Turkey, imposition of the borrowing constraint does not change the direction of the changes as a result of remittance fluctuations.

Since emerging countries are typically borrowing constrained and the borrowing constraints in the economy get tighter on the eve of a financial crisis, an exogenous shock that can be smoothed with foreign borrowing can lead to a Sudden Stop in such economies. With occasionally binding borrowing constraints in place, our model can generate Sudden Stops, allowing us to explore how remittance fluctuations affect Sudden Stops by analyzing model dynamics. For this purpose, we use forecasting functions. To derive those functions, conditional on the economy being in a state in which the borrowing constraint binds, we first give a one standard deviation negative tradable endowment shock and derive the response in End. Shock NB economy, and then we give simultaneous one-standard-deviation negative endowment shock and one-standard-deviation remittance shock and derive the response of the baseline NB economy. We choose the nature of remittance shocks by considering the opposing cyclical characteristics of remittances in Turkey and Mexico. We follow the same steps for the binding economies, as well. By taking the differences between these responses, we can calculate the additional response that remittance shocks trigger.

Figure 5 plots the conditional forecasting functions of aggregate consumption, tradable consumption, current account-GDP ratio and relative price of nontradables for Turkey. In the nonbinding cases, additional (negative) remittance shocks trigger mild additional responses (notice how close solid lines in Figure 5 are to the zero line). In the binding cases, however, remittance shocks trigger much larger additional responses. For example, remittance shocks lead to around 2 percent additional decline in tradable consumption, around 8 percent additional decline in aggregate consumption, around 3 percent additional surplus in current account-GDP ratio, and 0.7 percent additional decline in relative price of nontradables. These results suggest that on the eve of a financial crisis, remittance shocks can have a significant effect on the economy, as the borrowing constraints in the economy get tighter and small additional shocks get magnified by a Fisherian debt deflation process. (See Mendoza, 2005 for further analysis of Fisherian debt

deflation.)

Figure 6 plots the conditional forecasting function for Mexico. In this exercise, we compare the effect of a negative endowment shock per se with that of a negative endowment shock along with a positive remittance shock by considering the countercyclical nature of remittances in Mexico. In line with the results for the Turkish case, when the economy is not borrowing constrained, the remittance shocks do not alter the responses in the economy significantly. When the economy is borrowing constrained, however, positive remittance shocks provide a significant smoothing effect. For example, the positive remittance shock helps reduce the decline in tradable consumption by about 1.4 percent, that in aggregate consumption and relative price of nontradables by around around 6 percent and 0.5 percent, respectively, while smoothing current account reversal by about 2 percentage points.

4 Conclusion

Recently presented evidence in the literature indicate that remittances sent home by Turkish workers abroad move in the same direction as the business cycles in Turkey, whereas remittance receipts of Mexico are countercyclical to fluctuations in Mexican output. Given the procyclicality of remittances received by Turkey, drops in the amounts remitted by migrant Turkish workers during or shortly after cyclical contractions in Turkish GDP will tend to fan the flames of a crisis in the Turkish economy, whereas countercyclical remittances from migrant Mexican workers will tone down a crisis in the Mexican economy. Yet, the existing literature is largely silent about the magnitude of the effects of remittances on cyclical volatility of output and other macroeconomic variables, as well as Sudden Stops, particularly in the case of countries whose remittance receipts fluctuate procyclically.

This paper aimed to close this gap in the literature by exploring the effects of migrants' remittances flows with opposite responses to business cycle fluctuations in the recipient economies on key macroeconomic aggregates and Sudden Stops experienced by these countries. For this purpose, we considered Mexico and Turkey, two emerging economies that rank among the major recipients of remittances, whose receipts are countercyclical and procyclical to home business cycles, respectively. We employed a general equilibrium framework with a tradable and a nontradable sector to model small open economies of Mexico and Turkey. We allowed for dollarization of the liabilities and let agents face a borrowing constraint in international capital markets

for added realism in capturing the common structural characteristics of Mexican and Turkish economies. After calibrating this model to the data for each economy, we ran four different simulation experiments involving an endowment and a remittance shock for each country, under binding and non-binding borrowing constraint scenarios. Our results indicated the following:

- Remittances dampen the cycles in Mexico, whereas they amplify the cycles in Turkey.
- Long run effects of remittances do not significantly depend on the existence of borrowing constraints, but their short run effects depend on whether the economy is borrowing constrained or not.
- Fisherian debt-deflation can magnify the effects of fluctuations in remittances in the short run in both countries.
- In Turkey where remittances are procyclical, fluctuations in amounts transferred by migrants strengthen the precautionary savings behavior, because they reduce the catastrophic income levels.
- Countercyclical (or procyclical) remittance fluctuations can help to reduce precautionary savings by increasing (or reducing) catastrophic income levels.
- On the eve of a financial crisis, remittances packages received from abroad could significantly reduce (or increase) the impact effect of financial crises if the remittances are countercyclical (or procyclical), implying that it could indeed pour, when it rains in the case of procyclical remittances (as Kaminsky, Reinhart and Végh put it in their 2004 study on procylical capital flows).

These findings provide a rationale for the importance of remittances in mitigating macroeconomic fluctuations and Sudden Stops. While contributing to close an important gap in the literature, one aspect that we did not explore is the migrants' decision on how much and when to remit, i.e., what makes remittances procyclical or countercyclical. We rather took those cyclical properties of remittance fluctuations as given and looked at their implications. Expanding our analysis on those missing angles requires to consider a framework, which endogenizes altruistic motives of remittance decisions. Albeit interesting, this is a question that we leave for further research.

References

[1] Acosta, P. A., E. K.K. Lartey, and F. S. Mandelman (2007). "Remittances and the Dutch Disease." Working Paper, Federal Reserve Bank of Atlanta, 2007-8.

[2] Aguinas, D.R. (2006). "Remittances and Development: Trends, Impacts, and Policy Options (A Review of the Literature)." Washington: Migration Policy Research Institute.

[3] Aiyagari, S. R. (1994). "Uninsured Idiosyncratic Risk and Aggregate Saving." *Quarterly Journal of Economics*, v. 109, No. 3, pp. 17-31.

[4] Buch, C. and A. Kuckulenz (2004). "Worker Remittances and Capital Flows to Developing Countries." Discussion Paper, Centre for European Economic Research, 04-31.

[5] Buch, C.M., A. Kuckulenz and M. Le Manchec (2002). "Worker Remittances and Capital Flows, Discussion Paper, Kiel Institute for World Economics, 1130.

[6] Bugamelli, M., F. Paternò (2005). "Do Workers' Remittances Reduce the Probability of Current Account Reversals" World Bank Policy Research Working Paper No. 3766.

[7] Bugamelli, M., F. Paternò (2006). "Output Volatility and Remittances." Draft, Bank of Italy.

[8] Caballero, R. J., S. Panageas (2003). "Hedging Sudden Stops and Precautionary Recessions: A Quantitative Framework." Mimeo, MIT.

[9] Calvo, G. A., A. Izquierdo, and L. Mejía, 2004, "On the Empirics of Sudden Stops: The Relevance of Balance-Sheet Effects ," Working Paper, IADB, 509.

[10] Chami, R., T. F. Cosimano, and M. T. Gapen (2006). "Beware of Emigrants Bearing Gifts: Optimal Fiscal and Monetary Policy in the Presence of Remittances." Working Paper, International Monetary Fund, WP/06/61.

[11] Chami, R., C. Fullenkamp and S. Jahjah (2003). "Are Immigrant Remittance Flows a Source of Capital for Development?" Working Paper, International Monetary Fund, WP/03/189.

[12] Durdu, C. B. (2006). "Quantitative Implications of Indexed Bonds in Small Open Economies." Working Paper, Congressional Budget Office, 2006-12.

[13] Durdu, C. B., E. G. Mendoza (2006). "Are Asset Price Guarantees Useful for Preventing Sudden Stops?: The Globalization Hazard-Moral Hazard Tradeoff of Asset Price Guarantees." *Journal of Inernational Economics*, v. 69, pp. 84-119.

[14] Durdu, C. B., E. G. Mendoza, M. Terrones (2007). "Precatuionary Demand for Foreign Assets in Sudden Stop Economies: An Assestment of New Merchantalism." Working Paper, IMF, 07/146.

[15] Epstein, L. G. (1983). "Stationary Cardinal Utility and Optimal Growth under Uncertainty." *Journal of Economic Theory*, v. 31, pp. 133-152.

[16] IMF (2005). *World Economic Outlook: Globalization and External Imbalances*, Washington: International Monetary Fund.

[17] Kaminsky, G.L., C.M. Reinhart and C.A. Vgh, 2004, "When It Rains It Pours: Procyclical Capital Flows and Macroeconomic Policies" in *NBER Macroeconomics Annual* 2004, ed. by M. Gertler and K. Rogoff, Cambridge: MIT Press, pp. 11-53.

[18] Kim, S. H. and M. A. Kose (2003). "Dynamics of Open-Economy Business-Cycle Models: Role of the Discount Factor." *Macroeconomic Dynamics*, Cambridge University Press, vol. 7(2), pages 263-90.

[19] Kose, M. Ayhan (2002). "Explaining business cycles in small open economies: 'How much do world prices matter?'." *Journal of International Economics*, v. 56(2), pp. 299-327.

[20] Lane, P., G. M. Milesi-Ferretti (2001). "The External Wealth of Nations: Measures of Foreign Assets and Liabilities for Industrial and Developing Countries." *Journal of International Economics*, v. 55, pp. 263-294.

[21] Mendoza, E. G. (1991). "Real Business Cycles in a Small Open Economy," *American Economic Review*, v. 81, 797-818, September.

[22] Mendoza, E. G. (2002). "Credit, Prices, and Crashes: Business Cycles with a Sudden Stop" in *Preventing Currency Crisis in Emerging Markets*, ed. by S. Edwards and J. Frankel, University of Chicago Press.

[23] Mendoza, E. G. (2005). "Real Exchange Rate Volatility and the Price of Nontradables in Sudden-Stop Prone Economies" *Economia*, fall, pp. 103-148.

[24] Mishra, P. (2005). "Macroeconomic Impact of Remittances in the Caribbean." Unpublished, Washington: International Monetary Fund.

[25] Neumeyer, P. A., F. Perri (2005). "Business Cycles in Emerging Economies: the Role of Interest Rates." *Journal of Monetary Economics*, v. 52, pp. 345-380.

[26] Ostry, J. D., C. Reinhart (1992). "Private Saving and Terms of Trade Shocks." *IMF Staff Papers*, v. 39, pp 495-517.

[27] Oviedo, P. Marcelo (2005). "World Interest Rates, Business Cycles, and Financial Intermediation in Small Open Economies." mimeo, Iowa State University.

[28] Ratha, D., 2003, "Workers' Remittances: An Important and Stable Source of External Development Finance," (Chapter 7) in *Global Development Finance: Striving for Stability in Development Finance*, Washington: World Bank, pp. 157-175.

[29] Sayan, S. (2004). "Guest Workers' Remittances and Output Fluctuations in Host and Home Countries, pp. The Case of Remittances from Turkish Workers," Emerging Markets Finance and Trade, v. 40(6), pp. 70-84.

[30] Sayan, S. (2006). "Business Cycles and Workers' Remittances: How Do Migrant Workers Respond to Cyclical Movements of GDP at Home?" Working Paper, International Monetary Fund, WP/06/52.

[31] Sayan, S., A. Tekin-Koru (2007). "The Effects of Economic Developments and Policies in Host Countries on Workers' Remittance Receipts of Developing Countries: The Cases of Turkey and Mexico Compared," in R. Lucas, L. Squire and T. Srinivasan (eds.), The Impact of Rich Country Policies on Developing Economies. London: Edward Elgar, *forthcoming.*

[32] Tauchen, G., R. Hussey (1991). "Quadrature-Based Methods for Obtaining Approximate Solutions to Nonlinear Asset Pricing Models." *Econometrica*, v. 59, no. 2, pp. 371-396.

[33] Schmitt-Grohé, S., M. Uribe (2003). "Closing Small Open Economy Models." *Journal of Inernational Economics*, v. 61, pp. 163-185.

[34] UNCTAD (2006). Trade and Development Report, 2006. Geneva: United Nations.

[35] World Bank (2006a). *Global Economic Prospects: Economic Implications of Remittances and Migration*, Washington: World Bank.

[36] The World Bank (2006b). The Development Impact of Workers' Remittances in Latin America, Report No. 37026 (2 Volumes). Washington: World Bank.

Table 1: Business Cycle Facts for Mexico and Turkey

Variable:x	$\sigma(x)$	$\sigma(x)/\sigma(Y)$	$\rho(x)$	$\rho(x,Y)$	Sudden Stop	Sudden Stop relative to std.
Mexico					1994:4-1995:1	
GDP (Y)	2.26	1.0	0.80	1.0	-7.4	3.3
tradables GDP	2.7	1.2	0.7	0.92	-8.98	3.35
nontradables GDP	2.19	0.97	0.83	0.98	-6.18	2.82
remittance	12.38	5.48	0.26	-0.38	6.61	0.53
consumption	4.22	1.87	0.84	0.97	-11.20	2.65
real exchange rate	8.63	3.82	0.73	0.60	-32.84	3.81
CA/Y	0.70	0.31	0.83	-0.47	2.22	3.18
Turkey					1994:1-2	
GDP (Y)	3.70	1.00	0.67	1.00	-10.38	2.00
tradables GDP	3.51	0.95	0.52	0.96	-10.93	3.11
nontradables GDP	4.02	1.09	0.68	0.98	-10.01	2.49
remittance	20.67	5.60	0.42	0.22	-30.36	1.47
consumption	4.13	1.12	0.75	0.92	-10.10	2.4
real exchange rate	9.11	2.47	0.68	0.60	-31.63	3.47
CA/Y	2.74	0.74	0.63	-0.59	9.7	3.38

Source: Bank of Mexico, Central Bank of Turkey, International Financial Statistics. The data cover periods 1987:Q1-2004:Q4 for Mexico, 1987:Q1-2004:Q4 for Turkey. Data are quarterly seasonally adjusted real series. GDP and consumption data are logged and filtered using an HP filter with a smoothing parameter 1600. Real exchange rates are calculated using the IMF definition ($RER_i = NER_i \times CPI_i/CPI_{US}$ for country i).

Table 2: Parameter Values

Parameter	**Value**	**Definition**	**Source**
General Parameters			
σ	2	Relative risk aversion	RBC parametrization
y^T	1	Tradable endowment	normalization
R	1.0159	Gross interest rate	RBC parametrization
μ	0.316	Elasticity of substitution	Ostry and Reinhart (1992)
p^N	1	Relative price of NT	Normalization
Country Specific Parameters for Turkey			
y^N/y^T	1.3418	Share of NT output	Turkish data
Rem/GDP	0.03	Remittance-GDP ratio	Turkish data
κ	0.4	Constraint coefficient	Set to match SS dynamics
ω	0.4222	CES weight	Calibration
γ	0.0198	Elasticity of discount factor	Calibration
Country Specific Parameters for Mexico			
y^N/y^T	1.543	Share of NT output	Mexican data
Rem/GDP	0.02	Remittance-GDP ratio	Mexican data
κ	0.4	Constraint coefficient	Set to match SS dynamics
ω	0.3723	CES weight	Calibration
γ	0.0187	Elasticity of discount factor	Calibration

Table 3: Long Run Business Cycle Statistics of the Model Economy Calibrated to Turkey

	Economies			
	Baseline NB	**Baseline B**	**End. Shock NB**	**End. Shock B**
Means				
tradable consumption	1.06	1.07	1.06	1.07
aggregate consumption	1.21	1.22	1.21	1.22
relative price of NT	1.00	1.02	1.00	1.01
savings	-0.78	0.09	-0.79	-0.07
current account-GDP ratio	-0.03	-0.03	-0.03	-0.03
Standard Deviation (%)				
tradable consumption	1.77	1.41	1.51	1.20
aggregate consumption	0.78	0.62	0.67	0.53
relative price of NT	2.33	1.86	1.99	1.58
savings	97.94	60.34	84.20	52.13
current account-GDP ratio	1.48	1.43	1.48	1.45
Correlation with GDP				
tradable consumption	0.72	0.70	0.68	0.65
aggregate consumption	0.72	0.70	0.68	0.65
relative price of NT	0.72	0.70	0.68	0.65
savings	0.68	0.60	0.62	0.56
current account-GDP ratio	0.74	0.77	0.80	0.82
Autocorrelation				
tradable consumption	0.99	0.97	0.99	0.97
aggregate consumption	0.99	0.97	0.99	0.97
relative price of NT	0.99	0.97	0.99	0.97
savings	0.99	0.99	0.99	0.99
current account-GDP ratio	0.52	0.52	0.53	0.52

Notes: The first column shows the statistics in the model economy with non-binding borrowing constraint and with both the endowment and remittance shocks, the second column shows the statistics in the model economy with binding borrowing constraint and with both the endowment and remittance shocks. The last two columns show the statistics for the respective economies with non-binding and binding borrowing constraints but the endowment shocks only. NB refers to nonbinding economy, and B refers to binding economy. End. refers to endowment.

Table 4: Long Run Business Cycle Statistics of the Model Economy Calibrated to Mexico

	Economies			
	Baseline NB	**Baseline B**	**End. Shock NB**	**End. Shock B**
Means				
tradable consumption	1.04	1.05	1.04	1.05
aggregate consumption	1.32	1.34	1.32	1.33
relative price of NT	1.00	1.01	1.00	1.01
savings	-0.83	-0.32	-0.83	-0.21
current account-GDP ratio	-0.02	-0.02	-0.02	-0.02
Standard Deviation (%)				
tradable consumption	1.18	0.99	1.40	1.07
aggregate consumption	0.47	0.40	0.56	0.43
relative price of NT	1.55	1.30	1.84	1.40
savings	63.02	42.89	78.70	48.39
current account-GDP ratio	1.02	1.00	1.01	1.00
Correlation with GDP				
tradable consumption	0.74	0.72	0.78	0.74
aggregate consumption	0.74	0.73	0.78	0.74
relative price of NT	0.74	0.72	0.78	0.74
savings	0.66	0.60	0.71	0.63
current account-GDP ratio	0.75	0.78	0.71	0.76
Autocorrelation				
tradable consumption	0.97	0.95	0.99	0.97
aggregate consumption	0.97	0.95	0.99	0.97
relative price of NT	0.97	0.95	0.99	0.97
savings	0.99	0.99	0.99	0.99
current account-GDP ratio	0.60	0.60	0.60	0.60

Notes: The first column shows the statistics in the model economy with non-binding borrowing constraint and with both the endowment and remittance shocks, the second column shows the statistics in the model economy with binding borrowing constraint and with both the endowment and remittance shocks. The last two columns show the statistics for the respective economies with non-binding and binding borrowing constraints but the endowment shocks only. NB refers to nonbinding economy, and B refers to binding economy. End. refers to endowment.

Figure 1: Business Cycles in Turkey

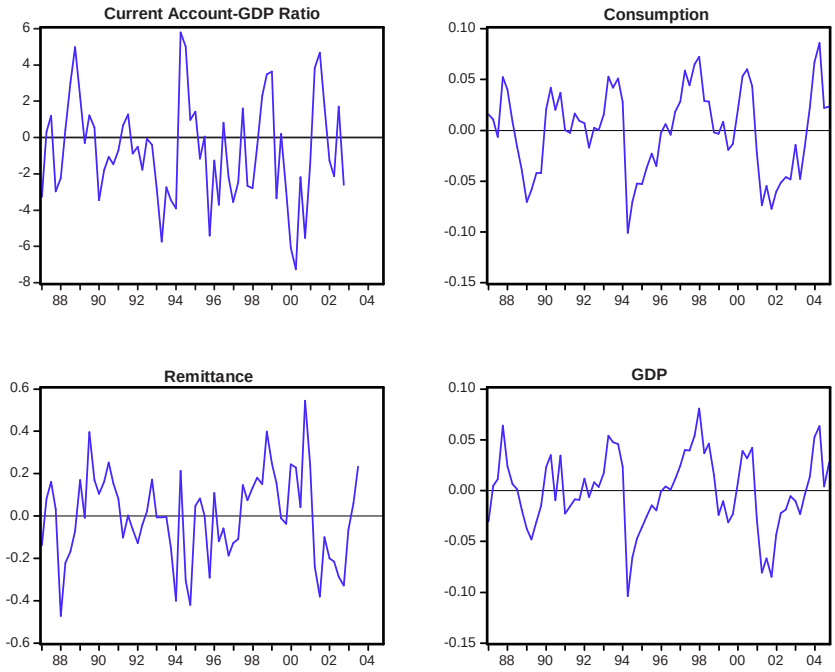

Figure 2: Business Cycles in Mexico

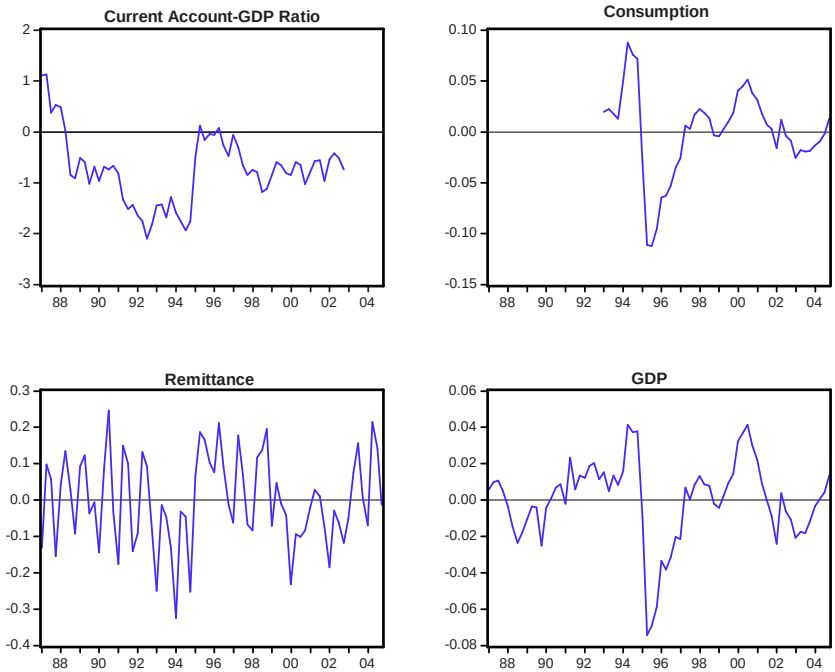

Figure 3: Long-Run Distributions of Bond Holdings in the Model Economy Calibrated to Turkey

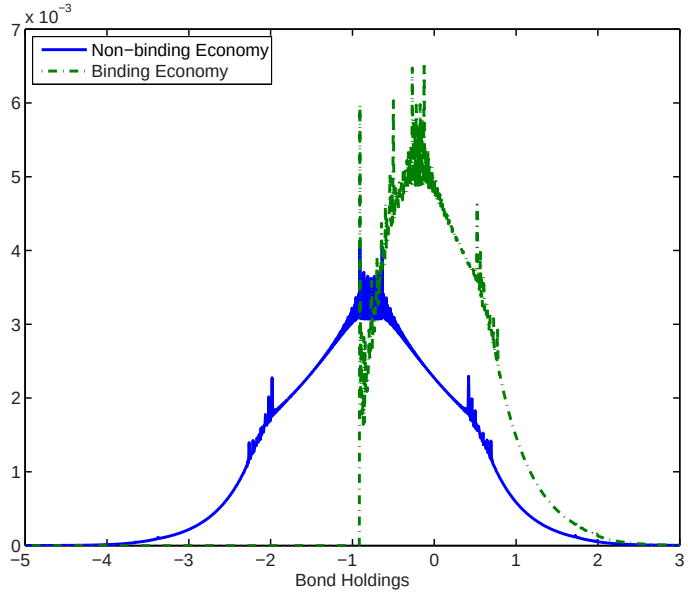

Figure 4: Long-Run Distributions of Bond Holdings in the Model Economy Calibrated to Mexico

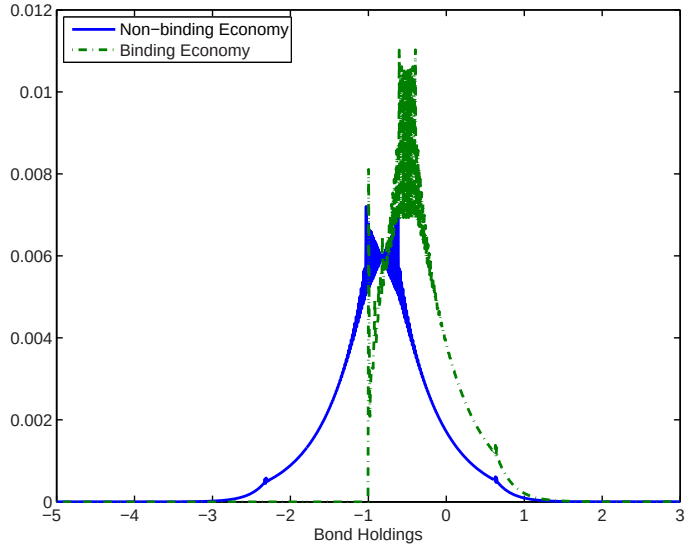

Figure 5: Conditional Forecasting Functions in the Model Economy Calibrated to Turkey

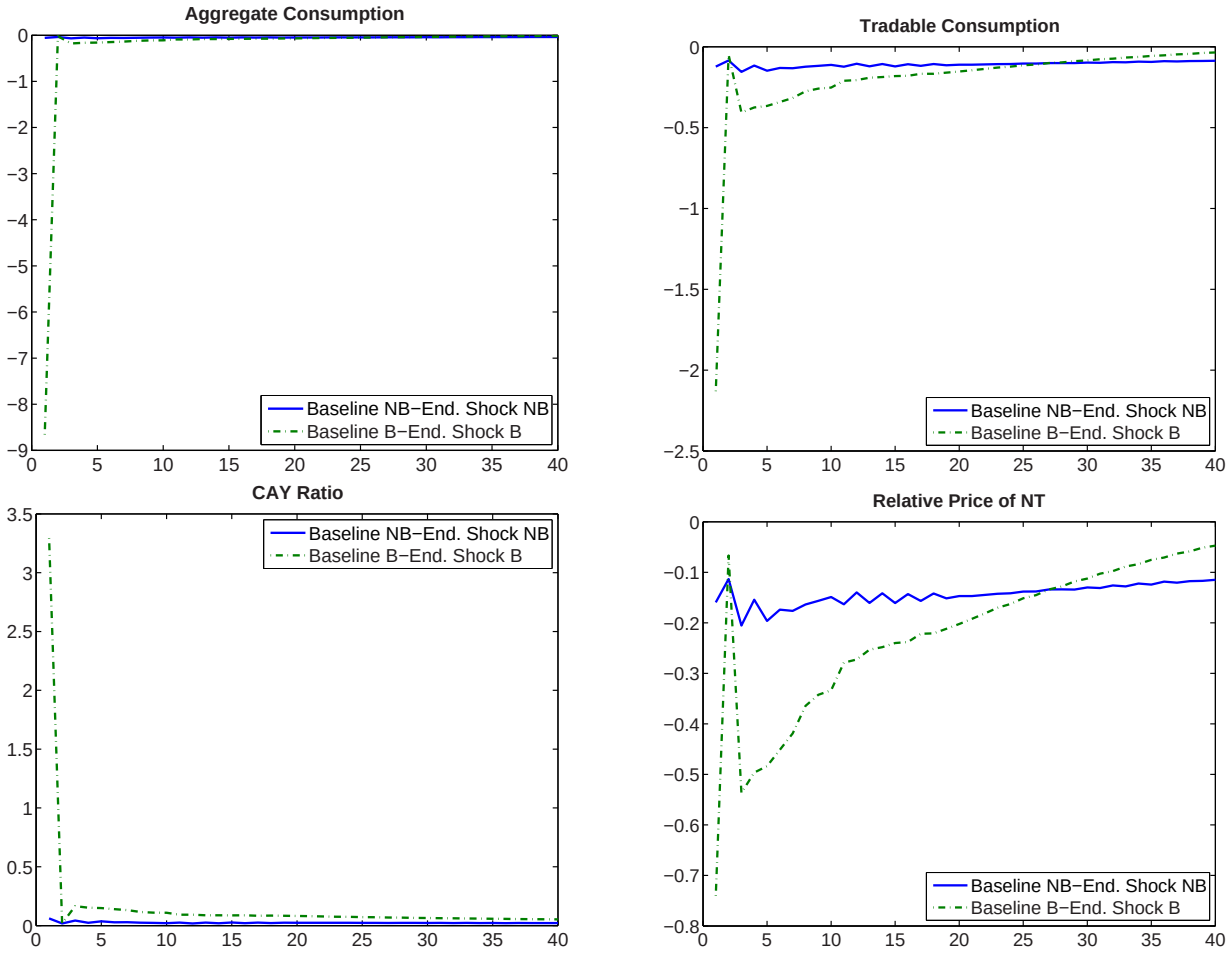

Figure 6: Conditional Forecasting Functions in the Model Economy Calibrated to Mexico