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Uncovering the Portfolio Balance Channel with the use of Sovereign Credit Ratings*

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Abstract

In this paper we study exchange rate effects due to shifts in the portfolio composition of the Colombian financial sector during 2003-2014. We first provide a theoretical understanding of the channel's transmission mechanism by modeling how the banking sector optimally allocates its portfolio composition. This allows us to characterize departures from the uncovered interest rate parity condition (UIP) in terms of foreign and domestic assets. In the empirical application, we control for a potential simultaneity bias by using a novel instrument for portfolio compositions: the use of sovereign credit ratings and outlook changes made by Moody's, Standard and Poor's and Fitch Ratings. Our findings indicate that shifts in portfolio balances affect only the long term (5-year) risk premium in up to five months before the effects subside. Additionally, we find stronger and more persistent portfolio effects in cases in which US ratings increased relative to Colombian ratings.

JEL Codes: C58, E44, G11, G14

Key Words: portfolio balance channel, sovereign credit rating, uncovered interest rate parity, monetary trilemma

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1 Introduction

The total currency turnover in global financial markets has dramatically increased ever since the end of the Bretton Woods system in the early 1970's. Moreover, progressive financial innovation and deregulation have prompted foreign exchange trading to exceed, by almost 20-fold, the volume of goods and services worldwide.[1] According to most of the theoretical literature, these flows are mostly driven by channels of expectations or portfolio balances; the latter being the main focus of our investigation.[2] Namely, it states that changes in relative expected returns induce agents to re-balance their portfolios. If agents are risk-averse, then shifts in the portfolio composition should have a direct effect on the exchange rate. Paradoxically, the recent literature has yet to reach a consensus on the effects of these channels. This is partially due to empirical obstacles which include data availability (especially when measuring exchange rate expectations) and disentangling confounding effects brought forth by economic variables that endogenously react to asset portfolios.

In this paper we first provide a theoretical understanding of the portfolio balance channel by modeling how the banking sector optimally allocates its portfolio composition. Hence, we follow the early works of Henderson and Rogoff (1982), Kouri (1981), Branson and Henderson (1985) and Weber (1986), and more recent works such as Gabaix and Maggiori (2014) and Cardozo et al. (2015), in order to characterize departures from the uncovered interest rate parity condition (**UIP**) in terms of foreign and domestic assets.

In the empirical application, we propose a novel instrument for shifts in the portfolio composition of US and Colombian assets: the use of sovereign credit ratings and outlook changes conducted by Moody's, Standard and Poor's and Fitch Ratings during 2003-2014. We argue that announcements on sovereign bonds largely affect investors' decisions given that they reflect the ability of a government to meet its financial commitments. In fact, they are particularly important for developing economies given the high degree of risk and limited flow of information (see Alsakka and Ap Gwilym (2012)).

Consequently, we first use an event study analysis in order to estimate the effects of credit ratings on portfolio compositions. We control for exchange rate volatility, commodity prices, relative output growth, interest rate differentials, and lagged values of credit ratings and portfolio balances in order to avoid endogenous or anticipatory movements within our instrument (i.e. omitted variable bias).[3] This allows us to isolate exogenous movements within portfolio compositions. We then study

[1] See the 2013 Triennial Central Bank Survey of the Bank for International Settlements (BIS).

[2] Theoretical surveys that provide an in-depth view of the portfolio balance channel include Sarno and Taylor (2001), Evans (2005), Lyons (2006), and Villamizar-Villegas and Perez-Reyna (2015).

[3] These variables are published by credit agencies as glossaries of key indicators and are used as criteria for the computation of ratings.

the effects of the estimated portfolio movements on departures from the UIP condition (i.e. risk premium).

Our findings indicate that shifts in portfolio balances affect only the long term (5-year) risk premium in up to five months before the effects subside. Additionally, we find stronger and more persistent portfolio effects in cases in which US ratings increased relative to Colombian ratings. The foregoing results show that credit announcements convey additional and possibly asymmetric information that is not correlated with exchange rate behavior.

We acknowledge the ample empirical literature that exists on either the effects of sovereign credit ratings or on the effects of the portfolio balance channel. However, to the best of our knowledge there is no study that uses credit ratings as an instrument of portfolio compositions, outside of the present study. Namely, studies that directly evaluate the impact of credit ratings on the exchange rate, without explicitly examining the portfolio balance channel include Alsakka and Ap Gwilym (2012), Treepongkaruna and Wu (2012), and Bissoondoyal-Bheenick et al. (2011). Alternatively, studies that center on the portfolio balance channel include Dominguez and Frankel (1993), Edison (1993), Dominguez (2003), Fatum and Hutchison (2003), Neely (2005), Menkhoff (2010), Villamizar-Villegas and Perez-Reyna (2015), Cardozo et al. (2015), and Kuersteiner et al. (2016). Hence, we believe that our investigation will shed some light on the ongoing debate regarding both the theoretical and empirical implications of the portfolio channel.

Our paper proceeds as follows: Section 2 describes the data and provides some descriptive statistics. Section 3 presents the theoretical underpinnings of the portfolio balance channel as seen from a partial equilibrium perspective. Section 4 presents the empirical strategy and comments on results. Finally, section 5 concludes.

2 Data Description

2.1 Sovereign Credit Ratings

Our period of study dates from January 2003 up until September 2014. Our chosen rating agencies consist of Moody's, Standard and Poor's (S&P) and Fitch Ratings (Fitch). These agencies, which correspond to the most representative agencies in Colombia, provide two types of announcements concerning sovereign bonds: Outlook/Watch and Grade ratings. While the former imparts an overall perspective of the underlying asset structure, namely a *Positive*, *Stable* or *Negative* outlook, the latter indicates an agency-specific grade ranking. We present a list of each grade announcement (per agency) in Table A1 of Appendix A. Additionally, Figures 1-4 depict announcements of long-term sovereign bonds (i.e. 1 and 5-year maturities) for both the United States and Colombia. Specifically, Figures 2 and 4 depict Outlook/Watch announcements and Figures 1 and 3 depict Grade ratings for the case of Colombia and the United States, respectively.

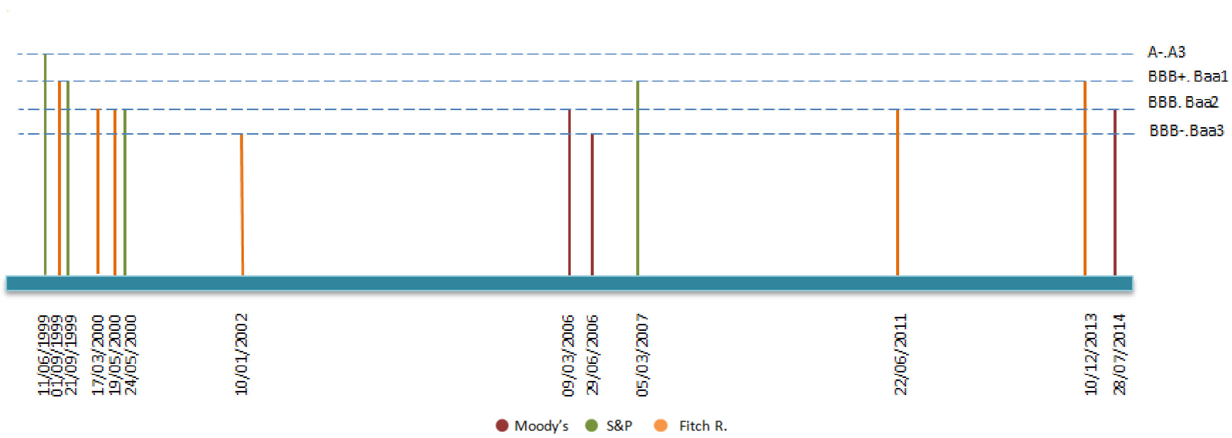

Figure 1: Grade Ratings of Colombian Sovereign Bonds (1 and 5-years)

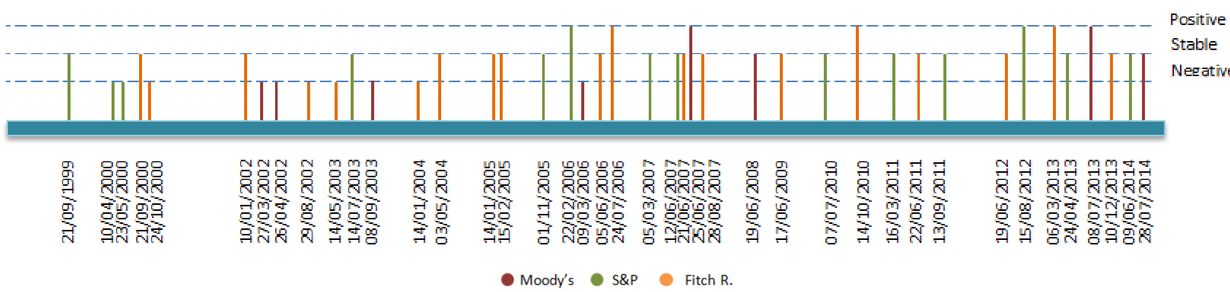

Figure 2: Outlook/Watch of Colombian Sovereign Bonds (1 and 5-years)

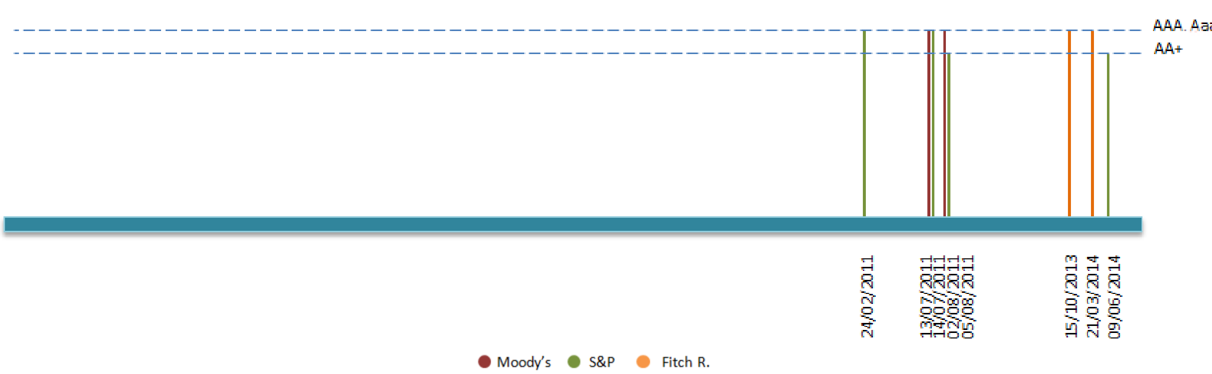

Figure 3: Grade Ratings of US Sovereign Bonds (1 and 5-years)

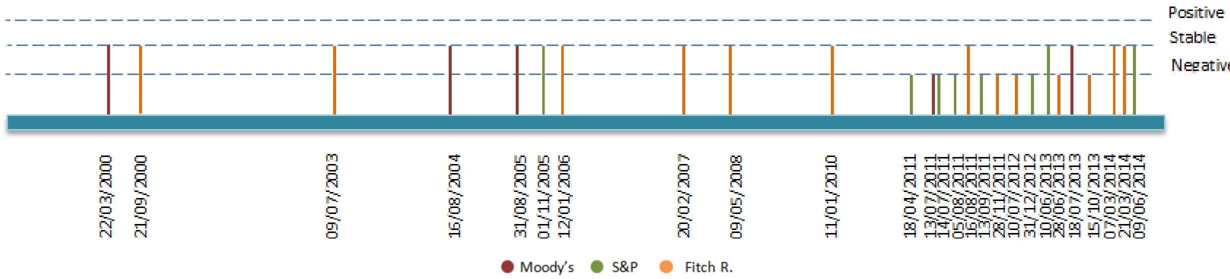

Figure 4: Outlook/Watch of US Sovereign Bonds (1 and 5-years)

2.2 Portfolio Measures

We employ two different portfolio measures in our estimations. Both are constructed with monthly data (of foreign and domestic bond holdings) obtained from the financial superintendency.[4]

Following Dominguez and Frankel (1993), our first measure (X^{DFp}) consists of foreign (US) bond investments expressed in domestic currency, $\varepsilon_t B_t^*$, relative to total investment, as follows:

$$X_t^{DFp} = \frac{\varepsilon_t B_t^*}{B_t + \varepsilon_t B_t^*}, \tag{2.1}$$

where B_t^* and B_t denote foreign and domestic bonds, respectively, and ε is the nominal exchange rate expressed in Colombian Pesos per US dollar (COP/USD). The second measure (X^{Ratp}) is simply the ratio of foreign to domestic investment, expressed in units of domestic currency, as follows:

$$X_t^{Ratp} = \frac{\varepsilon_t B_t^*}{B_t}. \tag{2.2}$$

Figure 5 depicts the two portfolio measures for cases in which US ratings increased relative to Colombian ratings ("+" henceforth) and for cases in which Colombian ratings increased relative to US ratings ("-" henceforth). As shown, portfolio substitution towards foreign assets was high during 2008-2009 and low during 2003-2008. The heightened acceleration after 2006 was likely attributed to the high credit and liquidity risk (of risky assets) preceding the financial world crisis.

[4]Data were obtained from the *Superintendencia Financiera de Colombia*. See Table 1 for a summary of descriptive statistics.

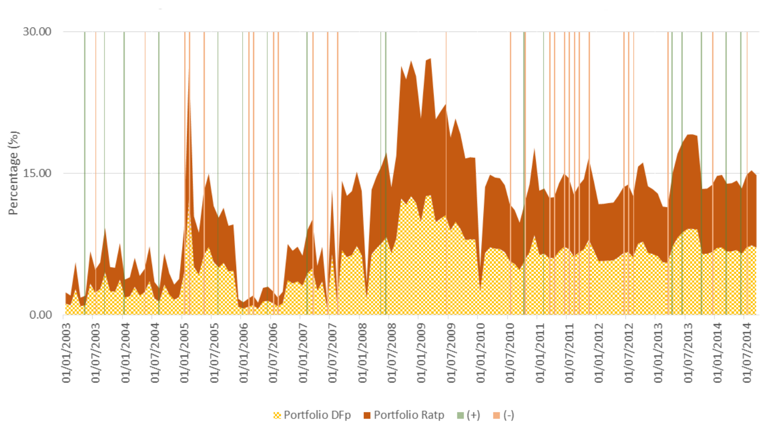

Figure 5: Evolution of Portfolio Measures X^{DFp} and X^{Ratp} (2003-2014)

2.3 Other Variables

The remaining variables in our dataset are described as follows:[5]

- Variables used to estimate treatment effects on portfolio compositions
  - Colombian Sovereign Bond (TES) Yields: Daily observations of treasury bond yields from the Central Bank of Colombia. Bond maturities of one and five years.
  - US Sovereign Bond (T-BILL) Yields: Daily observations from the Federal Reserve of the United States. Bond maturities of one and five years.
  - Exchange Rate Volatility (COP/USD): Daily observations from the Central Bank of Colombia, computed using an EWMA (Exponentially Weighted Moving Average). Other volatility measures using a GARCH(1,1) methodology and squared daily returns were also considered but not reported.
  - WTI Crude Oil prices: Daily observations obtained from Bloomberg (USD per Barrel).
  - Relative Output Growth: Difference between Colombian and US industrial production growth. Data from the Central Bank of Colombia and the Federal Reserve of the United States.
- Variables used to compute departures from the UIP condition (i.e. risk premium)
  - Exchange Rate (COP/USD): Daily average market rate from the Central Bank of Colombia.
  - Expected Exchange Rate (COP/USD): Daily observations from the Central Bank of Colombia. We use two measures of expected exchange rates: the first measure consists of the one-year exchange rate forecasts from the expectations survey conducted monthly by the Central Bank of Colombia and covers the largest commercial banks, stockbrokers and pension funds in the country. The second measure is the one-year and five-year ahead ex-post exchange rate.
  - Interest rate Differentials: Difference between US and Colombian sovereign bond yields.

[5]Median values were considered for variables with a daily and weekly frequency in order to match with the financial sector data. Normality tests and stationarity properties are reported in Tables A3 and A4 of Appendix C.

Finally, we present descriptive statistics for all variables in Table 1:

Table 1: Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Portfolio Composition					
Internal Sovereign Debt (billion COP)	141	68245	52728	13397	223454
Foreign Sovereign Debt (billion COP)	141	3664	2302	134	9196
Portfolio Measures					
DFp Portfolio (%)	141	5.635	2.943	0.643	12.689
Ratp Portfolio (%)	141	6.074	3.332	0.647	14.533
Exchange Rate					
Daily average rate (COP/USD)	141	2149	343	1708	2959
1-year ex-post exchange rate (COP/USD)	120	2091	283	1708	2748
5-year ex-post exchange rate (COP/USD)	72	1920	172	1708	2515
1-year surveyed expected exchange rate (COP/USD)	93	2311	336	1791	3077
Exchange Rate Volatility (%)	141	0.084	0.069	0.010	0.278
WTI Crude Oil Prices					
Change Oil Prices (%)	141	0.039	0.616	-3.056	1.342
Industrial Production Growth					
US (%)	141	0.998	4.895	-16.488	8.217
Col (%)	141	2.608	6.008	-15.399	15.015
Interest Rates					
Col (TES) 1-year maturity (%)	141	6.934	2.370	3.624	10.949
Col (TES) 5-year maturity (%)	141	9.248	2.900	4.469	16.009
US (TBILL) 1-year maturity (%)	141	1.650	1.758	0.100	5.220
US (TNOTE) 5-year maturity (%)	141	2.655	1.316	0.620	5.055

Source: Bloomberg, Treasury of Colombia and Authors' calculations. Billion COP correspond to 10^9.

3 The Portfolio Balance Channel

In this section, we provide a basic theoretical understanding of the portfolio balance channel by modeling how the banking sector optimally allocates its portfolio composition. This allows us to characterize departures from the UIP condition in terms of foreign and domestic assets. Formally, let the revenue of a given investment bank equal the return of investing in domestic and foreign sovereign bonds (B, B^*). Following the corporate finance literature, we assume that banks are risk averse in terms of dividends (see Bigio and Bianchi (2014), Allen and Michaely (2003), Kumar and Spatt (1987) and Guttman et al. (2010)). Hence, a representative bank maximizes:

$$\max_{\{B_t,B_t^*\}_{t=0}^{\infty}} E_0 \sum_{t=0}^{\infty} \gamma^t \frac{V_t^{1-\sigma}}{1-\sigma}$$

Subject to: (3.1)

$$V_t + B_t + \varepsilon_t B_t^* = \delta_{t-1}^{B}\left(1+i_{t-1}^{B}\right)B_{t-1} + \delta_{t-1}^{B^*}\left(1+i_{t-1}^{B^*}\right)\varepsilon_t B_{t-1}^* - \Psi\left(B_t, B_t^*\right)$$

where V_t corresponds to the bank's dividend in period t, δ_t^B and $\delta_t^{B^*}$ represent repayment probability rates (opposite to default rates) of domestic and foreign bonds, respectively, i_t^B and $i_t^{B^*}$ denote domestic and foreign bond yields, and ε_t is the nominal exchange rate expressed in units of domestic currency per unit of foreign currency. Additionally, we include a bond substitution cost function, $\Psi(\cdot)$, in order to allow bonds denominated in different currencies to be imperfect substitutes. For tractability purposes, we model this cost with a general CES representation:

$$\Psi\left(B_t, B_t^*\right) = \left[B_t^{\lambda_{1t}\nu} + \varepsilon_t \left(B_t^*\right)^{\lambda_{2t}\nu}\right]^{1/\nu}. \tag{3.2}$$

Intuitively, $\lambda_i \nu \leq 1$ corresponds to the substitution parameter between domestic and foreign bonds and captures the fact that some bonds are more liquid than others, possibly due to transaction costs (λ_1 and λ_2 represent liquidity parameters). Accordingly, the optimality conditions with respect to domestic and foreign bonds yield:

$$\mu_t \left\{1 + \left[B_t^{\lambda_{1t}\nu} + \varepsilon_t \left(B_t^*\right)^{\lambda_{2t}\nu}\right]^{1-\nu/\nu} \lambda_{1t}\left(B_t\right)^{\lambda_{1t}\nu-1}\right\} = \gamma E_t \mu_{t+1} \delta_t^B \left(1 + i_t^B\right) \tag{3.3}$$

$$\mu_t \varepsilon_t \left\{1 + \left[B_t^{\lambda_{1t}\nu} + \varepsilon_t \left(B_t^*\right)^{\lambda_{2t}\nu}\right]^{1-\nu/\nu} \lambda_{2t}\left(B_t^*\right)^{\lambda_{2t}\nu-1}\right\} = \gamma E_t \mu_{t+1} \delta_t^{B^*} \left(1 + i_t^{B^*}\right) \varepsilon_{t+1} \tag{3.4}$$

where μ is the Lagrange multiplier. Optimality conditions described in equations 3.3 and 3.4 imply that inter-temporal marginal costs of dividends are compensated with marginal returns of each asset. Combining equation 3.4 and 3.3 yields the Euler condition:

$$E_t\left[\frac{\varepsilon_{t+1}}{\varepsilon_t}\right] = \frac{\delta_t^B\left(1 + i_t^B\right)}{\delta_t^{B^*}\left(1 + i_t^{B^*}\right)\hat{\rho}(B_t, \varepsilon_t B_t^*)} \tag{3.5}$$

where $\hat{\rho}(B_t, \varepsilon_t B_t^*) = \left[\frac{1+\left[B_t^{\lambda_{1t}\nu} + \varepsilon_t (B_t^*)^{\lambda_{2t}\nu}\right]^{1-\nu/\nu} \lambda_{1t}(B_t)^{\lambda_{1t}\nu-1}}{1+\left[B_t^{\lambda_{1t}\nu} + \varepsilon_t (B_t^*)^{\lambda_{2t}\nu}\right]^{1-\nu/\nu} \lambda_{2t}(B_t^*)^{\lambda_{2t}\nu-1}}\right]$. As it turns out, equation 3.5 captures most of the intuition behind the UIP condition. Namely, expected exchange rate changes depend on interest rate differentials, relative repayment rates (i.e. country risk) and the risk premium. As stated in Villamizar-Villegas and Perez-Reyna (2015), the risk premium can be interpreted as the difference between a risk-free investment (foreign bond) and a risky investment (domestic bond) subject to unexpected exchange rate changes. As such, in the empirical exercise presented in Section 4, we use the following linear version of equation 3.5:

$$E_t[\Delta e_{t+1}] = i_t - i_t^* - \rho_t, \tag{3.6}$$

where $\rho_t = ln\hat{\rho}(B_t, \varepsilon_t B_t^*) - ln(\frac{\delta_t^B}{\delta_t^{B^*}})$ and $e_t = ln(\varepsilon_t)$. Note that equation 3.6 is the same equation used in Almekinders and Eijffinger (1996) and Kearns and Rigobon (2002).

We finally characterize a partial equilibrium in this setup as a sequence of individual allocations $\{V_t, B_t, B_t^*\}_{t=0}^{\infty}$, and prices $\{i_t^B, i_t^{B^*}, \varepsilon_t\}_{t=0}^{\infty}$, such that: (i) given $\{i_t^B, i_t^{B^*}, \varepsilon_t\}_{t=0}^{\infty}$, and $\{\delta_t^B, \delta_t^{B^*}\}$, the bank problem is solved and (ii) the sovereign bond market clears.[6] To better understand the intuition behind equation 3.5, in Appendix B we compute and analyze Impulse Response Functions (IRFs) to shocks on liquidity and repayment rates.

4 Empirical Analysis

Consistent with our theoretical framework, the first part of our methodology consists of estimating the effects of credit ratings on the Colombian portfolio composition, for which we use an event study analysis. We then study the effects of the estimated portfolio movements on departures from the UIP condition (i.e. risk premium).

Essentially, the main challenge of estimating portfolio effects is that they respond endogenously to factors which are correlated with the exchange rate. In the "selection on unobservables" literature, studies such as Dominguez and Frankel (1993) instrument portfolio changes with announcements on foreign exchange intervention so as to isolate effects driven by expectations. We believe, however, that even these intervention announcements might be subject to an endogenous relationship caused by exchange rate movements previous to the time of announcements.

We thus propose a novel instrument for shifts in the portfolio composition: the use of sovereign credit ratings. We argue that announcements on sovereign bonds largely affect investors' decisions given that they reflect the ability of a government to meet its financial commitments. Moreover, we control for variables that are included in the glossaries of credit agencies and which are used as criteria for the computation of ratings. In this sense, we isolate portfolio movements from confounding effects (i.e. factors that concurrently affect the exchange rate).

4.1 Calculating Abnormal Returns using an Event Study Analysis

Abnormal returns capture the main counterfactual of interest: *what would have happened to portfolio balances if credit ratings had not changed, given that they did.* Hence, they represent ideal candidates to test for variations in investment decisions which are as good as randomly assigned (at least with respect to factors that influence the exchange rate).

[6] If we assume a continuum of bonds $B(s)$ for $s \in (0,1)$, then the market clearing condition implies that $\int_0^1 (B_t + \varepsilon_t B_t^*)\, dF(s) = 0$.

As such, we first identify all Outlook/Watch and Grade ratings within our sample from Moody's, Fitch and S&P that could potentially produce a change in investment decisions (see Section 2). Specifically, we identify cases in which US ratings increased relative to Colombian ratings (+) and in which Colombian ratings increased relative to US ratings (-). In order to appraise the event's impact on our selected portfolio measures, we compute abnormal returns (X_t^*) defined as the difference between the observed ex-post value after each event (X_t) and the conditional mean of portfolio balances ($E_t\left[X_t|\Omega_t\right]$), otherwise known as the normal return. Formally,

$$X_t^* = X_t - E_t\left[X_t|\Omega_t\right], \tag{4.1}$$

where Ω_t denotes the conditioning information set at time t. Recall that we employ two different measures of portfolio balances (X_t^{DFp} and X_t^{Ratp}), as described in Section 2.2.[7]

In order to estimate the normal return of equation 4.1, we first define an estimation window of [-13,-3] months (i.e. time period prior to each event) so as to control for variables that could have systematically affected portfolio balances. We then regress the following specification confined to the estimation window:

$$X_t = \beta_0 + \beta_1 Vol_t + \beta_2 \Delta Oil_t + \beta_3(i_t - i_t^{US}) + \beta_4(\Delta y_t - \Delta y_t^{US}) + \beta_5 X_{t-1} + \beta_6 D_{event} + \upsilon_t \tag{4.2}$$

where Vol_t corresponds to exchange rate volatility, ΔOil_t is the change in WTI oil prices, $(i_t - i_t^{US})$ is the yield differential between US and Colombian sovereign bonds, $(\Delta y_t - \Delta y_t^{US})$ is the relative industrial production growth between the United States and Colombia, and D_{event} is a Dummy variable which captures past events (i.e. past changes in relative credit ratings).

Normal returns are then computed by projecting X_t onto the event window (time period after the event). That is, we use the estimated coefficients obtained in equation 4.2 but use post-event values of covariates (see Campbell et al. (1996)). Finally, in the last step of our methodology, we regress the risk premium on the estimated abnormal returns ($\hat{X}_t^*$) as follows:

$$\rho_t = \alpha + \beta \hat{X}_t^* + \eta_t. \tag{4.3}$$

It is in this final step where we benefit from the theoretical implications of our model. In particular, we assess whether abnormal returns of portfolio compositions have an effect on the risk premium (see equation 3.6). Significant results would suggest that the risk premium is in fact a relevant driver through which the portfolio balance channel operates.

[7] In the finance literature, the normal return compares the return of any given security to the return of the market portfolio. In our case, we assume a linear specification which follows from assuming a joint-normal distribution of asset returns.

4.2 Results

Results are based on the average Cumulative Abnormal Returns (CAR) of equation 4.1 by using an estimation window of [-13,-3] months and an event window of [-1,1] months.[8] As stated in the previous section, while the former allows us to control for episodes prior to the event, the latter is used for estimating abnormal returns.

Table 2 reports estimation results of equation 4.1 for the two portfolio measures: DFp and Ratp. Specifically, we report the one-sample *t-test* for the CAR of each event. We considered cases in which relative sovereign ratings increased (+) and decreased (-), as defined in section 4.1. Additionally, we control for exchange rate volatility (measured as an Exponentially Weighted Moving Average -EWMA), changes in WTI oil prices, interest rate differentials between domestic and foreign bonds, relative output growth, and past credit ratings (see equation 4.2).[9]

The resulting abnormal returns of Table 2 are robust (in significance and magnitude) across yield maturities of 1 and 5 years and across portfolio measures. In total, 33 out of 44 events were significant using 1-year bond maturities, and 27 out of 44 events were significant using 5-year bond maturities. Also, while positive (+) ratings led to both higher and lower portfolio balances, negative (-) ratings mostly led to a decrease in portfolio compositions (see Table 3). This last result, however, should be interpreted with caution given that abnormal returns are conditional on the set of control variables. In other words, the direction of portfolio shifts are obtained when accounting for movements in all covariates.

Tables 4-6 show results for the effects of the estimated abnormal returns on departures of UIP, as described by equation 4.3. Specifically, we use three measures of the risk premium which consist of: (i) the ex-post exchange rate at one year shown in Table 4, (ii) the surveyed expected exchange rate at one year shown in Table 5, and (iii) the ex-post exchange rate at five years shown in Table 6.

Results show that exchange rate effects are significant when considering departures from the UIP condition using 5-year exchange rate changes (Table 6). In fact, portfolio shifts (due to changes in credit ratings) increase the risk premium, as dictated by equation 3.6, in up to 5 months before the effects subside. This is not the case for the risk premium with a 1-year horizon, where effects are not statistically significant, except for the contemporary effect using the ex-post exchange rate (Table 4).

Additioanlly, Tables A5 and A6 of Appendix D show that, when estimating positive (+) and

[8]Results using event windows of [-2,2] and [-3,3] (not reported) yield similar results.

[9]Other volatility measures, using a GARCH(1,1) methodology and squared daily returns (not reported) were employed but not reported, with similar results.

negative (-) ratings separately, the risk premium has a significant effect, especially after positive ratings. That is, the risk premium responds more to when US ratings increased relative to Colombian ratings than vice-versa.

Table 2: Effects of Sovereign Credit Ratings on Portfolio Balances: Jan/2003-Sep/2014

		Portfolio Measure			
Event	Date	$X_t^{DFp} = \frac{s_t B_t^*}{B_t + s_t B_t^*}$ Interest Rates at 1 year	$X_t^{Ratp} = \frac{s_t B_t^*}{B_t}$ Interest Rates at 1 year	$X_t^{DFp} = \frac{s_t B_t^*}{B_t + s_t B_t^*}$ Interest Rates at 5 years	$X_t^{Ratp} = \frac{s_t B_t^*}{B_t}$ Interest Rates at 5 years
Average Cumulative Abnormal Returns (%)					
Positive Rating (+)					
1	2-Month change 2004m1	-3.834	-4.044	-4.448**	-4.693**
		(0.010)	(0.011)	(0.007)	(0.007)
2	2-Month change 2004m8	2.423	2.643	1.078	1.222
		(0.011)	(0.011)	(0.010)	(0.011)
3	2-Month change 2005m8	-9.649***	-11.129***	-13.215***	-14.986***
		(0.004)	(0.004)	(0.012)	(0.013)
4	2-Month change 2006m1	-17.116***	-19.929***	-13.574***	-14.656***
		(0.002)	(0.003)	(0.011)	(0.013)
5	2-Month change 2006m6	-24.591***	-29.586***	-35.976***	-39.465***
		(0.014)	(0.017)	(0.024)	(0.026)
6	2-Month change 2007m2	6.994***	7.492***	5.876**	6.289**
		(0.009)	(0.009)	(0.008)	(0.008)
7	2-Month change 2008m5	19.992***	21.689***	20.490***	22.372***
		(0.006)	(0.006)	(0.003)	(0.004)
8	2-Month change 2008m6	18.418***	20.187***	20.363***	22.295***
		(0.021)	(0.023)	(0.014)	(0.016)
9	2-Month change 2011m2	7.931***	8.914***	-4.255***	-4.920***
		(0.004)	(0.005)	(0.004)	(0.005)
10	2-Month change 2013m4	2.309	2.671	4.225*	4.897*
		(0.006)	(0.007)	(0.008)	(0.010)
11	2-Month change 2013m6	8.714***	10.081***	4.892***	5.781***
		(0.000)	(0.000)	(0.002)	(0.002)
12	2-Month change 2013m10	-7.673*	-9.029*	-7.329*	-8.647*
		(0.0113)	(0.016)	(0.013)	(0.015)
13	2-Month change 20014m3	-5.999***	-7.0299***	-4.721***	-5.503***
		(0.005)	(0.006)	(0.004)	(0.005)
14	2-Month change 20014m6	2.117	2.491	-8.890***	-10.425***
		(0.007)	(0.008)	(0.009)	(0.011)
Negative Rating (-)					
1	2-Month change 2004m5	-8.049	-8.306	2.592	2.783
		(0.020)	(0.020)	(0.012)	(0.013)
2	2-Month change 2005m1	8.760	10.416	10.492	12.285
		(0.042)	(0.048)	(0.039)	(0.045)
3	2-Month change 2005m2	21.440**	24.423**	24.380***	27.388***
		(0.029)	(0.034)	(0.027)	(0.032)
4	2-Month change 2005m5	-26.973***	-35.018***	-24.978**	-32.586**
		(0.032)	(0.045)	(0.037)	(0.051)
5	2-Month change 2006m2	-9.744***	-8.973***	-12.659***	-12.191***
		(0.0006)	(0.005)	(0.012)	(0.013)
6	2-Month change 2006m3	-1.768	-1.935	-28.596**	-28.463**
		(0.031)	(0.033)	(0.041)	(0.044)
7	2-Month change 2006m7	-29.116***	-30.887***	-36.497***	-38.838***
		(0.014)	(0.015)	(0.018)	(0.019)
8	2-Month change 2006m8	57.201***	61.664***	-11.629***	-11.713***
		(0.040)	(0.043)	(0.003)	(0.003)
9	2-Month change 2007m3	3.896	4.210	3.754	4.037
		(0.011)	(0.012)	(0.011)	(0.012)
10	2-Month change 2007m6	-16.220***	-17.261***	5.939	6.357
		(0.012)	(0.013)	(0.024)	(0.026)
11	2-Month change 2007m8	3.514	4.075	4.170	4.730
		(0.019)	(0.020)	(0.021)	(0.022)

Continued on Next Page...

Table 2 – Continued

Event	Date	Portfolio Measure $X_t^{DFp} = \frac{s_t B_t^*}{B_t + s_t B_t^*}$ Interest Rates at 1 year	$X_t^{Ratp} = \frac{s_t B_t^*}{B_t}$ Interest Rates at 1 year	$X_t^{DFp} = \frac{s_t B_t^*}{B_t + s_t B_t^*}$ Interest Rates at 5 years	$X_t^{Ratp} = \frac{s_t B_t^*}{B_t}$ Interest Rates at 5 years
Average Cumulative Abnormal Returns (%)					
12	2-Month change 2009m6	-18.064***	-22.872***	-8.670***	-10.807***
		(0.009)	(0.011)	(0.010)	(0.012)
13	2-Month change 2010m7	3.771**	4.295**	3.388	3.847
		(0.006)	(0.007)	(0.008)	(0.009)
14	2-Month change 2010m10	-5.612***	-6.169***	-8.438***	-9.331***
		(0.003)	(0.004)	(0.008)	(0.009)
15	2-Month change 2011m3	-14.935***	-17.230***	-18.478***	-21.176***
		(0.011)	(0.013)	(0.012)	(0.014)
16	2-Month change 2011m4	-0.256	-0.575***	4.011***	4.750***
		(0.001)	(0.001)	(0.002)	(0.002)
17	2-Month change 2011m6	0.623*	0.505	0.513	0.494
		(0.001)	(0.001)	(0.004)	(0.005)
18	2-Month change 2011m7	-0.780	-0.919	-3.840***	-4.327***
		(0.002)	(0.002)	(0.002)	(0.003)
19	2-Month change 2011m8	-1.742	-1.955	-8.333***	-9.454***
		(0.009)	(0.011)	(0.006)	(0.007)
20	2-Month change 2011m9	-6.165**	-7.050**	-4.972	-5.690
		(0.010)	(0.011)	(0.011)	(0.012)
21	2-Month change 2011m11	-6.981	-8.051	0.069	0.102
		(0.017)	(0.020)	(0.012)	(0.013)
22	2-Month change 2012m6	-3.128	-3.599	-2.173	-2.507
		(0.012)	(0.014)	(0.010)	(0.011)
23	2-Month change 2012m7	-4.076***	-4.672***	-3.665***	-4.200***
		(0.005)	(0.006)	(0.004)	(0.004)
24	2-Month change 2012m8	-4.032**	-4.571**	-3.358*	-3.812*
		(0.006)	(0.007)	(0.006)	(0.007)
25	2-Month change 2013m3	-4.792	-5.484	-1.330	-1.512
		(0.012)	(0.014)	(0.011)	(0.013)
26	2-Month change 2013m7	7.114***	8.235***	-0.059	0.059
		(0.002)	(0.002)	(0.003)	(0.003)
27	2-Month change 2013m12	-7.253***	-8.520***	-6.813***	-8.208***
		(0.004)	(0.005)	(0.005)	(0.006)
28	2-Month change 2014m7	2.339	2.793	4.214*	4.949*
		(0.007)	(0.008)	(0.008)	(0.010)

Source: Authors' calculations. The Table shows average Cumulative Abnormal Returns (CARs) using as control variables: exchange rate volatility, interest rate differentials, changes in oil prices, relative growth and past relative credit ratings (See Section 2). The first and third column refer to the Dominguez and Frankel (2013) portfolio measure, and the second and fourth column refer to the portfolio ratio (Ratp). We considered cases in which relative sovereign ratings increased (+) and decreased (-), as defined in section 4.1. ***, ** and * denote results at the 1%, 5% and 10% significance level. Standard Errors are in parenthesis.

Table 3: Summary of Abnormal Returns

	Number of Events	Positive and Significant CAR	Negative and Significant CAR
Portfolio measures (DFp and Ratp) with 1-year maturity yields			
(+)	14	5	6
(−)	28	6	10
Total	42	11	16
Portfolio measures (DFp and Ratp) with 5-year maturity yields			
(+)	14	5	9
(−)	28	4	13
Total	42	9	22

Source: Authors's calculations. Cumulative Abnormal Returns are estimated by controlling for exchange rate volatility, interest rate differentials, changes in oil prices, relative output growth and past credit ratings for an event window of [-1,1] and an estimation window of [-13,-3]. A positive (negative) rating refers to the case in which US ratings increase (decrease) relative to Colombian ratings.

Table 4: OLS Estimation: $\rho_t = \alpha + \beta\hat{\epsilon}^*_{it} + \eta_t$

Dependent Variable: Risk premium using the ex-post exchange rate at one year		
Period	Abnormal Return DFp Portfolio [-1,1]	Abnormal Return Ratp Portfolio [-1,1]
t	0.445*	0.372*
	(0.248)	(0.216)
t-1	0.292	0.236
	(0.251)	(0.218)
t-2	0.087	0.059
	(0.253)	(0.218)
t-3	0.046	0.028
	(0.252)	(0.219)
t-4	0.051	0.049
	(0.253)	(0.219)
t-5	0.099	0.103
	(0.253)	(0.219)

Source: Authors's calculations. Abnormal Returns are based on the Dominguez and Frankel's (1993) (DFp) portfolio definition and on the portfolio ratio (Ratp). We control for exchange rate volatility, interest rate differentials, changes in oil prices, output growth and past relative credit ratings when a positive and a negative event occur with an event window of [-1,1] and an estimation window of [-13,-3].***, ** and * denote results at the 1%, 5% and 10% significance level. Standard Errors are reported in parenthesis.

Table 5: OLS Estimation: $\rho_t = \alpha + \beta\hat{\epsilon}^*_{it} + \eta_t$

Dependent Variable: Risk premium using the surveyed expected exchange rate at one year		
Period	Abnormal Return DFp Portfolio [-1,1]	Abnormal Return Ratp Portfolio [-1,1]
t	-0.047	-0.044
	(0.078)	(0.068)
t-1	-0.043	-0.041
	(0.079)	(0.068)
t-2	0.020	0.011
	(0.080)	(0.069)
t-3	0.104	0.083
	(0.079)	(0.069)
t-4	0.100	0.083
	(0.080)	(0.069)
t-5	0.137*	0.118*
	(0.080)	(0.069)

Source: Authors's calculations. Abnormal Returns are based on the Dominguez and Frankel's (1993) (DFp) portfolio definition and on the portfolio ratio (Ratp). We control for exchange rate volatility, interest rate differentials, changes in oil prices and output growth when a positive and a negative event occur with an event window of [-1,1] and an estimation window of [-13,-3].***, ** and * denote results at the 1%, 5% and 10% significance level. Standard Errors are reported in parenthesis.

Table 6: OLS Estimation: $\rho_t = \alpha + \beta\hat{\epsilon}^*_{it} + \eta_t$

Dependent Variable: Risk premium using the ex-post exchange rate at five years		
Period	Abnormal Return DFp Portfolio [-1,1]	Abnormal Return Ratp Portfolio [-1,1]
t	1.164***	0.992***
	(0.222)	(0.203)
t-1	1.148***	0.979***
	(0.226)	(0.207)
t-2	1.112***	0.962***
	(0.233)	(0.211)
t-3	1.138***	0.987***
	(0.224)	(0.203)
t-4	0.877***	0.765***
	(0.255)	(0.228)
t-5	0.777***	0.682***
	(0.273)	(0.244)

Source: Authors's calculations. Abnormal Returns are based on the Dominguez and Frankel's (1993) (DFp) portfolio definition and on the portfolio ratio (Ratp). We control for exchange rate volatility, interest rate differentials, changes in oil prices and output growth when a positive and a negative event occur with an event window of [-1,1] and an estimation window of [-13,-3].***, ** and * denote results at the 1%, 5% and 10% significance level. Standard Errors are reported in parenthesis.

5 Conclusions

In this paper we provide a theoretical understanding of the portfolio balance channel by extending the UIP to a case in which the banking sector optimally allocates its portfolio composition. In the empirical application, we propose a novel instrument for shifts in the portfolio composition: the use of relative credit ratings for US and Colombian sovereign bonds.

Our findings indicate that, when properly controlled for, shifts in portfolio balances affect the long term (5-year) risk premium, defined as departures from the UIP condition, in up to five months before the effects subside. Additionally, when separately considering cases in which US ratings increased (+) and decreased (-) relative to Colombian ratings, we find that the risk premium responds more to positive (+) ratings. The foregoing results show that not every credit rating change has a significant impact on agents' asset allocations, but some announcements convey additional information (not correlated to exchange rate behavior) which triggers a re-balancing of their financial portfolios.

We acknowledge the ample empirical literature that exists on both the effects of sovereign credit ratings and the exchange rate. However, only a handful of studies have addressed both and, to the best of our knowledge, there is no study that uses credit ratings as an instrument for the portfolio composition, outside of the present study. Consequently, we believe that our investigation will shed some light on the ongoing debate regarding both the theoretical and empirical effects of the portfolio balance channel.

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Appendices

A Sovereign Credit Rating by Agency

Table A1: Sovereign Credit Rating by Agency

Long Term Grade Rating			Outlook/Watch
S&P	MOODY'S	FITCH	All Agencies
AAA	Aaa	AAA	Positive
AA+	Aa1	AA+	Stable
AA	Aa2	AA	Negative
AA-	Aa3	AA-	
A+	A1	A+	
A	A2	A	
A-	A3	A-	
BBB+	Baa1	BBB+	
BBB	Baa2	BBB	
BBB-	Baa3	BBB-	
BB+	Ba1	BB+	
BB	Ba2	BB	
BB-	Ba3	BB-	
B+	B1	B+	
B	B2	B	
B-	B3	B-	
CCC+	Caa1	CCC+	
CCC	Caa2	CCC	
CCC-	Caa3	CCC-	
CC	Ca	CC	
R	C	RD	
SD-D			
NR			

Source: Standard and Poor's Services, Moody's Investors Service and Fitch Ratings.

B Theoretical Underpinnings of the Portfolio Channel

To better understand the intuition behind equation 3.5, we calibrate parameters as reported in Table A2. Namely, the model replicates the steady state ratio of domestic and foreign sovereign bonds with respect to the Colombian GDP during 2003-2014.

Table A2: Parameters

Parameter	Value
δ_t^B	0.75
$\delta_t^{B^*}$	0.75
i_t^B	0.03
$i_t^{B^*}$	0.0625
$\lambda_{1t}\nu$	0.9
$\lambda_{2t}\nu$	0.9
ε_t	2
γ	0.997
B/GDP (%)	27.1
B*/GDP(%)	9.8

Source: Authors' calculations. Data obtained from the Colombian Treasury.

Additionally, we assume that shocks on domestic liquidity and repayment rates follow auto-regressive processes exemplified by B.1 and B.2:

$$\lambda_{1t} = \alpha\lambda_{1t-1} + \eta_t \tag{B.1}$$

$$\delta_t^B = \beta\delta_{t-1}^B + \zeta_t \tag{B.2}$$

and further assume that $\eta_t, \zeta_t \sim N\left(0, \sigma^2\right)$. Next, IRFs are computed to a one standard deviation shock in η_t and ζ_t.

Figure 6 depicts the response of bank's dividends, domestic and foreign sovereign bonds, and the exchange rate, to a domestic liquidity shock (η_t). Results are in line with the portfolio channel (see Weber (1986)) and show that the exchange rate depreciates given a higher demand for domestic bond holdings and a lesser demand for foreign bonds.[10] Alternatively, Figure 7 depicts the IRFs of the same four variables to a shock on the domestic repayment rate (ζ_t). Results now show a fall in domestic bond holdings with respect to foreign bonds and a subsequent appreciation of the exchange rate.

[10] The opposite is true after considering a foreign liquidity shock.

Figure 6: Shock on the substitution elasticity of domestic bond (η_{1t})

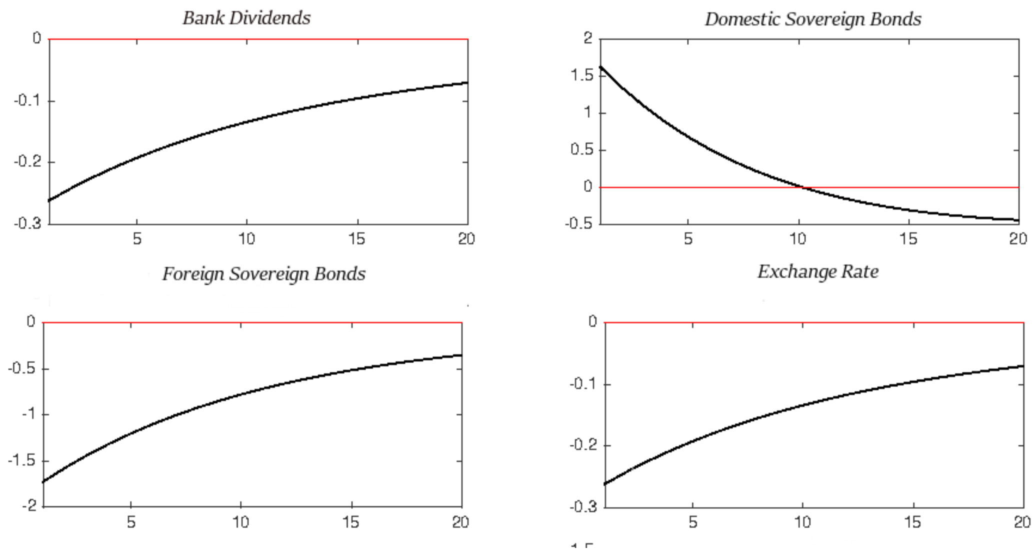
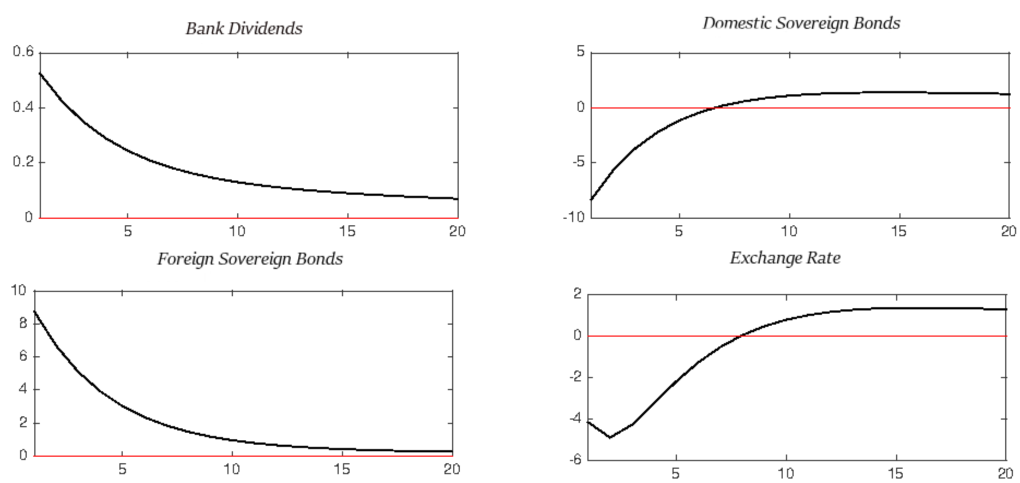


Figure 7: Shock on domestic repayment rate



C Normality and Unit Root Tests

Table A3: Normality Test 2003-2014 (Shapiro-Wilk W test)

Variable	Obs.	W	V	z	Prob>z
DFp Portfolio	141	0.95596	4.86	3.573	0.00018
Ratp Portfolio	141	0.95266	5.224	3.736	0.00009
Risk premium (1 year)	134	0.97323	2.829	2.344	0.00955
Risk premium (5 years)	86	0.96472	2.570	2.077	0.01892
Risk premium (Survey data)	93	0.95022	3.869	2.990	0.00140

Table A4: Dickey-Fuller Unit Root Test

Variable	Obs.	Test Statistic z(t)	Interpolated Dickey-Fuller z(t)		
			1% Critical Value	5% Critical Value	10% Critical Value
DFp Portfolio	141	-4.87	-4.027	-3.445	-3.145
Ratp Portfolio	141	-4.806	-4.027	-3.445	-3.145
Risk premium (1 year)	132	-3.912	-4.029	-3.446	-3.146
Risk premium (5 years)	84	-2.627	-4.075	-3.466	-3.160
Risk premium (Survey data)	91	-4.407	-4.060	-3.459	-3.155

D Robustness Checks

Table A5: OLS Estimation: $\rho_t = \alpha + \beta \hat{\epsilon}^*_{it} + \eta_t$

Dependent Variable: Risk premium using the ex-post exchange rate at one year				
	Abnormal Return DFp Portfolio [-1,1]		Abnormal Return Ratp Portfolio [-1,1]	
Period	$PositiveRating$	$NegativeRating$	$PositiveRating$	$NegativeRating$
t	2.532***	1.681***	2.291***	1.524***
	(0.744)	(0.461)	(0.673)	(0.419)
t-1	3.127***	1.052**	2.822***	0.935*
	(0.646)	(0.530)	(0.586)	(0.483)
t-2	2.650***	0.630	2.406***	0.537
	(0.794)	(0.550)	(0.719)	(0.501)
t-3	2.488***	0.514	2.257***	0.420
	(0.874)	(0.548)	(0.793)	(0.499)
t-4	0.543	0.829	0.490	0.711
	(0.070)	(0.545)	(0.972)	(0.498)

Source: Authors's calculations. Abnormal Returns are based on the Dominguez and Frankel's (1993) (DFp) portfolio definition and on the portfolio ratio (Ratp). We control for exchange rate volatility, interest rate differentials, changes in oil prices and output growth when a positive and a negative event occur with an event window of [-1,1] and an estimation window of [-13,-3].***, ** and * denote results at the 1%, 5% and 10% significance level. Standard Errors are reported in parenthesis.

Table A6: OLS Estimation: $\rho_t = \alpha + \beta\hat{\epsilon}^{*}_{it} + \eta_t$

Dependent Variable: Risk premium using the survey expected exchange rate at one year				
	Abnormal Return DFp Portfolio [-1,1]		Abnormal Return Ratp Portfolio [-1,1]	
Period	$PositiveRating$	$NegativeRating$	$PositiveRating$	$NegativeRating$
t	0.407**	-0.152	0.382**	-0.402
	(0.160)	(0.267)	(0.150)	(0.281)
t-1	0.083	-0.311	0.079	-0.352
	(0.204)	(0.253)	(0.191)	(0.294)
t-2	-0.232	-0.164	-0.215	-0.254
	(0.217)	(0.260)	(0.204)	(0.301)
t-3	-0.439**	0.013	-0.411**	-0.173
	(0.221)	(0.261)	(0.208)	(0.301)
t-4	-0.563***	0.291	-0.530***	0.208
	(0.210)	(0.242)	(0.404)	(0.199)

Source: Authors's calculations. Abnormal Returns are based on the Dominguez and Frankel's (1993) (DFp) portfolio definition and on the portfolio ratio (Ratp). We control for exchange rate volatility, interest rate differentials, changes in oil prices and output growth when a positive and a negative event occur with an event window of [-1,1] and an estimation window of [-13,-3].***, ** and * denote results at the 1%, 5% and 10% significance level. Standard Errors are reported in parenthesis.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