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The International Transmission of Risk: Causal Relations Among Developed and Emerging Countries' Term Premia^{*}

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Abstract

We study the effect of shocks to the United States government bonds term premium on Latin American government bonds term premia. For doing so, we compute dynamic multipliers. Our main findings indicate that Latin American countries' term premia respond permanently to changes in United States term premium. However, impulse-response functions vary depending on the country and particular time-length for which premia are computed. Responses are larger for Brazil and Colombia. Mexico exhibits the lowest responses for the four economies in our study.

Keywords: Term Premium; Sovereign Risk; Latin America; Dynamic Multipliers.

JEL Classification: E43; F36; C22.

^{*} The opinions expressed here are those of the authors and do not necessarily represent those of the Banco de la República or those of its Board of Directors. The usual disclaimers apply.

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1. Introduction

There is ample concern about the effects that the normalization of monetary policy by the Federal Reserve (FED) may produce in the United States and abroad. Many market analysts have expressed concern that Treasury yields, especially those corresponding to the medium and long terms, might rise significantly once the FED begins to raise the federal funds rate. Additionally, the end of quantitative easing (QE), a program through which the Fed purchased large quantities of long-term securities, including Treasuries, Agency bonds, and Agency Mortgage Backed Securities, might also lead to the upward correction of long-term rates of these and many other assets, as the FED may begin to sell the long-term securities that it purchased during the crisis.

The question of how to respond to long-term interest rate increases is of major importance to central bankers worldwide. However, the answer to that question is not trivial and depends on the source of that behavior as stated in Bernanke (2006).

A change in long term interest rates can be decomposed into the change in expected short-term rates and a term premium. Theoretically the term premium can be negative. However, in practice it is normally positive reflecting the fact that holders of longer term assets need to be compensated for the risk of facing future unexpected interest rate increases.

On the one hand, increases in long-term interest rates that obey only to the expectation of higher future short-term interest rates may reflect that investors are expecting better economic performance in the future, reflected in higher output growth and inflation. In that case, they may be expecting the Fed to raise the overnight interest rate in response to higher inflationary pressures. On the other hand, higher long-term interest rates reflecting increases in the term premium may show investors might be expecting quite the opposite scenario. If spending depends on long-term interest rates, factors augmenting the spread between long and short-term rates will depress aggregate demand. Thus, when the term premium increases, a lower short-term rate is required to obtain the long-term rate consistent with maximum sustainable employment and stable prices. Consistently, a higher

term premium may also reflect financial stability concerns such as fears about the solvency of debtors in the future.

Hence, identifying the source of changes in long-term interest rates is of major concern for central bankers, as depending on whether it is due to changes in expected future short-term rates or in the term premium it will call for opposite policy actions.

The fears about the effect of the ending of QE policies on interest rates and economic activity are shared both by developed and emerging market economies. There is significant evidence that QE policies have affected long-term interest rates in developed economies (see, for instance, Gagnon et al., 2010; Swanson, 2010; Krishnamurthy and Vissing-Jorgensen, 2011). Some recent papers have shown that QE policies have also affected the behavior of capital inflows, asset prices and long-term interest rates in emerging economies as well (e.g., Cho and Rhee, 2013; Fic, 2013; Lim et al., 2014). Hence, there is a generalized concern about the world-wide effects of monetary policy normalization.

In a recent Global Financial Stability Report, the IMF studies the implications of exit scenarios for longer-term interest rates, focusing in the world's major economies (United States, the United Kingdom, Canada, Germany and Japan. See IMF, 2014). The quantitative exercises that try to measure the effects on possible scenarios are based in studying changes in 10-year government bond yields. Although this study mentions some external risks and transition challenges faced by emerging market economies, a rigorous study on the behavior of long-term interest rates, the term premium and its relation to the term premium of developed economies is required for emerging market economies.¹

Latin American countries were important recipients of international capital flows associated with QE programs in developed economies (see de Paula et al., 2013; Ahmed and Zlate, 2014). And these surges in capital flows generated important effects in asset prices (especially housing), debt and credit growth (Moreno, 2012; Ocampo and Erten, 2014). A major concern of policy makers in countries belonging to this region consists in anticipating the effects of the QE program's termination on long-term interest rates, capital flows and asset prices.

¹ See, for instance, Ojeda-Joya and Gomez-Gonzalez (2014) and Guarin et al. (2014).

In this paper we partially fill that gap by estimating government bonds' term premia for four major Latin American countries (Brazil, Colombia, Mexico and Peru), and their interrelation with the United States Treasury's term premium. We use monthly information on government bond yields comprising the period March 2007 – December 2014 for the five countries considered in this study, and compute the term premium for 1, 2, 5 and 10-year government bonds taking the one-month interest rate for the short-term rate. Our focal interest relies in estimating the effect that possible changes in the United States term premium may have on the term premium of Latin American government bonds.

Specifically, after estimating term premia for our set of countries we test for the presence of instantaneous and Granger-type causality between the term premium of each Latin American country and the term premium of the United States. After confirming that causality runs unidirectionally from the United States to each other country's term premium, we compute impulse-response functions representing the effects of shocks to the United States term premium on each Latin American country's term premium. In these estimations we control for innovational and additive outliers.

Our main findings indicate that Latin American countries' term premia respond permanently to changes in United States term premium. However, impulse-response functions vary depending on the country and particular time-length for which premia are computed. Generally speaking, the response is larger for 5 and 10-year term premia. Additionally, responses are larger for Brazil and Colombia. Paradoxically, Mexico exhibits the lowest responses for the four economies in our study. This fact, however, has an intuitive explanation. According to a recent study on the influence of tapering on emerging market economies (Mishra et al., 2014) Mexico is a country with deeper financial markets than the rest of Latin America and as a consequence it is less affected by international financial shocks. For instance, it has been less affected during the bouts of volatility in 2013 and early 2014.

These results have interesting policy implications. An eventual increase in the federal funds rate, together with the tapering, may lead to increases in the 10-year term premium of United States government bonds. This increase may have a considerable positive impact in long-term bonds' term premia in Latin American economies, especially in Brazil and

Colombia. Higher term premia in Latin American economies might raise financial stability concerns about countries in the region and might lead to higher costs of funding for governments and firms. These higher financing costs may in turn lead to undesirable negative impacts on economic growth. These possible scenarios call for potential policy actions.

The rest of the paper is organized as follows. Section 2 presents the data used in this study and discusses the methodology used for estimating term premia. Section 3 presents empirical exercises and results. The last section concludes.

2. Data and Estimation of Term Premia

In this paper we study the effects of changes in the 10-year United States Treasury bonds term premium over 1, 2, 5 and 10-year government bonds term premia of four large Latin American economies.

The term premium cannot be directly observed. There are various ways of measuring it, which produce somewhat different estimates, as shown by Swanson (2007). Affine models are frequently used for decomposing long-term bond yields into expected future short-term rates and the corresponding term premium (see, for instance, Kim and Wright, 2005; Cochrane and Piazzesi, 2005 and 2008; Kim and Orphanides, 2007; Wright, 2011; Labordaa and Olmo, 2014). These models make several assumptions. They assume the stochastic discount factor is exponentially affine in the shocks affecting the economy. Additionally, they assume that risk pricing is affine with the state variables, and that both the innovations of these variables and those of the return errors are independently and identically Gaussian distributed. These models are usually estimated by maximum likelihood methods. This implies that assumptions have to be made on the correlations of the price of the returns' errors. Hence, these models are computationally very costly.

Recently, Adrian et al. (2013) presented an affine model for calculating bonds' term premia. This model is estimated by linear regressions in several stages. This methodology allows for dropping the assumption of no correlations among the prices of the returns'

errors. Additionally, it is less costly in computational terms than other competing affine models. Espinosa et al. (2014) follow this methodology for estimating term premia of long-term Colombian government bonds.

In this paper we also follow this newfangled methodology for estimating term premia for Brazil, Colombia, Mexico and Peru. We collect monthly data on government bond yields for these four economies and also for the United States, for the period March 2007 – December 2014. Table 1 shows summary data on the information used for estimating each term premium.

Table 1

Summary of data used to calculate term premia

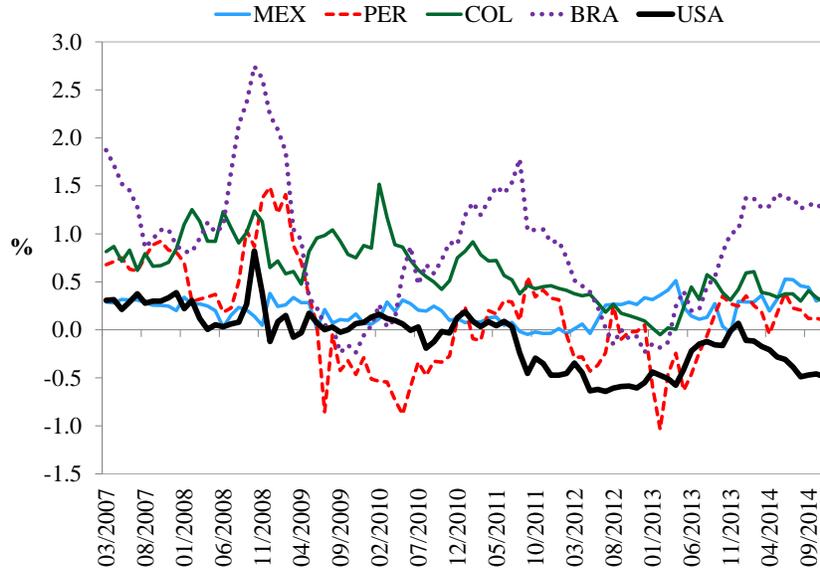
Country	Number of Pricing Factors	Sample Period
US	5	2000M1 - 2014M11
BRA	4	2007M3 - 2014M11
COL	4	2003M1 - 2014M11
MEX	5	2003M8 - 2014M11
PER	3	2006M5 - 2014M11

We use the longest available period for which we have complete data on government bond yields for these five countries. Information on bond yields was obtained from Bloomberg, and yields correspond to those obtained during the last day of transactions for each month.

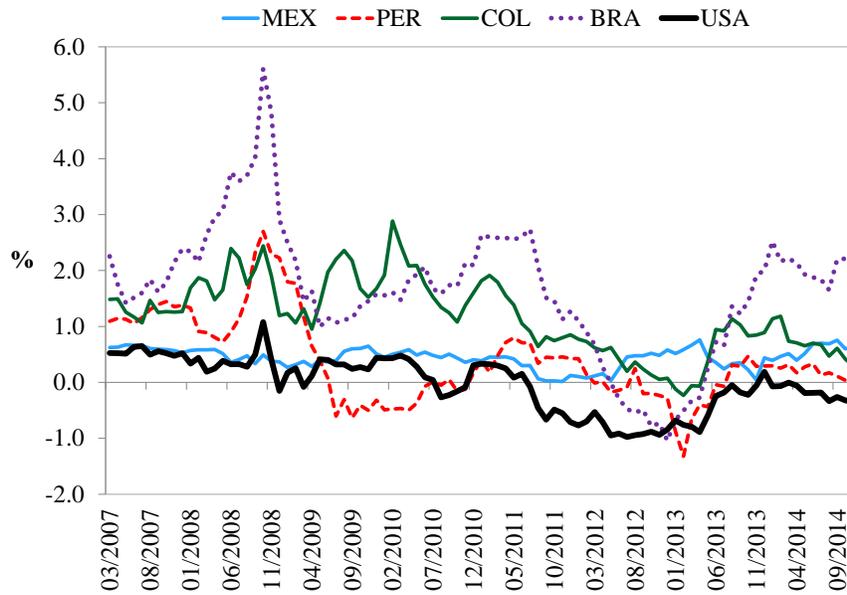
Figure 1

1,2, 5 and 10-year government bonds term premia for Brazil, Colombia, Mexico, Peru, and United States. March 2007 – December 2014

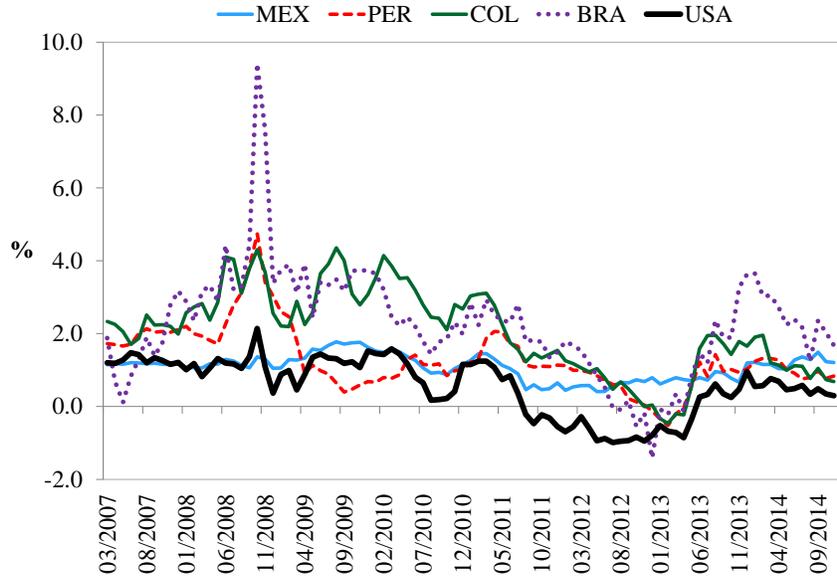
Panel A: 1-year term premia



Panel B: 2-year term premia



Panel C: 5-year term premia



Panel D: 10-year term premia

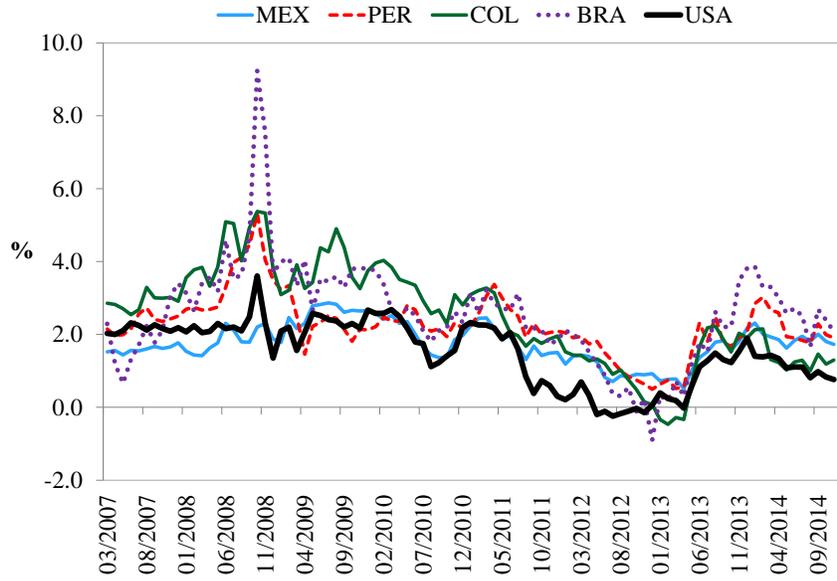


Figure 1 shows 1, 2, 5 and 10-year government bonds term premia for this set of economies. Although there is high variation in the data, some interesting facts are worth

noticing. First, during most of the observation period Brazil exhibits the highest term premia, followed by Colombia. This is particularly true for the cases of 1 and 2-year term premia. Meanwhile, as expected, the United States shows the lowest term premia, followed by Peru. Second, term premia show a peak in September and October 2008, around the Lehman Brothers' default event. Similarly, they exhibit a peak around May 2013, moment in which the FED announced the end of QE programs. The behavior of term premia around these two important episodes illustrates the fact that they effectively respond to risk perceptions of investors. Finally, during 2014 term premia show a downward slope, especially those corresponding to higher maturities.

3. Relation between the United States and Latin American Countries Term Premia

In this paper we are interested in studying the effect of changes in the United States term premium on the term premia of four large Latin American countries. However, before computing dynamic multipliers, we perform simultaneous² and Granger-type causality tests for checking that the exogeneity assumption of the United States term premium is a feasible one.

Table 1 presents results of these two types of causality tests between pairs of countries for 10-year government bond term premia. Results for 1, 2 and 5-year term premia are very similar to those shown here.

² We follow Lütkepohl (1993) for computing instantaneous Wald causality tests.

Table 2

Results of Instantaneous and Granger-type Causality Tests Term Premia by Pairs of Countries

Panel A: Instantaneous Causality Test 10-year term premia

Ho: No instantaneous causality (p-values)

Cause/ CAUSED	USA	BRA	COL	MEX	PER
US	-	0.0023***	0.0027***	0.0001***	0.0642*
BRA	0.0023***	-	0.0000***	0.0001***	0.0001***
COL	0.0027***	0.0000***	-	0.0001***	0.0000***
MEX	0.0001***	0.0001***	0.0001***	-	0.0003***
PER	0.0642*	0.0001***	0.0000***	0.0003***	-

*Denotes significance at 10% significance level; **denotes significance at 5% significance level; ***denotes significance at 1% significance level. Three dummies were included for controlling for the effect of the Lehman Brothers' default episode (October, November and December 2008).

Panel B: Granger Causality Test 10-year term premia

Ho: No Granger causality (p-values)

Cause/ CAUSED	USA	BRA	COL	MEX	PER
US	-	0.0176**	0.0045***	0.0003***	0.0352**
BRA	0.2743	-	0.6271	0.0304**	0.0026***
COL	0.4321	0.0382**	-	0.8713	0.1144
MEX	0.7432	0.8044	0.1369	-	0.0119
PER	0.2634	0.1939	0.0021***	0.1586	-

*Denotes significance at 10% significance level; **denotes significance at 5% significance level; ***denotes significance at 1% significance level. Three dummies were included for controlling for the effect of the Lehman Brothers' default episode (October, November and December 2008).

Results in Table 1 show that, as expected, instantaneous causality runs in both directions for each pair of variables for which causality tests were performed. For instance, at the 5% significance level the only test in which the null hypothesis cannot be rejected is that in which instantaneous causality is tested from Peru to the United States.

However, when Granger causality tests are performed, results suggest that causality runs unidirectionally in each case from the United States term premium to that of the other

countries included in our study. Particularly important for our empirical exercises, the term premium of the United States is not Granger caused by that of any other country.

Hence, it is reasonable to calculate the effect of changes in the United States term premium on the term premia of the four large Latin American countries included in our sample. In a recent study, the IMF (2014) estimates the effects of changes in the United States term premium over the term premia of other four developed countries (Canada, the United Kingdom, Germany and Japan). They estimate term premia using an affine model and run OLS regressions. Their results show that shocks to the United States term premium significantly affect the premia of the other developed economies.

In this paper we build upon the IMF (2014) estimations and build ARX models which have the advantage of considering the dynamic effects of both the dependent and exogenous variables included in the empirical exercise. We estimate the following equation:

$$\Delta TP_{i,t}^{(n)} = \alpha + \phi_1 \Delta TP_{i,t-1}^{(n)} + \dots + \phi_p \Delta TP_{i,t-p}^{(n)} + \beta_0 \Delta TP_{US,t}^{(n)} + \beta_1 \Delta TP_{US,t-1}^{(n)} \dots + \beta_s \Delta TP_{US,t-s}^{(n)} + \epsilon_{i,t}^{(n)} \quad (1)$$

Where TP stands for the term premium, i represents the analyzed country (Brazil, Colombia, Mexico or Peru), n denotes the maturity period and t is a time index. Additionally, we control for additive and innovational outliers across the different econometric specifications. Note that first differences of term premia are included instead of their levels, given that these are all I(1) series. Lag orders (p and s) were chosen for each specification according to conventional information criteria.

Diagnostic tests (Jarque-Bera, Breusch-Godfrey, ARCH and Pormanteau) were performed, indicating that the different empirical models estimated in this study are well-behaved. These results are available upon request.

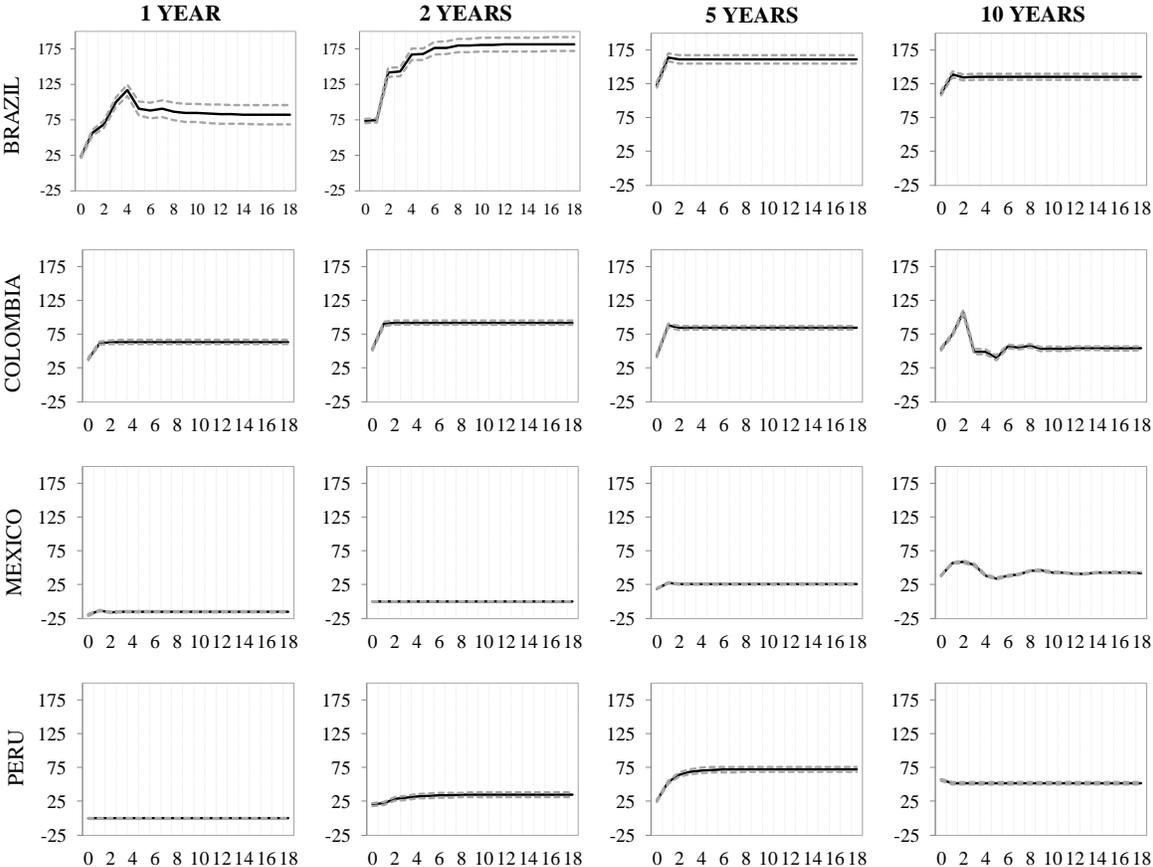
Figure 2 plots the corresponding impulse-response functions showing the effect of a one-time shock to the United States term premium on the other countries' term premia. These

results are shown for 1, 2, 5 and 10 year maturities. These dynamic multipliers are estimated using the variables in levels rather than in first differences.

Important to notice, in all cases except for 1 and 2-year maturities in Mexico, the effect of a one-time shock to the United States term premium generates a permanent change in the other country's term premium. This might indicate that a term-premium shock in the United States leads to a new stationary state for Latin American economies' term premia. In other words, sovereign risk in these set of countries is permanently affected when a shock occurs to the United States term premium.

Figure 2

Dynamic multipliers of 10-year term premia. Response of Latin American countries' term premia to shocks to US 10-year term premium



Impulse-response functions are plotted with 90% asymptotic confidence interval (see Lütkepohl, 1993).

However, our findings indicate that impulse-response functions vary depending on the country and particular time-length for which premia are computed. The response is larger for 5 and 10-year term premia than for 1 and 2-year term premia. This result is consistent with the fact that financial stability concerns affect assets depending on their maturity and risk perceptions are usually increasing in maturity. Additionally, responses are larger for Brazil and Colombia. Particularly, Brazil responds more than proportionally in the long-run to a one-time shock in the United States term premium. Paradoxically, Mexico exhibits the lowest responses for the four economies in our study. According to a recent study on the influence of tapering on emerging market economies (Mishra et al., 2014) Mexico is a country with deeper financial markets than the rest of Latin America and as a consequence it is less affected by international financial shocks. For instance, it has been less affected during the bouts of volatility in 2013 and early 2014.

In addition, Mexico is more commercially integrated than the rest of the countries in our sample with the United States. In that sense, as the tapering marks the beginning of growth in the United States after the international financial crisis, the impact on sovereign risk is expected to be lower than in other Latin American economies.

We performed additional exercises in which we tested whether a shock to Brazil's or Mexico's term premium had significant effects in the other Latin American countries. The computed dynamic multipliers showed evidence of no significant effects. These results confirm the findings of Granger causality tests, which show there is no evidence of causality running from Brazil or Mexico to other countries' term premia.

Our results have interesting policy implications. An eventual increase in the federal funds rate may lead to an increase in the United States government bonds' term premium. This increase may have a considerable positive impact in long-term bonds' term premia in Latin American economies, especially in Brazil and Colombia. Higher term premia in Latin American economies might raise financial stability concerns about countries in the region and might lead to higher costs of funding for governments and firms. These higher financing costs may in turn lead to undesirable negative impacts on economic growth.

4. Conclusions

In this paper we study the relation between government bonds' term premia of the United States and four major Latin American countries (Brazil, Colombia, Mexico and Peru). Our focal interest relies in estimating the effect that possible changes in the United States term premium may have on the term premium of Latin American government bonds.

Specifically, after estimating term premia for our set of countries we test for the presence of instantaneous and Granger-type causality between the term premium of each Latin American country and that of the United States. After confirming that causality runs unidirectionally from the United States to each other country's term premium, we estimate ARX models for the premium of each Latin American country including the United States government bonds' term premium as an explanatory variable. We compute dynamic multipliers for measuring the effect of a one-time increase in the United States term premium over the term premia of Latin American countries' government bonds.

Our main findings indicate that Latin American countries' term premia respond permanently to changes in United States term premium. However, impulse-response functions vary depending on the country and particular time-length for which premia are computed. Generally speaking, the response is larger for 5 and 10-year term premia. Additionally, responses are larger for Brazil and Colombia. Paradoxically, Mexico exhibits the lowest responses for the four economies in our study. This empirical regularity may be explained by the fact that Mexico is a country with deeper financial markets than the rest of Latin America. In consequence it is less affected by international financial shocks. For instance, it has been less affected during the bouts of volatility in 2013 and early 2014.

In addition, Mexico is more commercially integrated than the rest of the countries in our sample with the United States. In that sense, as the tapering marks the beginning of growth in the United States after the international financial crisis, the impact on sovereign risk is expected to be lower than in other Latin American economies.

Our results have interesting policy implications. An eventual increase in the federal funds rate may lead to an increase in the 10-year term premium of United States government bonds. This increase may have a considerable positive impact in long-term bonds' term premia in Latin American economies, especially in Brazil and Colombia. These higher term premia might raise financial stability concerns about countries in the region and may lead to higher costs of funding for governments and firms. These higher financing costs may in turn lead to undesirable negative impacts on economic growth. These possible scenarios call for potential policy actions.

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