Monetary Surprises and Global Financial Flows: A Case Study of Latin America *

Eric Fischer†

Federal Reserve Bank of San Francisco

January 28, 2017

Abstract

This paper examines the effect of Federal Reserve announcements on global financial flows to Latin America since the Global Financial Crisis. The Federal Reserve announcements are classified using daily measures of expectations from a shadow rate term structure model as easing (unexpected), tightening (unexpected), easing (expected), and tightening (expected). This classification is then used for an event study on daily global financial flows classified by asset class (debt, equity), currency (all currencies, hard currency, local currency), and region (Latin America, Brazil, Mexico). The results suggest easing (unexpected) and tightening (unexpected) announcements cause debt outflows but have no effect on equity flows to Latin America. Local currency debt flows to Latin America are more sensitive than the hard currency debt flows and Brazil is the country in Latin America that responds most to these announcements.

Keywords: International Financial Flows, Unconventional Monetary Policy, Latin America
JEL Classification: F32, G14, G15, N26

*I thank Jens H.E. Christensen for kindly providing me with the daily estimations from the AFNS and the B-AFNS model, John H. Rogers for his monetary policy surprise series, and Simon Ringrose for EPFR Global data. I also thank Michael M. Hutchison, Jens H.E. Christensen, Robin Koepke, and seminar participants at Banco de Mexico for comments and suggestions. The views in this paper are solely the responsibility of the author and should not be interpreted as reflecting the views of the Federal Reserve Bank of San Francisco or the Federal Reserve System.

†Email: eric.fischer@sf.frb.org.

1 Introduction

This paper examines the effects of Federal Reserve announcements since the Global Financial Crisis (GFC) on portfolio flows to Latin America. The combination of unconventional monetary policies by the Federal Reserve and other central banks in advanced economies as well as new banking regulations after the GFC has coincided with an increase in market based funding to emerging market economies in Latin America. The search for yield among international investors, and the global interconnectedness of emerging economies with the advanced economies, has generated massive portfolio inflows from advanced to emerging economies. While capital flows provide benefits in terms of financing for emerging economies they also present vulnerabilities in the form of asset price misalignment, macroeconomic distortions, and increased financial volatility. As the Federal Reserve has started its policy normalization from the zero lower bound these capital flows have become more volatile and uncertain for emerging market economies. These spillover effects of unconventional monetary policy is of particular concern to central banks and policymakers in Latin America.

Movements in foreign portfolio flows to Latin America since the 2008 Global Financial Crisis can be explained by a combination of factors including Federal Reserve unconventional monetary policy. One relevant example of the global spillover effects of Federal Reserve unconventional monetary policy occurred when Federal Reserve Chairman Ben Bernanke eventually hinted at ending unconventional monetary policy, in May and June of 2013, and the markets revised their expectations of future Federal Reserve rate hikes. This event, later termed the "taper tantrum", led to revisions in emerging market asset prices and portfolio outflows from emerging markets and Latin America. In Brazil, policymakers have responded to capital flow volatility with a combination of capital controls and foreign exchange intervention. In Mexico, policymakers have not used currency intervention nor have they used capital controls.[1] Nonetheless, the Bank of Mexico has remain concerned

[1]According to a speech by Ben Bernanke at the Bank of Mexico on October 14, 2013: "When the recent financial crisis in the United States and other advanced economies threatened to spill over to Mexico, the inflation credibility enjoyed by the Bank of Mexico allowed it to counter economic weakness by easing

about the exchange rate with the peso and adjusted its policy rate in step with the Federal Reserve to stem movements in capital flows. The authorities in Mexico have the greatest tolerance for volatility and, while concerned about exchange rate overshooting, show little inclination to intervene in foreign exchange markets.[2]

This paper addresses several related research questions. What are the effects of Federal Reserve announcements on portfolio equity and debt flows to Latin America since the Global Financial Crisis? Do these effects differ for debt flows and equity flows? Do these effects differ for debt flows in hard currency and and in local currency? Do these effects differ for Brazil and Mexico? To what degree are these effects explained by changes in global uncertainty, market liquidity, and economic fundamentals?

This paper answers these questions in two parts. First, the paper classifies all of the Federal Reserve announcements since the GFC using daily measures of interest rate expectations. This classification allows the announcements to be classified as easing (unexpected), tightening (unexpected), easing (expected), and tightening (expected). Second, the paper uses the announcement classification to conduct an event study to examine the effect of announcements on daily frequency data for equity flows and debt flows for funds dedicated to investing in Latin America, Brazil and Mexico. Brazil and Mexico receive the largest fraction of portfolio flows in Latin America and have globally domiciled funds dedicated to investing in their countries. Furthermore, robustness checks are conducted using intra-day data on interest rate expectations as well as daily frequency measures of the liquidity of the U.S. treasury market, uncertainty as measured by the VIX, global oil and commodity prices, and country fundamentals. This paper contributes to the literature by using market

monetary conditions, even though headline inflation was running above its target range at the time. The Bank's rate cuts helped stabilize the economy, and Mexican output returned to its pre-crisis level by late 2010. Strong countercyclical policy actions of this type were unlikely to have been feasible in Mexico a few decades ago; with little in the way of inflation-fighting credibility and an immature financial sector, the monetary authority in earlier years was often forced to respond to a crisis by tightening monetary conditions, rather than loosening them, in an effort to limit capital flight, exchange rate depreciation, and increases in inflation." Source: http://www.federalreserve.gov/newsevents/speech/bernanke20131014a.htm

[2]Jude Webber. "Fed Lift-off is Mexico's rate rise dilemma" Financial Times December 15, 2015.; Jonathan Wheatley "Mexico bank chief calls for EM Policy Action" Financial Times January 17, 2016.

expectations to classify the Federal Reserve announcements and by explaining their effects on portfolio equity and debt flows to Latin America. The empirical results indicate that easing (unexpected) and tightening (unexpected) Federal Reserve announcements cause debt outflows but have no effect on equity flows to Latin America. Local currency debt flows to Latin America are more sensitive than the hard currency debt flows and Brazil is the country in Latin America that responds most to these announcements.

This paper proceeds in the following manner. Section 2 motivates the paper by explaining its relation to the literature on classifying announcements at the zero lower bound, the effect of monetary policy on international portfolio flows, and financial stability in Latin America. Section 3 presents the daily data used to classify the Federal Reserve announcement days and the portfolio flow data from EPFR Global. Section 4 explains the methodology for classifying Federal Reserve announcements from October 8, 2008 until October 29, 2014 and for estimating the effect of Federal Reserve announcements on portfolio flows to Latin America. Section 5 presents the results from the Federal Reserve announcement classification and from the event study on the effects of Federal Reserve announcements on portfolio flows to Latin America. Section 6 conducts a robustness check by including liquidity measures, uncertainty measures, commodity prices, and country fundamentals into the analysis. Section 7 concludes with suggestions for future work.

2 Related Literature

This paper relates to the unconventional monetary policy literature by classifying all regularly scheduled Federal Reserve announcements using daily data on interest rate expectations. During times when monetary policy is conducted using the federal funds rate, Federal Reserve announcements are classified using thirty day federal fund futures contracts (Kuttner (2001), Bernanke and Kuttner (2005), Gürkaynak et. al. (2007)). However, when interest rates hit the zero lower bound the Federal Reserve used unconventional policies (Gagnon

et al (2011), D'Amico et.al. (2012), Krishnamurthy Vissing-Jorgensen (2013), Christensen and Rudebusch (2013), and Walsh (2014)) and these short term measures of expectations do not capture these effects. Furthermore, long term measures of these asset prices suffer from term premia and liquidity issues (Gürkaynak et al. (2007), Christensen and Kwan (2014).[3] For these reasons, this paper classifies announcements using daily frequency short rate expectations from a shadow rate term structure model developed by Christensen and Rudebusch (2014) which overcomes the liquidity and term premia issues from using federal fund futures contracts and eurodollar futures contracts at longer horizons and zero lower bound issues when using standard term structure models (Kim and Wright (2005), Piazzesi and Swanson (2008), Piazzesi (2010), Christensen and Rudebusch (2013), Adrian et. al. (2013), Christensen and Rudebusch (2014), Andreasen and Meldrum (2014), Lombardi and Zhu (2014), Krippner (2015)). This paper also conducts a robustness check using intra-day changes in U.S. bond yields the fifteen minutes before until 105 minutes after to classify Federal Reserve announcements (Rogers et.al. 2014 and 2015).

This paper relates to the literature about the global effects of unconventional monetary by looking at international spillovers on daily frequency flows of globally domiciled and regulated mutual funds and exchange traded funds. Several empirical studies have examined the global effects of conventional and unconventional U.S. monetary policy (Edwards (2012), Rey (2013), Berge and Cao (2014), Rogers et.al. (2014), Gilchrist et.al. (2014), McCauley

[3]In December 2008, the Federal Reserve lowered the target for its key monetary policy rate, the overnight federal funds rate, to a range between zero and 25 basis points. As shown in Figure 1 the Federal Reserve provided additional stimulus through large scale asset purchases that expanded its balance sheet. The first large balance sheet expansion occurred with LSAP 1 from November 2008 until March 2010 and led to the purchase of $300 billion in U.S. Treasuries, $1.25 trillion in agency mortgage backed securities and $170 billion of agency debt. This LSAP 1 program was followed by a brief pause in asset purchases until the Fed launched its LSAP 2 program from November 2010 until June 2011. The LSAP 2 program involved purchases of long-term U.S. Treasuries. From July 2011 until December 2012, the total balance sheet remained at a somewhat constant level of around $2.8 to 2.9 trillion. During this time, the Federal Reserve altered its balance sheet by purchasing long-term Treasuries with financing from its sale of short-term Treasuries referred to as the maturity extension program (MEP). The Federal Reserve launched the start of LSAP 3 in September 2012 which, unlike previous programs, did not include a fixed mount of purchases but instead included purchases of $45 billion of U.S. Treasuries and $40 billion of MBS per month with no end date. The LSAP 3 asset purchasing program was reduced or "tapered" until the program was completed in October 2014 with the Fed balance sheet of around $4.3 trillion.

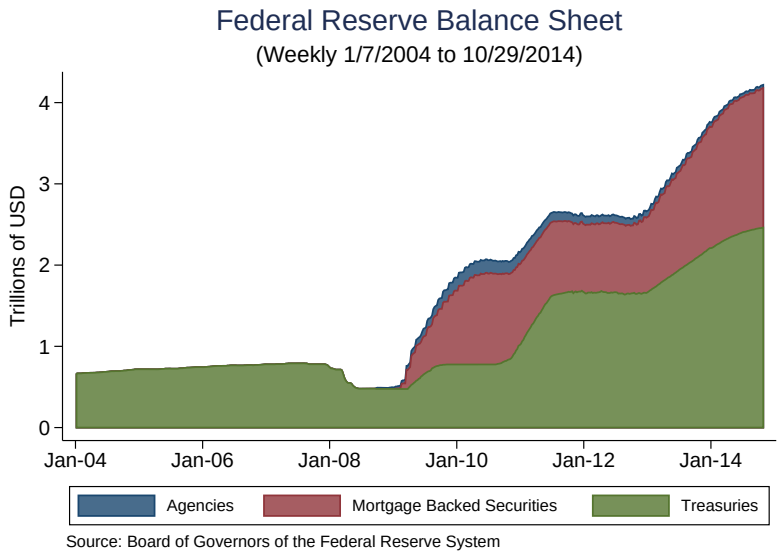

Figure 1: Federal Reserve Balance Sheet from January 7, 2004 until October 29, 2014.

et.al. (2015)), the response of emerging market asset prices to U.S. monetary policy (Moore et.al. (2013), Bowman et.al.(2014), Rogers et. al. (2014)), and the effect of tapering news on emerging market financial markets (Eichengreen and Gupta (2013), Aizenman et.al. (2014)). Other papers have studied the effect of monetary policy on portfolio flows to emerging market economies using quarterly IMF balance of payments data (Ahmed and Zlate (2013), Lim et.al. (2014))[4] as well as daily, weekly, and monthly frequency portfolio flow data from Emerging Portfolio Funds Research (EPFR) Global (Fratzscher et.al. (2013), Koepke (2014), Rai and Suchanek (2014), Dahlhaus and Vasishtha (2014), and Curcuru et.al. (2015)).[5] This paper builds upon work by Fischer (2016), which found that Federal Reserve announcements had the greatest effect on portfolio debt flows to Latin America of all the emerging market regions (Asia excluding Japan, Europe Middle East and Africa (EMEA), Latin America, Global Emerging Market (Global EM)) and examines the effects of announcements on both

[4]Ahmed and Zlate (2013) use quarterly IMF data from 2002Q1 to 2012Q2 for twelve countries (India, Indonesia, Korea, Malaysia, Philippines, Taiwan, Thailand, Argentina, Brazil, Chile, Colombia, Mexico) and show that net private capital inflows to emerging market countries are driven by a combination of interest rate differentials and global risk appetite.

[5]Fratzscher et al. (2013) uses daily EPFR Global data from January 2007 until December 2010 for 42 emerging markets and 21 advanced economies and find that Quantitative Easing 1 lowered sovereign yields and raised equity markets; Quantitative Easing 2 raised equity markets and had no effect on bond yields.

portfolio equity and debt flows to Latin America, Brazil, and Mexico.

This paper also contributes to the literature on the financial stability of the Latin America region by examining portfolio flows to Latin America as a region and to Brazil and Mexico. The financial crises that occurred in Latin America in the 1990s prompted the monetary authorities in this region to move from a system of fixed exchange rates to ones with their own independent monetary policy (Mishkin (2000), BIS (2009), BIS (2015), Edwards (2016)). Although Brazil and Mexico have been successful in their transitions from fixed exchange rates to inflation targeting monetary regimes (Bernanke (2013), DePooter et. al. (2014)) the GFC and monetary policies in advanced economies have had spillovers to Latin America. These spillovers have shown up in the form of volatile capital flows (Fratzscher et. al. (2013), Ahmed and Zlate (2014), and Curcuru et. al. (2015)), increased credit in banking systems in Mexico (Morais et. al. 2015), and the implementation of capital controls in Brazil (Forbes et. al. (2012), Jinjarak et. al. (2013)). Other research has examined the behavior of foreign and domestic mutual funds in Mexico (Zhou et. al. (2014), Xiao (2015)).

3 Data

This paper uses all the Federal Reserve announcement dates between October 8, 2008 and October 29, 2014. These announcements include all of the regularly scheduled Federal Reserve Open Market Committee (FOMC) announcement days and a few important announcements related to large scale asset purchases that were not part of the regularly scheduled FOMC announcement days. All of the FOMC announcement days are made publicly available and were obtained from the Federal Reserve Board of Governors website.[6] Any additional days were taken from Rogers et. al. (2014) examining the effect of Federal Reserve announcements on asset prices. However, unlike Rogers et. al. (2014) which include announcement days until early 2014, this paper includes FOMC announcement days until the end of large scale asset purchases in October 2014. In total, there are 54 announcements of which ten were

[6]The Federal Reserve Board of Governors website: http://www.federalreserve.gov

Tuesday announcements, forty one were Wednesday announcements, one was a Thursday announcement, and two were Friday announcements.

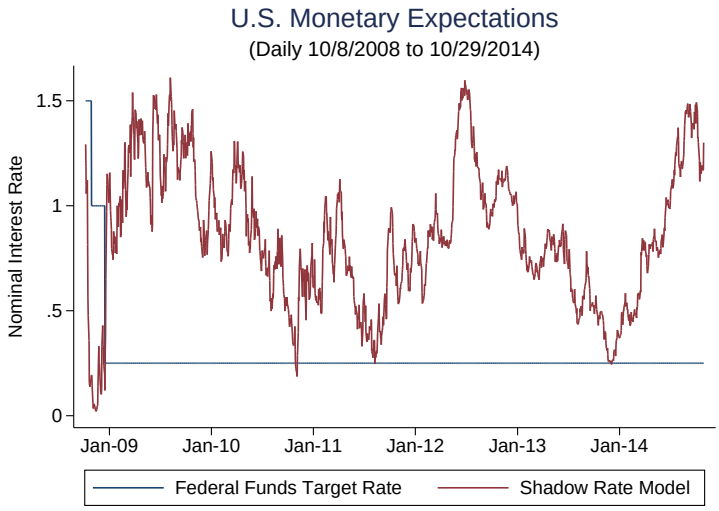

Figure 2: Federal Fund Funds Rate and Shadow Rate Model two year short rate expectations.

This paper uses daily interest rate expectations to classify these Federal Reserve announcements. This paper uses the daily two-year short rate expectations from a shadow rate Arbitrage-Free Nelson-Siegel model developed by Christensen and Rudebusch (2013) that assumes interest rates have a lower bound of zero.[7] Term structure models are widely used by financial market practitioners and central banks to examine the dynamic evolution of the yield curve using observed prices and estimating the slope, level and curvature of the yield curve. The Nelson-Siegel (1987) term structure model is the most widely used as it provides good yield curve fit for a cross section of yields (Kim and Wright (2005)).

This paper uses daily frequency portfolio equity and debt flow data collected and distributed by Emerging Portfolio Funds Research (EPFR) Global. Headquartered in Cambridge, MA, EPFR Global was founded in 1995 and tracks regulated mutual fund and exchange traded fund (ETF) flows that it collects from its direct relationships with fund managers and administrators. EPFR Global then uses this information to produce indicators

[7]More details on the Arbitrage-Free Nelson-Siegel (AFNS) model and the shadow rate Arbitrage-Free Nelson-Siegel (B-AFNS) model for estimating expectations and are included in the appendix. Please refer to Christensen and Rudebusch (2013) for even more detail.

for fund flows, country allocations, sector allocations and industry allocations and together with an allocation data series is able to estimate the flow data for country flows, sector flows, and industry flows. EPFR Global reports this data at the daily, weekly, and monthly frequencies.[8] EPFR Global currently tracks around 15,000 funds with investments across 130 countries and that cover $23.5 trillion worth of globally domiciled funds primarily domiciled in the United States and Europe. Of the $23.5 trillion of assets covered, approximately $16.2 trillion are from funds domiciled in the United States and $5.6 trillion in Europe.[9] The data covers 93 countries for equity flows, 100 countries for debt flows, and regional flows.

The flow data provided by EPFR Global is widely used among market participants and economic policymakers because of its timely release and its high frequency but has only recently been used by academic researchers.[10] The daily frequency flows are made available at 5pm EST for the previous day, the weekly fund fund flows data are made available at 5pm EST each Thursday for the previous 7 days, and the monthly data is reported at 5pm EST on the 23rd for the previous month. EPFR Global provides historical data for equity flows since January 1995 (monthly), October 2000 (weekly), and May 2007 (daily) and debt flows since January 2004 (monthly), April 2004 (weekly) and May 2007 (daily). The fund flows data includes daily flows in U.S. dollars, cumulative flows in U.S. dollars, daily percentage change in flows, daily percentage change in cumulative flows, total net assets, valuation change due to exchange rate, net asset value percentage change, and the percentage change in cumulative net asset value. As shown in Appendix Table B2 and B3, almost all of the

[8]Personal correspondence with EPFR Global indicates that many of the funds already report this data to regulators and to Bloomberg at these frequencies and so reporting to EPFR Global does not incur much cost. In addition, funds may receive some marketing value by reporting their activities to EPFR Global as they are included among other funds included in the data.

[9]To put this in perspective, the Investment Company Institute estimates in their Annual Report for 2015 that there are $33.5 trillion invested in mutual funds and ETFs worldwide. Therefore, EPFR Global covers roughly 75-80 percent of these funds.

[10]Emerging Portfolio Funds Research (EPFR) Global data has been used in 18 papers in topics related to political economy (Pepinsky (2014), Frot and Santiso (2012), capital flows (Miao and Pant (2012), Lo Duca (2012), Fratzscher et al. (2013), Fratzscher et.al. (2014), Curcuru et al. (2015), Jinjarak et al. (2011), Jotikasthira et al. (2012), Wei et al. (2010)), captial controls (Forbes et al. (2012), Jinjarak et al. (2013)), financial stability (Gelos (2011), Raddatz and Schmukler (2012), Yeyati and Williams (2012), Jones (2014), Xiao (2015), Puy (2016)), and international economic policy.

funds that report at the weekly frequency also report at the daily frequency. However, not all funds that report at the monthly frequency also report at the daily and weekly frequencies.

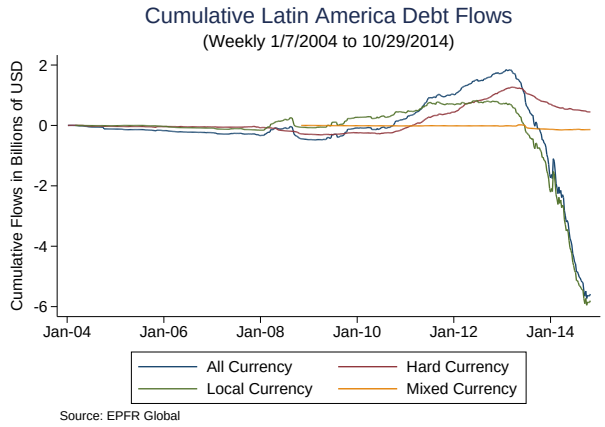

Figure 3: Latin America Debt Flows.

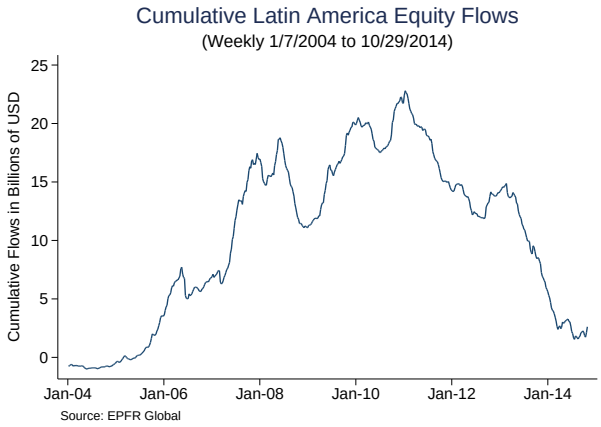

Figure 4: Latin America Equity Flows.

The flow data from EPFR Global and flow data IMF Balance of Payments differ in several ways. The IMF Balance of Payments data tracks cross-border capital flows but is only available on a quarterly basis and with a significant lag. Debt flows in the Balance of Payments are located in the financial account under portfolio investments and under liabilities. This portfolio liabilities line in the Balance of Payments covers all the cross border debt held by non-residents in that particular country. EPFR Global data is available at a much higher frequency than IMF Balance of Payments data and is released on a timely basis but covers a slightly different type of flows. The flow data provided by EPFR Global includes investment by residents and non-residents whereas the Balance of Payments data separates the debt flows by residency. EPFR Global data tracks fund flows that are domiciled globally but the vast majority of which are in the United States and Europe. In addition, EPFR Global portfolio flow data accounts for approximately 60 percent of total portfolio flows into emerging market funds. The EPFR Global data only tracks regulated managed funds and so does not track hedge funds, proprietary trading desks, foreign insurance companies investing in excess cash, and wealthy individuals and individual companies unless they invest in regulated managed funds. Miao and Pant (2012) find that the debt and equity data released by

EPFR Global data closely matches quarterly IMF data on debt and equities that are released at 3 to 6 month lags. These authors also find that because 80 percent of the funds in the EPFR Global are U.S. domiciled and U.S. investors and can be considered foreign investors in emerging markets. Nonetheless, the EPFR Global data and IMF Balance of Payments data are different in the sense that the Balance of Payments data by definition captures the transactions between residents and non-residents whereas fund flows cover inflows in and out of mutual funds and exchange traded funds.

This paper uses the daily frequency EPFR Global data for debt and equity fund flows for Latin America, Brazil, and Mexico.[11] The cumulative debt and equity flows to Latin America, shown in Figure 3 and 4, both show gradual inflows starting in 2008 but equity flows start to decline starting in 2011 and debt flows decline starting in 2013.[12] The decline in debt flows shown in Figure 3 starting in 2013 is evident in the local currency debt flows but not in the hard currency debt flows and mixed currency debt flows to Latin America.[13] Figure 5 shows the rapid decline in local currency debt flows to Brazil after 2013 while hard currency

[11]The EPFR Global regional classification for equity and debt flows is Asia excluding-Japan, Europe Middle East and Africa (EMEA) funds, Latin America, and Global Emerging Markets (Global EM). The hard currency debt is grouped as Asia ex-Japan Regional Funds (Asia ex-Japan Regional Funds, Philippines Funds), EMEA Funds (Africa Regional Funds, Emerging Europe Regional Funds, Middle East Regional Funds, Russia Funds, Slovak Republic Funds), GEM Funds (Global Emerging Markets Funds), Latin America Funds (Brazil Funds, Latin America Regional Funds, Mexico Funds). The local currency debt is grouped as: Asia ex-Japan Regional Funds (Asia ex-Japan Regional Funds, China Funds, Greater China Funds, India Funds, Indonesia Funds, Korea (South) Funds, Malaysia Funds, Taiwan Funds, Thailand Funds), EMEA Funds (Czech Republic Funds, Emerging Europe Regional Funds, Hungary Funds, Israel Funds, Poland Funds, Romania Funds, Russia Funds, South Africa Funds, Turkey Funds), GEM Funds (BRIC Funds, Global Emerging Markets Funds), Latin America Funds (Brazil Funds, Colombia Funds, Latin America Regional Funds, Mexico Funds). The mixed currency debt flows are grouped as Asia ex-Japan Funds, EMEA Funds (Africa Regional Funds, Emerging Europe Regional Funds, Europe Middle East and Africa Regional Funds, Middle East and Africa Regional Funds, Middle East Regional Funds, Poland Funds, Russia Funds, Turkey Funds), GEM Funds (BRIC Funds, Global Emerging Market Funds), Latin America Funds (Latin America Regional Funds).

[12]Figure 3 indicates that cumulative Latin America debt flows in all currency and local currency, but not hard currency or mixed currency, are negative after the summer of 2013. This could be due to a combination of factors including changes in exchange rates, outflows, and EPFR data coverage.

[13]The hard currency debt flows includes funds that invest 75 percent or more of their investment in traditional currency debt. These hard currency debt securities are denominated in U.S. dollars, Euros, British pound, Swiss franc, Japanese yen, Canadian dollar, Australian dollar, and Swedish krona. The local currency debt flows includes funds that invest 75 percent or more of their overall investment in local currency debt. These currencies include the Brazilian real, Polish zloty, Indian rupee, Chinese yuan and any currency other than the ones listed under hard currencies.

debt flows remained around the same and shows that hard and local currency debt flows to Mexico remained small throughout the sample.[14] The equity flows to Brazil and Mexico, shown in Figure 6, are not separated by currency and indicate a decline for Mexico and Brazil in 2013. There has been some previous research using EPFR Global data on portfolio flows to Latin America. In particular, a paper by Forbes et. al. (2012) uses monthly EPFR Global data for bonds and equities between January 2006 and July 2011 to examine how the externalities created by the imposition of capital controls (March 2008, October 2008, October 2009, and October 2010) and the imposition or relaxation of controls in Brazil leads to reallocation of portfolio shares to Russia, India, and China. Jinjarak et. al. (2013) use weekly EPFR Global data for Brazil from December 2007 until December 2011 to create a synthetic control and measure how capital controls impact the inflow surge. More recently, a paper by Xiao (2015) examines the differences between domestic and foreign mutual funds in Mexico and finds that foreign mutual funds respond to global financial conditions and engage in more herding, that debt funds are more sensitive than equity funds, and that domestic funds mitigate domestic market stress.

The robustness checks in this paper uses intra-day data on monetary surprises and daily data volatility, liquidity, commodity prices, and fundamentals. The intra-day data on monetary surprises are calculated from taking the first principal component of the change in future yields for 2 year, 5 year, 10 year, and 30 year Treasury futures in the 15 minutes before and 105 minutes after a Federal Reserve announcement (Rogers et. al. (2014 and 2015), Curcuru et. al. (2015)). The daily data on volatility is the VIX from Bloomberg, which measures the implied volatility of the S&P 500 index options calculated by the Chicago Board Options Exchange (CBOE) that measures the stock market's expectations of stock

[14]The funds included in Brazil hard currency debt flows include Banco Pactual, Bradesco Asset Management, Deutsche Asset & Wealth Management, Santander Asset Management, UBS Global Asset Management. The funds included in Brazil local currency debt flows include Aberdeen Asset Management, Ashmore Investment Management, Banco Multiplo, Bradesco Asset Management, BTG Pactual Asset Management, Credit Suisse Asset Management, Deutsche Asset & Wealth Management, HSBC Asset Management, Itau Asset Management Unibanco Asset Management, Western Asset Management. The fund included in the Mexico hard currency debt flows is BlackRock.

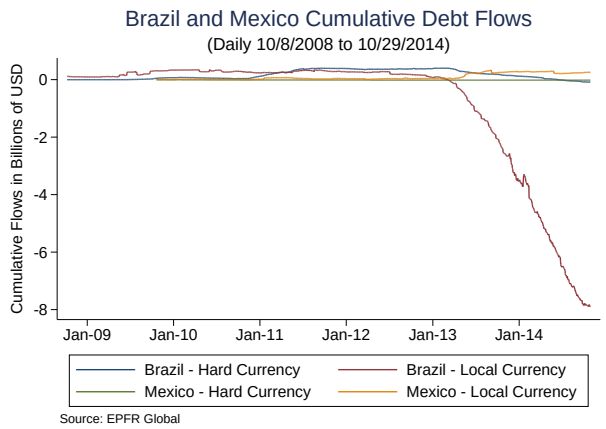

Figure 5: Brazil and Mexico Debt Flows.

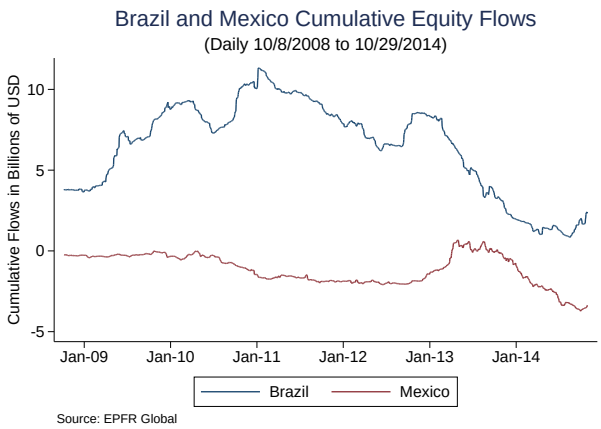

Figure 6: Brazil and Mexico Equity Flows.

market volatility over the next 30 day period. The daily data on commodity prices includes the West Texas Instruments (WTI) Cushing crude oil price, which is the most commonly used benchmark for global oil prices. The daily liquidity data is for the U.S. Treasury market and was developed by Hu et. al. (2013) based on the spread between seasoned and recently issued comparable Treasury securities, and weekly average trading volume in the secondary market for Treasury Inflation-Protected Securities (TIPS) as reported by the Federal Reserve Bank of New York.[15] The WTI Cushing crude oil price measures the price of crude at Cushing, OK and trades in pipeline lots of 1,000 to 5,000 barrels a day for delivery between the 25th of one month to the 25th of the next month. This paper also uses daily measures from the Bloomberg Commodity Index, which is a diversified group of commodities that relies on liquidity data and U.S. dollar weighted production data to determine the weights for commodities. In 2016, the Bloomberg Commodity Index included energy (31 percent), livestock (6 percent), softs (7 percent), industrial metals (17 percent), grains (23 percent), and precious metals (15 percent). The fundamentals data includes the J.P. Morgan EMBI and the MSCI equity index for Latin America, Brazil, and Mexico.

[15]Hu, Grace Xing and Jun Pan, Jian Wang. 2013. Noise as a Measure of Illiquidity. Journal of Finance. Vol. LXVIII, No. 6. http://www.mit.edu/~junpan/Noise_Measure.xlsx

4 Methodology

This section describes the methodology used for estimating the effect of changes to U.S. monetary expectations on emerging market debt flows in two parts. First, this section explains the methodology used for classifying the Federal Reserve announcements as easing (unexpected), tightening (unexpected), easing (expected) and tightening (expected) using changes to monetary expectations measured by the shadow rate model. Second, this section explains the methodology for estimating the effects of Federal Reserve announcements on portfolio flows to Latin America and to Brazil and Mexico.[16]

4.1 Classifying Federal Reserve Announcements

Federal Reserve announcements are classified by measuring the changes in interest rate expectations around announcement days. As described in the previous section these market expectations of the future short rate are measured using daily measures from a shadow rate term structure model. This measure of market expectations of the future short rate can change even if the actual short term policy rate remains unchanged. This measure of expectations is used to classify Federal Reserve announcements into one of the following four categories: easing (unexpected), tightening (unexpected), easing (expected), and tightening (expected). An announcement cannot be classified if the measure of expectations does not change on the announcement day.

The Federal Reserve announcements between October 8, 2008 and October 29, 2014 are classified in the following manner. First, the daily measure of expectations is converted into the daily percentage change of that measure of expectations. This daily percentage change measure is then converted into positive values by taking the absolute value of all the daily percentage change observations. Second, the mean change in the absolute value of

[16]Previous approaches to understanding the reaction of portfolio fund flows to Federal Reserve monetary policy have relied on VAR methods (Feroli et. al. (2014), Rai and Suchanek (2014), Dahlhaus and Vasishtha (2014), Global Financial Stability Report IMF (2014), McCauley et. al. (2014), Plantier (2015)), OLS regressions (Edwards (2012), Koepke (2014)), and an event study (Curcuru et. al. (2015).

all the daily percentage change observations is calculated to find the average level of daily change in expectations over the entire sample period. Third, each of the Federal Reserve announcements are classified by comparing the percentage change in expectations on that day relative to mean absolute value of the change in that measure of expectations on all the other days in the sample period. If the change in expectations on an announcement day is above an average change in expectations on all the other days in the sample period then it is unexpected. Conversely, if the change expectations on an announcement day is less than an average change in expectations on all other days, then it is expected. The announcements are also classified as easing if the change in expectations is negative and tightening if the change in expectations is positive.

4.2 Effects on Portfolio Flows to Latin America, Brazil, Mexico

The event study methodology used to estimate the effect of Federal Reserve announcements on portfolio flows uses the announcements classified by the shadow rate model together with the EPFR Global data. Equation (1) is the regression specification that is used to understand the effect of announcements on portfolio flows to Latin America.

$$Flows_{ijrt} = \widehat{\beta}_0 + \widehat{\beta}_1(Shadow\ Rate\ Announcements_{kt}) + \varepsilon_{ijrt} \tag{1}$$

The *Flows* variable on the left hand side of (1) is the data on daily frequency flows to Latin America from EPFR Global. This variable is classified by asset class subscript i for whether these portfolio fund flows are for debt flows or equity flows. The debt flows are in all currencies, local currency, hard currency, and mixed currency but the equity flows are in all currencies. As a result, the subscript j denotes whether debt flows are all currencies, hard currencies, local currencies, or mixed currencies. The subscript r specifies whether the investment focus is Latin America, Brazil, or Mexico. Finally, the subscript t denotes the day of the announcement to indicate the precise day for the flows around that announcement

day. On the right hand side of equation (1) is the *Shadow Rate Announcements* variable that is categorized using market expectations from the shadow rate model. These announcements are denoted by subscript k to specify the announcements as easing (unexpected), tightening (unexpected), easing (expected), and tightening (expected). Furthermore, the subscript t denotes the announcement day.

The event study methodology used in this paper tests whether there exists a statistically significant difference seven day average flows before and after each of the four Federal Reserve announcement classifications.[17] All four announcement classifications k are analyzed for both equity and debt i, currencies j, and regions r. Recall, the Federal Reserve announcements were classified using the daily expectations from the shadow rate model. Therefore, in order to examine the effect of easing (unexpected) announcements on all currency j debt flows i to Latin America r we examine only the debt flows that occur around the seven days before and after those 14 announcements. The first step in this event study methodology is to make sure that each Federal Reserve announcement occurs at time t equals zero. The next step involves taking each of the 14 easing (unexpected) announcements and assigning a dummy variable for the seven days after each of these announcements. Then, an ordinary least squares regression is used to examine if there is statistically significant difference in the average flows before and after all of the easing (unexpected) announcements. This difference estimate for the effect of easing (unexpected) announcements on debt flows to Latin America is reported in the upper left of Figure 8 with the average flows in each day represented by the blue dots. This same event study methodology is repeated for tightening (unexpected), easing (expected), and tightening (expected) Federal Reserve announcements. The results for each of event studies is standardized to the mean and standard deviation in order to compare the coefficients and significance across each of the announcement classifications.

This same event study methodology is used to explore the effects of all four announcement

[17]The seven day window size is large enough to capture the time that portfolio investors can take to respond to events while at the same time is small enough so that it captures effects from Federal Reserve announcements.

classifications on debt flows and equity flows to Latin America, Brazil, and Mexico. The Latin America flows are analyzed separately for debt flows and for equity flows. The Latin America debt flows are further separated into all currencies, hard currencies, local currencies and mixed currencies while the equity flows to Latin America are only in all currencies. The Brazil flows are also analyzed separately for debt flows, separated into hard currency and local currency debt flows, as well was for equity flows. The Mexico flows are analyzed only for equity flows since there is insufficient data on debt flows to Mexico.

$$Flows_{ijrt} = \widehat{\beta}_0 + \widehat{\beta}_1(Shadow\ Rate\ Announcements_{kt}) + Control_{mt} + \varepsilon_{ijrt} \tag{2}$$

The robustness checks used in the paper involves using a intra-daily data on interest rate expectations to classify Federal Reserve announcements and including additional control variables into the event study. The intra-daily data on interest rate expectations is used to classify announcements as easing if the expectations went down and tightening if the interest rate expectations went up. The *Flows* variable and the *Shadow Rate Announcements* variables in (2) are the same as those variables in (1). The control variables *Control* are introduced into the regression equation (2) to make sure that the changes in flows before and after Federal Reserve are not the result of changes in other domestic and international factors. These control factors denoted by subscript m at time t are introduced separately into the regressions and include a measure of uncertainty the VIX, market liquidity in the U.S. Treasury market, commodity prices, as well as J.P Morgan Emerging Market Bond Indices (EMBI) and MSCI equity indices. The robustness checks including these control variables for Latin America debt and equity flows as well as for Brazil debt flows, Brazil equity flows, and Mexico equity flows are reported in Appendix Table B7 to Appendix Table B16.

5 Results

The results are separated into a section for classifying Federal Reserve announcements using expectations from a shadow rate model and a section for the effects of Federal Reserve announcements on portfolio flows to Latin America. The results for the effects of Federal Reserve announcements on portfolio flows to Latin America are grouped into a subsection for overall Latin America flows and into a subsection for Brazil and Mexico.

5.1 Classifying Federal Reserve Announcements

The shadow rate model classifies all of the Federal Reserve announcements from October 8, 2008 and October 29, 2014. Table 1 and Figure 7 show that the shadow rate model classifies the 54 announcements during this time period as 14 easing (unexpected) events, 9 tightening (unexpected) events, 16 easing (expected) events, and 15 tightening (expected) events.

Table 1: Daily Classification of Federal Reserve Announcements

	Shadow Rate Model
Easing (Unexpected)	14
Tightening (Unexpected)	9
Easing (Expected)	16
Tightening (Expected)	15
Unclassified	0
Total	54

The mean absolute value change in expectations for the shadow rate model is 5.40 percent and with a standard deviation of 10.25 percent. The minimum change in expectations was 0 percent and the maximum change in expectation was 191.49 percent. Indeed, this is because the shadow rate model imposes a zero lower bound on the expectations for the short rate, which makes the model and the expectations for the short rate much more stable than without this zero lower bound. A significance test of the daily percentage change in shadow rate model measure of expectations on the announcement day relative to the previous seven days is shown in Appendix Figure B3.

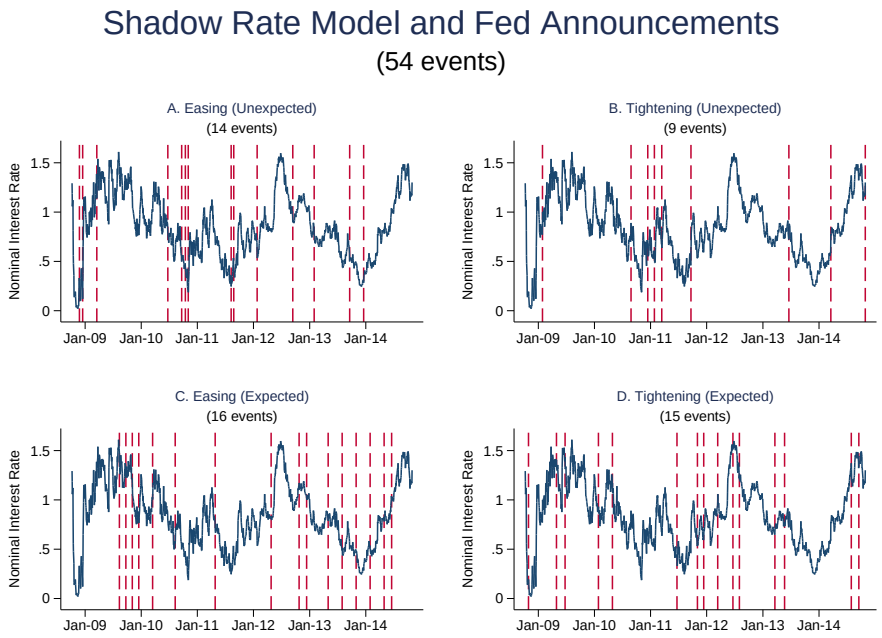

Figure 7: Classification of Federal Reserve announcements by the Shadow Rate Model as easing (unexpected), tightening (unexpected), easing (expected), and tightening (expected).

5.2 Effects on Portfolio Flows to Latin America, Brazil, Mexico

This section explains the event study results of Federal Reserve announcements on portfolio flows to Latin America. The main result from this analysis is that both easing (unexpected) and tightening (unexpected) announcements have a statistically significant effect on debt flows but not for equity flows to Latin America. Both easing (unexpected) and tightening (unexpected) announcements cause Latin America all currency debt outflows and local currency debt outflows but have no effect on hard currency debt flows. Similarly, the announcements affect debt flows but not equity flows for Brazil and Mexico. Finally, easing (unexpected) and tightening (unexpected) announcements cause local currency debt outflows but have no statistically significant effect on hard currency debt flows to Brazil.

5.2.1 Portfolio Flows to Latin America

The main result, as seen in Figure 8, is that both easing (unexpected) and tightening (unexpected) announcements have a statistically effect on portfolio debt flows to Latin America

within a seven day event window for all currencies. The easing (unexpected) announcements reduce all debt flows to Latin America by .32 standard deviations or $11.01 million less per week in flows the week after than the week before an easing (unexpected) Federal Reserve announcement. The tightening (unexpected) announcements reduce all debt flows to Latin America by .38 standard deviations or $12.54 million less per week in flows the week after than the week before a tightening (unexpected) Federal Reserve announcement.

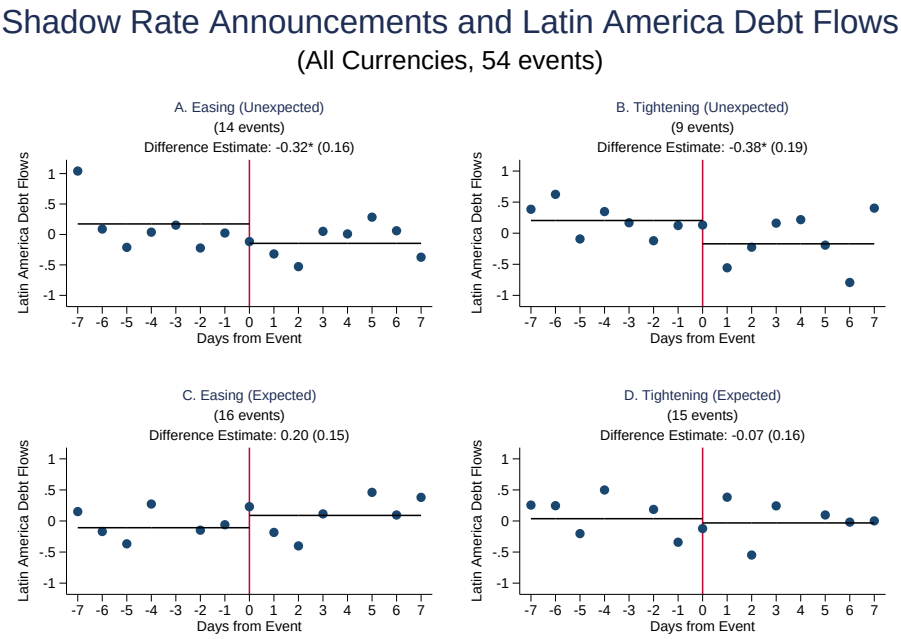

Figure 8: Standardized effects of Federal Reserve announcements classified by the Shadow Rate Model on Latin America debt flows.

An analysis of debt flows to Latin America by currency indicates that there is no effect for hard currency debt flows but there is an effect for local currency debt flows and mixed currency debt flows. As seen in Appendix Figure B5, the easing (unexpected) announcements reduce local currency debt flows to Latin America by .34 standard deviations or $11.66 million less per week in flows the week after than the week before an easing (unexpected) Federal Reserve announcement. The tightening (unexpected) announcements reduce local currency debt flows to Latin America by .41 standard deviations or $12.64 less per week in flows the week after than the week before a tightening (unexpected) Federal Reserve an-

nouncement. In Appendix Figure B6, easing (unexpected) announcements reduce mixed currency debt flows to Latin America by .29 standard deviations or $100 thousand less flows the week after from the week before an easing (unexpected) Federal Reserve announcement. Tightening (unexpected) announcements do not affect mixed currency debt flows.

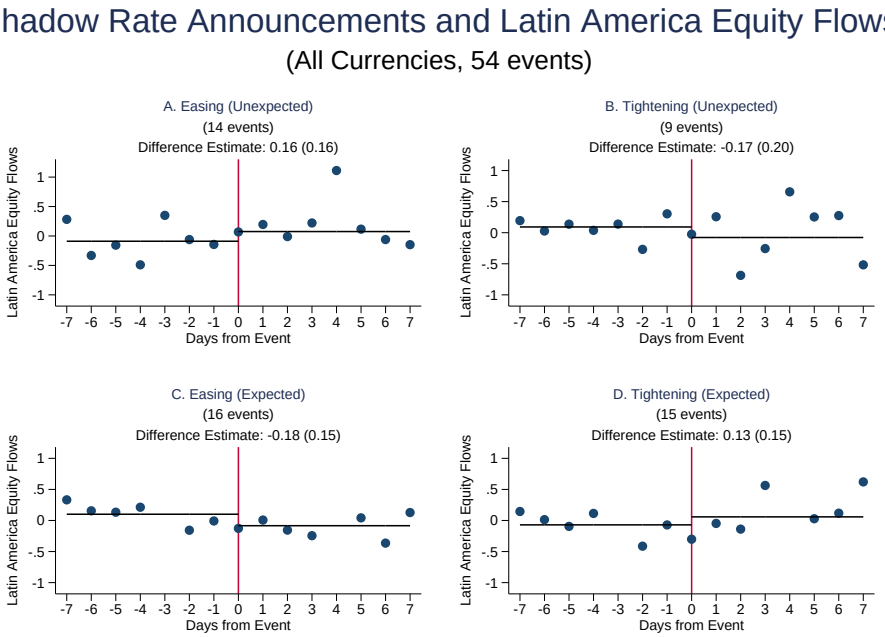

Figure 9: Standardized effects of Federal Reserve announcements classified by the Shadow Rate Model on Latin America equity flows.

As shown in Figure 9, the event study results indicate the Federal Reserve announcements do not have a statistically significant effect on equity flows to Latin America within the seven days before and seven day after event windows. This no result for equity flows to Latin America is in contrast to the statistically significant results for easing (unexpected) and tightening (unexpected) results for debt flows to Latin America.

5.2.2 Portfolio Flows to Brazil and Mexico

The same methodology for examining debt flows and equity flows to Latin America is used to analyze the debt flows and equity flows to Brazil and equity flows to Mexico. The debt flows to Brazil are in hard currency and local currency and the hard currency debt flows to

Mexico insufficient to be able to conduct empirical estimations. The equity flows to Brazil and Mexico are not classified by currency.

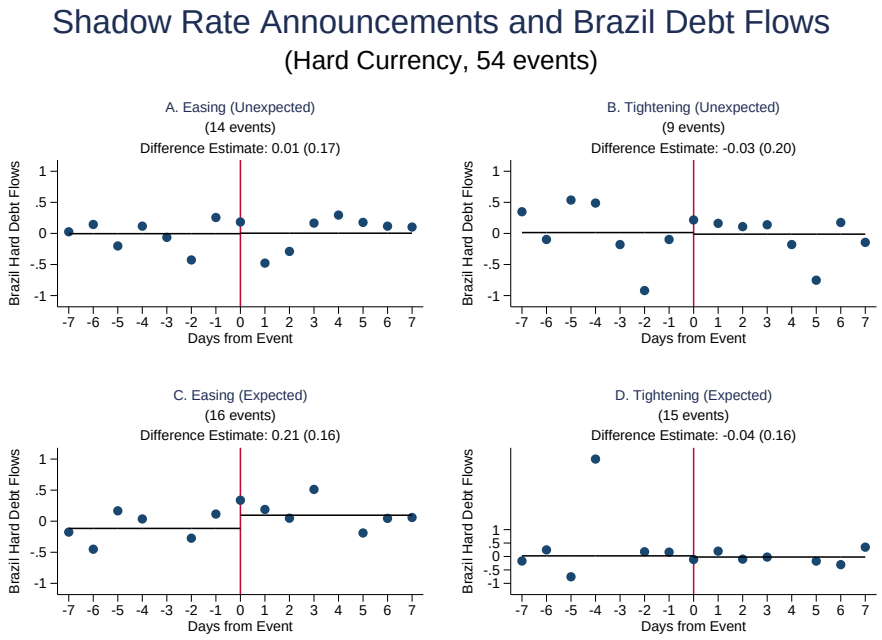

Figure 10: Standardized effects of Federal Reserve announcements classified by the Shadow Rate Model on hard currency debt flows to Brazil.

The event study results indicate that Federal Reserve announcements have an effect on debt flows to Brazil and inconclusive results for the effects on debt flows to Mexico. As seen in Figure 11 and Figure 10, the easing (unexpected) announcements have an effect on local currency debt flows to Brazil but do not have an effect on hard currency debt flows. The easing (unexpected) announcements reduce local currency debt flows to Brazil by .30 standard deviations or $5.44 million less per week in flows the week after than the week before an easing (unexpected) Federal Reserve announcement. As seen in Figure 10, the tightening (unexpected), easing (expected), and tightening (expected) announcements do not have a statistically significant effect on hard currency debt flows to Brazil. Data limitations prevent the estimation of Federal Reserve announcements on debt flows to Mexico.

The Federal Reserve announcements do not appear to have an effect on equity flows to Brazil or Mexico. As seen in Figure 12, the Federal Reserve announcements do not have

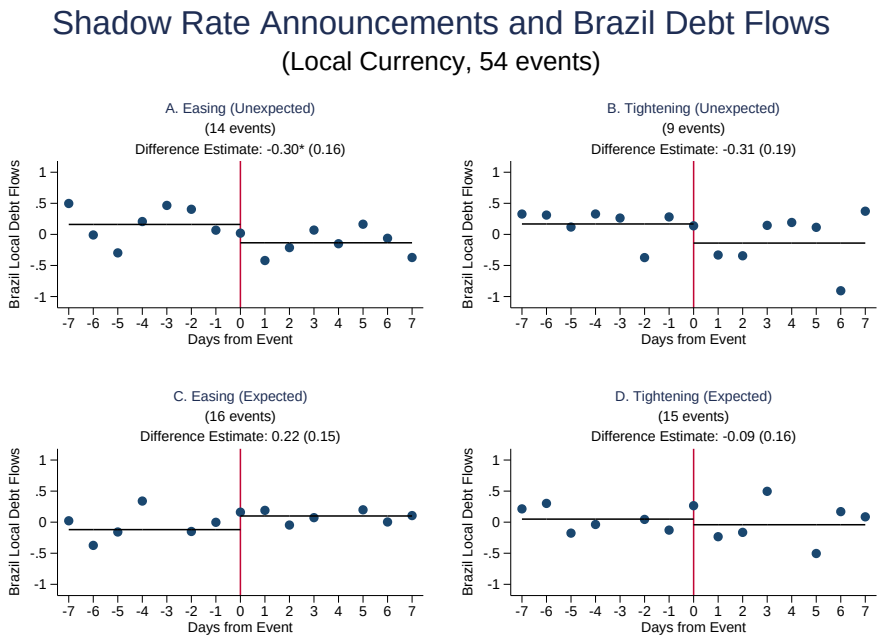

Figure 11: Standardized effects of Federal Reserve announcements classified by the Shadow Rate Model on local currency debt flows to Brazil.

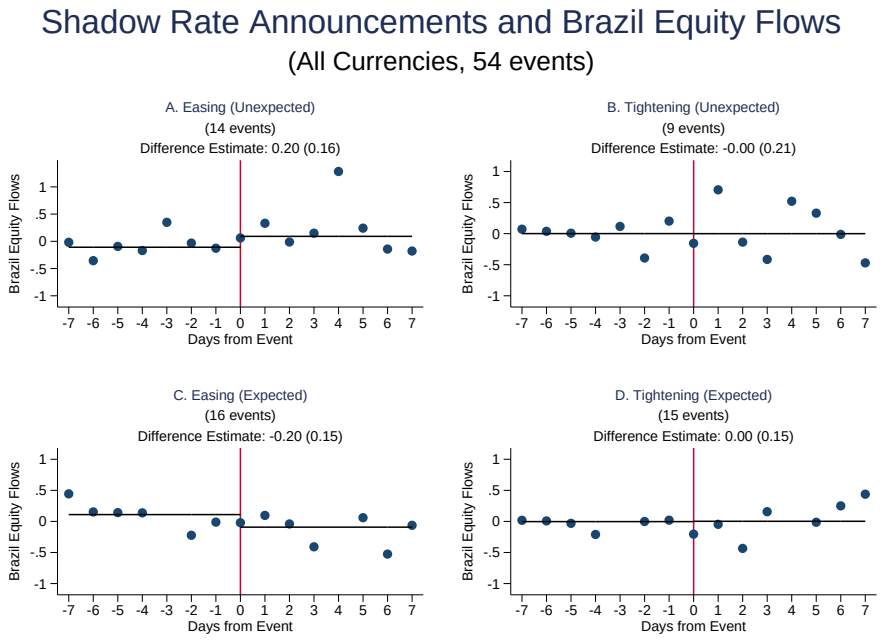

Figure 12: Standardized effects of Federal Reserve announcements classified by the Shadow Rate Model on equity flows to Brazil.

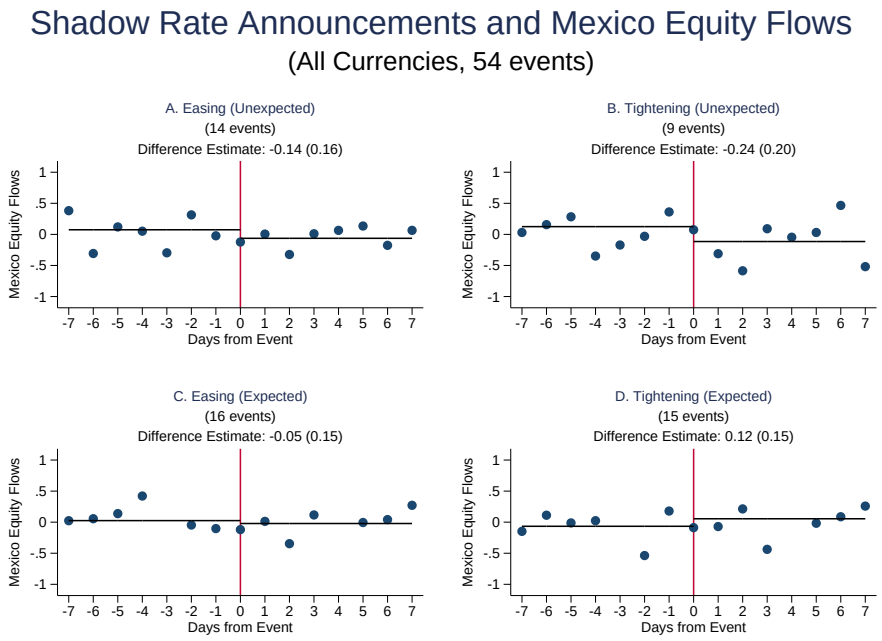

Figure 13: Standardized effects of Federal Reserve announcements classified by the Shadow Rate Model on equity flows to Mexico.

an effect on equity flows to Brazil within the seven days before and after a Federal Reserve announcement. Similarly, as seen in Figure 13, the equity flows to Mexico do not respond to any kind of Federal Reserve announcement classification within the seven days before and after an announcement.

As mentioned in the introduction, Brazil and Mexico used different set of policy response since the Global Financial Crisis. While authorities in Brazil have used capital controls and foreign exchange intervention the authorities in Mexico have followed a more market driven approach and have not intervened in financial markets. In these empirical results, we see that the easing (unexpected) Federal Reserve announcements cause local currency debt outflows to Brazil and had no effect on hard currency debt flows to Brazil. We also observe that the Federal Reserve announcements have no effect on equity flows to Brazil or Mexico. Although beyond the scope of this paper it would be interesting to explore to what degree this statistically insignificant result of Federal Reserve announcements on portfolio flows to Brazil and Mexico is due to the policy responses by authorities in these respective countries.

6 Robustness

The robustness checks in this paper include an announcement classification using intra-day data on monetary surprises as well as controls for volatility, liquidity, global commodity prices, and fundamentals in the regressions. The first robustness check compares the announcement classification using daily interest rate expectations with intra-day data on interest rate expectations. The second set of robustness checks introduce control variables into the regressions for uncertainty measured by the VIX, liquidity in the U.S. Treasury market, oil and commodity prices measured from Bloomberg, and fundamentals measured by J.P. Morgan EMBI and the MSCI equity index.

6.1 Intra-day Monetary Surprise Announcement Classification

One robustness check is to classify the Federal Reserve announcements using intra-day monetary surprises instead of daily changes in interest rate expectations. Recall, this paper used daily frequency expectations from a shadow rate term structure model to classify the Federal Reserve announcements as easing (unexpected), tightening (unexpected), easing (expected), and tightening (expected). However, this classification could be biased if other events occur on Federal Reserve announcement days that systematically influence the market expectations, either domestically or internationally. Intra-day data on monetary surprises are calculated from taking the first principal component of the change in future yields for 2 year, 5 year, 10 year, and 30 year Treasury futures in the 15 minutes before and 105 minutes after a Federal Reserve announcement (Rogers et. al. (2014 and 2015), Curcuru et. al. (2015)).

Table 2: Intra-day Classification of Federal Reserve Announcements

	Rogers et. al. (2014)
Easing	27
Tightening	25
Unclassified	2
Total	54

The intra-day monetary surprises are used to classify announcements where there is a positive interest rate change as a tightening announcement, announcements where there is a negative interest rate change as an easing announcement, and announcements where there is no change as unclassified. As seen in Table 2 the intra-day data on monetary surprises classifies 27 announcements as easing, 25 announcements as tightening, and leaves 2 announcements unclassified. Appendix Table B4 shows a complete list and comparison of all 54 Federal Reserve announcements from October 2008 until October 2014 using the shadow rate model and the intra-day monetary surprises. The intra-daily monetary surprise announcement classification matches the daily shadow rate model classification for most of the Federal Reserve announcements during this time period. The only other differences between the intra-daily announcement classification and the shadow rate model announcement classification are that the intra-daily classification leaves two announcements unclassified and that the intra-daily classification cannot be used to determine if it is expected or unexpected.

6.2 Control Variables

Another set of robustness checks involves including control variables into the regression specification (1) to see whether this changes the statistical significance for the coefficient for the shadow rate announcements. For both the debt flows and the equity flows the uncertainty as measured by the VIX, market liquidity in the U.S. Treasury market as measured by Hu, Pan, Wang (2013), and commodity prices as measured by Bloomberg are included in the regression specifications. For the debt flow regressions a control for the J.P. Morgan Emerging Market Bond Index is included as a proxy for fundamentals and for the equity flow regressions a control for the MSCI as proxy for fundamentals.

6.2.1 VIX

Previous literature has shown that global risk aversion, measured by the VIX, may help explain portfolio flows to emerging markets (Ahmed and Zlate (2013), Nier, Sedik, and

Mondino (2014), Rey (2014), Ananchotikul and Zhang (2014), Koepke (2014)). When global risk aversion is high, for example, global investors are more likely to put their money into "safe" assets such as U.S. Treasuries and less likely to put their money into emerging markets. The VIX is added to the regression in order to make sure that the portfolio flows to Latin America are responding to Federal Reserve announcements and not to changes in global risk aversion as measured by the VIX. The VIX measures the implied volatility of the S&P 500 index options calculated by the Chicago Board Options Exchange (CBOE) and measures the stock market's expectations of stock market volatility over the next 30 day period. The results from this robustness check, shown in Appendix Table B5 and Appendix Table B6, indicate that adding the VIX to the specification does not change the results for portfolio flows to Latin America or to Brazil and Mexico.

6.2.2 Liquidity

The measure of market liquidity, a measure developed by Hu, Pan, Wang (2013), is used as a control variable that may help explain the investment behavior of global financial flows to Latin America. This measure of market liquidity, available at daily frequency, captures the spread between seasoned and recently issued comparable Treasury securities and weekly average trading volume in the secondary market for Treasury Inflation Protected Securities (TIPS) as reported by the Federal Reserve Bank of New York. When this market is illiquid this suggests a shortage of arbitrage capital and tightening of liquidity in the overall market. This market liquidity measure has been shown to capture major financial events such as the 1987 stock market crash, the near collapse of LTCM, 9/11, the GM credit crisis, and the fall of Bear Sterns and Lehman Brothers. When this measure is low, this suggests there is sufficient arbitrage capital. Including a market liquidity variable tests to see if the Federal Reserve announcements are driving these portfolio flows to Latin America despite changes in overall market liquidity. The results from this robustness check, in Table B8 and Table B13, indicate that adding the this measure does not change the results for portfolio flows to Latin

America, Brazil, or Mexico.

6.2.3 Commodity Prices

The oil price, West Texas Intermediate (WTI), is used another separate control variable that may explain portfolio flows to Latin America. Latin American countries that are net oil exporters reliant on petroleum export receipts will be negatively affected by lower oil prices while Latin American countries that are net oil importers benefit from decline in oil price. Adding a control for oil prices before and after Federal Reserve announcements ensures that the portfolio flows are responding to the announcements and not the oil prices. The results from this robustness check, shown in Appendix Table B9 and Appendix Table B14, indicate that adding the oil price into the specification does not invalidate the results for portfolio flows to Latin America or to Brazil and Mexico.

A combination of commodity prices, Bloomberg Commodity Index, is added as a separate control variable that may explain portfolio flows to Latin America. Similar to the case of oil prices, countries in Latin America that are net commodity exporters will be negatively affected from lower commodity prices and Latin American countries that are net importers of commodities will benefit from the decline in the commodity price. Adding a control variable for commodity prices before and after Federal Reserve announcements ensures that the portfolio flows are responding to the announcements and not the changes in commodity prices. The result from this robustness check, shown in Appendix Table B10 and Appendix Table B15 indicate that adding commodity prices to the specification does not change the results for portfolio flows to Latin America or to Brazil and Mexico.

6.2.4 Fundamentals

The debt market fundamentals, measured by the J.P. Morgan Emerging Market Bond Index (EMBI) Global is used as a control variable to explain portfolio debt flows to Latin America. The EMBI Global covers 32 countries and is the most comprehensive emerging markets debt

benchmark covering U.S. dollar denominated Brady bonds, Eurobonds, traded loans and local market debt instruments issued by sovereign and quasi-sovereign entities. Instead of selecting countries according to a sovereign-credit rating level, this index defines emerging markets with a combination of World Bank defined per capita income brackets and each country's debt-restructuring history. The EMBI Global only considers emerging markets issues denominated in U.S. dollars with a minimum current face outstanding of $500 million and at least 2.5 years to maturity but relaxes some of the EMBI+ limits on secondary market trading.[18] The exact ticker symbol for EMBI Global Latin America is JPMGLAT, for EMBI Global Brazil is JPMGBRA, and for EMBI Global Mexico is JPMGMEX.

The equity market market fundamentals, proxied by the MSCI Emerging Market Index is used as a control variable to explain portfolio equity flows to Latin America. The MSCI EM Latin America Index, with Bloomberg ticker symbol MXLA, is a free-float weighted index that captures large and mid cap representation across five emerging market countries in Latin America: Brazil, Chile, Colombia, Mexico, and Peru. The index covers approximately 85 percent of the free float-adjusted market capitalization in each country. The MSCI Brazil Index, with Bloomberg ticker symbol MXBR Index, measures the performance of 61 large and mid cap Brazilian companies and covers approximately 85 percent of the equity market in Brazil. The MSCI Mexico Index, with Bloomberg ticker symbol MXMX Index, measures the performance of 27 large and mid cap companies in Mexico and covers 85 percent of the equity market in Mexico.

The results from including the EMBI and the MSCI in the regression (1) as a robustness check, shown in Appendix Table B11 and Appendix Table B16, indicate these variables do

[18]The EMBI Global is more commonly used than the EMBI Global Diversified and the EMBI+. The EMBI Global Diversified is a uniquely-weighted version of the EMBI Global that limits the weights of those index countries with larger debt stocks by only including specified portions of these countries' eligible current face amounts of debt outstanding. It also applies larger weights to less liquid issues from countries with smaller debt stocks. The EMBI+ covers 17 countries (including Brazil and Mexico) and comprises a set of broker-traded external debt instruments widely followed and quoted by several market makers. However, the EMBI+ only considers emerging markets issues denominated in U.S. dollars with a minimum current face outstanding of $500 million and at least 2.5 years to maturity and must meet strict criteria for secondary market trading liquidity.

not change the results. The only exception is that both the easing (unexpected) and tightening (unexpected) announcements become statistically significant for the specification that includes the EMBI a control variable whereas only the easing (unexpected) announcements were statistically significant without the EMBI.

7 Conclusion

This paper examined the effects of Federal Reserve announcements on portfolio flows to Latin America since the Global Financial Crisis. First, the paper classified all the Federal Reserve announcements from October 8, 2008 until October 29, 2014 as either easing (unexpected), tightening (unexpected), easing (expected), or tightening (expected). Second, this Federal Reserve announcement classification using the shadow rate model was used for an event study on debt flows and equity flows to Latin America as well as to Brazil and Mexico. The results showed that both easing (unexpected) and tightening (unexpected) announcements cause debt outflows from Latin America but that it only had an effect on local currency and not hard currency debt flows. These announcements did not have a statistically significant effect on equity flows. The easing (unexpected) Federal Reserve announcements had an effect on local currency debt flows to Brazil but had no effect on hard currency debt flows to Brazil or to equity flows to Brazil. There was no announcement classification that had an effect on equity flows to Mexico and data limitations for debt flows to Mexico made it impossible to estimate the effect of announcements on these flows using EPFR Global data. These results were robust to controlling for uncertainty measured by the VIX, liquidity measured from lack of arbitrage in the U.S. Treasury debt market, oil and commodity prices, and fundamentals measured by the J.P. Morgan EMBI bond index and the MSCI equity index.

These results are in contrast to some of the portfolio flow effects found in Fischer (2016) that only tightening (unexpected) announcements caused emerging market debt outflows. In this paper, using the same shadow rate announcement classification of Federal Reserve

announcements, both the easing (unexpected) announcements and the tightening (unexpected) announcements caused Latin America debt outflows but had not effect on equity flows. This result suggests that foreign debt portfolio investors to Latin America perceive any unexpected Federal Reserve announcement, regardless of whether it is an easing or tightening announcement, as an indication that it might be best to take the money out of Latin America. Second, a look at the subgroups of debt flows found that it was the local currency debt flows and not the hard currency debt flows that responded to these easing (unexpected) and tightening (unexpected) Federal Reserve announcements. This too was in contrast to the result that tightening (unexpected) announcements had a larger effect on hard currency debt flows than on local currency debt flows from Fischer (2016). The analysis of Brazil and Mexico indicated that Brazil was more sensitive to the Federal Reserve announcements. In particular, the easing (unexpected) Federal Reserve announcements caused local currency debt outflows from Brazil. The results for Mexico debt flows are inconclusive because there are fewer funds that are tracked by EPFR Global to Mexico than there are for Brazil. A more comprehensive data set for Mexico, that includes a richer set of funds, would enable an estimation of the effects of Federal Reserve announcements on portfolio flows to Mexico.[19]

This paper examined the effects of Federal Reserve announcement days on portfolio flows to Latin America since the Global Financial Crisis. Future work could use this same methodology and data to examine the effect of future Federal Reserve announcements on portfolio flows to Latin America when short term interest rate is no longer at the zero lower bound. Another possible paper would be to use this methodology and data to examine how these Federal Reserve announcements affect domestic investors in Latin America, Brazil, and Mexico. This paper used a portfolio data that are globally domiciled but most of which are based in the United States. Perhaps domestic and foreign investors respond differently to the same Federal Reserve announcements. Along those same lines, it would be

[19]One possibility would be to use daily frequency foreign portfolio data series released by the Banco de Mexico called GUBERNAMENTAL, Residentes en el Extranjero (II) or the daily frequency EM Portfolio Flows tracker data compiled by Robin Koepke and Scott Farnham at the Institute of International Finance.

interesting to examine the effect of these announcements on hedge funds, sovereign wealth funds, and central banks to see whether these other market participants and international financial flows respond similarly or differently to the regulated mutual funds and exchange traded funds examined in this paper. Finally, one could examine how the announcements by central banks in Latin America, such as the Banco de Mexico and the Banco do Brazil, affect market expectations and global financial flows.

References

Ahmed, Shaghil and Andrei Zlate. 2013 Capital Flows to Emerging Economies: a Brave New World? Board of Governors of the Federal Reserve System International Finance Discussion Papers No. 1081, 2013.

Aizenman, Joshua and Mahir Binici, Michael Hutchison. 2014. The Transmission of Federal Reserve Tapering News to Emerging Financial Markets. NBER Working Paper 19980, 2014.

Ananchotikul, Nasha and Longmei Zhang. 2014. Portfolio Flows, Global Risk Aversion and Asset Prices in Emerging Markets. IMF Working Paper.

Bank for International Settlements. Quarterly Review, December 2015: Uneasy calm awaiting lift-off.

Bank for International Settlements. 2015. Currency carry trades in Latin America. BIS Papers No 81.

Bank for International Settlements. 2009. Monetary policy frameworks and central bank market operations.

Bernanke, Ben S. Celebrating 20 Years of the Bank of Mexico's Independence. Bank of Mexico, Mexico City, Mexico. October 14, 2013.

Black, Fischer. 1995. Interest rates as options. The Journal of Finance. Vol. L, No. 7. December 1995.

Bowman, David and Juan M. Londono, Horacio Sapriza. 2014. U.S. Unconventional Monetary Policy and Transmission to Emerging Market Economies. International Finance Discussion Papers, Number 1109.

Canova, Fabio. 2005. The Transmission of US Shocks to Latin America. Journal of Applied Economics 20: 229-251.

Carstens, Agustin. Unconventional Monetary Policies, Spillovers and Policy Options for EMEs. January 12, 2016.

Chen, Jiaqian and Tommaso Mancini-Griffoli, Ratna Sahay. 2014. Spillovers from United States Monetary Policy on Emerging Markets: Different This Time? IMF Working Paper.

Christensen, Jens H.E. and Francis X. Diebold, Glenn D. Rudebusch. 2009. An arbitrage-free generalized Nelson-Siegel term structure model. Econometrics Journal. Volume 12, pp. C33-C64.

Christensen, Jens H.E. and Francis X. Diebold, Glenn D. Rudebusch. 2011. The affine arbitrage-free class of Nelson-Siegel term structure models. Journal of Econometrics 164 (2011) 4-20.

Christensen, Jens H.E. and Glenn D. Rudebusch. 2013. Modeling Yields at the Zero Lower Bound: Are Shadow Rates the Solution? January 15, 2015.

Christensen, Jens H.E. and Glenn D. Rudebusch. 2014. Estimating Shadow-Rate Term Structure models with Near-Zero Yields. Journal of Financial Econometrics, Vol. 0, No. 0, 1-34.

Christensen, Jens H.E. 2015. A Regime-Switching Model of the Yield Curve at the Zero Bound.

Christensen, Jens H.E. and Jose A. Lopez, Glenn D. Rudebusch. 2015. A Probability-Based Test of Federal Reserve Assets and Income. Draft Working Paper.

Christensen, Jens H.E. and Simon Kwan. 2014. Assessing Expectations of Monetary Policy. Federal Reserve Bank of San Francisco. Economic Letter 2014-27 (September 8, 2014).

Cuadra, Gabriel and Jose Sidaoui, Manuel Ramos-Francia. 2011. Global liquidity, capital flows and challenges for policymakers: the Mexican experience. "The influence of external factors on monetary policy frameworks and operations," BIS Papers, Bank for International Settlements, number 57, June.

Curcuru, Stephanie and Aaron Rosenblum, Chiara Scotti. International Capital Flows and Unconventional Monetary Policy. Board of Governors of the Federal Reserve System. Hong Kong Institute for Monetary Research Conference October 2015.

Dahlhaus, Tajana and Garima Vasishtha. 2014. The Impact of U.S. Monetary Policy Normalization on Capital Flows to Emerging-Market Economies. Bank of Canada Working Paper 2014-53.

DePooter, Michiel D., Patrice T. Robitaille, Ian A. Walker, and Michael Zdinak. 2014. Are Long-Term Inflation Expectations Well Anchored in Brazil, Chile, and Mexico? International Journal of Central Banking, vol. 10, no. 2, pp. 337-400.

Dooley, Michael. Can Emerging Economy Central Banks Be Market-Makers of Last Resort? BIS Paper No. 79.

Edwards, Sebastian. 2016. The Federal Reserve and Monetary Policy in Latin America. Is there a policy spillover? Working Paper.

Eichengreen, Barry and Poonam Gupta. 2013. Tapering Talk: The Impact of Expectations of Reduced Federal Reserve Security Purchases on Emerging Markets. World Bank Working Paper.

Fischer, Eric. 2016. U.S. Monetary Expectations and Emerging Market Debt Flows. Job Market Paper.

Forbes, Kristin and Marcel Fratzscher, Thomas Kostka, Roland Straub. 2012. Bubble thy neighbor: Portfolio Effects and Externalities from Capital Controls. NBER Working Paper Series. Working Paper 19052.

Fratzscher, Marcel and Marco Lo Duca, Roland Straub. 2014. ECB Unconventional Monetary Policy Actions: Market Impact, International Spillovers and Transmission Channels. 15th Jacques Polak Annual Research Conference.

Fratzscher, Marcel and Marco Lo Duca, Roland Straub. 2013. On the International spillovers of US Quantitative Easing. European Central Bank Working Paper Series No. 1557, 2013.

Frot, Emmanuel & Javier Santiso. 2013. Political Uncertainty and Portfolio Managers in Emerging Economies. Review of International Political Economy Vol. 20, No. 1, pp.26-51.

Gertler, Mark and Peter Karadi. 2015. Monetary Policy Surprises, Credit Costs, and Economic Activity. American Economic Journal: Macroeconomics, Vol. 7, No. 1, pp. 44-76.

Gelos, Gaston. 2011. International Mutual Funds, Capital Flow Volatility, and Contagion - A Survey. IMF Working Paper.

Global Financial Stability Report, IMF April 2014. Chapter 2: How do Changes in the Investor Base and Financial Deepening Affect Emerging Market Economies. April 2014.

Global Financial Stability Report, IMF April 2016. Chapter 2: The Growing Importance of Financial Spillovers from Emerging Market Economies

Gürkaynak, Refet S. and Brian Sack, Jonathan Wright. 2007. The US Treasury Yield Curve: 1961 to the Present. Journal of Monetary Economics 54, 2291-2304.

Gürkaynak, Refet S. and Brian P. Sack, Eric T. Swanson. 2007.Market-Based Measures of Monetary Policy Expectations. Journal of Business & Economic Statistics, Vol. 25, No. 2 (Apr., 2007), pp. 201-212.

Haldane, Andrew. 2014. The Age of Asset Management? Bank of England Speech at the London Business School April 4, 2014.

Hamilton, James D. and Jing Cynthia Wu. 2012. The Effectiveness of Alternative Monetary Policy Tools in a Zero Lower Bound Environment. Journal of Money, Credit and Banking, 44(1): 3-46, February 2012.

Hattori, Masazumi and Andreas Schrimpf, Vladyslav Sushko. 2013. The Response of Tail Risk Perceptions of Unconventional Monetary Policy. BIS Working Papers No. 425.

Hu, Grace, Jun Pan, and Jiang Wang. 2013. Noise as Information for Illiquidity. Journal of Finance 68(6) pp. 2,341-2,382.

Investment Company Institute. 2015 Investment Company Fact Book - A Review of Trends and Activities in the U.S. Investment Company Industry 55th Edition.

Jaramillo, Laura and Y. Sophia Zhang. 2013. Real money investors and sovereign bond yields. IMF Working Paper.

Jaramillo, Laura and Anke Weber. 2014. Global Spillovers into Domestic Bond Markets in Emerging Market Economies. IMF Working Paper.

Jinjarak, Yothin and Jon Wongswan, Huanhuan Zheng. 2011. International Fund Investment and Local Market Returns. Journal of Banking & Finance 35 pp. 572-587.

Jinjarak, Yothin and Ilan Noy, Huanhuan Zheng. 2013. Capital controls in Brazil - Stemming a Tide with a Signal? Journal of Banking & Finance 37.

Jones, Bradley. Identifying Speculative Bubbles: A Two-Pillar Surveillance Framework. IMF WP 14/208

Kim, Don H. and Jonathan H. Wright. 2005. An Arbitrage-Free Three Factor Term Structure Model and the Recent Behavior of Long-Term Yields and Distant-Horizon Forward Rates. Finance and Economics Discussion Series 2005-33.

Koepke, Robin. 2014. Federal Reserve Expectations and International Portfolio Flows. Working Paper.

Koepke, Robin and Scott Farnham. EM Portfolio Flows Tracker. Institute of International Finance.

Kuttner, Kenneth N. 2001. Monetary Policy Surprises and Interest Rates: Evidence from the Fed Funds Futures Market. Journal of Monetary Economics 47, 523-544.

Lo Duca, Marco. 2012. Modeling the Time Varying Determinants of Portfolio Flows to Emerging Markets. ECB Working Paper Series No. 1468.

McCauley, Robert N and Patrick McGuire, Vladyslav Sushko. 2015. Global Dollar Credit: Links to US Monetary Policy and Leverage. Working Papers No 483 January 2015.

Miao, Yanliang and Malika Pant. 2012. Coincident Indicators of Capital Flows. IMF Working Paper.

Miranda-Agrippino, S. and Helene Rey. World Asset Markets and the Global Financial Cycle. October 2015. Working Paper.

Mishkin, Frederic S. and Manuel A. Savastano. 2000. Monetary Policy Strategies for Latin America. NBER Working Paper 7617.

Morris, Stephen and Hyun Song Shin. 2014. Risk-Taking Channel of Monetary Policy: A Global Game Approach.

Morais, Bernardo and Jose-Luis Peydro, Claudia Ruiz. The International Bank Lending Channel of Monetary Policy Rates and QE: Credit Supply, Reach-for-Yield, and Real Effects. International Finance Discussion Papers 1137. July 2015.

Nelson, Charles R. and Andrew F. Siegel. 1987. Parsimonious Modeling of Yield Curves. The Journal of Business. Vol. 60, pp 473-489.

Office of Financial Research. Asset Management and Financial Stability. September 2013.

Pepinsky, Thomas B. The Politics of Capital Flight in the Global Economic Crisis. Volume 26, Issue 3, 431-456.

Piazzesi, Monika and Eric T. Swanson. 2008. Futures prices as risk-adjusted forecasts of monetary policy. Journal of Monetary Economics 55, 677-691.

Plantier, Chris. 2015. Regulated Funds, Emerging Markets, and Financial Stability. ICI Global Research Perspective. April 2015. Vol. 5, No. 1.

Puy, Damien. 2016. Mutual funds flows and the geography of contagion. Journal of International Money and Finance (60) 73-93.

Raddatz, Claudio and Sergio L. Schmukler. 2012. On the international transmission of shocks: Micro-evidence from mutual fund portfolios. Journal of International Economics (88) 357-374.

Rai, Vikram and Lena Suchanek. 2014. The Effect of the Federal Reserve's Tapering Announcements on Emerging Markets. Bank of Canada Working Paper 2014-50.

Rey, Helene. 2013. Dilemma not Trilemma: The Global Financial Cycle and Monetary Policy Independence. In Jackson Hole Economic Symposium.

Rogers, John H., Chiara Scotti, and Jonathan H. Wright. Unconventional Monetary Policy and International Risk Premia. Working Paper October 2015.

Rothenberg, Alexander D. and Francis Warnock. 2011. Sudden flight and true sudden stops. Review of International Economics, 19(3), 509-524.

Roubini, Nouriel and Brad Setser. Bailouts or Bail-Ins? Responding to Financial Crises in Emerging Economies. Institute for International Economics: Washington DC, 2004.

Shin, Hyun Song. 2013. The Second Phase of Global Liquidity and Its Impact on Emerging Economies. Federal Reserve Bank of San Francisco, 2013.

Swanson, Eric T. and John C. Williams. 2014. Measuring the Effect of the Zero Lower Bound on Medium- and Longer-Term Interest Rates. American Economic Review, 104(10): 3154-3185.

Walsh, Carl E. Monetary policy channels and policy instruments. "Monetary Policy and the Public" Federal Reserve Bank of Cleveland Conference, 2014.

Wei, Shang-Jin and Zhiwei Zhang, Qingyuan Du. 2010. Does the Global Fireman Inadvertently Add Fuel to the Fire? New Evidence from Institutional Investors' Response to IMF program Announcements. Journal of International Money and Finance.

Xiao, Jasmine. 2015. Domestic and Foreign Mutual Funds in Mexico: Do They Behave Differently? IMF Working Paper 2015.

Zhou, Jianping, Fei Han, and Jasmine Xiao, 2014. Capital Flow Volatility and Investor Behavior in Mexico: Selected Issues Paper, IMF Country Report No. 14/320 (Washington: International Monetary Fund).

Appendix A

A.1 Arbitrage-Free Nelson Siegel (AFNS) Model

Term structure models decompose the debt yields into the average expected future short-term rate and the term premium for a given maturity. The yield curve at time t for a given maturity τ debt can be written to be the sum of the average market expectations of the short-rate and a term premium at time time for a given maturity τ bond:

$$y_t(\tau) = \frac{1}{\tau}\int_t^{t+\tau} E_t^P[r_s]ds + TP_t(\tau)$$

the average expectations of the short rate is sometimes referred to as the risk neutral yield and written as $RN_t(\tau) = \frac{1}{\tau}\int_t^{t+\tau} E_t^P[r_s]ds$ and is identical for all debt of that maturity. The term premium, $TP_t(\tau)$ is a residual term that captures information about growth and inflation, changes in overall risk aversion, credit risk, and liquidity risk of the bond. The term premium $TP_t(\tau)$ can also be expressed in terms of the model $TP_t(\tau) = y_t(\tau) - \frac{1}{\tau}\int_t^{t+\tau} E_t^P[r_s]ds$. The forward short rates and forward term premia can be estimated from the the term structure model and will be compared to asset price measures of the short-rate.

The arbitrage-free Nelson-Siegel model (AFNS) by Christensen and Rudebusch (2012) is an affine Gaussian term structure model that builds off a representation introduced in Christensen et al. (2011) and contributes to a growing literature of dynamic term structure models.[20] Gaussian term structure models have risk-neutral Q-measure that captures factors in the short-term rate and a real world P-measure that captures factors in the term premium. This AFNS model has three latent state variables that represent the slope, level, and curvature of the yield curve $X_t = (L_t, S_t, C_t)$. The risk-neutral Q-measure is described by the following stochastic differential

[20] Other exmples of term structures include Hamilton and Wu (2012), Andreasen and Christensen (2015).

equations (SDEs):

$$\begin{pmatrix} dL_t \\ dS_t \\ dC_t \end{pmatrix} = \begin{pmatrix} 0 & 0 & 0 \\ 0 & \lambda & -\lambda \\ 0 & 0 & \lambda \end{pmatrix} \left[\begin{pmatrix} \theta_1^Q \\ \theta_2^Q \\ \theta_3^Q \end{pmatrix} - \begin{pmatrix} L_t \\ S_t \\ C_t \end{pmatrix} \right] dt + \sum \begin{pmatrix} dW_t^{L,Q} \\ dW_t^{S,Q} \\ dW_t^{C,Q} \end{pmatrix}, \qquad \lambda > 0 \quad (1)$$

The short-term rate is described by

$$r_t = L_t + S_t \quad (2)$$

This specification implies that zero-coupon bond yields are given by

$$y_t(\tau) = L_t + \left(\frac{1 - e^{-\lambda\tau}}{\lambda\tau} \right) S_t + \left(\frac{1 - e^{-\lambda\tau}}{\lambda\tau} - e^{-\lambda\tau} \right) C_t - \frac{A(\tau)}{\tau} \quad (3)$$

The factor loadings in the yield function are the level, slope, and curvature loadings introduced in Nelson and Siegel (1987). The $A(\tau)/\tau$ is a yield-adjustment term, which captures the convexity effects due to Jensen's inequality and ensures the absence of arbitrage. Diebold and Rudebusch (2011) explain that this adjustment term makes sure that the Nelson-Siegel bond prices are arbitrage-free and thus are not subject to the critique by Filipović (1999) that Nelson-Siegel models contain arbitrage opportunities.

The AFNS model is completed with a term premium specification that connects the measure of risk-free Q-factor dynamics with the measure of risk P-factor dynamics. The term premium is affine and implemented as in Duffee (2002). The factor dynamics of the maximally flexible

specification of the AFNS model are then given by:

$$\begin{pmatrix} dL_t \\ dS_t \\ dC_t \end{pmatrix} = \begin{pmatrix} \kappa_{11}^P & \kappa_{12}^P & \kappa_{13}^P \\ \kappa_{21}^P & \kappa_{23}^P & \kappa_{23}^P \\ \kappa_{31}^P & \kappa_{32}^P & \kappa_{33}^P \end{pmatrix} \left[\begin{pmatrix} \theta_1^P \\ \theta_2^P \\ \theta_3^P \end{pmatrix} - \begin{pmatrix} L_t \\ S_t \\ C_t \end{pmatrix} \right] dt + \sum \begin{pmatrix} dW_t^{L,P} \\ dW_t^{S,P} \\ dW_t^{C,P} \end{pmatrix}, \qquad \lambda > 0 \tag{4}$$

The AFNS forward rate is described by the following equation:

$$f_t(\tau) = L_t + e^{-\lambda\tau} S_t + \lambda\tau e^{-\lambda\tau} C_t + A^f(\tau) \tag{5}$$

The yield data used to estimate the shadow rate model includes a large sample of nominal U.S. Treasury zero-coupon yields from January 4, 1985 until March 5, 2015. The yields consist of three- and six-month Treasury bill yields from the H.15 series from the Federal Reserve Board as well as the one year, two years, three years, five years, seven years, and ten years data from Gurkaynak et al. (2007). The longest maturity Treasury yields are not available prior to November 25, 1985 and so that is why the sample is restricted to starting at that time. A standard Kalman filter is used to analyze the data.

The AFNS model is used to estimate the standard zero-coupon yield and forward rate decompositions as described in Christensen and Rudebusch (2012) for the time period October 8, 2008 until October 29, 2014. The estimated yield curve data includes fitted zero-coupon yields, average expected short rates, and zero-coupon yield term premiums. The estimated forward rate curve data includes the fitted forward rates, expected short-rates, and forward rate term premiums. The maturities for this includes six months as well as the one year, two years, three years, four years, five years, six years, seven years, eight years, nine years, and ten years.

The standard Gaussian and AFNS term structure models are unable to capture two features of the term structure that arise at the zero lower bound. First, as a Gaussian model, the AFNS model assigns positive probabilities of negative interest rates when the economy is near the zero

lower bound. When the interest rate is negative, a loan is to be repaid with a lower amount than the original proceeds (Munk (2011)). This assumption does not stand up to economic theory (Black (1995)) nor does it stand up to empirical observation. Second, the AFNS model assumes that yields have constant volatility over time. This second assumption does not stand up to empirical reality because yields are less volatile when constrained at the zero lower bound (Christensen and Rudebusch (2014)).

A.2 Shadow Rate Arbitrage-Free Nelson-Siegel (B-AFNS) Model

The shadow rate (B-AFNS) model developed by Christensen and Rudebusch (2013) is an AFNS model except that it replaces the short-rate with a shadow rate that is truncated at zero and it also allows yields to become less volatile as the economy gets closer to the zero lower bound (Christensen and Rudebusch (2014)).[21] Otherwise, the B-AFNS model is the same as the standard three factor AFNS model.

The state variables follow the same risk neutral dynamic process for the Q-measure as the popular Nelson and Siegel (1987) model:

$$\begin{pmatrix} dL_t \\ dS_t \\ dC_t \end{pmatrix} = \begin{pmatrix} 0 & 0 & 0 \\ 0 & \lambda & -\lambda \\ 0 & 0 & \lambda \end{pmatrix} \left[\begin{pmatrix} \theta_1^Q \\ \theta_2^Q \\ \theta_3^Q \end{pmatrix} - \begin{pmatrix} L_t \\ S_t \\ C_t \end{pmatrix} \right] dt + \sum \begin{pmatrix} dW_t^{L,Q} \\ dW_t^{S,Q} \\ dW_t^{C,Q} \end{pmatrix}, \qquad \lambda > 0 \quad (6)$$

where $\sum$ is the constant covariance (or volatility) matrix.

The short-rate in the B-AFNS model is still the sum of the level and slope but constrained to be a non-negative process of the AFNS model:

$$s_t = L_t + S_t, \qquad r_t = \max\{0, s_t\} \quad (7)$$

[21] Christensen and Rudebusch (2014) follow Kim and Singleton (2012) and refer to a world without physical currency by using the "B-" prefix in recognition of the work by Black (1995).

The estimated bond yields in the B-AFNS models are allowed to be negative and follow the same popular level, slope and curvature factor loading Q-dynamics as the Nelson and Siegel (1987):

$$y_t(\tau) = L_t + \left(\frac{1-e^{-\lambda\tau}}{\lambda\tau}\right) S_t + \left(\frac{1-e^{-\lambda\tau}}{\lambda\tau} - e^{-\lambda\tau}\right) C_t - \frac{A(\tau)}{\tau} \tag{8}$$

where $A(\tau)/\tau$ is a maturity-dependent yield-adjustment term because of Jensen's inequality.

The risk factor P-measure dynamics of the B-AFNS follow the same process as in the AFNS model:

$$\begin{pmatrix} dL_t \\ dS_t \\ dC_t \end{pmatrix} = \begin{pmatrix} \kappa_{11}^P & \kappa_{12}^P & \kappa_{13}^P \\ \kappa_{21}^P & \kappa_{23}^P & \kappa_{23}^P \\ \kappa_{31}^P & \kappa_{32}^P & \kappa_{33}^P \end{pmatrix} \left[\begin{pmatrix} \theta_1^P \\ \theta_2^P \\ \theta_3^P \end{pmatrix} - \begin{pmatrix} L_t \\ S_t \\ C_t \end{pmatrix} \right] dt + \sum \begin{pmatrix} dW_t^{L,P} \\ dW_t^{S,P} \\ dW_t^{C,P} \end{pmatrix}, \qquad \lambda > 0 \tag{9}$$

The B-AFNS shadow forward rate equation is the same as the AFNS forward rate:

$$f_t(\tau) = L_t + e^{-\lambda\tau} S_t + \lambda\tau e^{-\lambda\tau} C_t + A^f(\tau) \tag{10}$$

where the final term is another maturity dependent yield-adjustment term due to Jensen's inequality.

The shadow-rate AFNS model is as flexible and empirically tractable as the standard AFNS model and is used to estimate the daily standard zero-coupon yield and forward rate decompositions as described in Christensen and Rudebusch (2013) for the time period October 8, 2008 until October 29, 2014. Similar to the AFNS model, the yield data used for the estimations comes the daily H.15 database and from Gürkaynak et.al. (2007). The model is estimated for fitted zero-coupon yields, average expected short rates, zero-coupon yield term premiums, fitted forward rates, expected short-rates, and forward rate term premiums at daily frequency. The expected short rates are estimated for 6 months to 10 year durations. This paper uses the B-AFNS model expected short rate at two year durations.

Appendix B

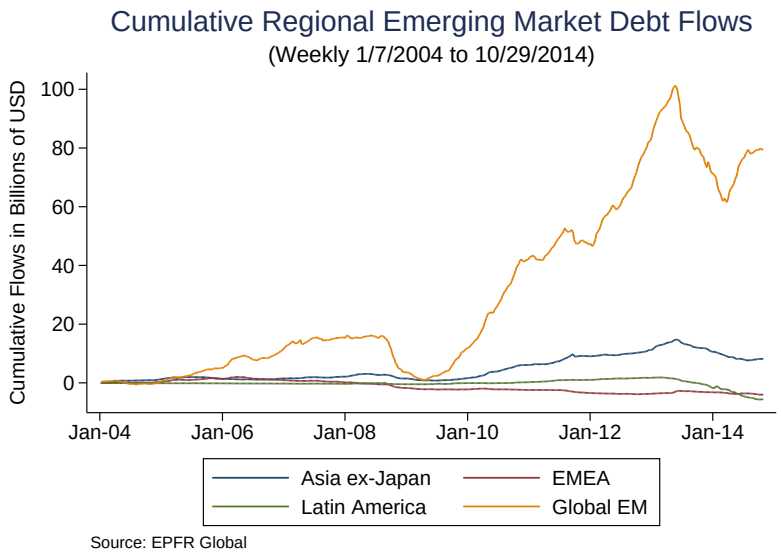

Figure B1: Cumulative Regional Emerging Market Debt Flows.

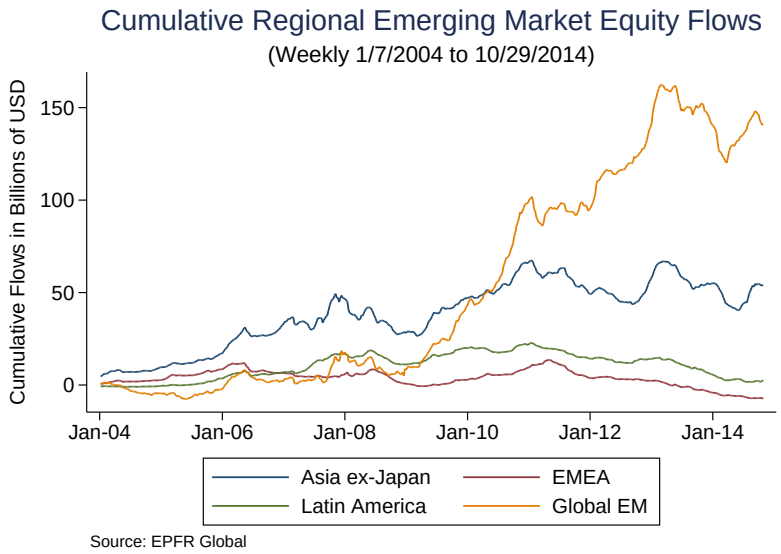

Figure B2: Cumulative Regional Emerging Market Equity Flows.

Table B1: Summary Statistics

	Obs	Mean	Std. Dev.	Min	Max
Latin America, Debt (All Currencies)	1573	-3.49	39.61	-420.60	458.93
Latin America, Debt (Hard Currency)	1573	0.37	5.26	-36.96	33.66
Latin America, Debt (Local Currency)	1573	-3.80	38.73	-418.31	458.21
Latin America, Debt (Mixed Currency)	1554	-0.07	1.29	-32.72	18.50
Brazil, Debt (Hard Currency)	1573	-0.05	2.91	-33.20	14.96
Brazil, Debt (Local Currency)	1305	0.20	4.36	-92.39	42.26
Mexico, Debt (Local Currency)	1573	-5.55	80.39	-603.10	644.36
Latin America, Equity	1573	-5.55	80.39	-603.10	644.36
Brazil, Equity	1573	-0.96	60.88	-363.55	629.91
Mexico, Equity	1573	-2.02	32.68	-247.83	231.78
VIX Index	1581	22.37	11.22	10.32	80.86
Liquidity	1516	3.39	3.77	0.72	20.47
WTI Oil Price	1581	86.25	16.76	31.41	113.93
Bloomberg Commodity Index	1581	136.16	14.08	102.00	175.42
JP Morgan EMBI Latin America	1581	499.91	94.96	265.62	642.00
JP Morgan EMBI Brazil	1581	870.10	127.87	495.63	1049.96
JP Morgan EMBI Mexico	1581	506.81	78.68	296.65	627.31
MSCI Latin America	1581	3579.76	647.87	1659.16	4729.96
MSCI Brazil	1581	2803.30	609.47	1286.54	3923.12
MSCI Mexico	1581	5826.92	1237.14	2335.10	7771.69

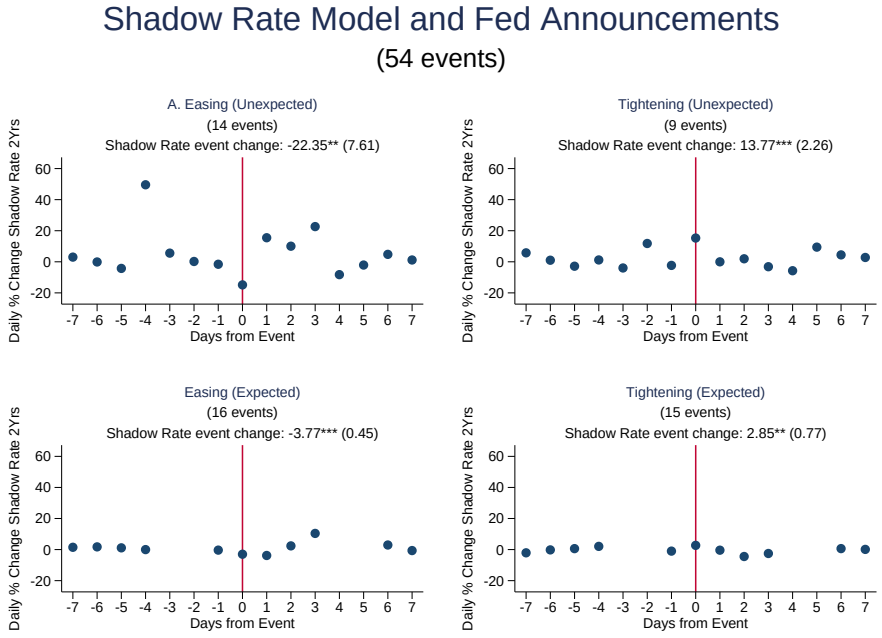

Figure B3: Significance test of the daily percentage change in Shadow Rate Model two year short rate expectations on the Fed announcement day relative to the previous seven days.

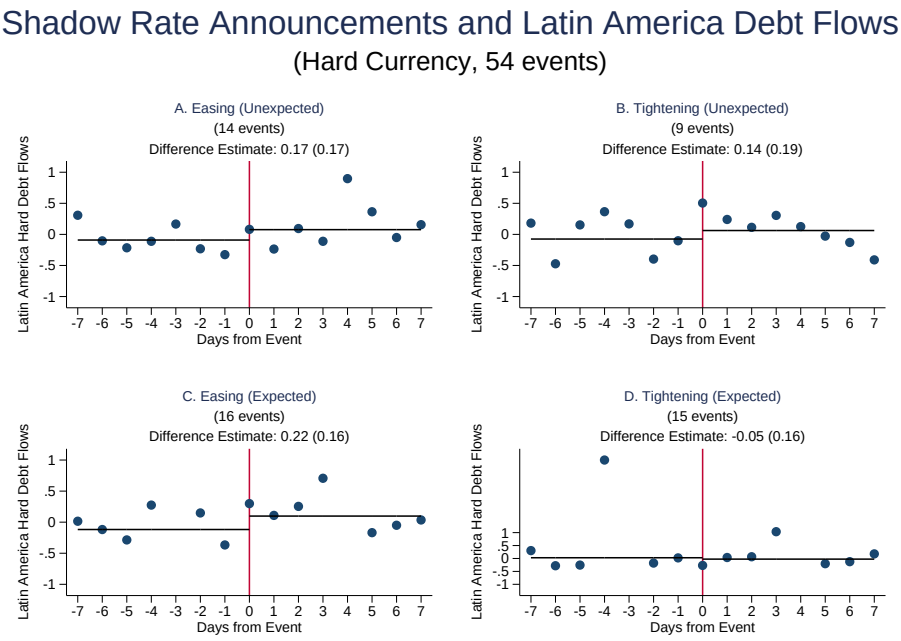

Figure B4: Standardized effects of Federal Reserve announcements classified by the Shadow Rate Model on Latin America debt flows in hard currency.

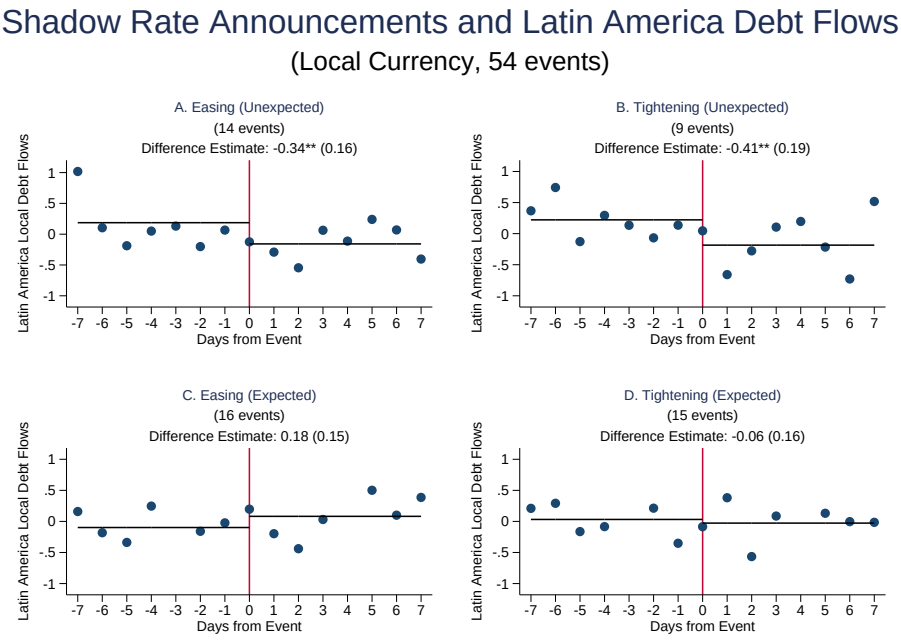

Figure B5: Standardized effects of Federal Reserve announcements classified by the Shadow Rate Model on Latin America debt flows in local currency.

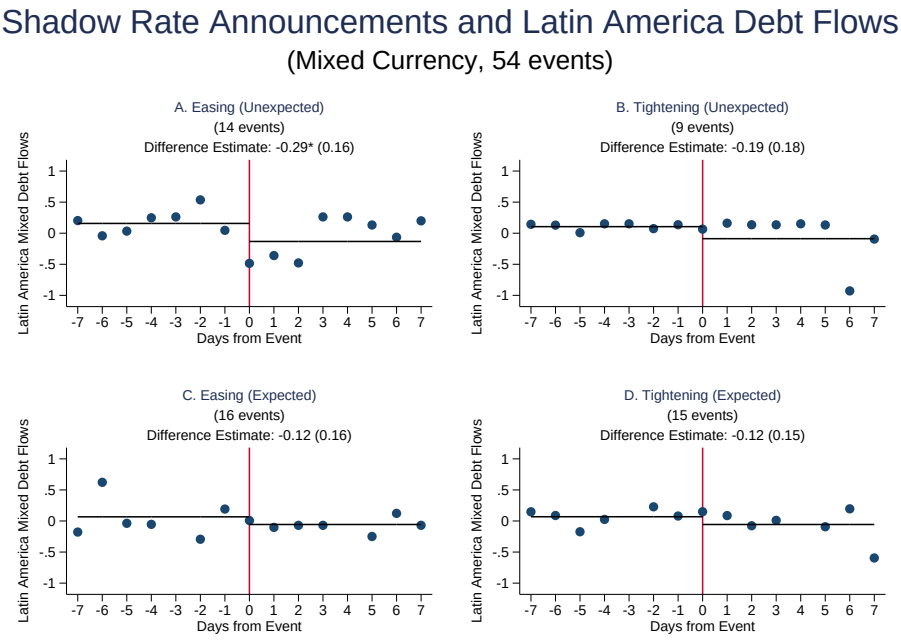

Figure B6: Standardized effects of Federal Reserve announcements classified by the Shadow Rate Model on Latin America debt flows in mixed currency.

Table B2: EPFR Global Equity Flow Coverage

	Daily Frequency		Weekly Frequency		Monthly Frequency	
Fund Group	# of Funds	$US Billions	# of Funds	$US Billions	# of Funds	$US billions
	(1)	(2)	(3)	(4)	(5)	(6)
Asia ex-Japan	2,486	304	2,500	303	2,932	375
EMEA	691	40	693	40	803	51
GEM	1,878	405	1,897	414	2,241	537
Global	7,194	1,675	7,278	1,702	9,591	3,323
Japan	1,001	206	1,005	207	1,081	213
Latin America	471	34	472	48	465	77
Pacific	367	48	366	48	465	77
USA	8,801	3,333	9,057	3,404	11,022	6,676
Western Europe	4,672	970	4,669	974	5,074	1,091
Total	27,561	7,015	27,937	7,125	33,735	12,396

Source: EPFR Global

Table B3: EPFR Global Debt Flow Coverage

	Daily Frequency		Weekly Frequency		Monthly Frequency	
Fund Group	# of Funds	$US Billions	# of Funds	$US Billions	# of Funds	$US billions
	(1)	(2)	(3)	(4)	(5)	(6)
Balanced	1,657	590	1,676	591	2,354	1,321
Emerging Markets	2,728	227	2,735	228	3,029	314
Global	5,030	923	5,051	930	6,045	1,458
High Yield	2,112	451	2,134	461	2,437	627
Money Market	2,400	3,505	2,411	3,528	2,650	3,793
USA	3,935	1,305	4,174	1,358	5,201	2,653
Total	17,862	7,001	18,181	7,096	21,716	10,166

Source: EPFR Global

Table B4: Federal Reserve Announcements Classification Results

Date	Event	Shadow Rate Model	Rogers et.al. (2014)	Shadow Rate Model	Rogers et. al. (2014)
		(1)	(2)	(3)	(4)
10/8/2008	FOMC/Joint CB Statement				
10/29/2008	FOMC Meeting	Tightening (Expected)	Easing	1.72	-0.009
LSAP 1					
11/25/2008	Fed MBS/Agency Purchases	Easing (Unexpected)	Easing	-23.48	-0.061
12/16/2008	FOMC Meeting	Easing (Unexpected)	Easing	-38.97	-0.270
1/28/2009	FOMC Meeting	Tightening (Unexpected)	Tightening	14.27	0.020
3/18/2009	FOMC Meeting	Easing (Unexpected)	Easing	-17.90	-0.370
4/29/2009	FOMC Meeting	Tightening (Expected)	Tightening	0.56	0.053
6/24/2009	FOMC Meeting	Tightening (Expected)	Tightening	3.02	0.109
8/12/2009	FOMC Meeting	Easing (Expected)	Easing	-2.83	-0.026
9/23/2009	FOMC Meeting	Easing (Expected)	Easing	-3.89	-0.099
11/4/2009	FOMC Meeting	Easing (Expected)	Easing	-3.93	-0.024
12/16/2009	FOMC Meeting	Easing (Expected)	Tightening	-2.70	0.028
1/27/2010	FOMC Meeting	Tightening (Expected)	Tightening	5.34	0.064
3/16/2010	FOMC Meeting	Easing (Expected)	Easing	-2.58	-0.043
4/28/2010	FOMC Meeting	Tightening (Expected)	Easing	4.01	-0.009
6/23/2010	FOMC Meeting	Easing (Unexpected)	Easing	-6.93	-0.025
LSAP 2					
8/10/2010	FOMC Meeting	Easing (Expected)	Easing	-3.63	-0.085
8/27/2010	Bernanke at Jackson Hole	Tightening (Unexpected)	Tightening	13.20	0.086
9/21/2010	FOMC Meeting	Easing (Unexpected)	Easing	-10.53	-0.071
10/15/2010	Bernanke at Boston Fed	Easing (Unexpected)	Unclassified	-6.66	0.000
11/3/2010	FOMC Meeting	Easing (Unexpected)	Easing	-11.46	-0.057
12/14/2010	FOMC Meeting	Tightening (Unexpected)	Tightening	6.49	0.032
1/26/2011	FOMC Meeting	Tightening (Unexpected)	Easing	6.87	-0.019
3/15/2011	FOMC Meeting	Tightening (Unexpected)	Tightening	5.82	0.068
4/27/2011	FOMC Meeting	Easing (Expected)	Easing	-1.53	-0.034
6/22/2011	FOMC Meeting	Tightening (Expected)	Tightening	0.12	0.037
MEP					
8/9/2011	FOMC Meeting	Easing (Unexpected)	Easing	-31.48	-0.142
8/26/2011	Bernanke at Jackson Hole	Easing (Unexpected)	Easing	-14.39	-0.008
9/21/2011	FOMC Meeting	Tightening (Unexpected)	Tightening	31.38	0.032
11/2/2011	FOMC Meeting	Tightening (Expected)	Unclassified	0.31	0.000
12/13/2011	FOMC Meeting	Tightening (Expected)	Tightening	1.06	0.007
1/25/2012	FOMC Meeting	Easing (Unexpected)	Easing	-14.76	-0.057
3/13/2012	FOMC Meeting	Tightening (Unexpected)	Tightening	4.42	0.047
4/25/2012	FOMC Meeting	Easing (Expected)	Tightening	-2.37	0.015
6/20/2012	FOMC Meeting	Tightening (Expected)	Tightening	3.18	0.015
8/1/2012	FOMC Meeting	Tightening (Expected)	Tightening	2.33	0.053
LSAP 3					
9/13/2012	FOMC Meeting	Easing (Unexpected)	Tightening	-6.51	0.016
10/24/2012	FOMC Meeting	Easing (Expected)	Easing	-2.04	-0.002
12/12/2012	FOMC Meeting	Easing (Expected)	Tightening	-1.46	0.005
1/30/2013	FOMC Meeting	Easing (Unexpected)	Easing	-5.91	-0.024
3/20/2013	FOMC Meeting	Tightening (Expected)	Tightening	4.30	0.011
5/1/2013	FOMC Meeting	Easing (Expected)	Tightening	-2.00	0.003
5/22/2013	Bernanke Testimony	Tightening (Expected)	Tightening	4.96	0.031
6/19/2013	FOMC Meeting	Tightening (Unexpected)	Tightening	16.29	0.198
7/31/2013	FOMC Meeting	Easing (Expected)	Easing	-3.16	-0.054
9/18/2013	FOMC Meeting	Easing (Unexpected)	Easing	-13.56	-0.223
10/30/2013	FOMC Meeting	Easing (Expected)	Tightening	-1.13	0.048
12/18/2013	FOMC Meeting	Easing (Unexpected)	Easing	-5.53	-0.020
1/29/2014	FOMC Meeting	Easing (Expected)	Easing	-3.50	-0.013
3/19/2014	FOMC Meeting	Tightening (Unexpected)	Tightening	32.20	0.147
4/30/2014	FOMC Meeting	Easing (Expected)	Easing	-4.21	-0.017
6/18/2014	FOMC Meeting	Easing (Expected)	Easing	-1.70	-0.022
7/30/2014	FOMC Meeting	Tightening (Expected)	Easing	2.89	-0.012
9/17/2014	FOMC Meeting	Tightening (Expected)	Tightening	2.80	0.078
10/29/2014	FOMC Meeting	Tightening (Unexpected)	Tightening	11.12	0.055

Table B5: Shadow Rate Announcements and Latin America Flows

	Debt Flows				Equity Flows
	All	Hard	Local	Mixed	All
	(1)	(2)	(3)	(4)	(5)
Easing (Unexpected)	-0.32*	0.17	-0.34*	-0.29*	0.16
	(0.16)	(0.17)	(0.16)	(0.16)	(0.16)
Observations	153	153	153	153	153
Tightening (Unexpected)	-0.41**	0.19	-0.46**	-0.22	-0.15
	(0.20)	(0.20)	(0.20)	(0.20)	(0.20)
Observations	94	94	94	94	94
Easing (Expected)	0.20	0.22	0.18	-0.12	-0.18
	(0.15)	(0.16)	(0.15)	(0.16)	(0.15)
Observations	176	176	176	176	176
Tightening (Expected)	-0.07	-0.05	-0.06	-0.12	0.13
	(0.16)	(0.16)	(0.16)	(0.15)	(0.15)
Observations	165	165	165	156	165

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

Table B6: Shadow Rate Announcements and Brazil and Mexico Flows

	Brazil Debt Flows		Brazil Equity Flows	Mexico Equity Flows
	Hard	Local	All	All
	(1)	(2)	(3)	(4)
Easing (Unexpected)	0.01	-0.30*	0.2	-0.14
	(0.17)	(0.16)	(0.16)	(0.16)
Observations	153	153	153	153
Tightening (Unexpected)	0.09	-0.31	0	-0.24
	(0.21)	(0.20)	(0.21)	(0.20)
Observations	94	94	94	94
Easing (Expected)	0.21	0.22	-0.2	-0.05
	(0.16)	(0.15)	(0.15)	(0.15)
Observations	176	176	176	176
Tightening (Expected)	-0.04	-0.09	0.00	0.12
	(0.16)	(0.16)	(0.15)	(0.15)
Observations	165	165	165	165

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

Table B7: Latin America Flows Controlling for the VIX

	Debt Flows				Equity Flows
	All	Hard	Local	Mixed	All
	(1)	(2)	(3)	(4)	(5)
Easing (Unexpected)	-0.32*	0.16	-0.34*	-0.27*	0.15
	(0.16)	(0.17)	(0.16)	(0.15)	(0.16)
Observations	153	153	153	153	153
Tightening (Unexpected)	-0.42*	0.20	-0.47*	-0.23	-0.16
	(0.21)	(0.21)	(0.20)	(0.21)	(0.21)
Observations	94	94	94	94	94
Easing (Expected)	0.20	0.22	0.18	-0.12	-0.19
	(0.15)	(0.16)	(0.15)	(0.16)	(0.15)
Observations	176	176	176	176	176
Tightening (Expected)	-0.07	-0.06	-0.05	-0.12	0.13
	(0.16)	(0.16)	(0.16)	(0.15)	(0.16)
Observations	165	165	165	156	165

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

Table B8: Latin America Flows Controlling for Liquidity

	Debt Flows				Equity Flows
	All	Hard	Local	Mixed	All
	(1)	(2)	(3)	(4)	(5)
Easing (Unexpected)	-0.32*	0.19	-0.35*	-0.29*	0.16
	(0.17)	(0.17)	(0.17)	(0.16)	(0.16)
Observations	151	151	151	151	151
Tightening (Unexpected)	-0.41*	0.19	-0.46*	-0.22	-0.16
	(0.20)	(0.20)	(0.20)	(0.20)	(0.20)
Observations	94	94	94	94	94
Easing (Expected)	0.20	0.22	0.18	-0.12	-0.2
	(0.15)	(0.16)	(0.15)	(0.17)	(0.15)
Observations	173	173	173	173	173
Tightening (Expected)	-0.04	-0.03	-0.03	-0.10	0.13
	(0.15)	(0.16)	(0.16)	(0.16)	(0.15)
Observations	164	164	164	155	164

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

Table B9: Latin America Flows Controlling for the Oil Price

	Debt Flows				Equity Flows
	All	Hard	Local	Mixed	All
	(1)	(2)	(3)	(4)	(5)
Easing (Unexpected)	-0.32*	0.17	-0.34*	-0.30*	0.16
	(0.16)	(0.17)	(0.16)	(0.15)	(0.16)
Observations	153	153	153	153	153
Tightening (Unexpected)	-0.41*	0.19	-0.46*	-0.22	-0.16
	(0.20)	(0.20)	(0.20)	(0.20)	(0.20)
Observations	94	94	94	94	94
Easing (Expected)	0.19	0.22	0.17	-0.12	-0.19
	0.15	(0.16)	(0.15)	(0.16)	(0.15)
Observations	176	176	176	176	176
Tightening (Expected)	-0.07	-0.05	-0.06	-0.12	0.13
	0.16	(0.16)	(0.16)	(0.15)	(0.15)
Observations	165	165	165	156	165

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

Table B10: Latin America Flows Controlling for Commodity Prices

	Debt Flows				Equity Flows
	All	Hard	Local	Mixed	All
	(1)	(2)	(3)	(4)	(5)
Easing (Unexpected)	-0.33*	0.14	-0.35*	-0.30*	0.16
	(0.16)	(0.16)	(0.16)	(0.16)	(0.16)
Observations	153	153	153	153	153
Tightening (Unexpected)	-0.42*	0.18	-0.46*	-0.22	-0.14
	(0.20)	(0.19)	(0.20)	(0.20)	(0.19)
Observations	94	94	94	94	94
Easing (Expected)	0.20	0.23	0.18	-0.12	-0.18
	0.15	(0.15)	(0.15)	(0.17)	(0.15)
Observations	176	176	176	176	176
Tightening (Expected)	-0.07	-0.05	-0.06	-0.13	0.12
	(0.16)	(0.16)	(0.16)	(0.15)	(0.15)
Observations	165	165	165	156	165

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

Table B11: Latin America Flows Controlling for the EMBI and MSCI

	Debt Flows				Equity Flows
	All	Hard	Local	Mixed	All
	(1)	(2)	(3)	(4)	(5)
Easing (Unexpected)	-0.32*	0.17	-0.34*	-0.29*	0.15
	(0.16)	(0.17)	(0.16)	(0.15)	(0.16)
Observations	153	153	153	153	94
Tightening (Unexpected)	-0.44*	0.16	-0.48*	-0.25	-0.15
	(0.21)	(0.21)	(0.21)	(0.22)	(0.20)
Observations	94	94	94	94	94
Easing (Expected)	0.20	0.22	0.18	-0.12	-0.18
	(0.14)	(0.16)	(0.14)	(0.16)	(0.15)
Observations	176	176	176	176	176
Tightening (Expected)	-0.07	-0.06	-0.06	-0.12	0.13
	(0.16)	(0.16)	(0.16)	(0.15)	(0.15)
Observations	165	165	165	156	165

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

Table B12: Brazil and Mexico Flows Controlling for the VIX

	Brazil Debt Flows		Brazil Equity Flows	Mexico Equity Flows
	Hard	Local	All	All
	(1)	(2)	(3)	(4)
Easing (Unexpected)	0.02	-0.28*	0.19	-0.13
	(0.17)	(0.16)	(0.16)	(0.16)
Observations	153	153	153	153
Tightening (Unexpected)	0.11	-0.32	-0.01	-0.25
	(0.21)	(0.21)	(0.21)	(0.21)
Observations	94	94	94	94
Easing (Expected)	0.21	0.22	-0.20	-0.05
	(0.15)	(0.15)	(0.15)	(0.15)
Observations	176	176	176	176
Tightening (Expected)	-0.03	-0.07	0.01	0.11
	(0.16)	(0.16)	(0.15)	(0.15)
Observations	165	165	165	165

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

Table B13: Brazil and Mexico Flows Controlling for Liquidity

	Brazil Debt Flows		Brazil Equity Flows	Mexico Equity Flows
	Hard	Local	All	All
	(1)	(2)	(3)	(4)
Easing (Unexpected)	0.01	-0.30*	0.2	-0.13
	(0.17)	(0.16)	(0.16)	(0.17)
Observations	151	151	151	151
Tightening (Unexpected)	0.09	-0.31	-0.01	-0.24
	(0.21)	(0.20)	(0.21)	(0.20)
Observations	94	94	94	94
Easing (Expected)	0.21	0.22	-0.21	-0.25
	(0.16)	(0.15)	(0.15)	(0.21)
Observations	173	173	173	94
Tightening (Expected)	-0.03	-0.04	0.00	0.12
	(0.16)	(0.15)	(0.15)	(0.15)
Observations	164	164	164	164

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

Table B14: Brazil and Mexico Flows Controlling for the Oil Price

	Brazil Debt Flows		Brazil Equity Flows	Mexico Equity Flows
	Hard	Local	All	All
	(1)	(2)	(3)	(4)
Easing (Unexpected)	0	-0.30*	0.2	-0.14
	(0.17)	(0.16)	(0.16)	(0.16)
Observations	153	153	153	153
Tightening (Unexpected)	0.09	-0.31	-0.01	-0.24
	(0.21)	(0.20)	(0.20)	(0.20)
Observations	94	94	94	94
Easing (Expected)	0.21	0.21	-0.21	-0.05
	(0.16)	(0.15)	(0.15)	(0.15)
Observations	176	176	173	176
Tightening (Expected)	-0.05	-0.10	0.00	0.11
	(0.16)	(0.16)	(0.15)	(0.15)
Observations	165	165	165	165

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

Table B15: Brazil and Mexico Flows Controlling for Commodity Prices

	Brazil Debt Flows		Brazil Equity Flows	Mexico Equity Flows
	Hard	Local	All	All
	(1)	(2)	(3)	(4)
Easing (Unexpected)	-0.01	-0.30*	0.18	-0.13
	(0.17)	(0.16)	(0.15)	(0.17)
Observations	153	153	153	153
Tightening (Unexpected)	0.07	-0.31	0.01	-0.24
	(0.19)	(0.20)	(0.20)	(0.20)
Observations	94	94	94	94
Easing (Expected)	0.23	0.23	-0.2	-0.05
	(0.16)	(0.15)	(0.15)	(0.15)
Observations	176	176	176	176
Tightening (Expected)	-0.04	-0.09	0.00	0.12
	(0.16)	(0.16)	(0.15)	(0.15)
Observations	165	165	165	165

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

Table B16: Brazil and Mexico Flows Controlling for the EMBI and MSCI

	Brazil Debt Flows		Brazil Equity Flows	Mexico Equity Flows
	Hard	Local	All	All
	(1)	(2)	(3)	(4)
Easing (Unexpected)	0.01	-0.30*	0.19	-0.13
	(0.17)	(0.16)	(0.16)	(0.16)
Observations	153	153	153	153
Tightening (Unexpected)	0.03	-0.35*	0.01	-0.25
	(0.20)	(0.21)	(0.20)	(0.21)
Observations	94	94	94	94
Easing (Expected)	0.22	0.22	-0.2	-0.05
	(0.15)	(0.15)	(0.15)	(0.15)
Observations	176	176	176	176
Tightening (Expected)	-0.04	-0.08	0.00	0.12
	(0.16)	(0.15)	(0.15)	(0.15)
Observations	165	165	165	165

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