Introduction

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The current tasks of central banks officials have become much more complex than they used to be before the Great Recession. Not only new possibilities have been added to the toolkit of the policymaker (quantitative easing, forward guidance, among others), but also the international dimension seems to be more relevant now. On the one hand, before the Great Recession, monetary policy was implemented exclusively through changes in official interest rates in order to meet some established domestic objectives in the long run: price stability and, for some central banks, maximum employment. Interest rates affect business and household decisions through changes in liquidity and the assets portfolio; thus, the challenge for the monetary authorities was to determine the magnitude of the tightening or relaxation of monetary conditions, minimizing the uncertainty for other domestic agents on the path that these financial conditions will follow.

On the other hand, in normal times, central banks in each country make their monetary policy decisions solely in response to their domestic conditions and, according to some scholars, this was the best way to stabilize global demand. Traditionally, it was considered that trade was the main transmission channel of a central bank's decisions to the rest of the world.

Thus, as a monetary tightening (relaxation) in a particular country reduces (increases) its GDP, it also diminishes (increases) the external demand from the rest of the world. Obviously, the other countries would be more or less affected depending on the intensity of their trade linkages.

However, it is possible that the growing globalization of financial markets has increase the relevance of the financial channel. This process of financial globalization has very well-known gains, among them a more efficient allocation of financial resources around the world and an improved risk-sharing. Nevertheless, it has also generated closer and faster interlinkages among economies. This probably implies that the effects of policy actions in one country to the rest of the world are stronger today than they used to be. In fact, after the Great Recession some central banks have expressed concerns about their ability to influence domestic interest rates as a result of the so-called global financial cycle even in the presence of flexible exchange rate regimes.

The financial channel operates mainly through changes in capital flows and the prices of the different financial assets, transmitting the liquidity conditions globally. Gross cross-border capital flows surged by a multiple of four in the two decades up to the global financial crisis in 2008. In fact, by that time capital flows to advanced economies reached a value equivalent to 25% of their aggregate GDP and those to emerging economies over 10% of their aggregate GDP (7% for Latin America). Capital flows showed significant shifts in composition over time, gaining relevance those among banks, in line with the growing importance of global banks. A tightening (relaxation) of the monetary policy in a given country will induce a capital outflow (inflow) in the rest of the world, which will have an impact in the price of the external financial assets.

Besides, the exchange rate also reacts when the stance of monetary policy changes in a context of free capital movements. In particular, it is expected that a tightened (relaxed) of monetary policy appreciates (depreciates) the currency of that country as a result of the increase in the yields of the assets denominated in that currency. This would mean gains in the rest of the world competitiveness, counteracting to some extent the impact of the trade channel. Besides, long-term interest rates in other countries can also be affected by changes in those of the country that is taking monetary policy decisions.

However, there is great uncertainty about the magnitude of these impacts and their dynamics. Specifically, interest rates of the public debt often show a high correlation between countries, but in addition to moving in response to monetary policy actions and/or expectations in other countries, they also do so in response to changes in other macro variables such as the expected behavior of growth or inflation at the global level. In the same way, and given the degree of financial integration between countries, long-term interest rates in other economies will react to an increase in rates in another country depending on investors' perception of risk. It is therefore crucial to determine whether the transmission between countries of monetary policy shocks is different depending on the situation in those countries.

United States is the world's largest economy by the size of its GDP; moreover, it is the centerpiece of the international financial system and the dollar is the main global reserve currency. Therefore, it is not surprising that most of the empirical analysis on the effects of the international transmission of monetary policy has focused on the decisions of the Federal Reserve (Fed). Notice that these factors are even more relevant for Latin America, as the US is its main trading partner and foreign investor. Now that the Federal Reserve has initiated the process of monetary policy normalization, it is of paramount importance to determine how this is going to affect the different economies.

The empirical evidence before the Great Recession, when the main monetary instrument was the official interest rate, indicates that US monetary disturbances have a significant effect in the rest of the world but with differences in the spillovers among countries, being higher in Latin America or Asia than in Europe. These results suggest that the exchange rate channel is more important than the commercial one, and that the structure of financial markets in each country determines the magnitude and dynamics effects of the shock.

However, these are average results. Focusing on past episodes of monetary tightening by the Federal Reserve, singularities can be seen in the spillovers to the rest of the world, suggesting the need to control for the circumstances in which they occur. In particular, the 1994-1996 episode produced the biggest contagion. The impact on financial markets was unexpected and of great magnitude, with an increase in bond yields in most advanced economies. Emerging markets saw a sharp increase in risk perception, a depreciation of their

currencies and falling prices of other assets. By contrast, during the 2004-2006 period of monetary tightening, uncertainty was reduced, long-term interest rates diminished and even the dollar depreciated.

Since late 2008, the central banks of the major advanced economies have embarked on the implementation of unconventional monetary policy measures once the official interest rates reached the limit of 0%. These measures can be classified into two groups. First, financial assets purchase programs, which intend to reduce the yields of public or private instruments in the medium and long term. The key transmission channel in this case is the recomposition of portfolios of investors, which replace instruments of different degree of liquidity, risk and term. Obviously, this channel also acts globally, especially in the case of the US, as their Treasury bonds play a pivotal role in the international financial markets and dollar-denominated assets are part of the portfolio of most investors. Another identified channel, the confidence, could also operate internationally.

The second category of unconventional monetary policy measures is the forward guidance, which aims to signal the tone of monetary policy in the future. The goal is to reduce uncertainty about the path of official interest rates in the future and, thus, reduce the term premium. As US plays a central role in the international financial system, this could also reduce the term-spread around the world.

Obviously, the empirical evidence is scarcer in this case, as the experience is still reduced. However, it tends to show that the actions adopted by the Federal Reserve reduced long-term rates of emerging and developed economies, increasing demand for assets with higher returns. Also, a positive effect is observed in the flows of capital to these economies, jointly with currency appreciations. Obviously, this has also made to resurge the interest in the tools to manage capital flows. The empirical analysis put much emphasis on the need to differentiate the effects of the various programs of unconventional monetary expansion in the US (and the announcement of the end of the purchases in 2013), to identify the channels through which these policies act and to determine the characteristics of the countries that make spillovers more or less intense.

The process of normalization of monetary policy in the US started some years ago, in 2013, when Fed's officials begin talking about the possibility of tapering the securities the central bank was buying in the financial markets. This only possibility generated important turbulences in the capital flows, with a clear reduction in those directed

to emerging economies but differentiating depending on domestic conditions, and important increases in long run interest rates. After numerous clarifying interventions by the Fed, turbulences receded and, finally, by the end of 2014 the third financial assets purchase program was closed. It was necessary to wait for more than one year, until December 2015, to see the first increase in official interest rates in the US. The second increase took place one year later, in December 2016. The unusual slowness in the current process of monetary policy tightening relates to various factors. For example, inflation was below the target and, in fact, inflation expectations seem anchored according to surveys, but not so, by that time, according to financial markets. Besides, there were some doubts on the current stance of the labor market, even taking into account the reduced unemployment rate. Not less, there was some evidence on the reduction of the equilibrium real interest rate.

The situation changed very quickly when the presidential candidate Donald Trump won the elections by November 2016. Financial markets, probably incorporating in their prospects the expansionary fiscal program presented by this candidate during the campaign, reflected an increase in long run interest rates, which transmitted worldwide. In the case of emerging economies, not only interest rates increased, but also spreads, have been showing a contraction in capital flows similar to those observed during the tapering talk period. Although in the last few months, the situation has calm down substantially, with flows coming back and spreads diminishing, the analysis seems to have greater importance now. The Fed announced they will continue with the process of normalization of monetary policy at a faster path than before and, for the first time after the Great Recession, this view is also shared by the financial markets. However, provided the uncertainty that still surrounds the fiscal plans of the new US administration, the risks are on the side of higher monetary policy tightness.

This book tries to add evidence on the international transmission mechanism of monetary policy, focusing on emerging countries and, particularly, in Latin America. The book is eclectic in the sense that it uses various methodologies, analyzes the effects on different variables (real, financial, prices) and for a number of countries. But it has the same common thread, the effects in the rest of the world of the various nonconventional monetary programs implemented by the Federal Reserve of the United States.

The book group the nine papers finally published here in three sections. The first one tries to disentangle the main theoretical channels of the international spillovers of monetary policy. It includes three papers that make use of advanced dynamic stochastic general equilibrium models (DSGE) to analyze these channels in three economies, Mexico, Chile and Costa Rica, whose main difference is the degree of integration, in financial and also trade terms, with the US economy.

The first one, *The Transmission of US Monetary Policy Normalization to Emerging Markets*, was written by Kólver Hernández while he was working for CEMLA. This paper uses a two-country DSGE monetary model, with several real and financial channels needed to capture the international transmission of shocks, to analyze the potential macroeconomic effects for the Mexican economy in response to an increase in the US monetary policy rate. Based on the real model of Hernández and Leblebicioğlu (2016),[1] extended with monetary factors and estimated with quarterly data for Mexico and the US from 2001Q1 to 2015Q2, Hernández describes the transmission mechanisms and performs an out-of-sample forecast for scenarios where the US interest rates rises. Hernández's model describes that an expansionary US preference shock, which through demand increases US GDP, puts pressure on US inflation and leads the Federal Reserve to increase interest rates. This demand-side preference shock would, through the higher US demand for Mexican goods and the peso depreciation, increase Mexican GDP, inflation, and lead to an increase in the Mexican interest rates. Meanwhile, a positive US technology shock increases US GDP and lowers US inflation and US real interest rates, which by lowering Mexican financial costs, increases Mexico's GDP, reduces Mexico's inflation and appreciates the peso. Furthermore, a pure contractionary US monetary policy shock lowers US inflation, causes peso depreciation and generates inflationary pressures in Mexico leading to a contractionary increase in Mexican interest rates. The forecasting exercise predicts that an increase in US interest rates is likely to take place under a recovery of US economic growth, which will imply a positive externality through US demand for Mexican goods, but that would require an aggressive response of

[1] Hernández, K., and A. Leblebicioğlu (2016), *The Transmission of US Shocks to Emerging Markets*, mimeo., CEMLA.

Mexico's policy interest rate to contain the depreciation of the real exchange rate and stabilize inflation.

The second paper goes further as it tries to analyze empirically the relevance of the spillovers. In particular, in *Reassessing the Effects of Foreign Monetary Policy on Output: New Evidence from Structural and Agnostic Identification Procedures*, Jorge Fornero, Roque Montero and Andrés Yany, from the Banco Central de Chile, compare the impulse response functions of a recursive VAR model, an agnostic VAR model and a DSGE model to analyze the propagation of a foreign monetary policy shock over the Chilean economy. Based on the Banco Central de Chile core DSGE model, this chapter shows that a tightening of foreign monetary conditions causes capital outflows from the domestic economy, an increase in its country risk premium and nominal and real exchange rate depreciations. Within the DSGE model, the presence of inflationary pressures associated to the exchange rate movements prompts the domestic central bank to raise interest rates, which contracts investment and consumption. They find that the recursive VAR model does not properly identify the shock and that it gives counterfactual responses of inflation and investment. Meanwhile, the agnostic VAR model does identify the shock and have impulse response functions in line with macroeconomic theory. A point to note is that despite a sharp depreciation of the domestic currency, the agnostic VAR model shows no impact over domestic prices due to the strong drop in economic activity, while the estimated DSGE model has an increase in prices as the depreciation prompts an expansion of output. Therefore, monetary policy prescriptions based on the agnostic VAR would call for leaving the interest rate unchanged, while the inflationary pressures captured in the DSGE model requires the central bank to raise interest rates.

In *The Effect of International Monetary Policy Expansions on Costa Rica,* José Pablo Barquero, from Banco Central de Costa Rica, and Pedro Isaac Chávez López, at the time working for CEMLA, study if the international monetary policy has a major effect on the Costa Rican economy. The analysis is performed estimating a structural Bayesian Vector autoregression (SBVAR) and a dynamic stochastic general equilibrium (DSGE) small open economy model with Bayesian Maximum Likelihood methods using data from 2000 to 2014. The SBVAR estimation provides evidence that shocks to US interest rates, US inflation and US output in conjunction accounts for the following share of fluctuations: 43.2%, of nominal exchange rates, 52.2% of

Costa Rican interest rates, 35.1% of Costa Rican inflation and 51.4% of Costa Rican output. The DSGE model describes the mechanisms through which the local and foreign disturbances affect Costa Rica.

The common element of the second section of the book is that the spillovers of US monetary policy to various countries are studied and compared, analyzing if there are country specific characteristics which explain the differences observed. Each of the three papers focus in different aspects of the economy: financial market variables, capital flows and macroeconomic aggregates.

Thus, Fructuoso Borrallo, Ignacio Hernando and Javier Vallés, from the Banco de España, perform an event analysis study in *The Effects of US Unconventional Monetary Policies in Latin America* with financial market variables. Using daily data from October 1, 2008 to April 24, 2015, this chapter documents that quantitative easing (QE) announcements in 2008/2009 and the *tapering talk* in 2013 affected sovereign yields, the exchange rate and the stock market prices in a set of emerging market countries. The event study analysis is complemented with a monthly panel data setup to study the effect of country-specific fundamentals on the transmission channel of US financial disturbances. Inflation, CDS spread, official reserves ratio and market capitalization are determinants of emerging market economies' vulnerabilities to US monetary policy announcements.

A different focus (capital flows) and methodology (panel data) is considered in the second paper of this section. In *Have QE Programs Affected Capital Flows to Emerging Markets?: A Regional Analysis*, Claudia Ramírez and Miriam González, from Banco de México, use a panel of 15 emerging market economies to analyze the determinants of gross capital flows in the 2005Q1-2015Q1 period. Their analysis incorporates real monetary policy rate and economic growth differentials of each of the 15 emerging market economies relative to the US levels as pull factors attracting capital inflows. In addition, to measure the impact of US QE programs on capital flows, the authors use treasuries purchases and 10-year interest rates, which together with the VIX index, introduced as a proxy for global risk aversion, are the push factors expelling capital out from advanced economies. A dummy variable identifying the period of QE stimulus from 2008Q4 to 2015Q1 is introduced alone and interacted with the 10-year interest rate. Overall, the results show that external factors are an important driver of total and portfolio capital flows, but the results are not significant for foreign direct investment. Based on their analysis, since

the first QE program was implemented, capital flows as a percentage of GDP have increased 19.5% and portfolio investment 11.8%. A 1% increase in the treasuries purchases increase capital flows by 8.8% and portfolio investment by 2.7%. A 1% decrease in the US 10-year interest rate leads, on average, to a 2.2% increase in gross capital flows and 0.7% increase in portfolio flows. An increase in risk aversion is associated with capital outflows from emerging market economies. Of the pull factors, per 1% GDP growth that the emerging market economy exceeds US growth rate, capital flows as a percentage of GDP increase on average 0.7%, while the real monetary policy rate even though positive, it is not significant.

The third paper in this section compares the response of macroeconomic variables in the countries of Central America using country specific VAR models. In particular, in *The Effects of US Monetary Policy on Central America and the Dominican Republic*, Ariadne M. Checo, Salomé Pradel and Francisco A. Ramírez, from the Banco Central de la República Dominicana, use a factor augmented vector autoregressive (FAVAR) model with sign restrictions to estimate the impact of US monetary policy shocks on the eponymous economies. The results provide evidence that an unexpected increase in the US shadow federal funds rate causes contractions in output, exports and imports for each of the analyzed economies, while interest rates and the risk premium increase, with limited effects on inflation. For these economies, nominal and real exchange rate adjustments are not significantly different from zero, reflecting what the authors interpret to be a limited role of the exchange rate as a shock absorber. Finally, this increase in monetary policy shocks leads to a contraction in US industrial production which produces a negative outflow of remittances to Central America and the Dominican Republic.

Finally, the third section is reserved for individual country's analysis of Brazil, Jamaica and Uruguay. Again, the three papers considered here are relatively heterogeneous in terms of the variables analyzed and the methodology used.

In the first place, João Barata R.B. Barroso from the Banco Central do Brasil, author of *Quantitative Easing and Portfolio Rebalancing Towards Foreign Assets*, provides evidence that QE programs caused US investors' portfolio rebalancing towards foreign assets in emerging market economies. Taking advantage of a comprehensive dataset of monthly Brazilian capital flows from January 2003 to March 2014, this chapter disentangles the QE programs effects by comparing the

differentiated portfolio's compositions of US investors, more affected by the QE programs, relative to that of investors from the rest of the world. Estimates show that additional flows due to QE programs range from 54 billion USD to 58 billion USD, which represent 54% of US flows and 10% of total flows to Brazil accumulated over the period. The effect on portfolio flow ranges from 41 billion USD to 48 billion USD and on portfolio debt flow ranges from 28 billion USD to 31 billion USD. The data also allows the author to directly measure the impact on the banking sector where the effect on portfolio flow ranges from 10 billion USD to 12 billion USD and on portfolio debt flow ranges from 6 billion USD to 7 billion USD.

Turning again to the effects of US monetary policy spillovers on macroeconomic variables using VAR methodologies, André Murray, from the Bank of Jamaica, has contributed to the joint research with the paper *Investigating Monetary Policy Spillovers from the United States of America to Jamaica*. He uses a structural vector autoregressive (SVAR) model to quantify the responses of Jamaican interest rates, inflation, GDP and the bilateral exchange rate versus US in response to US monetary policy shocks and Jamaican monetary policy shocks, domestic inflation shocks and exchange rate depreciation shocks. This chapter uses the method developed by Lombardi and Zhu (2014)[2] to derive a shadow policy interest rate for Jamaica and contrasts the dynamics of the SVAR when using actual and shadow interest rates reaching the conclusion that the use of the shadow interest rates generates impulse response functions that are more consistent with intuition. The results show that an unexpected increase in US shadow federal funds rate causes an initial increase in the Jamaican interest rates and a Jamaican dollar weakening, while GDP and inflation exhibit moderate contractionary responses. In response to an unexpected increase in Jamaican shadow interest rate, inflation decreases, there is a moderate expansion and a Jamaican dollar depreciation. In response to a Jamaican inflationary shock, the shadow interest rate increases, the Jamaican dollar depreciates and GDP contracts. Finally, in response to a currency depreciation shock, the interest rate increases, inflation surges and GDP expands.

In *Impact of International Monetary Policy in Uruguay: A FAVAR Approach*, Elizabeth Bucacos, from Banco Central del Uruguay, uses

[2] Lombardi, Marco, and Feng Zhu (2014), *A Shadow Policy Rate to Calibrate US Monetary Policy at the Zero Lower Bound*, BIS Working Papers, No 452.

Factor Augmented Vector Autoregressive (FAVAR) models and data from 1996Q2 to 2014Q4 to analyze the effects of changes in US monetary policy on the Uruguayan economy. The study carries out a two-stage analysis: in the first stage the impact of US monetary policy on commodity prices, US output and regional output is measured; in the second stage the effects on real exchange rate, Uruguayan assets and Uruguayan output are analyzed. An unexpected increase in US monetary policy rates increases Uruguayan interest rates and country-risk premium, while it reduces external demand, commodity prices and Uruguayan asset prices and output. Historical shock decomposition of the Uruguayan output growth shocks show that US monetary policy shocks have had a fairly large importance on Uruguayan expansions and recessions.