U.S. MONETARY POLICY'S IMPACT ON LATIN AMERICA'S STRUCTURE OF PRODUCTION (1960-2010)

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This paper examines the effects of U.S. monetary policy on Latin America's production structure before two economic crises, specifically the effects of monetary policy on the real economy at the industrial level. Changes in the federal funds rate produce uneven effects on output trends across sectors and industries that are more capital-intensive and involved in relatively long-term projects are more sensitive to changes in the federal funds rate. Periods of loose monetary policy result in resource misallocation that is costly to correct during a bust if investment is irreversible, with a particular pattern of economic distortion during an unsustainable boom.

JEL classification: E32, E52, F44

Keywords: monetary policy, Latin America, international business cycles, structure of production

1. INTRODUCTION

The two deepest economic crises in Latin America in the last 50 years occurred in the early 1980s and in 2009; both of these episodes followed the two longest periods of deviation from the Taylor rule by the Federal Reserve. Previous research has shown that commodity prices and U.S. interest rates are among the variables that significantly impact the economic performance of Latin America (Canova, 2005; Corbo and Tokman, 2007; Gallego, Gardó, Martin, Molina, and Serena, 2010; Izquierdo and Talvi, 2008; Jara, Moreno, and Tovar, 2009; Ocampo, 2010).¹

After the 2008 subprime crisis, some authors turned to Wicksell effects as embedded in the Mises-Hayek business cycle theory to explain what went wrong. This theory suggests that, all else being equal, loose monetary policy will have a greater effect on industries that are more capital-intensive and forward-looking than industries that are less capital-intensive and forward-looking (Borio and Disyatat, 2011; Cachanosky, 2014c; Calvo, Leiderman, and Reinhart, 1993; Calvo, 2013;

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1. Although China has increased its economic integration with Latin America in recent years, the latter remains highly integrated with the U.S. economy (Cesa-Bianchi *et al.*, 2011).

Diamond and Rajan, 2012; Garrison, 2001; Lal, 2010; Leijonhufvud, 2009; Ohanian, 2010; Young, 2012). In this article, I study whether U.S. monetary policy produces uneven Wicksell effects at the industrial level. Young (2012) finds evidence of this relationship with respect to the U.S. economy during the period 2002–2007. Because Latin America has been found to be sensitive to U.S. monetary policy, this begs the question of whether a similar relationship exists between the Federal Reserve and Latin America. I find evidence suggesting that loose U.S. monetary policy contributes to Latin American countries' bias towards activities that are more capital-intensive and forward-looking.

Contrary to most studies that analyze the problems of international monetary shocks by focusing on the monetary transmission mechanism, this paper evaluates the impact that Federal Reserve monetary policy has on the real economy at the industrial level in Latin American countries. I find that Wicksell effects are correlated with the Federal Reserve funds as a proxy for U.S. monetary policy. This has policy implications, since a country that decides to fix its exchange rate to avoid movements in the prices of tradable to non-tradable goods through the exchange rate is more prone to importing Wicksell effects when the U.S. follows an expansionary monetary policy. As I discuss below, it may not be an accident that the two largest Latin America crises followed the Federal Reserve's two largest deviations from the interest rate prescribed by the Taylor rule.

The rest of this paper is organized as follows: Section 2 describes the data and methodology used to analyze the impact of U.S. monetary policy on Latin America's production structure. Section 3 presents and explains the results, Section 4 discusses the policy implications, and Section 5 concludes.

2. DATA AND METHODOLOGY

2.1 Methodology

Building on Cachanosky and Lewin (2014b), Hayek (1931), and Kirzner (2010), I refer to the combination of capital intensity and time horizon as the “roundaboutness” of economic activity. Activities that are relatively more capital-intensive and forward-looking are more roundabout than activities that are less capital-intensive and forward-looking. I divide the sector-level output of eight Latin American countries into three groups: high roundaboutness (HR), medium roundaboutness (MR) and

low roundaboutness (LR). The rationale for this categorization is that activities that are more roundabout are expected to be more sensitive to changes in discount rates than activities that are less capital-intensive and forward-looking (Cachanosky and Lewin, 2014b). If we assume that investment is irreversible, then it becomes costly to reallocate resources once they are invested in the wrong group (Dixit, 1991). In addition, capital goods and resources that are misallocated may become wasted if their re-allocation is too costly, thus reducing total factor productivity (Hsieh and Klenow, 2009; Restuccia and Rogerson, 2008). Therefore, monetary policy can contribute to producing macroeconomic cycles through accumulated distortions in real markets.

Because the present value (PV) of longer free cash flows (FCFs) is more sensitive to changes in discount rates than the present value of shorter FCFs, changes in discount rates affect the relative price of investment projects. Namely, the downward movement of a given discount rate increases the PV_{HR}/PV_{LR} ratio. In other words, the relationship between roundaboutness and interest rates is captured by the Hicks-Macaulay duration.² In addition, if the FCF is rewritten in terms of capital invested, as is usually the case in the economic value added (EVA®) literature, then FCFs from larger projects, in terms of capital invested, are also more sensitive to changes in the discount rate (Cachanosky and Lewin, 2014b; Lewin and Cachanosky, 2014).³ Like Bernanke and Blinder (1992), I use the federal funds rate as a proxy for U.S. monetary policy in my analysis of whether changes in U.S. monetary policy produced uneven economic effects in different sectors of Latin America's economy.

Although the relationship examined is between investment and discount rates, investment information at the industry level is lacking for the sample period and therefore I use output as a proxy for the effects of monetary policy on economic activities, since investment is usually intended to increase output.⁴ The lags included in the interest rate variable account for the delayed effects of monetary policy on output changes.

I use yearly data from 1960 to 2010 for (1) Argentina (ARG), (2) Colombia (COL), (3) Costa Rica (COS), (4) Mexico (MEX), (5) Panama (PAN), (6) Paraguay (PAR), (7) Peru (PER) and (8) Venezuela (VEN). The

2. Macaulay develops the concept of duration to analyze bonds. Hicks uses elasticity operators to analyze Böhm-Bawerk's average period of production and reaches the same analysis as Hicks.

3. For EVA®, see Rappaport (1986) and Stewart III (1991, 2002). For an application of EVA® business cycles, see Cachanosky and Lewin (2014a), and Cachanosky (2014a).

4. If $Y_i = A \times F(K_i, L_i)$ where $i = \{LR, MR, HR\}$, Y is output, A is technology, K is capital, and L is labor, then investment that increases K also increases output.

sample of countries is constrained by the availability of data. Brazil, a large country that is representative of the region, has an incomplete series. Also, the analysis requires information at the industrial level, which may be either incomplete or lacking for certain countries. Finally, although GDP numbers are usually reported on a quarterly basis, information at the industrial level is usually available only on a yearly basis.

In this analysis:

- 1) The Taylor rule is used as a federal funds rate benchmark to identify periods when the monetary authority clearly deviated from equilibrium values. This yields two periods of interest for the study of whether changes in U.S. monetary policy produce uneven reactions in Latin American countries' production structures.⁵
- 2) Economic sectors are divided into three roundabout groups: HR, MR, and LR.
- 3) A VAR model is estimated for each country with one equation for each activity group (HR, MR, and LR), where the output of each sector is on the left-hand-side of the regression and the federal funds rate and control variables are on the right-hand-side.
- 4) Hypothetical output values are estimated for each activity group in the event of a 0.5% downward deviation in the federal funds rate only for the periods identified as deviating from the Taylor rule, to avoid dragging the shock effects for the rest of the series. For example, if the federal funds rate in period t is 4%, I estimate new output values for a federal funds value of 3.5%. As is shown below, this is significantly below observed deviations from the Taylor rule.
- 5) The new set of hypothetical output values is used to estimate output/federal funds rate elasticities. If elasticities for each group are different, then U.S. monetary policy is correlated with non-neutral effects at the industrial level in Latin America.

I calculate classic Taylor rule interest rates between 1960 and 2010 with the following equation:⁶

$$i_t = r_t^* + \pi_t + 0.5(\pi_t - \pi_t^*) + 0.5(y_t - \bar{y}_t) \quad (1)$$

5. The Taylor rule is used as a benchmark because it is a well-known rule. Other approaches that pay more attention to real interest rates and changes in productivity, e.g., Selgin *et al.* (2011), yield similar monetary policy deviation periods.

6. I use the same equation as Taylor (1993). For a more general treatment of Taylor rules, see Martins (2000) and Orphanides (2007).

Where i_t is the target federal funds rate for year t , r_t^* is the estimated equilibrium value for the real interest rate, π_t is yearly inflation as measured by the GDP deflator, π_t^* is the inflation target (assumed to be 2%), y_t is the log of real output, and $\bar{y}_t$ is the log of potential output. The first plot in Figure 1 shows the federal funds rate, the Taylor rule rate, and the spread between both series, while the second plot contrasts Latin American and Caribbean growth rates with the Taylor rule spread.

Figure 1. Taylor rule, federal funds and LAC growth

Source: Author's calculations using data from the St. Louis FRED® Economic Data and ECLAC.

Figure 2. LAC growth rates and Taylor rule spread

Source: Author's calculations using data from the St. Louis FRED® Economic Data and ECLAC.

The first plot shows two periods with deviations from the Taylor rule: 1971-1980 and 2002-2007. The second plot shows that the two largest drops in Latin American output occurred after the two largest deviations from the Taylor rule. This invites consideration of the possibility that structural distortions accumulated during these loose monetary periods may have played a role in the two Latin American crises. Table 1 shows the spread between the Taylor rule rate and federal funds rate for both periods.

Table 1. Taylor rule and federal funds rate spread, 1971-1980 and 2002-2007

Year	T. rule	Federal fund	Spread	Year	T. rule	Federal fund	Spread
1971	9.0	4.7	-4.3	2002	3.9	1.7	-2.3
1972	8.0	4.4	-3.5	2003	4.6	1.1	-3.5
1973	9.8	8.7	-1.1	2004	5.7	1.3	-4.4
1974	15.1	10.5	-4.6	2005	6.5	3.2	-3.3
1975	15.7	5.8	-9.8	2006	6.4	5.0	-1.4
1976	10.1	5.0	-5.1	2007	5.9	5.0	-0.8
1977	11.1	5.5	-5.5				
1978	12.0	7.9	-4.1				
1979	14.0	11.2	-2.8				
1980	15.2	13.4	-1.8				
Source: Author's calculations.							

As Table 1 shows, the values of the spread between the federal funds rate and the Taylor rule rate are not insignificant. In 1971, for example, the spread value is almost as high as the value of the federal funds rate itself. This means that a linear estimation of output values based on a model using Taylor rule values instead of federal funds rates might be inaccurate; using Taylor rule values rather than federal funds rates to estimate new output levels for each group is more than a minor change. For this reason, I estimate alternative output values with a 0.5% deviation from the federal funds rates rather than the Taylor rule values. Therefore, the hypothetical output values provide linear estimations of the direction and intensity of the correlation between each group's output and movements in the federal funds rate but do not provide estimates of the total deviation from what output would have been if the federal funds rate had not deviated from the Taylor rule.

2.2 Transmission mechanism

It should be noted that the sample comprises two different scenarios. Before 1980, Latin American countries had closed economies and capital controls; after 1980, some countries started to deregulate and open their economies. Exceptions to this are Venezuela and Argentina after its 2001 crisis. A comment, therefore, on the transmission mechanism is needed.

The first thing to note is that even though Latin American countries can be described as closed and with capital controls in the pre-1980 period, capital inflows were not absent. According to Calvo, Leiderman, and Reinhart (1994), capital inflows in the late 1970s exceeded capital inflows in the early 1990s, when measured as a percentage of GDP rather than in absolute values. That study also shows that during the late 1970s, bank loans and bonds were more common than foreign direct investment in the early 1990s. These authors conclude that although economic reforms took place in many countries from the 1970s to the early 1990s, the U.S. may have played an important role in determining the inflow of capital to the region.

It is also notable that the region shows signs of fear to float (Calvo and Reinhart, 2002; Hausmann, Panizza, and Stein, 2001). Fear to float occurs when countries state that they have a floating exchange rate but in fact they intervene in their foreign exchange market, importing U.S. monetary policy. Frankel, Schmukler, and Servén (2004) find a global transmission of interest rates from the U.S. to other countries, including Latin America, for the 1970s, 1980s, and 1990s.⁷ While floating exchange rates do protect the domestic economy from external shocks, the effects on interest rates might be temporary.

Third, I use Levy-Yeyati and Sturzenegger's (2003) *de facto* categorization of exchange rates. Excluding Panama, none of the countries had a floating exchange rate for more than 40% of the time between 1974 and 2000 scattered throughout the period. The years and percentage of time (in parenthesis) with floating exchange rate in the Yeyati-Sturzenegger classification are as follows: ARG: 5 (19%), COL: 12 (44%), COS: 5 (19%), MEX: 6 (22%), PAR: 6 (22%), PER: 11 (41%), VEN: 3 (11%).⁸ This means that together, these countries were under a floating exchange

7. The two countries not included in their sample that are studied in this paper are Panama and Peru.

8. The years logged as floating are ARG: 1977-1980, 1986; COL: 1974, 1984, 1988-1991, 1995-2000, COS: 1974, 1988, 1990-1992, MEX: 1977, 1984, 1992-2000, PAR: 1990, 1992-1993, 1998-2000, PER: 1975, 1978-1982, 1993, 1995-1996, 1998-1999; VEN: 1992-1993, 1990.

rate 25% of the time; this regime was scattered along the sample rather than there being a long period of floating exchange rates.

The aforementioned studies do not cover the same sample used in this paper; rather, they usually start their analysis in the 1970s and end it sometime in the 1990s. If there is less transmission in the years in my sample than the levels suggested by previous studies, that fact should counter the expected results, as the link between U.S. monetary policy and Latin American industrial output values should be less robust.

Domestic interest rates for the sample period are lacking. However, U.S. monetary policy has been found to affect Latin America's economy at different points in time, suggesting a connection with the region. Certainly the inclusion of domestic interest rates would provide a more robust result. But again, the lack of domestic interest rates and other economic variables plays against the expected results by underestimating them. The relationship pattern under observation is very distinctive of discount rate movements.

2.3 Economic activities categorization

Because there is no available measure of industrial roundaboutness, activities are grouped according to a mix of assumptions relating to their relative roundaboutness and a proxy of roundaboutness taken from Young's (2012) study of U.S. activities (discussed below.) For example, mining and quarrying are assumed to be more roundabout than manufacturing, which in turn is assumed to be more roundabout than real estate brokerage. Table 2 shows the categorization of each activity into one of the three groups. The objective is not to place all activities in a particular group but to construct representative groups according to relative roundaboutness. Therefore, activities for which relative roundaboutness is unclear or activities in which there is heavy regulation or a strong presence of state-run companies (i.e., public services and public administration) are dropped from the sample.⁹

This classification is not without some shortcomings. For example, the least roundabout activity in the most roundabout group may be less roundabout than the most roundabout activity in the medium roundabout group. It may also be the case that, between 1960 and 2010, some activities

9. Powell (2002) and Robbins (1934) use a similar approach to study Japan's recession in the 1990s and the Great Depression, respectively.

increased in their roundaboutness while others decreased, to the point that they should be re-categorized. In addition, some activities may have different relative roundaboutness in different countries. A sensitivity analysis could be performed by changing some of the sub-activities of each group. For instance, a manufacturing industry may be moved to the HR or LR group. However, data for this level of disaggregation is not available for the time frame in observation and therefore this exercise is not feasible. Manufacturing, which is the only sector representing the MR group, is composed of seven sub-sectors without data for the sample period.¹⁰ However, as long as it is plausible to assume that this grouping captures relative roundaboutness, the result will shed some light on the correlation between interest rates and roundaboutness.¹¹

Table 2. Economic activity classification
(roundaboutness)

Economic activity	Roundaboutness
Mining and quarrying	High
Construction	High
Transport, storage and communications	High
Manufacturing	Medium
Wholesale and retail trade, repair of goods, and hotels and restaurants	Low
Financial services, real estate intermediation, and business activities	Low
Agriculture, hunting, forestry and fishing	Omitted
Electricity, gas and water supply	Omitted
Public administration, defense, compulsory social security, education, health and social work, and other community, social and personal service activities	Omitted
Source: ECLAC.	

Young (2012) estimates yearly roundabout values for different U.S. industries between 1998 and 2009 and builds a measure called TIOR (total industry-output requirement) that is “the amount of gross output from other industries that must be produced per dollar of a given industry’s output: *the ratio of total gross output to final output for an*

10. Cachanosky (2014c) offers an analysis of this lower aggregation for Colombia and Panama for the 2002-2007 period.

11. Due to missing data, “mining and quarrying” is not part of Costa Rica’s HR group and “transport, storage and communications,” “wholesale and retail trade...,” and “financial intermediation...” are not part of Peru’s sample.

industry.” The idea is that roundaboutness is correlated with TIOR. In this approach, the larger the ratio of total gross output to final output, the more previous work is required by a particular industry and, therefore, the more roundabout it is.

Even though the industrial classification used by Young does not exactly match the one used by the United Nation’s Economic Commission for Latin America and the Caribbean (ECLAC), it is nonetheless a useful guideline for constructing the classification proposed in Table 2. As a reference, I use Young’s calculations for 1998. For example, “primary metals” and “other transportation equipment” are among the more roundabout U.S. activities. Other activities such as “retail trade,” “rental and leasing services and lessors of intangible assets” and “real estate” are among the less roundabout. Finally, activities such as “miscellaneous manufacturing,” “fabricated metal products” and “non-metallic products” are ranked around the middle of Young’s roundabout index. However, there are a few differences. If I divide Young’s ranking of roundaboutness into three groups, sorting them by more to less roundabout, construction appears in the upper section of the middle group rather than in the most roundabout group. Nonetheless, construction shows a higher degree of roundaboutness than a number of manufacturing activities, such as support activities for mining and publishing industries. Although there may be some overlap between activities in the HR, MR and LR groups, the classification in Table 2 follows a pattern similar to Young’s classification.¹²

2.4 The VAR model

To estimate the effects of changes in the federal funds rate on Latin American countries, I run a vector autoregressive (VAR) model where the dependent variables are the cyclical component of the HP filtered log of real output of each group. The independent variables are (1) the federal funds rate (period average) with two lags in addition to the contemporaneous value, (2) the cyclical component of the HP filtered log of U.S. real output, (3) the ratio of exports to imports as a trade variable and (4) the cyclical component of the HP filtered prices of commodities.¹³ Because Latin American countries do not affect the

12. I would like to thank Andrew T. Young for sharing his database and calculations. His methodology cannot be replicated for Latin American countries due to the lack of data.

13. The price of commodities is an average of the real prices of the Energy price index, the Non-energy price index and the Precious Metals price index in the World Bank Commodity Price Data (Pink Sheet).

U.S. economy, it is unlikely that the effects of U.S. monetary policy in Latin America will produce a feedback effect into the U.S. economy that would trigger a revision of its own policy.¹⁴

Independent variables (1) and (2) capture the relationship between the U.S. and Latin American countries (i.e., monetary and real shocks.) Independent variable (3) captures the effects of terms of trade between Latin American countries and the rest of the world. Variable (4) captures independent external commodity price shocks, which is an important variable for Latin American countries. This variable also captures external shocks other than those generated by the U.S. Although the United States remains Latin America's largest trading partner, the impact of other economies has grown significantly. Cesa-Bianchi, Pesaran, Rebucci, and Xu (2011) find that the importance of China in Latin America's trade increased from 1% in 1980 to 12% in 2009. These authors also find that China has direct and indirect effects (through its effect on other countries) on Latin America. In particular, a significant characteristic in the emergence of economies in Asia is the effect on the price of commodities. Given the importance of commodities prices for Latin American countries, and the effect of the rest of the world on such prices, this variable captures non-U.S. shocks that might be relevant.

Due to missing values, Peru's regression starts in 1970. In addition, because the model must work with the direct relationship between the federal funds rate and each country, and not with the behavior of domestic authorities, movements by domestic monetary authorities that are independent of the Federal Reserve are not captured in these regressions. Furthermore, potential cross-correlation between the outputs of each country is not captured in the model due to the lack of degrees of freedom to add the output of all countries in all equations.

The number of lags used is that which yields the best information criteria values constrained by the presence of inverse unit roots inside the unit circle. This is because the estimated coefficients will be used to estimate a series of hypothetical output values that depend on lag values, and the presence of inverse roots outside the unit circle would produce unstable and unreliable results.¹⁵

14. Data sources are as follows: (1) Economic Commission for Latin America and the Caribbean (ECLAC) (GDP, exports and imports for Latin American countries); (2) FRED® Economic Data (federal funds rate, U.S. real GDP); (3) World Bank Commodity Price Data, Pink Sheet (commodity prices).

15. Lags: ARG = 2, COL = 1, COS = 6, MEX = 1, PAN = 3, PAN = 6, PAR = 3, PER = 2 and VEN = 2.

Using the coefficients from each model, hypothetical output values are estimated for each group (LR, MR, and HR) for each country for the 1971-1980 and 2002-2007 periods with a permanent downward deviation of 0.5% from the federal funds rate. Hypothetical output values are calculated with a deviation from the federal funds rate rather than the Taylor rule rate because the spread between these two series is too large for a linear estimation to yield reliable numbers. To avoid carrying differences throughout the entire sample, the hypothetical output value with deviated federal funds rates is calculated only for periods in which deviations from the Taylor rule are identified, namely, 1971-1980 and 2002-2007.

Model 1 shows the VAR(p) specification used to estimate the coefficients. The y vector includes the cyclical component of the three groups (HR, MR, and LR). Each model has three equations: one per activity group (HR, MR, and LR). The FF variable is the federal funds rate trend, and the X vector contains the other variables of the model, as specified above. Once Model 1 is calculated, Model 2 is used to estimate a new y series for each group using $d = 0.5$ as the deviation from the observed federal funds rate in the periods 1971-1980 and 2002-2007. Each country has its own Model 1 and Model 2.

$$\begin{aligned} \text{Model 1} \quad [y_t] &= C + A_1 y_{t-1} + \dots + A_p y_{t-p} + B_1 FF_t + B_2 FF_{t-1} \\ &\quad + B_3 FF_{t-2} + EX_t + e_t \\ \text{Model 2} \quad [\hat{y}_t] &= C + A_1 y_{t-1} + \dots + A_p y_{t-p} + B_1 (FF_t - d) \\ &\quad + B_2 (FF_{t-1} - d) + B_3 (FF_{t-2} - d) + EX_t + e_t \end{aligned}$$

3. RESULTS

3.1 Monetary policy effects at the industrial level

Table 3 shows which output ratios changed during the periods 1971-1980 and 2002-2007, and in which direction—up or down—according to the observed data. There are a total of 24 output ratios, for eight countries with three output ratios each: (1) HR/LR, (2) HR/MR and (3) MR/LR. If the output ratios increase, then activities that are relatively more roundabout increase their output more than the relatively less roundabout industries. I use a change of 2.5%, 5.0%, 7.5%, and 10%

for each period as a threshold to determine whether a change in the output ratio should be considered economically relevant. Any output ratio that changes more than the threshold value is marked “Up” or “Down” according to the direction of movement. If the change is less than the threshold value, then the output ratio shows “No change.” For example, with respect to a threshold level of 5%, there were a total of 13 output ratios that increased by more than the threshold level between 1971 and 1980 and a total of 11 output ratios that did the same between 2002 and 2007. A total of 6 output ratios decreased more than 5% for the first period and 5 output ratios did the same for the second period. Finally, 5 and 8 output ratios show no change at the 5% threshold level for the respective periods. The table shows that, for all threshold levels, more output ratios move upward than downward in both periods with the exception being the 10% threshold level for the 2002-2007 period.

Table 3. Total output ratio changes above threshold levels
(1980 and 2007)

Threshold level	1980	2007	1980	2007	1980	2007	1980	2007
	2.5%		5.0%		7.5%		10.0%	
Output ratio increase	15	13	13	11	12	10	11	8
No change	7	5	6	5	5	4	5	4
Output ratio decrease	2	6	5	8	7	10	8	12
Source: Author's calculations.								

Table 4 shows the estimated output/federal funds rate elasticities between 1971-1980 and 2002-2007 when the federal funds rate is deviated downward by 50 basis points.¹⁶ The first notable result is that each sector shows different elasticity values, while the second notable result is that the elasticity values for each sector for 1971-1980 differ from the elasticity values for the same sectors for 2002-2007. Third, the relatively more roundabout sectors do not always have a higher elasticity than less roundabout sectors. This may be due to a combination of the following factors: activities being misclassified, too much overlap between the LR and MR groups, a specific regulatory framework in the region that affects the manufacturing sector differently

16. To calculate the elasticity, the average federal funds value is used as a reference for each period.

than the rest of the economy, changes in relative roundaboutness that occurred during the time sample that are not captured in the regression, varying behavior by domestic monetary authorities, and greater isolation from U.S. monetary policy.

Table 4. Output/fed fund elasticity with 100bp downward deviation

Country	Group	1971-1980	2002-2007	Country	Group	1971-1980	2002-2007
ARG	HR	0.69	0.03	PAN	HR	-2.36	-0.46
	MR	-2.01	-2.21		MR	-0.62	-0.41
	LR	-1.99	-1.36		LR	-0.02	-0.37
COL	HR	-0.22	-0.28	PAR	HR	-2.13	-0.69
	MR	-0.93	-0.21		MR	-1.50	-0.41
	LR	-0.22	-0.37		LR	-1.22	-0.65
COS	HR	-2.99	0.43	PER	HR	-1.74	-0.34
	MR	-1.25	-0.18		MR	-1.33	-0.17
	LR	-1.17	0.12		LR	-1.30	-0.11
MEX	HR	-1.56	0.01	VEN	HR	-0.88	-0.26
	MR	-1.05	0.01		MR	-1.20	-0.28
	LR	-1.21	0.11		LR	-1.49	-0.50
Source: Author's calculations.							

Finally, I use the same threshold levels of 2.5%, 5%, 7.5%, and 10% to determine how many HR elasticities are larger (in absolute values) than LR output/fed funds rate elasticities. For instance, if the HR output/fed funds rate elasticity is 5% larger (smaller) than the LR output/fed funds rate elasticity, then it is categorized as “HR > LR” (“HR < LR”). If the difference between both elasticities is less than the threshold level, then the table shows the label “HR = LR.” Table 5 shows that HR group output is consistently more sensitive to changes in the federal funds rates than LR group output and that significant differences at the threshold level are persistent.

The results shown in the tables above indicate the presence of uneven effects on the production structure of Latin American countries as captured in different elasticities; for all thresholds, the number of different elasticities is less than the total number of different elasticities. Also, the table suggests that more roundabout sectors are more sensitive to changes in interest rates.

3.2 Floaters and non-floaters

To determine if floaters and non-floaters behave differently during a boom and bust cycle, I rank the countries according to nominal exchange rate variability, which is calculated as the coefficient of variation (CV) of their nominal exchange rates. A country with a fixed exchange rate will have a value of zero for the standard deviation of the nominal exchange rate and therefore a value of zero for the CV. In contrast, a country with a high standard deviation of the nominal exchange rate with respect to the mean will be a floater. I calculate the CV of the nominal exchange rate for each country for the periods 1971-1980 and 2002-2007. Panama, a dollarized economy, has the same position as a fixed exchange rate economy in both periods, whereas other countries demonstrate different exchange rate behaviors in each period. Argentina, for example, is a floater in the first period but behaves like a fixed exchange rate economy in the second period due to its managed float policy.

Table 6 shows the CV for each country and for each group. Note that the nominal exchange rate variability for each of the eight countries decreased in the second period relative to the first period. Figure 3 shows the yearly growth rate for each country in each group in both periods, plus/minus one standard deviation. The reason the periods of analysis were extended by five years and three years, respectively, is to account for the effect of the crises on these two measures of output for each group. The graph shows no discernible pattern in either the yearly growth rates or the standard deviations. Specifically, neither floaters nor non-floaters have a higher yearly growth rate or demonstrate less output level volatility. Namely, at the industrial level, exchange rate regimes do not seem to protect against an exogenous loose monetary policy.

Table 6. Nominal exchange rate coefficient of variability (CV)

1971 – 1980	CV	2002 – 2007	CV
ARG	1.54	VEN	0.21
PER	0.84	COS	0.14
MEX	0.31	COL	0.11
COL	0.27	PAR	0.08
COS	0.12	MEX	0.05
VEN	0.01	PER	0.04
PAR	0.00	ARG	0.03
PAN	0.00	PAN	0.00

Source: Author's calculations based on the International Monetary Fund's IFS database.

Comparing with Table 4, the predicted effects show up unambiguously in the fixed exchange cases: Panama for both periods and Paraguay between 1971 and 1980. The expectation is that the lower the CV of the exchange rate, the more direct the transmission from U.S. monetary policy and the more clearly the Wicksell effects show up. In the opposite case, a pure or perfect floating exchange rate would show less Wicksell effects but, on the other hand, would show a larger effect between tradable and non-tradable sectors since the exchange rate moves freely. However, because the region is not completely isolated from U.S. monetary policy, these effects also appear in the other countries, even if they are not as unambiguous as the fixed exchange rate cases. This means that in the presence of an expansionary monetary policy of a large economy there is a trade-off between exchange rate appreciation and the import of Wicksell effects (Cachanosky, 2014d).

Figure 3. Yearly output growth rate +/- one standard deviation

HR group average growth rate +/- 1 st. dev.

Figure 3. (continued)

Source: Author's calculations based on the IMF's IFS database and ECLAC.

4. POLICY IMPLICATIONS

The results presented in this paper have two important policy implications. The first one is that because the exchange rate can either magnify or absorb an external shock, countries that have different exchange rate regimes are expected to react differently to a similar shock. In the presence of a monetary shock, a fixed exchange rate regime avoids changes in the relative price of tradable and non-tradable goods, while a floating exchange rate distorts the relative price between these two sectors. Conversely, in the presence of a productivity shock, a flexible exchange rate allows for faster accommodation in the relative price of tradable and non-tradable goods if necessary, but carries foreign exchange rate risk (Calvo and Mishkin, 2003; Corsetti and Pesenti, 2005). However, studies have found that Latin American countries that follow different exchange rate regimes show similar rather than divergent output behavior (Canova, 2005). This paper helps to solve this puzzle. If excess liquidity in the years prior to a crisis can explain a common set of economic distortions in Latin America, then U.S. monetary policy prior to an economic crisis can explain part of the unexpected co-movement in the business cycles of Latin American countries with different exchange rates.

The second implication is the fact that economic imbalances caused by a loose monetary policy can occur in the absence of inflation, as the 2008 subprime crisis shows. Borio and Disyatat (2011), Leijonhufvud (2009) and Selgin, Beckworth, and Bahadir (2011) argue that the Federal Reserve was misled into keeping interest rates too low for too long by the use of price level stability as a proxy for monetary

stability. The problem is that price level stability can be an unreliable measure of monetary stability in the presence of productivity gains. A monetary policy that keeps interest rates too low for too long in order to keep price levels stable in the presence of productivity gains does not cause observable inflation but does produce implicit inflation by preventing the price level from falling. There is an excess of money supply which eventually affects the allocation of resources in the market. Because of this problem, some authors have recently suggested that a productivity-norm policy that stabilizes a measure of nominal income, such as NGDP, is a better monetary policy than price level stability (Selgin, 1997; Sumner, 2012; White, 2007).¹⁷

5. CONCLUDING REMARKS

The effects studied in this paper suggest that the fact that both of the two largest economic crises in Latin America occurred after a period of monetary deviation by the Federal Reserve is not a coincidence. Young (2012) identifies an increase in the roundaboutness of the U.S. economy during the period 2002-2007; this paper shows a correlation between the roundaboutness of Latin American and U.S. monetary policy. Some scholars have shown an interest in whether Wicksell effects as embedded in the Mises-Hayek business cycle theory can contribute to an explanation of what went wrong in the 2008 financial crisis. This paper offers an analysis of how particular concepts of the Austrian theory can contribute to our understanding of international business cycles.

Studies on the international transmission of Wicksell effects are lacking. This paper sheds some light on the presence of these effects and points out some potential transmission mechanisms. But the paper also reveals the need for more detailed research about how this effect materializes in the case of dirty floats. Following previous findings, fear to float seems to be a good candidate, but this may not apply to other countries or regions and may not be the only transmission mechanism.

These results also invite further research. For example, have these problems been present in other regions and business cycle periods? What are the effects on labor markets and production factors? Taking the international context into consideration, what type of monetary policy would minimize imbalances in domestic and international economies?

17. For a historical account of the productivity norm, see Selgin (1996, Chapter 8). For a discussion of different approaches to and applications of this problem, see Cachanosky (2014b).

REFERENCES

- Bernanke, B.S. and A.S. Blinder (1992), “The federal funds rate and the channels of monetary transmission,” *American Economic Review* **82**(4): 901–21.
- Borio, C. and P. Disyatat (2011), “Global imbalances and the financial crisis: Link or no link?” BIS Working Papers 346.
- Cachanosky, N. (2014a), “Expectation in Austrian business cycle theory: Market share matters,” *The Review of Austrian Economics*. doi:10.1007/s11138-014-0267-7
- Cachanosky, N. (2014b), “Hayek’s rule, NGDP targeting, and the productivity norm: Theory and application,” *Journal of Stock & Forex Trading* **3**(2). doi:10.4172/2168-9458.1000121
- Cachanosky, N. (2014c), “The effects of U.S. monetary policy on Colombia and Panama (2002–2007),” *The Quarterly Review of Economics and Finance* **54**: 428–36. doi:10.1016/j.qref.2014.03.003
- Cachanosky, N. (2014d), “The Mises-Hayek business cycle theory, fiat currencies and open economies,” *The Review of Austrian Economics* **27**(3): 281–99. doi:10.1007/s11138-012-0188-2
- Cachanosky, N. and P. Lewin, P. (2014a), “Financial foundations of Austrian business cycle theory,” *SSRN Electronic Journal*.
- Cachanosky, N. and P. Lewin (2014b), “Roundaboutness is not a mysterious concept: A financial application to capital theory,” *Review of Political Economy* **26**(4): 648–65. doi:10.1080/09538259.2014.957475
- Cachanosky, N. and A.W. Salter (2013), “The view from Vienna: An analysis of the renewed interest in the Mises-Hayek theory of the business cycle,” *SSRN Electronic Journal*. doi:10.2139/ssrn.2363560
- Calvo, G.A. (2013), “Puzzling over the anatomy of crises: Liquidity and the veil of finance,” IMES Discussion Paper Series, (13-E-09). Retrieved from <http://www.columbia.edu/~gc2286/documents/CalvoBOJpaperMay2013REVJune282013.pdf>
- Calvo, G.A., L. Leiderman, and C.M. Reinhart (1993), “Capital inflows and real exchange rate appreciation in Latin America,” IMF Staff Papers **40**(1): 108–51.
- Calvo, G.A., L. Leiderman, and C.M. Reinhart (1994), “Capital inflows to Latin America: The 1970s and the 1990s,” in E. L. Bacha (ed.), *Economics in a Changing World* (pp. 123–48). London: Macmillan.
- Calvo, G.A. and F.S. Mishkin (2003), “The mirage of exchange rate regimes for emerging market countries,” *Journal of Economic Perspectives* **17**(4): 99–118.
- Calvo, G.A. and C.M. Reinhart (2002), “Fear of floating,” *The Quarterly Journal of Economics* **117**(2): 379–408.
- Canova, F. (2005), “The transmission of U.S. shocks to Latin America,” *Journal of Applied Econometrics* **20**(2): 229–51. doi:10.1002/jae.837
- Cesa-Bianchi, A., M.H. Pesaran, A. Rebucci, and T. Xu (2011), “China’s emergence in the world economy and business cycles in Latin America,” IDB Working Paper Series 266.

- Corbo, V. and A. Tokman (2007), "Latin America in a global world: Challenges ahead," *Documentos de Política Económica* 19.
- Corsetti, G. and P. Pesenti (2005), "International dimensions of optimal monetary policy," *Journal of Monetary Economics* **52**(2): 281–305. doi:10.1016/j.jmoneco.2004.06.002
- Diamond, D.W. and R.G. Rajan (2012), "Illiquid banks, financial stability, and interest rate policy," *Journal of Political Economy* **120**(3): 552–91.
- Dixit, A.K. (1991), "Irreversible investment with price ceilings," *Journal of Political Economy* **99**(3): 541–57.
- Frankel, J., S.L. Schmukler, and L. Servén (2004), "Global transmission of interest rates: Monetary independence and currency regime," *Journal of International Money and Finance* **23**(5): 701–33. doi:10.1016/j.jimonfin.2004.03.006
- Gallego, S., S. Gardó, R. Martin, L. Molina, and J.M. Serena (2010), "The impact of the global economic and financial crisis on Central Eastern and South Eastern Europe (CESEE) and Latin America," *Documentos Ocasionales* 1002.
- Garrison, R.W. (2001), *Time and money: The macroeconomics of capital structure*. London and New York: Routledge.
- Hausmann, R., U. Panizza, and E. Stein (2001), "Why do countries float the way they float?" *Journal of Development Economics* **66**: 387–414. doi:10.1016/S0304-3878(01)00168-7
- Hayek, F.A. (1931), *Prices and production, 1967 edition*. New York: Augustus M. Kelley.
- Hsieh, C.T. and P.J. Klenow (2009), "Misallocation and manufacturing TFP in China and India," *Quarterly Journal of Economics* **CXXIV**(4): 1403–48.
- Izquierdo, A. and E. Talvi (2008), "All that glitters may not be gold: Assessing Latin America's recent macroeconomic performance," Inter-American Development Bank.
- Jara, A., R. Moreno, and C.E. Tovar (2009), "The global crisis and Latin America: Financial impact and policy responses," *BIS Quarterly Review* (June): 53–68.
- Kirzner, I.M. (2010), *Essays on Capital and Interest*. Indianapolis: Liberty Fund.
- Lal, D. (2010), "The Great Crash of 2008: Causes and consequences," *Cato Journal* **30**(2): 265–77.
- Leijonhufvud, A. (2009), "Out of the corridor: Keynes and the crisis," *Cambridge Journal of Economics* **33**(4): 741–57. doi:10.1093/cje/bep022
- Levy-Yeyati, E. and F. Sturzenegger (2003), "To float or to fix: Evidence on the impact of exchange rate regimes on growth," *American Economic Review* **93**: 1173–93. doi:10.1257/000282803769206250
- Lewin, P. and N. Cachanosky (2014), "A financial framework for understanding macroeconomic cycles: The time structure of production is relevant," *SSRN Electronic Journal*. doi:10.2139/ssrn.2443591
- Martins, F. (2000), "Taylor rules," *Economic Bulletin* (March): 49–57. Retrieved from [http://www.bportugal.pt/en-US/BdP Publications Research/AB200001_e.pdf](http://www.bportugal.pt/en-US/BdP_Publications_Research/AB200001_e.pdf)

- Ocampo, J.A. (2010), “How well has Latin America fared during the global financial crisis?” Retrieved from <http://bakerinstitute.org/publications/ECON-pub-OcampoLatinAmCrisis-112910.pdf>
- Ohanian, L.E. (2010), “The economic crisis from a neoclassical perspective,” *Journal of Economic Perspectives* **24**(4): 45–66. doi:10.1257/jep.24.4.45
- Orphanides, A. (2007), “Taylor rules,” Federal Reserve Board Finance and Economics Discussion Series 18. Retrieved from <http://www.federalreserve.gov/pubs/feds/2007/200718/200718pap.pdf>
- Powell, B. (2002), “Explaining Japan’s recession,” *The Quarterly Journal of Austrian Economics* **5**(2): 35–50.
- Rappaport, A. (1986), *La creación de valor para el accionista, 1998 edition*. (L. Corrons, trans.). Bilbao: Ediciones Deusto S.A.
- Restuccia, D. and R. Rogerson (2008), “Policy distortions and aggregate productivity with heterogeneous establishments,” *Review of Economic Dynamics* **11**(4): 707–20. doi:10.1016/j.red.2008.05.002
- Robbins, L. (1934), *The Great Depression, 1971 edition*. Freeport, New York: Books for Libraries Press.
- Selgin, G.A. (1996), *Bank Deregulation and Monetary Order, 2002 edition*. New York: Routledge.
- Selgin, G.A. (1997), “Less than zero,” Institute of Economic Affairs Hobart Paper 132. Retrieved from <http://www.iea.org.uk/publications/research/less-zero>
- Selgin, G.A., D. Beckworth, and B. Bahadir (2011), “The productivity gap: Productivity surges as a source of monetary excess,” *SSRN Electronic Journal*. doi:10.2139/ssrn.1966659
- Stewart III, B.G. (1991), *The quest for value*. New York: Harper Collins.
- Stewart III, B.G. (2002), “Accounting is broken, here’s how to fix it. A radical manifesto,” *EValuation* **5**(1): 1–31.
- Sumner, S. (2012), “The case for nominal GDP targeting,” Mercatus Center, George Mason University.
- Taylor, J.B. (1993), “Discretion versus policy rules in practice,” Carnegie-Rochester Conference Series on Public Policy **39**: 195–214.
- White, L.H. (2007), “What type of inflation target?” *Cato Journal* **27**(2): 283–88.
- Young, A.T. (2012), “The time structure of production in the U.S., 2002–2009,” *The Review of Austrian Economics* **25**(2): 77–92. doi:10.1007/s11138-011-0158-0