CHALLENGES TO INFLATION TARGETING in Central America

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Challenges to Inflation Targeting in Central America

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Significant progress has been made in strengthening monetary schemes in Central America. The design and formulation of monetary policy, decision-making, transparency and accountability, and transmission of policy rates to short-term market rates on inflation-targeting central banks improved substantially during the last decade. However, regional inflation rates have not converged to those of advanced economies. We find stronger evidence of transmission of policy rates to nominal market rates than to real rates. Empirical determinants of transmission rates suggest that further financial market development and greater exchange rate flexibility are essential to improve monetary policy effectiveness.

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I INTRODUCTION

Important strides have been made in most Central American countries to strengthen monetary policy effectiveness. The region presents a group of relatively homogeneous small, open economies, with limited exchange rate flexibility, a relatively high degree of dollarization and underdeveloped financial markets, which are at different stages to strengthen monetary policy control. Its achievements and challenges, with special emphasis on the countries that have adopted an inflation-targeting (IT) framework (Costa Rica, Dominican Republic, and Guatemala), are relevant as they would useful for similar economies beyond Central America.

This working paper analyzes empirically the transmission to nominal and real rates for the three countries in the region that have adopted IT. Monetary policy effectiveness depends on policy rates' transmission channels to market rates. We found that, in general, transmission is weak and varies between countries. The factors that may explain this heterogeneity are analyzed, including size of the financial sector, bank concentration, exchange rate regime, institutional quality, and ease of doing business. Progress in strengthening central bank autonomy, both financially and legally, is crucial, to allow their decision-making process to be more consistent with the monetary control strategy.

The paper is organized as follows: Section II analyzes monetary policy design and formulation, and the decision-making process of the governing bodies of the central banks; Section III examines transparency and accountability; Section IV assesses new strategies of monetary control; Section V estimates the transmission of monetary policy interest rates to nominal and real rates; and Section VI concludes.

II CHANGES TO THE MONETARY POLICY FRAMEWORK IN CENTRAL AMERICA

The increase in capital mobility has been a major challenge for monetary policy formulation in the region. From the early 1980s, a dominant topic of discussion for open, small economies in Central America and other parts of the world has been the difficulty to manage an independent monetary policy in a context of increasing capital mobility. Deregulation of capital account movements and financial globalization has imposed, from the beginning of the 1990s, a fundamental restriction to central banks' ability to conduct monetary policy. This restriction, known in the literature as "the impossible trinity," has limited the effectiveness of the old models for monetary policy in the region, as countries cannot maintain an open capital account, a fixed exchange rate, and an independent monetary policy with the objective of general price level stability. Central American Monetary Council data shows that capital inflows to the region amounted to an annual average of US$1.4 billion during 1990-1999. These inflows increased fourfold to US$4.8 billion during 2000-2006. Monetization increased due to the growing capital inflows and had to be sterilized partially or totally, mainly through open market operations. These operations impacted the quasi-fiscal deficits, which in turn affected monetary policy effectiveness.

Prior to starting the transition to IT, central banks of the region used structural liquidity monetary policy targets. Thus, liquidity projections were used to forecast the main monetizing factors of the monetary program. Forecasting used econometric techniques and daily factors of seasonality. The objective was to project monetary policy out to six or eight quarters to identify when auctions of central bank paper should be conducted. In general, central bank securities had terms of more than 30 days. Under this strategy, the operational target of the monetary policy was the relevant monetary aggregate (such as monetary emission in Guatemala and the restricted monetary base in Dominican Republic). The adoption of more flexible monetary schemes relegated primary liquidity management to a monetary control support role. This way, excess primary liquidity could be sterilized at longer terms and short-term money market management became easier. Central banks shifted increasingly their focus to the forecast and administration of liquidity in the money market since 2010.

Most central banks of the region have begun to adopt flexible monetary policy schemes. Responding, to some extent, to the increasing capital inflows, monetary schemes in the region started to evolve in two different directions to escape the restrictions imposed by the impossible trinity. Some countries adopted rigid schemes, such as El Salvador, which dollarized the economy on January 1, 2001. Other countries went the route of increased flexibility, such as in Costa Rica where, after more than 20 years maintaining a crawling peg framework, the government introduced an exchange-rate band scheme on October 17, 2007.[2] Meanwhile, Guatemala formally adopted IT on January 1, 2005, after gradually implementing monetary policy changes since early 2000. More recently, on January 1, 2012, Dominican Republic adopted an IT scheme. The remaining central banks in the region (Honduras and Nicaragua) have also started processes to improve the effectiveness of their monetary policies. While the shift started over a decade ago, it accelerated from 2011, particularly in countries going toward a full IT scheme.

IT countries developed monetary operations in parallel to the policy shift, but interbank markets remain underdeveloped. Costa Rica, and Guatemala, with the support of technical assistance provided by CAPTAC-DR, focused their monetary control strategies in overnight auctions, to strengthen the transmission of monetary policy rates to interbank market rates. Dominican Republic also started overnight auctions on January 2013. The strategy includes the daily calculation of bank liquidity. In the case of Guatemala, the central bank interacts every morning with the banking system to calculate the daily cash movements. Adding this information to the initial banks' current account balances at Bank of Guatemala, the end-day liquidity position can be projected. The latter is relevant to determine the amount of central bank securities to be auctioned in the monetary market. The daily exercise of monitoring the supply and demand for bank liquid reserves has increased the effectiveness of central bank's participation in the monetary market. However, interbank market transactions remain infrequent and of low volume, distorting policy transmission signals.

Most central banks in the region are converging on the explicit objective to maintain price stability, but challenges remain to improve the effectiveness of monetary policy. Notwithstanding the progress made in implementing IT in Costa Rica, Dominican Republic, and Guatemala, using short-term interest rates *(overnight)* as an operative goal, there are still important challenges to improve the effectiveness of monetary policy. This is evidenced mainly by the fact that domestic inflation rates have not yet converged to the rates of developed countries or main trade partners. A comparative analysis of institutional factors follows in Section III, while Section IV concludes that the development of financial markets and greater exchange rate flexibility are two key determinants for improving transmission mechanisms and monetary policy effectiveness in Central America.

III DECISION-MAKING AND THE MONETARY POLICY DESIGN PROCESS

A. Composition of Governing Bodies and Decision-Making Processes

By law, the ultimate responsibility in determining monetary policy in Central American central banks corresponds to their governing bodies.[3] Their composition is of utmost importance, as expert judgment, one of the three essential operational aspects of IT,[4] depends critically on it. Figure 1 depicts the general—non-official—design and monetary policy formulation process in Guatemala, which is alike to the rest of the countries in the region.

Decisions on monetary policy implementation lay with the Implementation Committee, while the Monetary, Exchange and Credit Policy Department implements these decisions. The latter and the Macroeconomic Analysis and Forecast Department follow up on the implementation of monetary policy and inform the Implementation Committee. This process ends with a monetary policy proposal, which is determined, as indicated previously, by the governing body of the central bank.

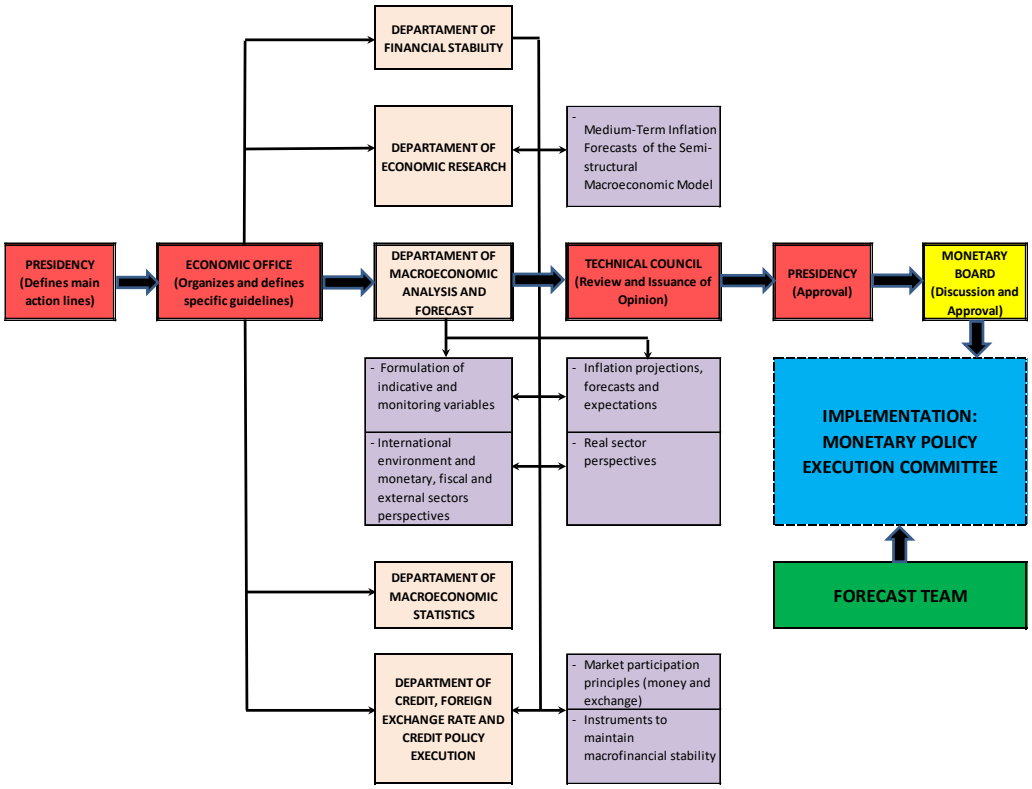
2 In January 2015, Costa Rica abandoned the exchange-rate band scheme and introduced a managed float exchange rate arrangement. According to The Exchange Arrangements and Exchange Restrictions Report of the IMF, from 2005 to 2014 Costa Rica went from Crawling Peg to "Other Managed Arrangement"; Guatemala from Managed Floating to a Crawl-like Arrangement.

3 The governing bodies in the central banks of the region are the Monetary Board (Dominican Republic and Guatemala), the Board of Directors (Costa Rica and Honduras), and the Board (Nicaragua).

4 These are: (a) informative or indicative variables; (b) models; and (c) expert judgment.

Figure 1. Bank of Guatemala

Monetary Policy Design and Formulation



Source: authors, based on Bank of Guatemala information. Not an official version.

The design and formulation of monetary policy is sustained by a well-structured process. The authorities provide guidelines, which are implemented by specific teams and departments that provide technical support. These teams, usually not formally constituted, develop short and medium-term inflation forecasts based on the running of semi-structural models as well as on formulating indicative monetary policy variables.[5] Table 1 summarizes the forecasting models used by central banks in the region.

5 CAPTAC-DR has provided technical assistance for the development of these models to the central banks in Central America since 2010.

Table 1. Models and Forecast of Central Banks

(end-December, 2012)

Country	Type of Models		Interest Rates Assumptions
	Short Term Inflation Forecasts	Medium-Term Inflation Forecasts	
Costa Rica	ARIMA and Others	Semi-structural and DSGE (under construction)	Yes
Guatemala	ARIMA + Regression + Expert Judgement	Semi-structural (since 2006) + Structural (expected from 2013)	Non constant path ; endogenous (policy rule, variant of the Taylor Rule). It communicates as a indicative variable of monetary policy, but it does not imply forecast or commitment.
Honduras	ARIMA and Others	Semi-structural (under construction)	n/a
Nicaragua	ARIMA	Semi-structural	Exchange rate is the policy instrument, announced mini devaluations. Interest rate is exogenous (i = i* + TED) and of market.
Dominican Republic	Single equation models, consistency models and ARIMA models	Yes, general equilibrium reduced model, semi-structural model	Yes, Taylor style policy rule.

n/a = Not avaible.
Source: Central Banks.

All central banks in the region have an Open Market Operations Committee (OMOC—"Execution Committee" in Bank of Guatemala, and "Open Market Committee" in Banco Central de Costa Rica). The OMOC analyzes the execution of monetary policy as related to monetary operations and structural liquidity, reserves, and participation in the exchange market, and follows up on it. This Committee is the technical liaison between the forecast team and the governing body of each central bank.

The conformation of the governing bodies of the central banks puts into perspective the importance of the work of the Implementation Committees, in their crucial role of providing feedback and technical analysis for the decision-making process. This, coupled with the implementation of transparency and accountability practices, helps to strengthen the effectiveness of monetary policy in the region.

B. Size of Governing Bodies

There is no clear correlation between the size of the board and the size of the economy. The governing bodies of the region's central banks have an average of seven members. Countries in the region with IT policies have an average of eight members, one more than the average of 27 countries that apply this strategy of monetary policy worldwide (Table 2).

Table 2. Decision - Making of Governing Bodies in Selected IT Central Banks

(end-December, 2012)

Country	Number of members of the Board of the Central Bank	External Members	Meetings per years to decide on Monetary Policy rates	Term of the President of the Bank		Decision making process		Are votes published?
				In years	Same the term with the President of the Republic (only Central America and DR)	By votes	By consensus	
I. Central America and Dominican Republic								
Costa Rica	7	6	12	4	Yes	X		No
Guatemala	8	7	8	4	No	X		No
Honduras	5	No, attends SEFIN with voice but no vote, not a member of the Directory	8 (in 2012)	4	Yes	X		No
Nicaragua	6	5	Not applicable	5	Yes	X		No
Dominican Republic	9	8	12	2	Yes	X		No
II. South America and Mexico								
Brazil	8	No	8	Set term		X		Balance of votes
Canada	6	No	8	7			X	n/a
Chile	5	No	12	5		X		Yes
Colombia	7	No	12	4		X		Majority or unanimity
Mexico	5	No	8	6			X	n/a
Peru	7	No	12	Term of Parliament		X		No
III. Other countries								
New Zealand	Governor	n/a	8	5		Decision of the Governor		n/a
Norway	7	5	6	6			X	n/a
United Kingdom	9	4	12	5		X		Yes
Sweden	6	No	6	6		X		Yes

n/a = Not avaible.
Source: Central Banks of America and Dominica Republic, and Hammond, G. (2012).

Decision making procedures in the region seem to favor long-term over short-term efficiency. In all countries of the region, the governing body makes decisions by vote. Per Vandenbussche (2006), consensus appears to favor more in-depth discussions leading sometimes to more accurate judgment; however, it also leads to "convergence of members' views over time, which may be detrimental to preserving a healthy diversity of perspectives within the Monetary Policy Committee". Decisions are made by vote in most IT countries, while consensus is observed in Australia, Canada, Ghana, Iceland, Mexico, Norway and South Africa.[6]

C. Autonomy, Transparency and Accountability

The composition of government bodies in the region deviates from international best practices in terms of autonomy. In Dominican Republic, Guatemala and Nicaragua, members of the Monetary Board are appointees of institutional sectors,[7] while in some countries, external members of governing bodies are elected by law, based on technical criteria.[8] Furthermore, except in Honduras, the number of external members is relatively large, and the Ministry of Finance is a member with full voting rights. Another aspect to consider is that, in all countries except Guatemala, the term of the President of the Central Bank coincides with the term of the President of the Republic.[9] This differs from best practices as increases the potential for political influence on the central bank objectives.

6 Hammond, G., 2012.
7 For example, in Nicaragua the President of the Republic designates four of the members of the Board "in consultation with the private sector", as indicated by their Organic Law.
8 External members are all those who are not officials of the Central Bank. All external members in Costa Rican and Honduras are selected based on technical criteria.
9 Overlapping mandates were introduced in the reform of the organic law of the Bank of Guatemala approved on June 2, 2002.

There has been substantial progress in terms of transparency during the last 15 years. With the passing of new organic laws and implementation of more flexible monetary schemes, the region's central banks gained additional tools for explaining monetary policy results. Except for the Dominican Republic, presidents of the central banks report to their respective legislative bodies on actions taken. Presidents also hold press conferences and/or issue press releases (Table 3). Additionally, in Guatemala and Dominican Republic, minutes of the meetings of the central banks' governing bodies are published when decisions about the operational goals of monetary policy are made. All central banks in the region report on inflation and explain the relevant aspects of the execution of monetary policy, but only the central banks of Guatemala and Honduras produce a financial stability report.

Table 3. Central Bank Transparency and Accountability

(end-December, 2012)

Country	Open letter to inform Monetary Policy results	President of the CB reports to Congress	Press Conference (PC) / Press Release (PR)	Minutes of the meetings of the Board of Directors of the Central Banks published	Inflation report	Annual frequency	Financial Stability Report (FSR)	FSR Published
Costa Rica	No	Yes, every year in March	Yes, including macro programs and policy measures adopted	No	Yes	2	No	No
Guatemala	No	Yes, twice a year	PC and PR	Yes, 4 weeks later	Yes	3	Yes	No
Honduras	No	Yes, by Congress invitation	Occasional PR, PC	No	No	n/a	Yes	Yes
Nicaragua	No	Yes, once a year	PC and PR	No	Yes	12	No	No
Dominican Republic	No	No	PR	Yes	Yes	2	No	No

n/a = Not avaible.
Source: Central Banks.

Opportunities to strengthen the institutional framework of central bank government bodies in the region remain. Further accountability to Congress and civil society in general, strengthen political independence by overlapping mandates of central bank governors and those of governments, eliminate Board representation of groups of interest and public officers other than the central bank governor, are among the measures that could foster transparency and accountability. These are critical to monetary policy effectiveness, as they contribute to anchor inflationary expectations under IT, as well as to strengthen central bank autonomy.

IV TRANSMISSION OF MONETARY POLICY RATES

This section estimates the transmission of policy interest rates to short-term market rates in the three countries that have adopted IT in Central America. (Costa Rica, Dominican Republic, and Guatemala). Assuming that the central bank is independent and has macroeconomic stability as its main goal, the transmission of policy rates is crucial for the effectiveness of IT. For economic expectations to be affected by monetary policy, market rates must respond closely to monetary policy rates, only in this way can monetary policy have an impact on aggregated demand and inflation. The monetary policy maker expects that policy rates impact the short-term market rate, and this will, in turn, affect longer-term interest rates along the yield curve. Then, the long-term nominal interest rate will impact the real interest rate, which normally moves closely to the nominal rate, this relationship is defined in the fisher equation. Because the inflation rate is positive, it is expected that the nominal interest rate exceeds the real interest rate. In this context, it is important to take into account that the economic agents make decisions based on real interest rates and, therefore, the central banks aim to impact on real interest rates. In addition, different maturity rates are expected to respond with some lags, but the objective is to have an impact on the entire financial system to influence decisions on production, work, investment, and consumption by homes and firms. Therefore, the transmission of policy interest rates to short-term market rates is of paramount importance: if this is weak, the transmission to other rates and the impact on macroeconomic variables will also be weak and the central bank will not be effective in the conduct of its monetary policy. The patterns of the policy rates of Costa Rica, Dominican Republic, and Guatemala seems not to be affected by the movements of the Federal Reserve Rate (Appendix II, Figure 1). Therefore, the Federal Reserve Rate was not included as an exogenous variable in the models.

Available literature provides evidence that the transmission of policy rates is particularly weak in the Central American countries. (Appendix I). Seminal work by Mishra, Montiel and Spilimbergo (2010), who found that monetary transmission is weak and not reliable in low income countries with rudimentary financial systems and with fiscal rigidities. Medina, Carrión-Menéndez and Frantischeck (2011a) concluded that transmission of monetary policy signals in Central America is weaker than in other Latin American countries.

The objective of this section is to assess and quantify the effect that changes in the policy interest rate have on short-term market interest rates. The effects on both nominal and real interest rates are assessed using time series. Dynamic correlations between policy interest rates and market rates are examined in Section A. Granger causality tests are carried out in Section B to determine whether the policy rate explains, in the Granger sense, the short-term market rate. Additionally, impulse-response functions from a vector autoregressive model are estimated in Section C to examine the dynamics of policy shocks on market interest rates. The policy rate pass-through to market rates is quantified in Section D and compared with the results of Medina, et al (2011a).

A. Dynamic Correlations

Policy rates and sort-term market rates do not appear to move in unison. Figures 2, 3, and 4 show the evolution of monetary policy interest rates and short-term market interest rates,[10] both in nominal and real terms, for Costa Rica, Dominican Republic and Guatemala. Even though some trend co-movement between these rates is observed, there are important gaps between them. In some periods, market rates follow the policy rate with some lags, but in other episodes, the movements are completely divergent.

Figure 2.
Costa Rica Interest Rates

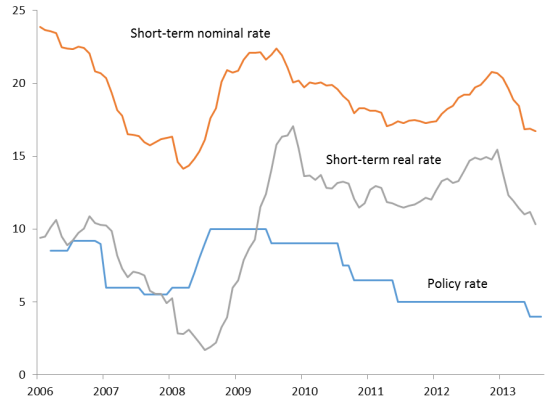


Figure 3.
Dominican Republic Interest Rates

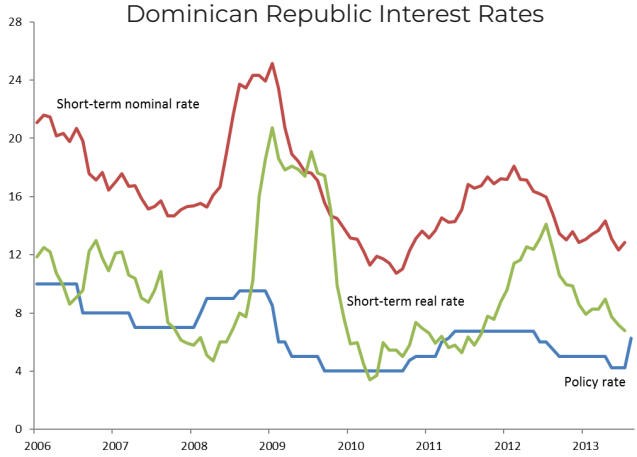


Figure 4.
Guatemala Interest Rates

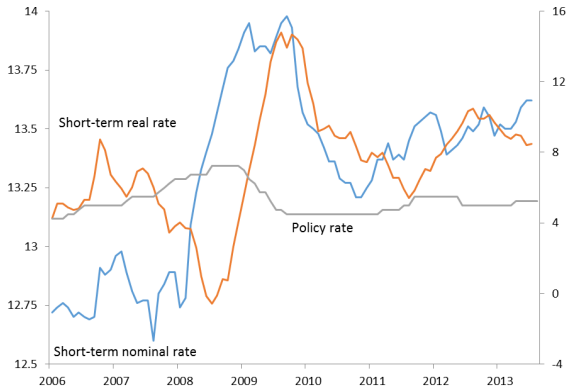
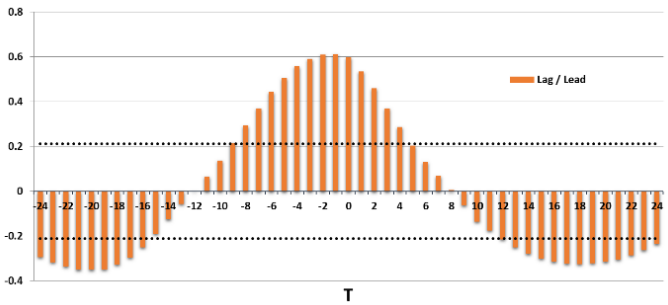


Figure 5.
Costa Rica: Dynamic correlation between short-term nominal interest rate and Policy rate
(Monthly data, 2004-2013)



10 Short-term interest rates and monetary policy interest rates were obtained from the Macroeconomic Data Base (SIMAFIR) of the Central American Monetary Council (http://www.secmca.org/simafir.html).

Figure 6.

Dominican Republic: Dynamic correlation between short-term nominal interest rate and Policy rate
(Monthly data, 2004-2013)

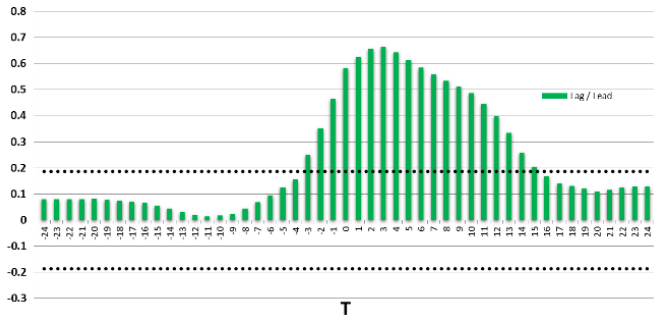
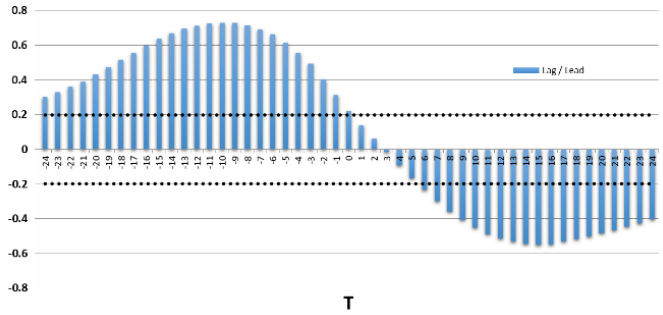


Figure 7.

Guatemala: Dynamic correlation between short-term nominal interest rate and Policy rate
(Monthly data, 2004-2013)



Dynamic correlations are calculated to analyze the dynamics of the changes in policy rates and the movements of market rates. (Figures 5 to 7 illustrate the correlation between short-term nominal interest rates and lags and leads of the policy rate. The direction of the dynamic correlation goes from the lags and leads of the policy rate to the short - term nominal interest rates. The results show that the relationship between the policy and market rates in Costa Rica is mostly contemporary, the linear association is stronger and concentrated around T, with the maximum value at T-2. In Dominican Republic, the linear association is stronger between the rates in T+2, as if the market anticipated the movements of the policy rate. In Guatemala, the linear association between rates presents important lags. The stronger linear association is with a lag of ten months; meanwhile the contemporary association is almost statistically not significant, per the statistical significance lines.

While these results constitute a valuable starting point to the quantitative analysis of mechanisms for transmission of interest rates, they shall be considered with caution. All series were tested for unit-root and all of them are integrated of order one. This means that, in levels, they behave as random walk. The econometric analysis below transforms them into first differences to avoid spurious regressions.

B. Granger Causality

The Granger causality test can provide valuable information for the analysis of the transmission of interest rates. Basically, it tests whether a variable contains information that can be used to predict another. In this sense, if the policy interest rate contains predictive power over the market rate, one can conclude that the first causes the second, in the Granger sense. Based on the arguments presented above, for monetary policy to be effective in an IT scheme, it is necessary for monetary policy to not only affect nominal rates but to also affect real rates. Therefore, Granger causality tests are conducted testing causality from policy rates to short-term market rates, both in nominal and real terms (Appendix II). There is evidence of direct Granger causality in both Costa Rica and Dominican Republic, since both the short-term nominal and short-term real interest rates are affected by the policy rate. There is no direct evidence in the case of Guatemala.

While no evidence of direct Granger causality from the policy rate to the short-term market rate is found for Guatemala, Granger causality is found from repo rate to the short-term market rate. Results of the Granger causality test are presented in Table 4.

Figure 8.

Guatemala: Dynamic correlation between repo operations rate and policy rate
(Monthly data, 2004-2013)

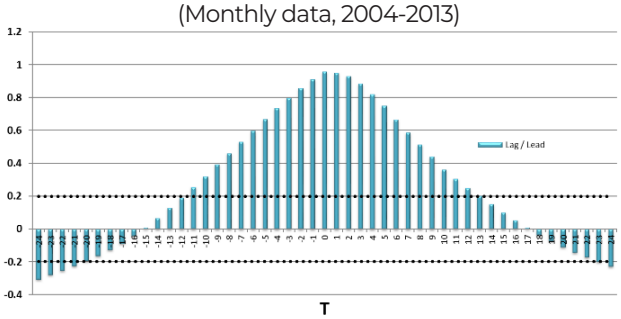


Table 4. Granger Causality Test between en Short-Term Rates and Monetary Policy Rates

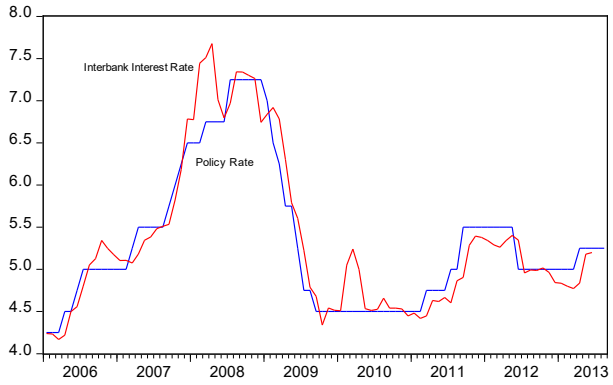
	COSTA RICA		DOMINICAN REPUBLIC		GUATEMALA	
Shock: Policy Rate	**Lags**	**Causality/sample**	**Lags**	**Causality/sample**	**Lags**	**Causality/sample**
Response: Short-term nominal interest rate	2	YES*** (2004-2013)	2	YES*** (2006-2013)	2	YES*** (2004-2013)
Response: Short-term real interest rate	2	YES* (2004-2013)	5	YES* (2009-2013)	2	NO

* Significant at 1 percent ** Significant at 5 percent *** Significant at 10 percent

Given that no direct Granger causality was found, additional tests were conducted using the interbank interest rate (repurchase agreement rate or repo rate) as a policy rate proxy. The contemporary dynamic correlation between the repo interest rate and policy rate for Guatemala is close to one and distributed symmetrically. When using the repurchase operations rate, evidence shows that the causality of the policy rate (repo rate proxy) to the market rate is significant in Guatemala. Thus, the policy rate determines the repo rate, and this in turn determines short-term market rates. Accordingly, the repo rate is used in this paper thereafter as the policy rate proxy for Guatemala and the short-term market rate is the loan rate.[11] The dynamic correlations of the repo rate with the market rate for Guatemala are shown in Figure 8. In addition, the interbank interest rate is used by the Central Bank of Guatemala in the money market to make the open market operations, and their patterns move very close. (Figure 9).

Figure 9.

Policy Rate and Interbank Interest Rate



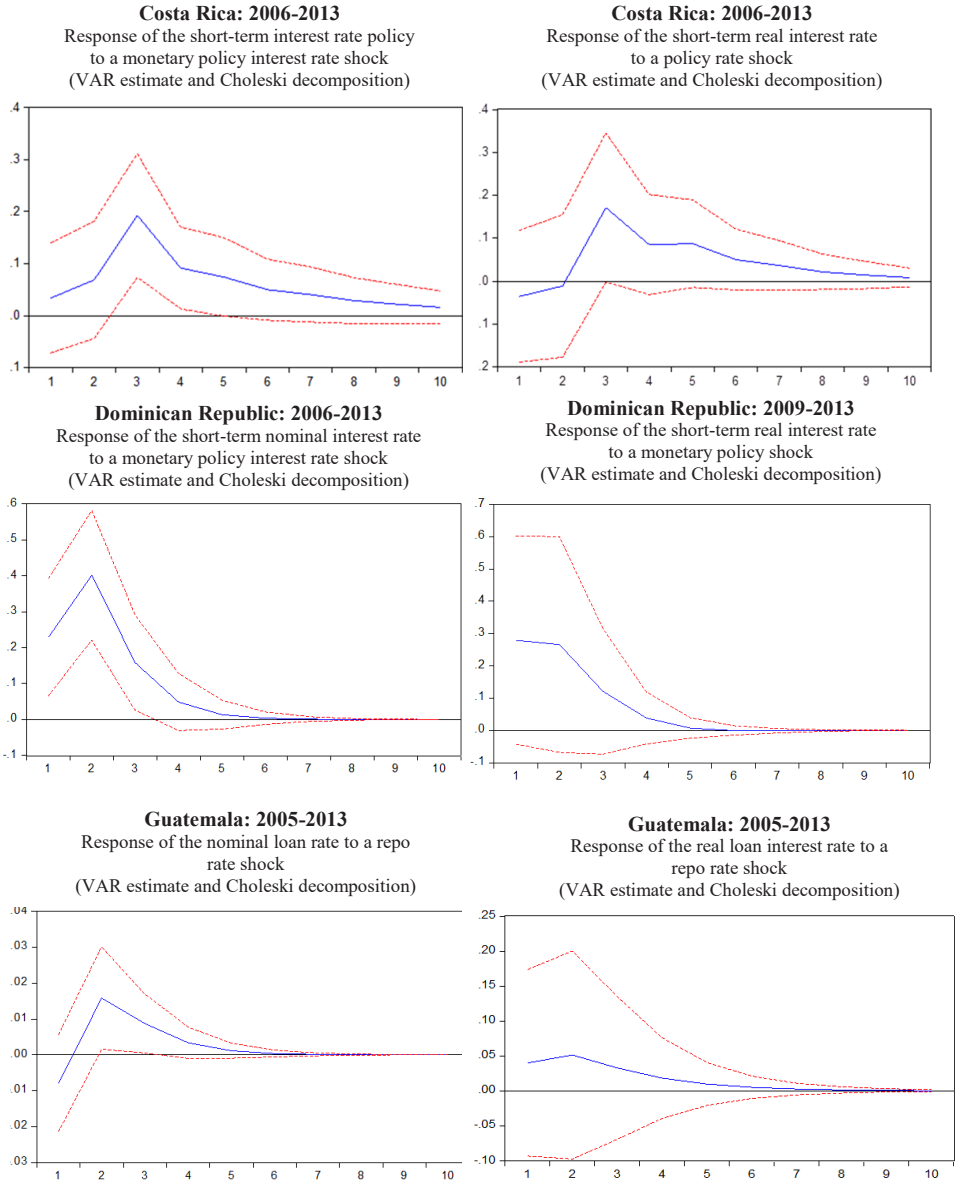
C. Impulse-Response Functions

Given that there is evidence of significant transmission from policy interest rates to market rates, it is important to investigate the dynamics of such effects. This implies estimating the magnitude and duration of the effect of a policy shock over real and nominal market rates. To this end, vector autoregressive models (VAR) and their impulse-response functions are estimated (Appendix II).

The impulse-response functions reveal that, unlike nominal rates, real market rates are not affected by policy shocks (Figure 10). In Costa Rica, the response of the nominal market rate to a shock equivalent to one standard deviation in the policy rate becomes significant after two months and disappears before five. Meanwhile, the effect over the real rate is not statistically significant, which is contrary to the Granger causality test result. This inconsistency of results could be a consequence of different levels of significance. The Granger test is significant to 10%, while the bands of significance in the decomposition of Cholesky represent 95% confidence. Similarly, in Dominican Republic, the monetary policy shock has a contemporaneous effect; it reaches its peak at the second month and disappears before the fourth month. There is no significant effect observed on the real rate, contrary to the Granger causality test result. Finally, in Guatemala, the effect over the nominal loan rate is significant between two or three months of lag and, consistent with the Granger causality tests, there is no significant effect over the real rate. The sample used to estimate the VAR models of every country depends on the data availability. In the case of Guatemala, the sample starts at the beginning of the inflation target regime.

11 Empirical research found that the interbank rate is closely correlated with the policy rate. Given this correlation, some authors have used the interbank rate as a proxy for the policy rate in their research (Mishra, et al., 2010). This is because, generally, the policy varies infrequently and a variable with more volatility has better econometric properties for model calibration.

Figure 10.
Impulse Response Functions



D. Short and Long-Term Effects of the Policy Rate

Monetary transmission in the Central American countries that have adopted IT is weak, unreliable, and with significant differences from one country to another. The equation (1) estimates the pass-through of policy rates to nominal market rates,

$$y_{it} = \sum_{k=1}^{K} \alpha_{ik} y_{it-k} + \sum_{k=0}^{K} \gamma_{ik} x_{it-k} + \varepsilon_{it} \qquad (1)$$

where $\boldsymbol{y_{it}}$ is the change in nominal market interest rates and $\boldsymbol{x_{it}}$ is the change in policy interest rates. Results are compared with those obtained by Mishra, et al., 2010 (Appendix II). There are wide differences among the three countries (Table 5). The contemporaneous correlation of Costa Rica is comparable to low-income economy levels, the one from Guatemala is almost nonexistent, and the one for the Dominican Republic is equivalent to that of emerging economies. Regarding the short-term effect, all three countries have very low correlations, even lower than the ones for low-income economies. Finally, with respect to the long-term pass-through, Costa Rica is above emerging economies but below advanced economies, Guatemala is well below low-income economies, and the Dominican Republic approaches the level of emerging economies. It is important to note that in the case of the Dominican Republic, when using smaller samples eliminating the oldest data, the evidence of long-term correlations even exceeds, by far, the advanced economies (up to about 1.5). However, such atypical results require further investigation. The next section seeks to identify the factors that could explain this outcome.

Table 5. Contemporaneous, Short- and Long-Term Correlations between Policy and Market Rates

				2006-2013	2006-2013	2007-2013
	Advanced Economies	Emerging Economies	Low-Income Economies	Costa Rica	Dominican Republic	Guatemala
Contemporaneous correlation	0.29	0.30	0.23	0.20	0.34	-0.03
Short-Term Effect	0.81	0.74	0.59	0.11	-0.09	0.10
Long-Term Effect	0.96	0.59	0.40	0.85	0.48	0.16

* Significant at 1 percent ** Significant at 5 percent *** Significant at 10 percent

V DETERMINANTS OF MONETARY POLICY TRANSMISSION

This section analyzes the factors contributing to the observed gap between policy and market rates in the region, identifying determinants for the low monetary policy transmission levels. The contribution of bank concentration, the size of the financial sector, business environment, and the exchange rate regime are examined.

- High bank concentration reflects limited competition in the financial market, where some institutions may have relatively high market power in setting interest rates and, therefore, the influence of the policy rate on the market will be weaker. We use the Herfindahl-Hirschman index applied to bank credit to proxy bank concentration.

- When the financial sector is large, compared to the economy, and well-regulated, transmission rates are more effective because they involve a large and transparent market in which almost all commercial and financial operations are performed as in advanced economies. On the other hand, a poorly banked economy with a rudimentary financial system and a weak regulatory environment is more conducive to the existence of a weak regulatory structure and supervision. We proxy the relative size of the financial sector through its share in real GDP.

- In general, a good business environment that is well-regulated and has strong institutions helps the transmission of policy rates. A weak judicial system may affect business confidence and reduce incentives for banks to lend to each other or to the nonfinancial sector. In this context, bank precautionary liquidity reserves increase, resulting in expensive credit and low transmission levels (Mishra, et al, 2010). Business environment and institutional quality are proxied through World Banks' Corruption Perceptions and Ease of Doing Business indices.

- The IMF (2016) exchange rate regime classification is used as an indicator of exchange rate flexibility. A more flexible regime allows the exchange rate to be more responsive to the foreign currency market. An increase in the policy rate leads to a depreciation in the exchange rate according to the Uncovered Interest Parity (UIP) to avoid arbitrage conditions, which increase both the domestic inflation and the aggregate demand. As a consequence, the nominal interest rate should rise because of both the depreciation in the nominal rate and the increase in the policy rate, which restore the equilibrium by decreasing both the domestic inflation and the aggregate demand. Therefore, it is expected that exchange rate fluctuations are highly correlated with changes in the central banks' policy rate. Consequently, the effect on aggregate demand and prices will be more significant, which amplifies monetary policy signals.

We use panel data econometrics to examine how each of the factors described above impacts monetary policy transmission. The model to be estimated may be considered as a "two-way effect" model, where the intercept may vary from one individual to another and over time, as in the equation (2),

$$y_{it} = \alpha_i + \gamma_t + x'_{it}\beta + \varepsilon_{it} \qquad (2)$$

were y_{it} is the difference between nominal interest rates and short-term interest rate policy, α_i are the individual effects of one individual to another and γ_t are individual effects over time. The xit matrix contains the observations of the explanatory variables: bank concentration, size of the financial sector, institutional quality, ease of doing business, and the exchange rate regime. The term ε_{it} represents stochastic disturbances. The dependent variable is the gap between the market nominal interest rate and the policy rate. In this sense, we aim to explain the difference between the market interest and the policy rates (Figures 2, 3 and 4). To compare alternative estimates and search for robustness, estimations were made using different methods. Results, using quarterly data from Q1 2008 to Q4 2012, are presented in Table 6. Estimation of the Determinants of the Monetary Policy Transmission. Appendix II details the estimation methods used to calculate each column in Table 6, as well as data used for estimates.

Table 6. Determinants of Monetary Policy Transmission

Variable	OLS	POLS	GLS	GLSb	GLSc	PGLS
Banking Concentration	55.248***	55.248***	32.336**	31.853**	32.336 **	32.170**
	-14.454	-15.027	-17.409	-16.444	-15.864	16.234
Financial Sector Size	1.232*	1.232*	-0.149	-0.102	0.149	-0.078
	-0.912	-0.897	-0.474	-0.219	-0.469	-0.211
Quality of Institutions	-0.336	-0.336	0.214	-0.079	0.214	-0.163
(Transparency Index)	-1.247	-1.118	-1.15	-0.636	-1.096	-0.624
Ease of Doing Business	0.045*	0.045*	0.012	0.031*	0.012	0.036*
	-0.034	-0.037	-0.047	-0.027	-0.037	-0.027
Exchange Rate Regime	-3.346*	-3.346**	-4.116**	-4.087***	4.116**	-4.153***
	-2.345	-2.026	-1.992	-1.21	-2.327	-1.163
Tendency	0.078*	0.078*	0.145**	0.161***	0.145**	0.168***
	-0.051	-0.051	-0.07	-0.043	-0.067	-0.043
Constant	11.494	11.494	26.684*	25.132***	26.684*	25.089***
	-21.691	-19.622	-18.131	-9.68	-19.802	-9.391

* Significant at 1 percent; ** significant at 5 percent; *** significant at 10 percent.

Bank concentration, business environment and exchange rate regime are found to be significant determinants of monetary policy transmission in all cases. The bank concentration variable is consistently significant in the different methods. The Herfindahl-Hirschman index ranges from zero to one; values closer to one show a larger concentration. In this regard, the positive sign is the expected one. Higher levels of bank concentration broaden the difference between market rate and policy rate. The size of the financial sector is only significant when the estimation is made with OLS and using the 10% of significance level but does not have the expected sign. The transparency index, an indicator of the quality of the institutions, is not significant under any estimation method. The Ease of Doing Business Index is statistically significant in most estimations at 10% of significance and does have the expected sign. Its positive value denotes that the lower the position in the ranking (higher the numeric value), the less is the ease of doing business and the divergence between policy rates and market rates is larger. Finally, the exchange rate regime index is always significant and negative. This means that an increase in the flexibility of the exchange rate (measured by an increase in the exchange rate index), decreases the difference between the nominal interest rate and the short-term interest rate policy.

This implies that more flexible regimes contribute to the convergence of policy and market rates, and thus a better transmission of monetary policy. Also, more flexible exchange rates increase the independence of the monetary policy; therefore, the policy rate can impact more closely the nominal interest rate.

VI CONCLUSIONS AND RECOMMENDATIONS

Further strengthening the transparency, accountability and independence of central banks' government bodies is necessary to anchor inflation expectations. Strengthening accountability to Congress and civil society in general, and political independence by overlapping mandates of central bank governors and those of governments and by eliminating representation of groups of interest and public officers other than the central bank governor, could foster transparency, accountability and independence. Together, these measures contribute to anchor inflationary expectations under IT, boosting the credibility of central banks as policy-makers.

Substantial progress has been made regarding the implementation of semi-structural and structural models for forecasting inflation in the medium term. This is particularly the case in Costa Rica and Guatemala, both with IT schemes. This contributes to transparency and accountability, and complements the framework for decision making, supported by indicative variables and expert judgment.

Transmission of monetary policy rates to nominal market rates is relatively strong but varies from country to country and has little persistence. Dynamic correlations of the rates are contemporary in Costa Rica, while in Guatemala the strongest correlation is with important lags and in Dominican Republic the strongest correlation is with substantial leads. There is clear and significant evidence of the transmission of policy rates to nominal interest rates in the three countries with IT. The dynamics of the effect of policy shocks on nominal market rates in Costa Rica and Guatemala operate with lags of three to four and two to three months, respectively. In the case of Dominican Republic, the shocks have significant effect during the first three months.

Changes in the policy rate have an extremely weak effect on the real rate in Costa Rica and are almost nonexistent in Guatemala and Dominican Republic. The pass-through effect is quite heterogeneous. Contemporaneous correlation in Costa Rica is comparable to the transmission seen in low-income economies but, in the long term, the transmission is equivalent to advanced economies. Dominican Republic is more in line with contemporary and long-term correlations of emerging economies, although more recent samples showed much higher values than the average for advanced economies. Contemporary and long-term correlations in Guatemala are very weak and below low-income countries. Short-term correlations in the three economies are very low, below the observed in low-income economies.

Reducing bank concentration, increasing exchange rate flexibility and improving the business environment will strengthen the transmission mechanism of monetary policy. Bank concentration, exchange rate regime and, with less significance, business environment are the main determinants of the gap between short-term nominal market interest rates and policy rates. There is mixed evidence that the size of the financial sector relative to the economy may also have some influence in monetary policy pass-through.

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Appendix I. Literature Review

	I. IMF WP/07/54	II. IMF WP/11/240 III. IMF WP/11/245	IV. BANGUAT WP
Date	March 2007	October 2011	
Authors	Luis I. Jácome and Eric Parrado	Stephanie Medina Cas, Alejandro Carrión-Menéndez and Florencia Frantischek	José Alfredo Blanco-Valdés, Héctor Augusto Valle Samayoa and Fernando L. Delgado
Title	The Quest for Price Stability in Central America and Dominican Republic	II. The Policy Interest-Rate Pass-Through in Central America III. Improving the Monetary Policy Frameworks in Central America	Challenges to IT in Central America
Purpose	To examine the institutional foundations underpinning the formulation and management of monetary policy and analyze how central banks in Central America react in practice, drivers for market expectations and, hence, inflation (p.4).	II. To assess the effectiveness of the interest-rate transmission mechanism in in Central America and Dominican Republic (CADR) and to provide recommendations to policy makers to enhance monetary policy effectiveness. III. To review the literature on the reforms needed for strengthening the monetary policy frameworks, and examine the experiences of selected IT countries in Latin America (Chile, Peru, and Uruguay) to distill lessons for CADR (p.4).	To review the monetary policy framework of Central American countries, identifying major recent achievements, challenges and factors contributing to the successful implementation of monetary policy, mainly on IT countries.
Findings and Specific issues	**A. Despite new central bank (CB) legislation, institutional flaws seem to be adversely affecting the conduct of monetary policy, thereby hampering**	**A. Reducing the constraints to monetary policy transmission in CADR would enhance the effectiveness of their monetary policy frameworks. The**	**A. The Design and Formulation of monetary policy is largely decided through internal decision-making processes in each CB, which ultimately**

	I. IMF WP/07/54	II. IMF WP/11/240 III. IMF WP/11/245	IV. BANGUAT WP
	CBs credibility and eventually undermining their ability to harness inflation (p.5). 1. A snapshot of CBs reform and main weaknesses: 1) Policy mandate accompanied by other objectives in some countries, i.e. Costa Rica (CR) and Honduras (HN), include the external value of their currencies (p.5); 2) Weak *de jure* political autonomy; 3) Operational independence of CBs is a common pattern region wide, although lack of effective financial autonomy and quasifiscal losses, as well as some form of fiscal dominance underminet operational independence to different degrees (p.6); 4) Accountability requirements are a key innovation in CB legislation but there is room for improvement i.e. (a) more timely reports about the general stance of monetary policy, (b) incorporate current policy analysis and projections into monetary and inflation reports (P.7); 5) De jure transparency has also improved in	**interest-rate transmission mechanism is weakened by factors such as limited exchange rate flexibility, the level of dollarization, and the underdevelopment of the financial sector. The reputation and credibility of central banks needs to be further strengthened to achieve better inflation results** (p.10). 1. Multiple objectives. In addition to price stability, all CBs in CADR place importance on exchange rate stability, thus blurring to different extents the priority attached to the inflation target or price stability (p.11). 2. Absence of fiscal dominance. The conditions in CADR in this area are generally positive. All central banks by law are not allowed to provide credit to the government, though CR, HN, and NC permit some short-term lending. CBs of GT and DR only lend to the government under emergency circumstances (P.11). 3. Central Bank Independence. 3.1) Following changes in legislation in the 1990s and in the first-half	**are determined by the decisions adopted by the Boards of Directors.** 1. The design and formulation of monetary policy is sustained by a well-structured process, originated in the guidelines from authorities and supported by technical work based on inflation projections from different departments and teams that develop short and medium-term inflation forecasts (based on the running of a semi-structural model). Inflation projections are also based on the formulation of indicative variables of monetary policy, though such teams in general are not formally constituted. 2. The expert judgment falls to the technical bodies and, finally, to the governing bodies of the central banks, therefore, the way these bodies are integrated is important. 3. All CBs in the region have an "Open Market Operations Committee" that, in general, is the technical team analyzing issues related to the execution of monetary policy (such as those related to monetary

	I. IMF WP/07/54	II. IMF WP/11/240 III. IMF WP/11/245	IV. BANGUAT WP
	most countries as all central banks are required to disclose their financial statements. However, financial statements are generally not compatible with international accounting standards, thereby undermining central bank transparency. 2. Legal CB Independence: By means of a Cukierman´s Index augmented by a criterion of transparency and accountability the paper finds that even legal legislation **[unclear]** improved with the new legislation, CA CBs still lag behind most in South America and Mexico, in particular Bolivia, Chile, Colombia, Mexico, and Peru (P.8). 3. Characterizing Monetary Policy: A Preliminary View: 1) According to a questionnaire sent to each country, CR, HN, and NC have an exchange rate targeting regime; DR monetary targeting, and GT inflation targeting. 1.1) Formulation and Implementation of Monetary Policy in Central America. 1.1.1) All countries share a common	of the 2000s, the central banks of CADR were empowered with de jure instrument independence. However, political autonomy needs to be strengthened further to enhance institutional independence in the following aspects: the process to appoint/dismiss central bank governors, the terms of the board linked to political cycles, and the composition of the board. (P.11). 3.2) Operational autonomy is undermined in all countries by weaknesses in central bank balance sheets. The CADR CBs have been running operational deficits and have negative or insufficient capital under accounting frameworks that comply with IFRS. (P.14). 4. The effectiveness of policy instruments. 4.1) All CBs in CADR rely on rules-based instruments and open market-type operations, with	operations and structural liquidity, reserves, and participation in the exchange market). This Committee is the technical liaison between the forecast team and each CB governing body. 4. Unlike fifteen years ago, when modeling was emerging in the design process and formulation of monetary policy, CBs now use more sophisticated tools. 5. Some CB governing bodies in the region are appointed by different sectors: i.e. GT, DR, and NC. In the rest of the countries, there are external members, though their laws consider technical criteria, in some measure, for their election. 6. In all countries of the region, except GT, the term of the President of the CB coincides with the term of the President of the Republic; this does not separate the CB from the ups and downs of the political cycle in each country. 7. The conformation of the Monetary Boards/Boards of Directors of the Central Banks puts into perspective

	I. IMF WP/07/54	II. IMF WP/11/240 III. IMF WP/11/245	IV. BANGUAT WP
	analytical framework, namely financial programming, which serve as the basis for the formulation and implementation of monetary policy. 1.1.2) CBs identify an inflation target for the corresponding calendar year. NC targets inflation by using the ER crawl as its nominal anchor. GT combines financial programming with an IT framework. 1.1.3) regarding policy formulation, most countries have created open market operations committees. This new institutional arrangement is intended to strengthen and speed up short-term policy responsiveness and separate the execution from the formulation of monetary policy (the latter typically a responsibility of CBs boards). 1.1.4) the main instrument is open market operations. 1.1.5) there is a lax management of short-term liquidity.1.1.6) Most CBs have recently adopted a policy rate with the aim of boosting the effectiveness of monetary policy, but this has been ineffective.	only partial reliance on money market operations. This reflects the relatively underdeveloped situation of the money market. With the exception of NC, all CBs have an explicit policy rate, but the signaling of the policy stance is hindered by a structural liquidity surplus and shallow interbank markets. The Banguat has strengthened the monetary operation framework in recent years and introduced an overnight rate with a one-day instrument as its operational target in June 2011. The BCRD and BCCR use lending and deposit facilities at the CB to establish a corridor for short-term interest rates. The BCRD is gradually narrowing the interest-rate corridor, and the BCCR also plans to do so. (P.12-13). 4.2) The transmission mechanism from the policy rate to lending rates in CADR is weakened by low exchange rate flexibility and financial	the importance of the work of the "Policy Committees", in their crucial role to provide feedback to those governing bodies with technical analysis for decision-making. This, coupled with transparency and accountability practices, helps to strengthen the effectiveness of monetary policy in the region. **B. Transparency and Accountability.** 8. Except for DR, the presidents of the central banks, report to their respective legislatures on actions taken; the CBs also hold press conferences (except for DR), and issue press releases to that effect. In GT and DR only, the minutes of the meetings of the Board of Directors of the CBs are published when decisions are made about the level of the operative goal of the policy. All countries issue inflation reports which explain relevant aspects of the execution of monetary policy, and the CBs of GT, HN, and NC, produce a financial stability report. **C. Changes in the Strategy of Monetary Control.**

	I. IMF WP/07/54	II. IMF WP/11/240 III. IMF WP/11/245	IV. BANGUAT WP
		dollarization (Medina Cas, et. al., 2011). 5. Other elements for strengthening the monetary policy framework. 5.1) It will be important to continue strengthening further the financial systems in CADR, and also capital markets and foreign exchange markets. (p.13). 5.2) CBs in the region need to develop methodologies for inflation forecasting (p.13). The CBs in CADR generally have appropriate accountability and transparency frameworks. They report annually to their respective Congresses and publish annual audited financial statements and decisions regarding monetary policy actions. The Banguat is one of the most transparent CBs in the region as it publishes the minutes of its monetary policy decisions and its governor appears twice a year before Congress. The CADR CBs publish several monetary policy reports	9. Since 2011 central banks have made improvements in their monetary control strategies, in particular the ones implementing IT. Thus, before 2011 liquidity projections were those that forecast the main monetizing factors of the monetary program, for which they used econometric techniques and daily factors of seasonality, as required in each variable case. Since 2011, Costa Rica and Guatemala have focused their strategies of monetary control in overnight paper auctions, in order to ensure that the market rate of interbank transactions of this term are placed according to the leading monetary policy rate. The strategy includes daily calculation of banking liquidity.

	I. IMF WP/07/54	II. IMF WP/11/240 III. IMF WP/11/245	IV. BANGUAT WP
		during the year, except for HN which only publishes one, and they publish extensive monetary and economic data on their websites.	
Empirical Analysis	**B. Econometric Analysis**	**B. Econometric Analysis.** **Interest-rate transmission in CADR** 1. Correlations of the Policy Rate with Market Rates. 1.1) Correlation analysis between the policy rates and banks´ borrowing and lending rates provide a first take on the strength and speed of the interest-rate transmission mechanism. It suggests that the pass-through is generally weaker in CADR than in LA6 countries, and its strength varies by country. 1.2) With the exception of Peru (and Uruguay in the case of the pass-through of the policy rate to deposit rates), LA6 countries have higher long-term correlation coefficients than CADR. Within CADR,	**D. Econometric Analysis** 1. Dynamic correlations are used in this paper to examine the relationship between the policy rate and nominal market interest rates. This relationship does not necessarily have to be contemporaneous, therefore the dynamic correlation analysis seeks to find evidence about the impact of monetary policy on leads and lags in nominal interest rates. The analysis finds evidence of positive correlation between both rates in all three countries. 2. Granger causality tests are employed in this research to test whether the policy rate in each country causes nominal and real market rates. Specifically, the Granger test examines if a variable has any predictive power over another variable. The analysis tested whether or not present and past

	I. IMF WP/07/54	II. IMF WP/11/240 III. IMF WP/11/245	IV. BANGUAT WP
		Costa Rica has the highest correlation, while Nicaragua, with its exchange rate anchor, has the lowest correlation. 1.3) Changes in policy rates explain a smaller proportion of the variance in lending and deposit rates in CADR countries than in the LA6. 1.4) Lending rates tend to have a higher correlation with the policy rate than deposit rates in most Latin American countries. 2. Factor that appear to be influencing the transmission mechanism -TM- in CADR. 2.1) The TM seems to be positively correlated to the degree of exchange rate flexibility, financial intermediation (measured by the amount of bank credit to the private sector in percent of GDP), and the institutional environment (measured by the World Bank´s governance indicator on regulatory quality); and	realizations of the policy rate determine present and future movements in the real and nominal market rates. The study found that the policy rates did cause, in the granger sense, nominal market rates in the three countries and real rates in Costa Rica and Dominican Republic but not in Guatemala. 3. Vector Autoregression (VAR) Models. The dynamics of the relationship between the policy rates and the real and nominal market rates was investigated for each country with the impulse-response functions of VAR models. 4. The pass-through from policy rates was estimated with a least squares model. The short term pass-through is the coefficient of the first lag of the policy rate and the long-term is estimated with a pass-through equation, based on the values of the longer lags coefficients. The conclusion is that the monetary transmission to interest rates in Central America, in countries with *IT,*

	I. IMF WP/07/54	II. IMF WP/11/240 III. IMF WP/11/245	IV. BANGUAT WP
		negatively correlated with the degree of financial dollarization, bank concentration, and fiscal dominance (measured by central bank claims on the government in percent of GDP). 3. Speed of TM. In general, the speed of transmission of the policy rate to lending rates appears to be faster in the LA6 than CADR though it does vary by country. CR has the fastest speed of transmission of the policy rate to lending rates (about six months), while DR, GT, and HN have the slowest (from eight months to a year). 4. Interest-Rate Transmission: Empirical Evidence. Measuring the pass-through from policy rates to banks´ lending rates through a panel estimation, incorporating the effects of dollarization, exchange rate flexibility, the size of the banking sector, and banking concentration.	is weak, unreliable and varies from country to country. 5. To answer the question of which factors contribute to making the transmission of interest rates weak and unreliable in the region, data panel econometrics is employed. The contribution of bank concentration, the size of the financial sector, the business environment, and the exchange regime was investigated. The panel is from 2008 to 2012 and the individuals are the three countries (Costa Rica, Guatemala and Dominican Republic). Several panel data econometrics methods were employed in the search for robustness, i.e. pooled data ordinary least squares, Prais-Winsten regression and generalized least squares. The variables that consistently are significant in explaining the gap between the policy rate and the market rate are bank concentration, the Ease of Doing Business Index and the exchange rate regime.

Appendix II. Technical Note

A. Granger Causality Test

The Granger causality test is sensitive to the sample size and to the number of lags. In this sense, and considering that the samples are large enough, the Schwartz, Akaike, and Hanna-Queen information criteria were used to choose the number of lags of the sample. Preference was given to the Schwartz criteria but, when in doubt, tests using other criteria were conducted.

The series are nonstationary so they were transformed in first differences, to avoid having spurious regressions. In all three countries analyzed, there is clear evidence that policy interest rates cause (or have predictive power) over nominal market rates. This means that there is statistically significant evidence of transmission of monetary policy to nominal rates. On the other hand, the evidence of the transmission to real interest rates is less clear. There is evidence of transmission to real rates in Costa Rica and Dominican Republic but with a lower level of confidence (90%). The evidence is significant in Dominican Republic when the sample is shortened to start in June 2009. In the case of Guatemala, there is no evidence of monetary transmission to real rates.

B. Vector Autoregressive Models

The Impulse-response functions identification is obtained based on Cholesky recursive identification. The order of the variables is important in this identification. The first variable has contemporary effects over the second, but the second does not have contemporary effects on the first. The logical order for the variables in this study is to place the policy rate first and the market rate second.

The VAR models are estimated with two variables, policy rate and market interest rate. The data is monthly and nonstationary series were transformed in first differences. This means that the analysis is carried out over changes in policy and market rates.

C. Pass-through from Policy Rates to Market Rates

The pass-through effect is quantified by equation (1)

$$y_{it} = \sum_{k=1}^{K} \alpha_{ik} y_{it-k} + \sum_{k=0}^{K} \gamma_{ik} x_{it-k} + \varepsilon_{it} \qquad (1)$$

Where $\boldsymbol{y_{it}}$ is the change in nominal market interest rates and $\boldsymbol{x_{it}}$ is the change in policy interest rates. The number of lags, $\boldsymbol{K}$, was determined using the Schwartz information criteria.

Short-term correlation is estimated as the coefficient of the first lag of the policy interest rate ($\boldsymbol{k=1, y_1}$) and the long-term effect (LTE) is calculated by equation (2).

$$ELP = \frac{\sum \gamma_{ik}}{1 - \sum \alpha_{ik}} \qquad (2)$$

The data is monthly and the sample for Costa Rica and Dominican Republic is from January 2006 to August 2013; for Guatemala, the sample is from January 2007 to August 2013.

D. Monetary Policy Transmission Econometric Model

Variables and Data

We proxy bank concentration by the Herfindahl-Hirschman index applied to bank credit. The size of the financial sector is calculated as the share of the financial sector in the Gross Domestic Product in real terms. The characterization of the business environment and business regulatory framework is measured by the Corruption Perceptions Index and Ease of Doing Business Index of the World Bank. The Corruption Perceptions Index comprises a range of one to ten; lower values represent a greater perception of corruption. Lower values mean less transparency and would be expected to be associated with lower monetary transmission. Meanwhile, the Ease of Doing Business index is a global ranking of countries. The lower the value the higher the country's ranking. Lower ranking positions (high values) should negatively affect transmission. The IMF (2016) classification is used as an indicator of the flexibility of the exchange rate regime. This classification provides a numerical value from 1 to 6, with 1indicating high exchange rate rigidity and 6 high exchange rate flexibility.

We use quarterly data from 2008 to 2012 (Appendix II, Tables 1, 2 and 3). Therefore, the data constitutes a long panel, where the number of individuals (3) is significantly lower than the number of time observations (60). The sources of the data are the Executive Secretariat of the Central American Monetary Council, World Bank, IMF, Central Bank of Costa Rica, Bank of Guatemala and Central Bank of the Dominican Republic. Policy and market interest rate data, both nominal and real, was obtained from the Central American Monetary Council website. Bank of Guatemala is the source for the repurchase agreement rate and the loans rate for Guatemala.

Appendix II. Table 1. Data

Date	Country*	Financial Sector/GDP	Bank Concentration	Transparency Index	Ease of doing business	Policy Rate	Short-Term Rate	Real Interest Rate PC	Exchange Rate Regime
2005.1	1	4.52611911		4.2			23.69	9.06666667	5
2005.2	1	4.60285349		4.2			24.0766667	8.87333333	5
2005.3	1	4.55928888		4.2			24.1766667	9.18666667	5
2005.4	1	4.69242535		4.2			24.01	8.71666667	5
2006.1	1	4.53164692		4.1	105	8.51	23.6966667	9.67	5
2006.2	1	4.66603479		4.1	105	8.51	22.7833333	9.66	5
2006.3	1	4.70448849		4.1	105	9.2	22.4266667	9.67333333	5
2006.4	1	4.81782571		4.1	105	8.97	21.1966667	10.5333333	5
2007.1	1	4.76100231		5	99	5.98	19.2866667	9.42333333	5
2007.2	1	4.79041994		5	99	5.98	16.9033333	7.02666667	5
2007.3	1	4.83405663		5	99	5.52	16.0166667	6.52333333	5
2007.4	1	4.99981322		5	99	5.52	16.1366667	5.33666667	5
2008.1	1	4.91504764	0.13967437	5.1	118	5.99	15.0266667	3.63333333	6
2008.2	1	5.10379149	0.13967437	5.1	118	8	14.8366667	2.64	6
2008.3	1	5.12380547	0.13967437	5.1	118	10	17.3433333	1.93666667	6
2008.4	1	5.37101344	0.13967437	5.1	118	10	20.5766667	4.40333333	6
2009.1	1	5.43549562	0.14577152	5.3	121	10	21.5233333	7.68333333	6
2009.2	1	5.539742	0.14577152	5.3	121	10	21.95	11.0566667	6
2009.3	1	5.35623967	0.14577152	5.3	121	9	22.1	15.4	6
2009.4	1	5.4138665	0.14577152	5.3	121	9	20.4533333	16.34	6
2010.1	1	5.22543548	0.14920943	5.3	121	9	19.9166667	13.5633333	6
2010.2	1	5.20014656	0.14920943	5.3	121	9	19.9366667	13.1133333	6
2010.3	1	5.20124151	0.14920943	5.3	121	7.5	19.1833333	13.19	6
2010.4	1	5.40557635	0.14920943	5.3	121	6.5	18.1766667	11.7766667	6
2011.1	1	5.21389279	0.15265137	4.8	121	6.5	18.0766667	12.8166667	6
2011.2	1	5.20793073	0.15265137	4.8	121	5	17.22	11.7466667	6
2011.3	1	5.2411619	0.15265137	4.8	121	5	17.3866667	11.5766667	6
2011.4	1	5.45298584	0.15265137	4.8	121	5	17.3366667	12.03	6
2012.1	1	5.30531446	0.15182426	4.8	122	5	17.8433333	13.1433333	6
2012.2	1	5.32078999	0.15182426	4.8	122	5	18.8966667	13.47	6
2012.3	1	5.39612068	0.15182426	4.8	122	5	19.6266667	14.79	6
2012.4	1	5.58332049	0.15182426	4.8	122	5	20.5933333	15.0533333	6
2005.1	2	3.07684893		2.5		2.97916667	13.5308333	4.58083333	7
2005.2	2	3.64623244		2.5		2.249	13.1641667	4.43083333	7
2005.3	2	3.77074316		2.5		2.794	12.9898333	3.6165	7

2005.4	2	3.47470544		2.5		3.66816667	12.7931667	3.42316667	7
2006.1	2	4.06975072		2.6	118	4.28716667	12.7896667	5.24966667	7
2006.2	2	3.87351923		2.6	118	4.55983333	12.7861667	5.23616667	7
2006.3	2	3.74859627		2.6	118	5.10783333	12.715	6.135	7
2006.4	2	3.72698601		2.6	118	5.3595	12.8581667	8.17816667	7
2007.1	2	4.23189988		2.8	128	5.19716667	12.9508333	6.33083333	7
2007.2	2	4.10011882		2.8	128	5.35483333	12.8306667	7.104	7
2007.3	2	3.82205415		2.8	128	5.5845	12.7791667	6.4025	7
2007.4	2	3.78719341		2.8	128	6.3655	12.8708333	4.3375	7
2008.1	2	4.57666224	0.15392726	3.1	116	7.2595	12.9285	4.1785	7
2008.2	2	4.09766732	0.15392726	3.1	116	7.26183333	13.3061667	1.2495	7
2008.3	2	4.18689256	0.15392726	3.1	116	7.24416667	13.5793333	0.046	7
2008.4	2	3.78264252	0.15392726	3.1	116	7.24433333	13.8245	2.7645	7
2009.1	2	4.82651049	0.15689027	3.4	117	6.84366667	13.929	7.469	7
2009.2	2	4.53949769	0.15689027	3.4	117	5.9855	13.8845	11.7078333	7
2009.3	2	4.08352416	0.15689027	3.4	117	4.98433333	13.9566667	14.29	7
2009.4	2	3.81078431	0.15689027	3.4	117	4.77583333	13.829	14.3423333	7
2010.1	2	4.54800457	0.16043541	3.2	100	5.10233333	13.5723333	10.959	7
2010.2	2	4.51986839	0.16043541	3.2	100	4.84033333	13.4493333	9.67266667	7
2010.3	2	4.17276557	0.16043541	3.2	100	4.74733333	13.3311667	9.33783333	7
2010.4	2	4.0583609	0.16043541	3.2	100	4.62316667	13.2813333	8.23133333	7
2011.1	2	4.99073334	0.16342759	2.7	93	4.5575	13.3866667	8.34333333	7
2011.2	2	4.38801534	0.16342759	2.7	93	4.759	13.4443333	7.25433333	7
2011.3	2	4.11215594	0.16342759	2.7	93	4.90816667	13.4868333	6.18016667	7
2011.4	2	4.02744377	0.16342759	2.7	93	5.41316667	13.5901667	7.29016667	7
2012.1	2	5.20330009	0.16249803	3.3	98	5.367	13.5773333	8.524	7
2012.2	2	4.80129105	0.16249803	3.3	98	5.36816667	13.4918333	9.61301196	7
2012.3	2	4.56169138	0.16249803	3.3	98	5.09783333	13.56	10.6095387	7
2012.4	2	4.51748559	0.16249803	3.3	98	5.04083333	13.6066667	10.3045574	7
2005.1	3	2.3		3		4	30.45	18.96	7
2005.2	3	2.4		3		8	24.0933333	22.5233333	7
2005.3	3	2.4		3		10	21.5033333	20.3833333	7
2005.4	3	2.6		3		10	20.39	14.2266667	7
2006.1	3	2		2.8	117	10	21.3866667	12.1933333	7
2006.2	3	2		2.8	117	10	20.0966667	9.73333333	7
2006.3	3	2.4		2.8	117	8	19.3466667	10.3066667	7
2006.4	3	2.9		2.8	117	8	17.07	11.8866667	7
2007.1	3	2.2		3	114	8	17.1066667	11.6366667	7
2007.2	3	2.4		3	114	7	15.9366667	9.39	7
2007.3	3	2.8		3	114	7	15.2333333	9.27	7
2007.4	3	3.4		3	114	7	15.03	6.34	7
2008.1	3	3	0.24160926	3	110	9	15.3866667	5.73	7
2008.2	3	3.1	0.24160926	3	110	9	17.2333333	5.59	7
2008.3	3	3.1	0.24160926	3	110	9.5	22.9566667	7.58	7
2008.4	3	3.7	0.24160926	3	110	9.5	24.2033333	14.91	7
2009.1	3	3.2	0.23895865	3	102	6	23.0966667	19.0633333	7
2009.2	3	3.3	0.23895865	3	102	5	18.3533333	17.7933333	7
2009.3	3	3.3	0.23895865	3	102	4	16.7666667	18.0466667	7
2009.4	3	3.8	0.23895865	3	102	4	14.3266667	10.8466667	7
2010.1	3	3.2	0.22323921	3	86	4	12.8266667	5.46	7
2010.2	3	3.4	0.22323921	3	86	4	11.65	4.35666667	7
2010.3	3	3.3	0.22323921	3	86	4	11.0566667	5.30666667	7
2010.4	3	4	0.22323921	3	86	5	13.0133333	6.69	7
2011.1	3	3.2	0.21811063	2.6	105	6	13.7866667	6.32	7
2011.2	3	3.4	0.21811063	2.6	105	6.75	14.5433333	5.57	7
2011.3	3	3.3	0.21811063	2.6	105	6.75	16.73	6.24	7
2011.4	3	4	0.21811063	2.6	105	6.75	17.14	8.04666667	7
2012.1	3	3.4	0.22360033	3.2	113	6.75	17.49	10.9	7
2012.2	3	3.5	0.22360033	3.2	113	6	16.5533333	12.6866667	7
2012.3	3	3.5	0.22360033	3.2	113	5	14.7333333	12.3433333	7
2012.4	3	4.1280984	0.22360033	3.2	113	5	13.1533333	9.47333333	7

Appendix II. Table 2. Classification of Exchange Rate Regime

	Classification of Exchange Rate Regime
1	Exchange arrangement with no separate legal tender
2	Currency board arrangement
3	Other conventional fixed peg
4	Pegged exchange rates within horizontal bands
5	Stabilized arrangement
6	Crawling peg or crawl-like arrangement
7	Exchange rates within crawling bands
8	Managed floating with no preanounced path for the exchange rate or Other managed arrangement
9	Independtly floating
10	Floating

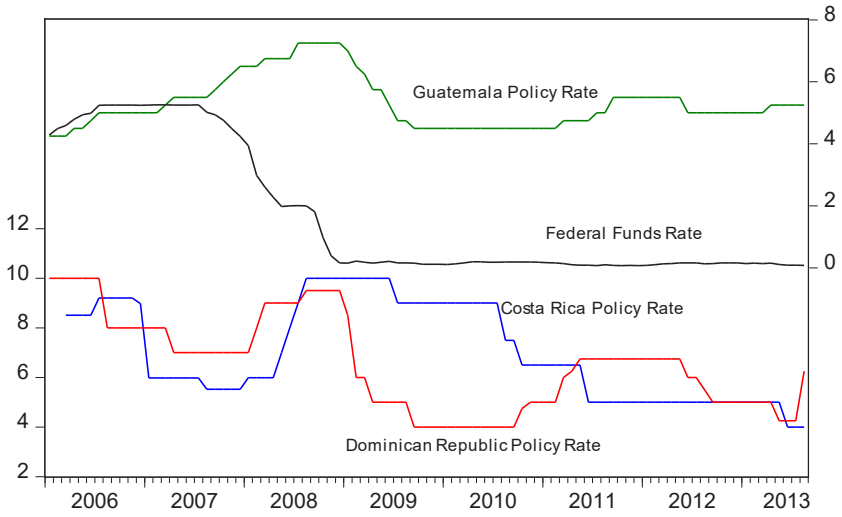
Source: IMF (2016).

Appendix II. Table 3. Dates of Change in Classification of Exchange Rate Regime

Date	Costa Rica	Guatemala	Dominican Republic
30/06/2003	6	8	8
31/12/2003	6	9	8
30/06/2004	6	9	9
31/12/2004	6	8	9
30/06/2005	6	8	8
31/12/2005	6	8	8
31/07/2006	6	8	8
30/04/2008	7	8	8
01/04/2009	8	10	8
08/10/2010	8	10	5
01/11/2011	8	10	6
14/09/2012	8	5	6
15/12/2013	5	10	6
08/10/2014	8	6	6
01/10/2015	5	6	6
11/11/2016	5	10	6

Source: IMF (2016).

Appendix II. Figure 1. Policy Rates and Effective Federal Funds Rate



Methodology

To make comparisons between different estimation models and to search for robustness, estimations were made using different methods. The treatment of long panels requires econometric techniques that differ from those typically applied to short panels, where N (number of individuals) is very large and T (time observations) is small. In general, the treatment of fixed effects using dichotomous variables is easier since N is small. Dichotomous variables should also be used for each time observation, which would be problematic when T is very large. However, instead of that, a time trend variable can be used, which is more convenient and includes the advantage of discrete changes in the series (equivalent to changes in a dichotomous variable). Another important variant for the estimation of long panels is the estimation of pooled data models using ordinary least squares or generalized least squares. These models can generate results with good econometric properties if lags are properly used.

Considering that T is large, it is necessary to specify a model for serial correlation in the error term. The estimators of least squares and generalized least squares of pooled data used here, allow the error term to be correlated from one individual to another (through i), it may also include the use of autoregressive processes of order one AR(1) for the error term over time, and also to accept the presence of heteroskedasticity. We use six methods to estimate the model:

- OLS. The results of the first column correspond to ordinary least squares (OLS) estimations with separate panels, corrected standard errors and no autocorrelation.
- POLS. Column two shows the results of pooled OLS for correlated panels, corrected standard errors and no autocorrelation.
- PW. The Prais-Winsten regression for correlated panels, with corrected standard errors and common autocorrelation or the errors of AR(1) type is presented in column three.
- GLS. The estimations presented in column four were made with generalized least squares (GLS) with correlated errors across countries and individual AR(1) models for the errors of each country.
- GLSb. Column five contains the result of GLS with separate homoscedastic panels and a common AR(1) process for the errors for all panels.
- GLSc. Finally, the results in column 6 are obtained with GLS assuming correlated panels and common model AR(1) for term error.
- PGLS. The GLS estimators are generalized least squares computed for pooled data. If the model for the errors is well specified, the GLS estimators are more asymptotically efficient than the OLS estimators.


BANCO DE GUATEMALA