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INTERNATIONAL MONETARY FUND

GUATEMALA

SELECTED ISSUES

April 28, 2023

Approved By
Western Hemisphere Department

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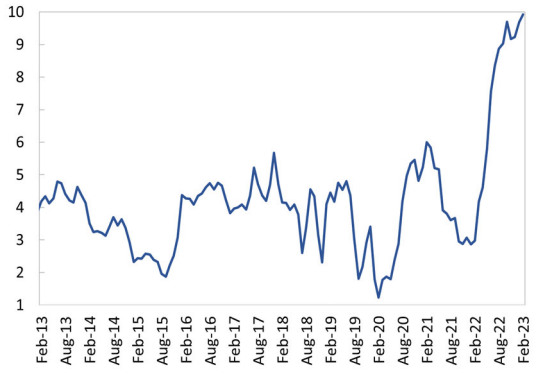
CONTENTS

INFLATION IN GUATEMALA: DETERMINANTS, RISKS, AND EXPECTATIONS[1]

1. Under the 2005 Inflation Targeting (IT) framework, Guatemala has accumulated a record of inflation stability and anchored expectations in the past years. Guatemala has a long track record of macroeconomic stability, with headline inflation remaining since 2013 within the range established by the Central Bank. The IT framework helped maintain low inflation and anchor expectations of domestic agents around the target (4.0 +/- 1 percent). Fueled by global inflationary pressures, Guatemala's inflation has been on the rise since mid-2022, first driven by external factors but domestic factors catching up as time passed.[2] In 2022, inflation (average and eop[3]) was 6.9 and 9.2 percent, respectively.

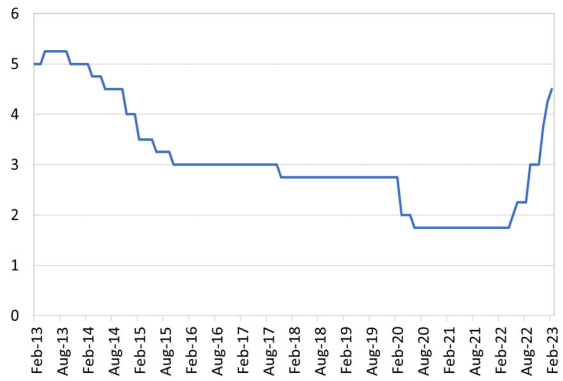
2. In this context, the monetary authority decided to increase the monetary policy rate by 300 basis points in a 10-month period. With the increases the Central Bank sent a strong message in its determination to fight inflation. This signaling helped inflation expectations to remain still relatively anchored. High uncertainty in the external scenario and higher inflation levels could pose a challenge to keep expectations anchored in Guatemala. Inflation expectations in Guatemala have an important adaptive component, especially at shorter horizons, albeit the sensitivity to inflation disturbances has been decreasing over time.

Headline Inflation (In Percent)



Source: INE Guatemala, IMF staff calculations.
Note: CPI inflation, annual percentage change.

Monetary Policy Rate (In Percent)



Source: Bank of Guatemala, IMF staff calculations.

[1] Prepared by Maria A. Oliva, Paula Beltran-Saavedra, Alex Nguyen-Duong, Rozi Lamprakaki, Metodij Hadzi-Vaskov, and Luis Carlos Ibanez.

[2] In 2011, the monetary authority reaffirmed the commitment to reach a medium-term inflation target of 4.0% +/- 1 percentage point from 2013. For 2012, the inflation target was 4.5% +/- 1 percentage point.

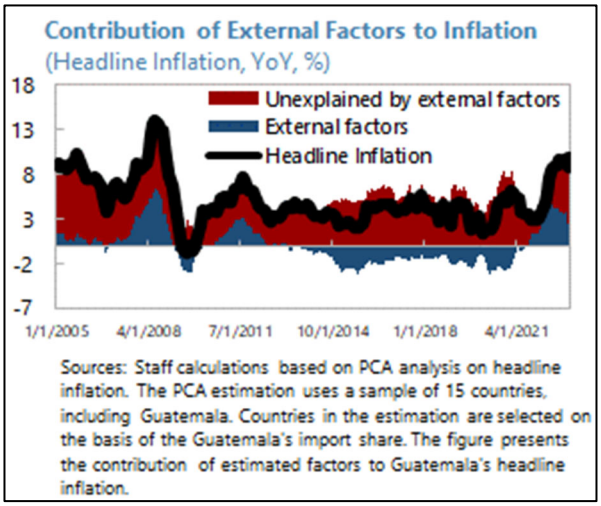
[3] End of period.

3. This chapter covers determinants, inflation-at-risk, and expectations. It analyses (i) quantify the role of external and domestic factors on the dynamics of inflation in Guatemala. It identifies imported factors driving inflation dynamics and estimates their importance for Guatemala; (ii) presents a risk assessment of core inflation by estimating the determinants of upside risks across countries, focusing on Guatemala; and (iii) analyzes the behavior of inflation expectations under a high inflation scenario and investigates the main factors that explain IE over the medium term.

4. The main results of the chapter are: first, external factors explained around 58 percent of headline inflation in early 2022, but their contribution has declined to 30 percent in recent months. Second, the distribution of inflation has widened, with upside risks mainly driven by domestic factors. Third, the main drivers of inflation expectations in Guatemala are domestic and reflect higher monetary policy credibility.

A. Determinants of Inflation in Guatemala

5. What has been the contribution of external and domestic factors in the recent increase in Guatemala's headline inflation? The analysis looks into the common variation across inflation rates for Guatemala and its main trade partners.[4] Estimates of the contribution of external factors to inflation in Guatemala are statistically significant but small. External factors correlated to commodity and energy prices explained a sizable share of Guatemala's headline inflation in early 2022. However, the contribution has declined significantly, with mostly domestic factors expanding their weighing.



Sources: Staff calculations based on PCA analysis on headline inflation. The PCA estimation uses a sample of 15 countries, including Guatemala. Countries in the estimation are selected on the basis of the Guatemala's import share. The figure presents the contribution of estimated factors to Guatemala's headline inflation.

6. The empirical model decomposes the evolution of the inflation rate into external and idiosyncratic factors. That is,

$$\pi_{it} = \underbrace{\sum_{f=1}^{F} \lambda_i^f F_t^f}_{\text{External factors}} + \varepsilon_{it}, \quad (1)$$

where π_{it} is the inflation rate in country i and time t; ε_{it} represents country i 's idiosyncratic factor; and F_t^f is an external factor $f \in \{1,2,\cdots,F\}$ to be estimated. The model allows for heterogeneous sensitivities across countries, captured by λ_i^f, i.e., country i's loading coefficient for the external factor F_t^f. The model is estimated using Principal Component Analysis (PCA) with data on Guatemala's main trading partners. Equation (1) was estimated using PCA with monthly year-on-year inflation data for Guatemala and its main trading partners between January 2000 to January 2023. PCA helped reduce the dimensionality of determinants by estimating external factors that

[4] The sample considers Guatemala's main sources of imports. The results are robust to other samples.

preserve as much information as possible from the original time series. The inflation rates in the model were standardized with mean zero and one-standard deviation. The sample selection was determined by the country of origin's imports share to Guatemala being larger than one percent.[5]

7. Two factors on external and global conditions explain about 50 percent of the variation of inflation. These identified external factors are strongly correlated to three variables reflecting global conditions, that is, the broad dollar index, VIX, and commodity prices. These three variables explained about 80 percent of the variation of the estimated external factors. Other external factors, propane, fertilizer, and food prices also added explanatory value. Robustness checks confirmed the appropriate number of factors to consider is around two[6].

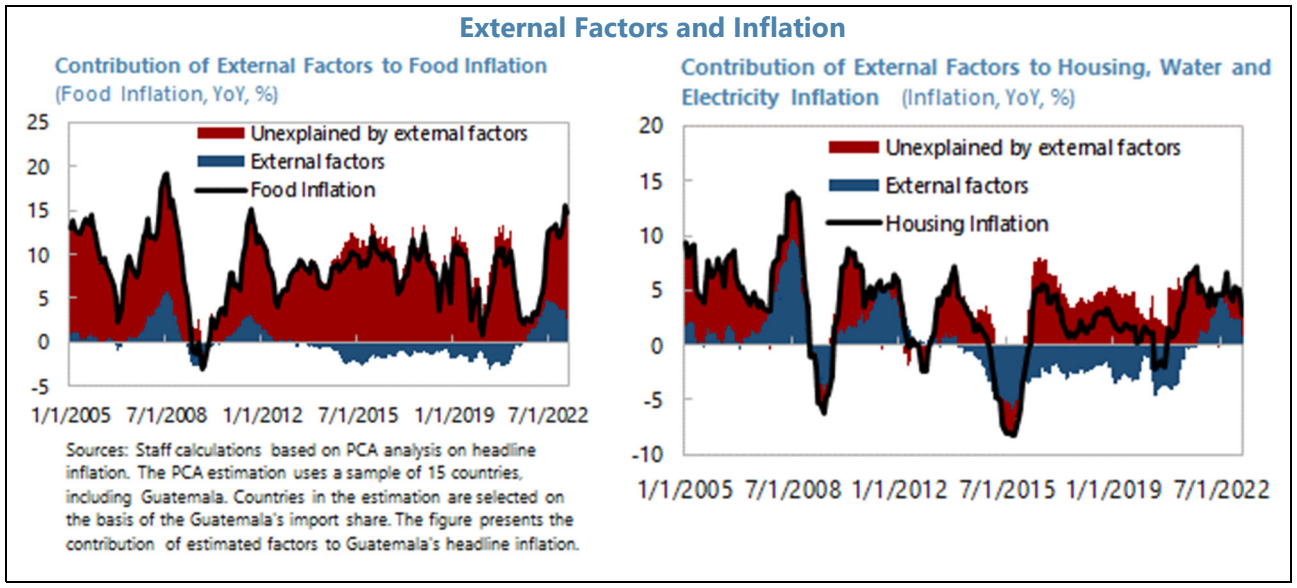
External Factors and Global Conditions

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	PC1	PC1	PC2	PC2	External Factors Guatemala	Factors Guatemal
Broad Dollar Index	0.0523***	0.107***	-0.122***	-0.0980***	-0.0151***	0.00402
	(0.0134)	(0.0126)	(0.00421)	(0.00625)	(0.00358)	(0.00364)
VIX	0.0511***	-0.0274**	0.0388***	0.0417***	0.0214***	0.00277
	(0.0166)	(0.0120)	(0.00521)	(0.00594)	(0.00442)	(0.00347)
Commodity Prices	0.0574***		-0.00397***		0.0132***	
	(0.00426)		(0.00134)		(0.00113)	
Energy Prices		0.0288***		-0.0168***		0.00324
		(0.00710)		(0.00351)		(0.00205)
Oil Prices		-0.0196**		0.0151***		-0.00136
		(0.00764)		(0.00378)		(0.00220)
Propane Prices		0.0124***		0.00566***		0.00435***
		(0.00241)		(0.00119)		(0.000694)
Fertilizer Prices		0.0326***		0.00260*		0.00860***
		(0.00318)		(0.00157)		(0.000915)
Food Prices		-0.0446***		-0.0125***		-0.0138***
		(0.00924)		(0.00456)		(0.00266)
Constant	-14.37***	-14.97***	12.45***	9.661***	-0.694	-1.477***
	(1.650)	(1.491)	(0.517)	(0.736)	(0.439)	(0.430)
Observations	219	219	219	219	219	219

Bootstrapped errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Note: PC1 and PC2 are the first and second principal components estimated using PCA. External Factors Guatemala represents the contribution of external factors for Guatemala's inflation as defined in equation (1)



8. External factors contributed to inflationary pressures in Guatemala in the last half of 2022. By June 2022, external factors explained 58 percent of Guatemala's headline inflation. The

[5] Alternative samples are considered as a robustness check, leading to similar quantitative results.

[6] The appropriate number of factors is also guided by Gagliardini et al. (2019) and Cattell (1966) tests. Both statistical tests suggest using two external factors.

increase in global commodity prices and demand recovery associated with the start of the Ukraine war fueled the inflation dynamics in Guatemala for several months. Food, housing, water, and electricity components of inflation were significantly impacted by external factors.

9. Second round effects and domestic shocks started gaining prominence in fueling inflation later in 2022. By February 2023, domestic factors explained about 70 percent of inflation pressures.[7] In addition, food inflation remains high as domestic components of inflation continue to weigh in.

B. A Risk Assessment of Core Inflation in Guatemala: An Augmented Phillips Curve

10. What are the key drivers of Guatemala's inflationary risks distribution? The analysis relied on an augmented Phillips curve, with liquidity and credit variables as explanatory variables. Following Johnson et al (2022), the distribution of the core inflation is described by:

$$\pi_{i,t+h}^{core,p} = \alpha_{i,p} + \beta_{i,p}\pi_t^{core} + \delta_{i,p}gap_{i,t} + \kappa_{i,p}\Delta NEER\%_{i,t} + \theta_{i,p}\pi_{i,t}^{e} + \phi_{i,p}\Delta\pi_{i,t}^{Com,\star}$$

$$+\gamma_{i,p}\Delta Money\%_{i,t} + \nu_{i,p}\Delta Credit\%_{i,t} + \omega_{i,p}Covid_t + \varepsilon_{i,t}^{p},$$

where $\pi_{i,t+h}^{core,p}$ is the percentile p of core inflation h periods ahead in country i. The model assumes the core inflation depends on the output gap, $gap_{i,t}$; nominal depreciation, $\Delta NEER\%_{i,t}$; inflation expectations, $\pi_{i,t}^{e}$; global commodity prices, $\Delta\pi_{i,t}^{Com,\star}$; money growth, $\Delta Money\%_{i,t}$; real credit growth, $\Delta Credit\%_{i,t}$; and an unobserved cost-push shock, $\varepsilon_{i,t}^{p}$. The model controls for the Covid-19 shock.

11. Commodity prices (a proxy for external factors) are found to have a significant, albeit small, effect on Guatemala's core inflation. The elasticity of core inflation for commodity prices (about 0.02) implies a commodity price increase of about 50 percent - about two standard deviations - to increase core inflation by about 100 basis points. The result is stronger in shorter horizons, i.e., two quarters ahead projections.

Quarters Ahead
(In Percent)

Quantile Regression of Guatemala's Core Inflation on Determinants; *h=2*

Variables/Percentile	p=10%	p=25%	p=50%	p=75%	p=90%
Core inflation	0.236	0.282*	0.652**	0.860***	0.905***
	(0.152)	(0.158)	(0.267)	(0.114)	(0.0739)
Output gap	0.193	0.192	0.244	0.231	0.300
	(0.433)	(0.254)	(0.228)	(0.252)	(0.256)
Expectations	-0.0769	0.128	0.237	0.441**	0.470***
	(0.348)	(0.178)	(0.170)	(0.182)	(0.129)
NEER depreciation	3.818	-2.240	0.532	1.653	-0.0732
	(5.186)	(3.225)	(3.628)	(2.297)	(2.682)
Money Growth	-0.0898	-0.0467	-0.0525	-0.0454	-0.0590
	(0.0802)	(0.0392)	(0.0562)	(0.0522)	(0.0501)
Real Credit Growth	9.552**	8.445***	6.046**	5.911**	5.960*
	(3.978)	(2.484)	(2.786)	(2.661)	(3.356)
Commodity Price Growth	0.0181**	0.0148*	0.0117	0.0202***	0.0227***
	(0.00857)	(0.00769)	(0.00875)	(0.00642)	(0.00672)
Covid	-0.138	0.479	0.708	0.647	0.693
	(1.036)	(0.794)	(0.962)	(0.885)	(0.738)
Constant	2.664	1.515	0.314	-0.899	-0.814
	(2.242)	(0.975)	(1.165)	(1.028)	(0.491)
Observations	74	74	74	74	74

Bootstrapped errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Quarters Ahead
(In Percent)

Quantile Regression of Guatemala's Core Inflation on Determinants; *h=4*

Variables/Percentile	p=10%	p=25%	p=50%	p=75%	p=90%
Core inflation	-0.231***	-0.208	-0.0269	0.765**	0.715***
	(0.0724)	(0.152)	(0.361)	(0.316)	(0.267)
Output gap	-0.0914	-0.121	0.0391	0.177	0.282
	(0.238)	(0.185)	(0.274)	(0.527)	(0.572)
Expectations	0.150	0.221	0.281	0.755**	0.946***
	(0.199)	(0.190)	(0.193)	(0.305)	(0.288)
NEER depreciation	-2.368	-4.011	-0.306	5.983	8.807
	(2.620)	(3.868)	(4.962)	(7.989)	(7.022)
Money Growth	0.0438	0.0416	0.00400	-0.00750	-0.110
	(0.0345)	(0.0457)	(0.0684)	(0.0847)	(0.0744)
Real Credit Growth	10.63***	10.74***	9.973**	11.66*	15.13**
	(2.222)	(3.075)	(4.787)	(6.047)	(6.369)
Commodity Price Growth	0.0168***	0.0246***	0.0239***	0.0166*	0.0239*
	(0.00561)	(0.00553)	(0.00542)	(0.00918)	(0.0138)
Covid	-0.132	-0.292	0.258	0.798	1.063
	(0.489)	(0.479)	(0.965)	(1.148)	(1.146)
Constant	1.785	1.635*	1.547	-2.423	-1.516
	(1.173)	(0.892)	(1.040)	(1.604)	(1.478)
Observations	72	72	72	72	72

Bootstrapped errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Source: IMF Staff estimates.

[7] For February 2023 headline inflation, the predicted inflation (y-o-y) explained by external factors was found to be close to 3 percent, implying the non-external factors accounted for 6.9 percent of the 9.9 percent February headline inflation rate.

12. Domestic factors also explained Guatemala's core inflation-at-risk. First, core inflation persistence (captured by lagged core inflation) was statistically significant in most regressions, with coefficients ranging between 0.8 to 0.9 for the upper tail of the distribution (at least 75 percent percentile). Higher persistence appeared in shorter horizons. Second, inflation expectations appear to be significant in explaining tail core inflation risks, more so for longer horizons. This result suggests maintaining expectations anchored during high-inflation episodes is very important in reining in core inflationary pressures. Third, real credit growth has a positive on the core inflation. The elasticity of the core inflation to real credit growth ranges between 0.06 to 0.15, implying, a two standard deviation increase in real credit growth could increase the core inflation by more than 100 basis points. The estimated effects of real credit growth on the upper tail of the distribution are stronger.

13. Broadly similar results are found when expanding the analysis to a pool of IT and non-IT economies. Staff estimates for the 90th percentile of core inflation for a pool of IT and non-IT economies show:

a. Commodity price increases pose a significant risk, regardless of the monetary framework of the country under consideration. The elasticity of core inflation to commodity price growth ranges between 0.02-0.07, with slightly higher weights in non-IT countries. Guatemala's elasticity is below the IT-non-IT groups' average.

b. The persistence of core-inflation during inflationary episodes is estimated between 0.14-1.43, but significantly lower for other IT economies.

c. Inflation expectations significantly affect upside risks for countries with an IT framework, and more so for Guatemala.

d. The NEER depreciation pass-through is also a significant explanatory variable for IT countries in a short-time horizon, reflecting the role of the exchange rate as a shock absorber. The coefficient is not significant for Guatemala.

e. Real credit growth is an important variable in explaining upside risks to inflation for IT economies, but more so for Guatemala.

Inflation at Risk: Explaining the Upside Risks to Inflation

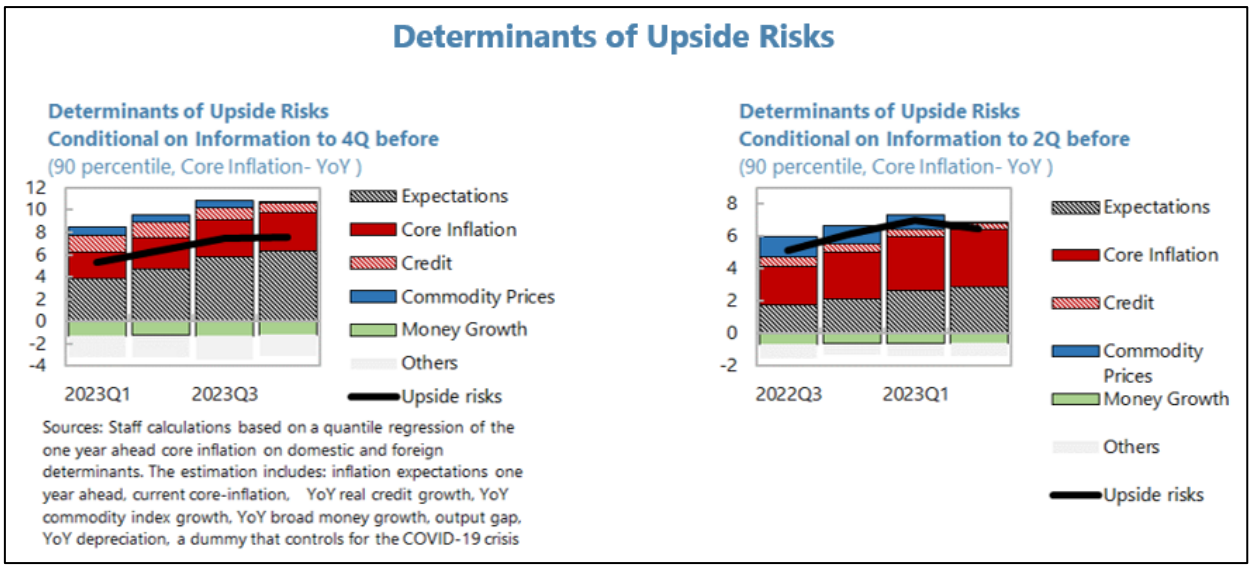
	h=2			*h=4*		
	(1)	(2)	(3)	(1)	(2)	(3)
VARIABLES	Guatemala	IT	Non-IT	Guatemala	IT	Non-IT
Core inflation	0.905***	0.758***	1.378***	0.697***	0.140	0.595**
	(0.119)	(0.0548)	(0.213)	(0.217)	(0.138)	(0.251)
Output gap	0.301	0.0468	-0.102	0.289	0.0519	-0.0393
	(0.239)	(0.0732)	(0.0641)	(0.533)	(0.0811)	(0.0861)
Expectations	0.470***	0.229**	-0.0373	1.024***	0.539***	0.309
	(0.126)	(0.106)	(0.203)	(0.356)	(0.198)	(0.290)
NEER depreciation	-0.000722	0.0697***	-0.0340	0.130**	0.0826***	-0.138*
	(0.0298)	(0.0124)	(0.0633)	(0.0627)	(0.0141)	(0.0754)
Money Growth	-0.0590	0.0114	0.0178	-0.119	0.0274	-0.00971
	(0.0499)	(0.0149)	(0.0114)	(0.0858)	(0.0171)	(0.0194)
Real Credit Growth	0.0594**	0.0551***	1.809	0.140***	0.0412	4.486**
	(0.0264)	(0.0184)	(1.608)	(0.0520)	(0.0285)	(1.913)
Commodity Price Growth	0.0227***	0.0346***	0.0376***	0.0148	0.0474***	0.0703***
	(0.00669)	(0.00339)	(0.00940)	(0.0107)	(0.00743)	(0.0151)
Covid	0.697	0.554	0.379	0.947	0.491	1.876***
	(0.800)	(0.636)	(0.536)	(1.333)	(0.528)	(0.673)
Observations	75	738	403	73	718	389

Bootstrapped errors in parentheses

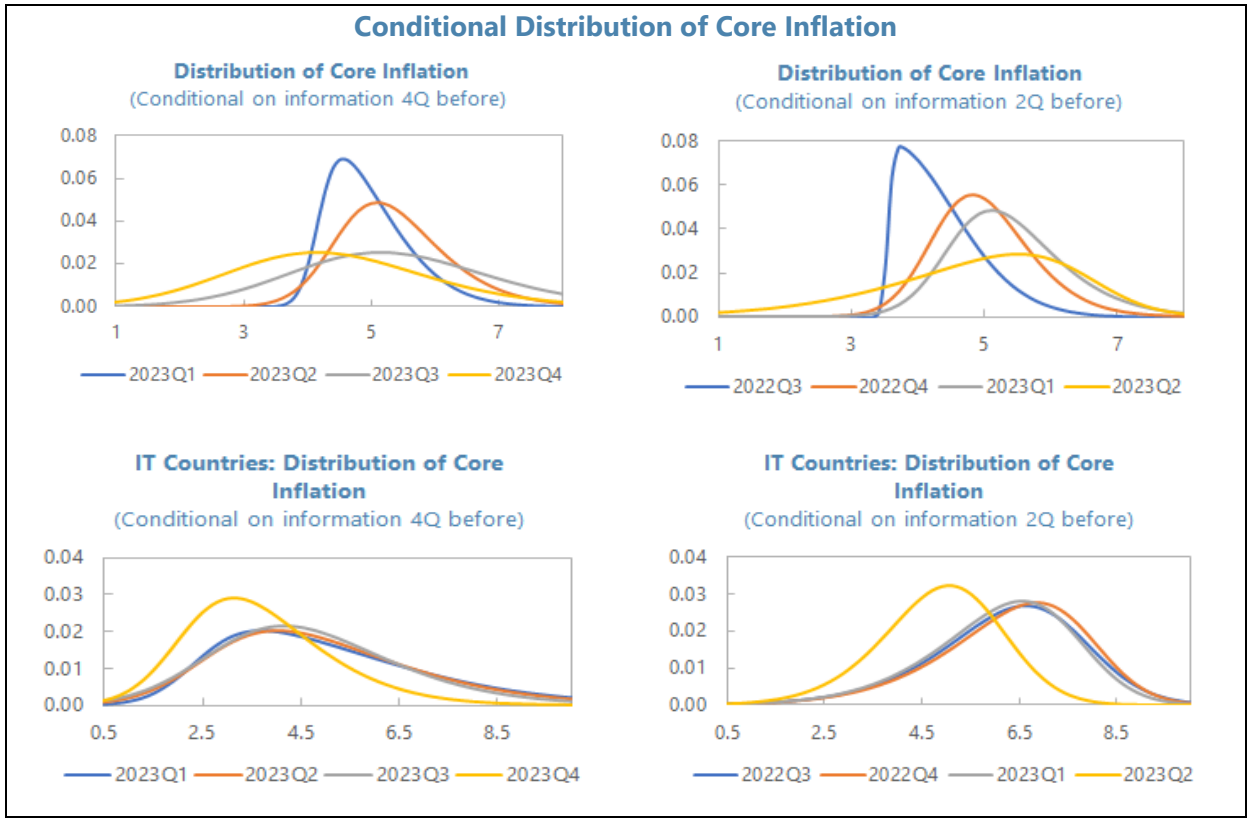
*** p<0.01, ** p<0.05, * p<0.1

14. Guatemala's upside risks have increased, explained by domestic and external factors. Estimates of the upside risks show commodity prices contribute positively to upside risks to the core inflation but its contribution has declined as commodity prices cede in the last part of 2022.

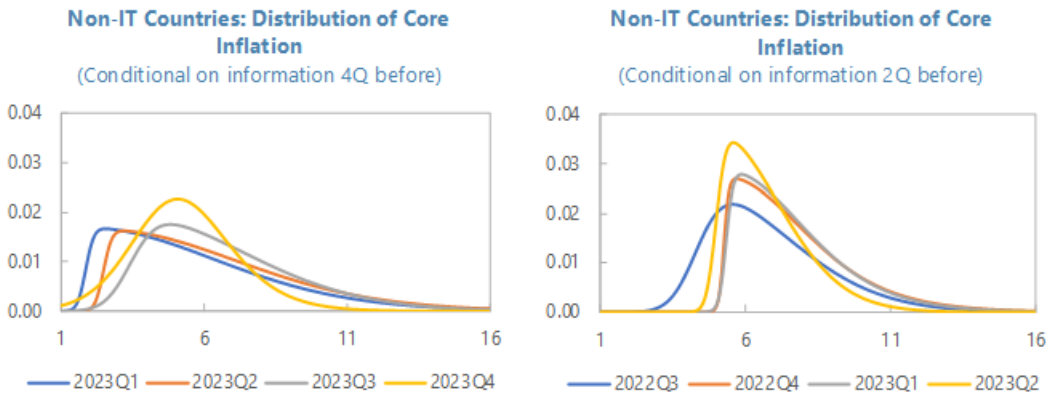
Persistence of the core inflation and expectations also contributed to predicted upside risks in Guatemala.



15. Guatemala's balance of inflationary risks has widened, with upside risks broadly comparable to other IT countries. Estimates of the future conditional distribution of the core inflation in Guatemala exhibit a ticker right tail for the end of 2023. The distribution of future core inflation for other IT countries reflects a similar pattern.



Conditional Distribution of Core Inflation (concluded)

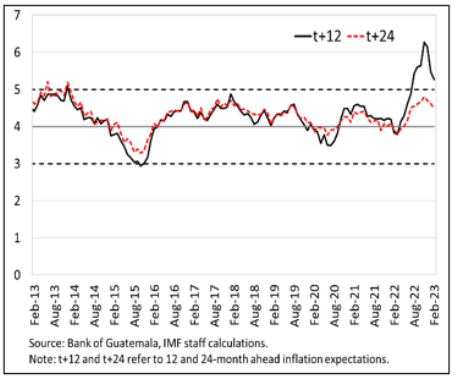


Source: IMF Staff estimates.
Note: Figure 6 shows the conditional distribution of core inflation estimated conditional on data 2 and 4 quarters before (for example, data in 2022Q1 will predict the distribution in 2023Q1). The conditional distribution is estimated based on the quantile regression predictions and fitting a t-skewed distribution. For IT and Non-IT regimes, the charts present the median country.

C. Inflation Expectations Amid Inflationary Pressures

16. Higher uncertainty in the external scenario and higher inflation levels could pose a challenge to keep expectations anchored in Guatemala. Inflation expectations (IE) in Guatemala show an important adaptive component, especially at shorter horizons, albeit the sensitivity to inflation disturbances has been decreasing over time. This section analyzes the behavior of IE under a high inflation scenario, as well as to determine the main factors that explain IE over the medium term.

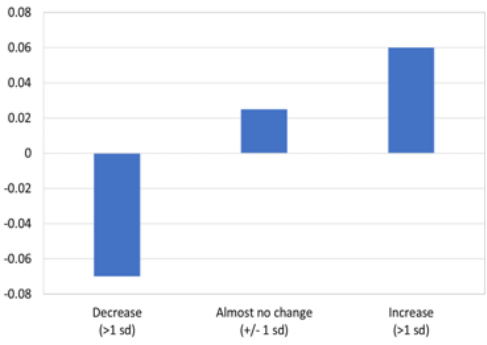
Inflation Expectations
(in percent)



Source: Bank of Guatemala, IMF staff calculations.
Note: t+12 and t+24 refer to 12 and 24-month ahead inflation expectations.

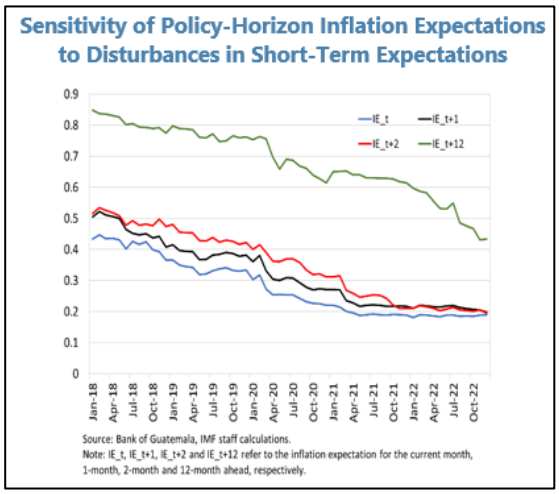
17. Inflation expectations in Guatemala have an important adaptive component at short horizons. The sharp increase in actual inflation since mid-2022 led domestic agents swiftly adjust their 12-month ahead expectations at levels outside the target band. Nonetheless, the 24-month ahead expectation remained within the target band, pointing at the credibility of the Central Bank, as well as the waning importance of the adaptive expectations component at longer horizons. The evidence suggests that increases (declines) in actual inflation rates (greater than one standard deviation) have been associated with upward (downward) adjustments to the 24-month-ahead expectations, albeit these adjustments have been generally limited.

Reaction of IE to Changes in Inflation



Source: Bank of Guatemala, IMF staff calculations.
Note: The IE refers to the 24-month ahead expectations. Changes in inflation denote the monthly changes in the year-on-year CPI inflation rate.

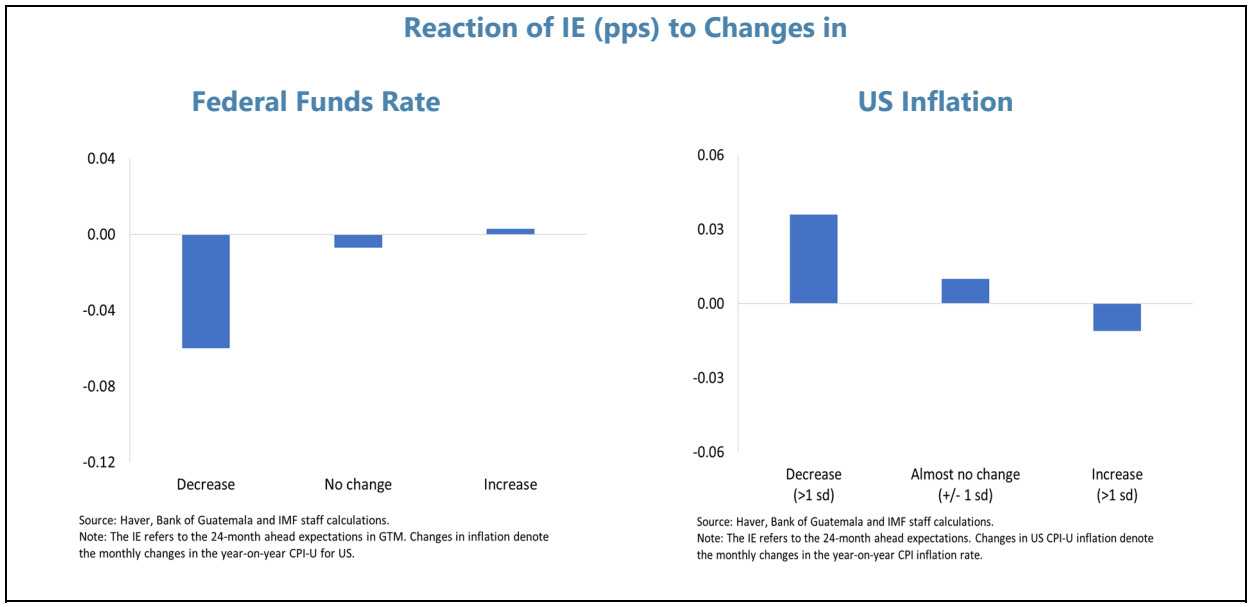
18. The sensitivity of long-term inflation expectations to inflationary pressures has been decreasing over time. Following the methodology used by Bems et al. (2018), the sensitivity of the 24-month ahead expectations to inflation shocks has been estimated using rolling regressions with 60-month rolling windows. The Figure shows the estimated coefficients from the rolling regressions over time:



- First, the sensitivity of inflation expectations over the policy horizon (24-month ahead) has been decreasing continuously over time.

- Second, the impact of shorter-term changes in IE (y-o-y) for the current month (t), 1-month ahead (t+1) and 2-month ahead (t+2) upon longer-term inflation expectations (24-month ahead) is very limited. However, the sensitivity between 24-month ahead expectations and 12-month ahead expectations is markedly larger, and this difference across horizons has persisted over time. In turn, these findings point at the importance of avoiding large disturbances in the 12-month-ahead expectations as an intermediate step towards maintaining expectations well anchored over the policy horizon.

19. Inflation expectations in Guatemala do not seem to react to changes in external variables. New information coming from changes in the Federal funds rate and the U.S. inflation rate does not seem to be incorporated in the longer-term inflation expectations in Guatemala. The figure shows that changes in the 24-month ahead IE are quite small.



20. The main drivers of inflation expectations in Guatemala seem to be the actual inflation dynamics, changes in the monetary policy rate, and lagged expectations. As an open economy, Guatemala is affected by external shocks. However, domestic agents seem to form their inflation expectations considering inflation's actual value, changes in the monetary policy rate and lagged expectations only. The baseline model used to identify the determinants of IE[8] is:

$$\pi_t^{e,t+24} = \pi_{t-1} + \Delta MPR + \pi_{t-1}^{e,t+24} + EAI_{t-2} + FX\ dep_t + FD_t + \Delta EFFR_t + \Delta US\pi_t + \Delta Oil_t \qquad (I)$$

Where $\pi_t^{e,t+24}$ denotes inflation expectation 24-moth ahead in period *t*, $\pi_{t-1}^{e,t+24}$ denotes lagged expectations in period *t-1*, π_{t-1} denotes actual inflation data at time *t-1*, ΔMPR is the monthly change in the level of monetary policy rate, EAI_{t-2} is the latest print of the economic activity indicator (IMAE) available at the time of the expectations survey *t*; $FX\ dep_t$ is the year-on-year change in the exchange rate, in percent; FD_t denotes the fiscal deficit; $\Delta EFFR_t$ in the monthly change in the effective federal funds rate in the US; $\Delta US\pi_t$ denotes the monthly change in the US inflation rate; finally, ΔOil_t is the year-on-year change of the world crude oil index.

21. The key determinants of changes in inflation expectations are the inflation rate and policy rate changes. First, as expected, an increase in the actual inflation rate is associated with an increase in inflation expectations, and this effect is statistically significant and economically meaningly. Second, monetary policy decisions seem to affect expectations as well; an increase in the monetary policy rate to tame inflationary pressures is associated with a decline in inflation expectations over the policy horizon. Third, the autoregressive component of inflation expectations seems to be quite important – previous period expectations enter with a sign of about 0.7 and are statistically significant. Fourth, neither the set of other domestic indicators (economic activity, exchange rate movements, and fiscal deficit) nor external indicators (changes in the federal funds rate and US inflation, and growth in global oil prices) seem to play a significant role upon expectations formation in Guatemala. Finally, these results are robust to alternative regression specifications that include growth in world energy, commodities, and food prices.

Policy-Horizon Inflation Expectations
(24-month ahead)

24-month ahead inflation expectations	I	II	III	IV
π_{t-1}	0.0658***	0.0653***	0.0659***	0.0656***
ΔMPR,t	-0.249**	-0.254**	-0.248**	-0.247**
$\pi_{t-1}^{e,t+24}$	0.724***	0.705***	0.724***	0.723***
EAI, t-2	-0.00174	-0.00104	-0.00182	-0.00202
FX depreciation, t	0.00348	0.00168	0.00365	0.00415
Fiscal deficit, t	0.0307	0.0345	0.0300	0.0290
ΔEFFR,t	0.00360	0.00755	0.00369	0.00733
Δ US inflation, t	0.0121	0.00615	0.0119	0.00948
Growth Oil	0.000233	0.00165	0.000148	0.000131
Growth Energy		-0.00120		
Growth Commodities			0.000157	
Growth Food				0.000605
Constant	1.095***	1.098***	1.105***	1.131***
observations	108	108	108	108
R-squared	0.837	0.839	0.837	0.837
Adj R-squared	0.822	0.823	0.82	0.82

*** p<0.01, ** p<0.05, * p<0.1
Source: IMF staff calculations.

[8] For alternative regression specifications see Moessner (2022). For alternative key variables in the evolution of inflation expectations see Sousa and Yetman (2016).

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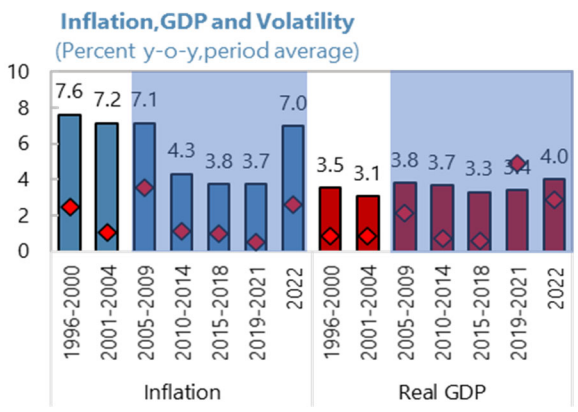
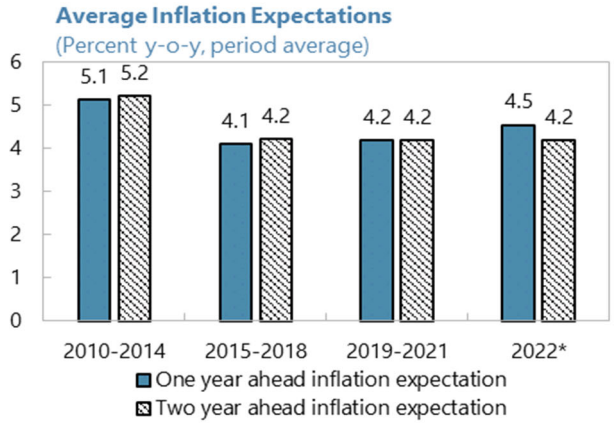
MONETARY POLICY TRANSMISSION IN GUATEMALA: RESPONSE ON OUTPUT AND PRICES[1]

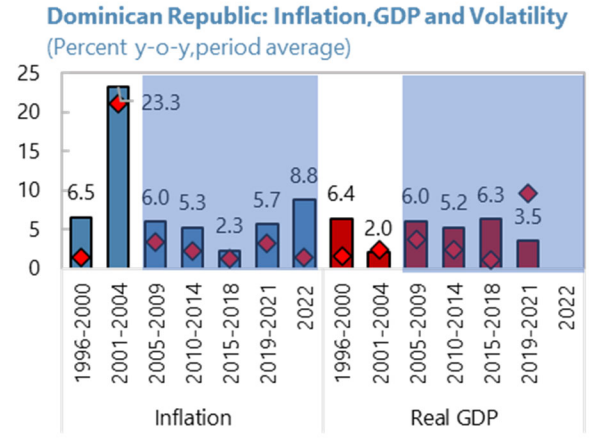
1. The adoption of IT frameworks is typically associated with higher credibility, lower levels of inflation, and lower market volatility. Guatemala's adoption of the IT framework in 2005 officialized headline inflation as the nominal anchor. Changes in the policy rate are to change economic actors' behavior and impact aggregate demand via different channels: market interest rates, the exchange rate, asset prices, and the expectations channel. In Guatemala, the adoption of the IT framework was followed by a decline in inflation and output volatility and historically low long-term inflation expectations. Even during the COVID shock, while output volatility increased, inflation volatility remained low until mid-2022, when the energy and food price shock caused inflation to spike. Other countries in the region followed a different experience.

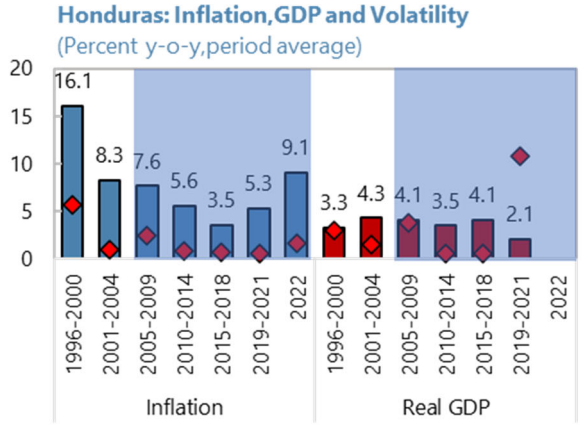
Historical Account of Inflation and GDP





Note: 2022 is average until September'22.





Source: Haver, Banguat; and IMF Staff estimates.

[1] Prepared by Rozi Lamprakaki and Maria A. Oliva.

2. This chapter updates Guatemala's monetary transmission mechanism analysis using Brandao et al. (2020). The monetary policy shock (interest rate) is identified by removing the effect of macroeconomic conditions and future inflation. The output and price responses to such shocks in Guatemala are estimated using Jorda's (2005) local projections method. The results are compared against countries that have adopted IT and non-IT regimes in Central America.

3. Staff estimates of Guatemala's monetary policy transmission based on Brandao et al. (2020) would point to a weaker transmission to prices overall. Updated estimates for Guatemala also point to a weaker transmission of the policy rate to prices. This chapter highlights the accenuated monetary policy shock effect once we allow for the exchnage rate to interact as well. The chapter estimates two responses; one with the exchange rate and keeping all other variables constant and the second where there is a simultaneous shock to monetary policy—i.e., the policy rate increases and the exchange rate appreciates. Both output and prices decrease further (statistically significant) when allowing the exchange rate to appreciate. Furthermore, once we condition for a contemporaneous change in the nominal exchange rate, the estimated response is in line with what is expected in theory; the price puzzle observed at Sims's (1992) and Eichenbaum's (1992) research disappears. Finally, the chapter also elaborates on the different dynamics when the sample is further broken down in smaller period segments.

A. Statistical Methods

4. The model used to estimate the monetary policy shock draws on the Taylor rule, with policy rate changes Δi at time t

$$(1)\ \Delta i_t = \alpha_{1\iota} E_\tau \pi_{t+12} + \sum_{j=1}^{2} a_2 \Delta y_{t-j} + \sum_{j=1}^{2} a_3 \Delta p_{t-j} + \sum_{j=1}^{2} a_4 \Delta neer_{t-j} + \sum_{j=1}^{2} a_5 i_{t-j} + \varepsilon_t$$

where $\alpha_{1\iota} E_\tau \pi_{t+12}$ is the 12- month ahead forecasts of inflation as reported by Banguat. The variables *y, p, i*, and *NEER* denote monthly economic activity, prices, policy rate, and the nominal effective exchange rate (in logs). The shock captured by the residual ε (unexplained deviations) is the monetary policy shock. Lagged CPI appears to be highly statistically significant in explaining Guatemala's changes in the policy rate. A priori, the fit of the estimated Taylor rule would be expected to be a good fit for IT countries unless using other instruments in addition to the policy rate or focus on other than inflation and output forecasts when setting their policy instruments.

Taylor Rule Regression for Guatemala

VARIABLES	(1) Guatemala	(2) Dominican Republic	(3) Honduras
CPI forecast	0.00839	0.0210	0.00198
	(0.0119)	(0.0144)	(0.0163)
Policy rate (lagged once)	0.0113	0.102	0.208***
	(0.0680)	(0.0724)	(0.0714)
Policy rate (lagged twice)	-0.0252	-0.122*	-0.220***
	(0.0675)	(0.0712)	(0.0710)
Δlog CPI (lagged once)	11.09***	1.791	4.812
	(2.642)	(2.525)	(5.925)
Δlog IMAE (lagged once)	0.290	-0.447	-0.229
	(0.320)	(0.369)	(0.352)
Δlog CPI (lagged twice)	11.08***	7.641***	4.487
	(2.823)	(2.469)	(5.836)
Δlog IMAE (lagged twice)	0.0673	0.0351	0.610*
	(0.326)	(0.370)	(0.367)
Δlog NEER (lagged once)	-0.233	-0.850	-1.227
	(1.208)	(1.325)	(3.252)
Δlog IMAE (lagged twice)	0.495	2.385*	-2.079
	(1.187)	(1.359)	(3.250)
Constant	-0.0702	-0.0593	-0.00430
	(0.0504)	(0.0452)	(0.111)
Observations	214	189	170
R-squared	0.251	0.155	0.116

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Source: IMF Staff estimates.

5. Jorda's (2005) local projections methodology[2] is used to estimate the impulse responses of the identified monetary policy shocks on output and prices, and Romer and Romer (2014) is used to identify the Taylor rule shock.

$$(2) \quad \Delta Y_{it} = \sum_{j=0}^{2} \beta_{1_j}^{h} R_{t-j} + \delta_0^h \Delta neer_t * \hat{\varepsilon}_{it} + \sum_{j=0}^{2} \gamma_{1_j}^{h} \hat{\varepsilon}_{t-j} + x_{1_t}^{h} comm_i + x_{2_t}^{h} ln_{1,2} comm_i + \varphi_t^h$$

where $\hat{\varepsilon}_{it}$ is the estimated policy shock, the vector Z includes contemporaneous and lagged values for output *y*, *p,* and *NEER,* and *comm* is the World Commodities Price Index also lagged. The dependent variable, *Y*, is the change in prices and output relative to the previous period and is estimated separately every time to capture the effect. The regression is estimated for every horizon (*j*=1, …, h), which corresponds to 18 months, after which we estimate the impulse response function similarly. The coefficient associated with the contemporary shock $\beta_{1_j}^{h}$ is the response of economic activity or prices when we control the exchange rate and $\beta_{1_j}^{h} + \sigma\delta_0^h$ is the total response when we also allow the exchange rate to also increase by one standard deviation simultaneously with the policy/interest rate shock. We estimate equation (1) with OLS and equation (2) with Newey and West's (1987) standard errors of order 3 using the estimator where the bandwidth expands with the horizon h of the impulse response.

B. Monetary Policy Transmission: Key Results

6. This section shows the estimated results for Guatemala. The analysis that follows is tracking the impulse response function of a one standard deviation monetary policy shock on prices and output. The charts illustrate the evolution of the response for 18 months out while all charts contain the no interaction (control scenario) and the NEER scenario when we allow the exchange rate (NEER) to increase by a simultaneous one standard deviation. The study also examines the evolution of monetary policy transmission in two periods, prior to 2008 (except for Honduras) and between 2008 and 2020.

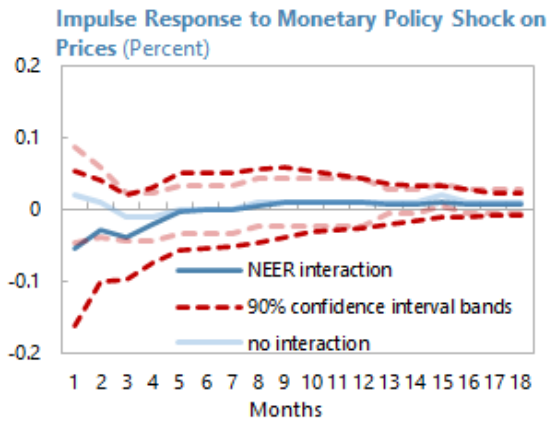
7. The monetary policy transmission response for output is weaker than for prices for the period sample but strengthens when considering the exchange rate. When considering the exchange rate interaction, prices in Guatemala decrease cumulatively by 0.15 percent after 7 months but increase by 0.01 percent when not allowing the exchange rate to fluctuate. Output responses are not statistically significant in this period.

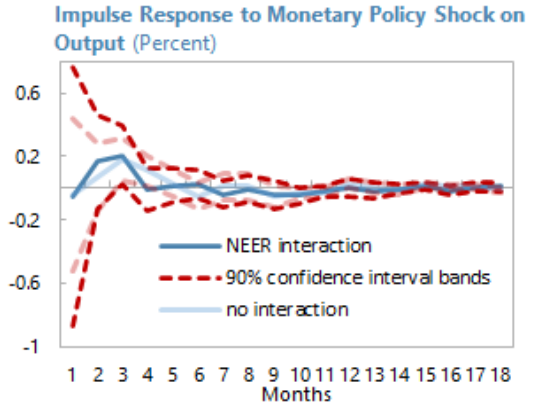
8. The transmission of monetary policy shocks to output was stronger (albeit weak) during 2008-2020. output shows a much stronger response, with a noticeable difference when allowing the exchange rate to interact**.** In Guatemala, in the exchange rate scenario, output declines cumulatively by 1.5 percent in the first 12 months versus a decrease of 0.66 percent in the control

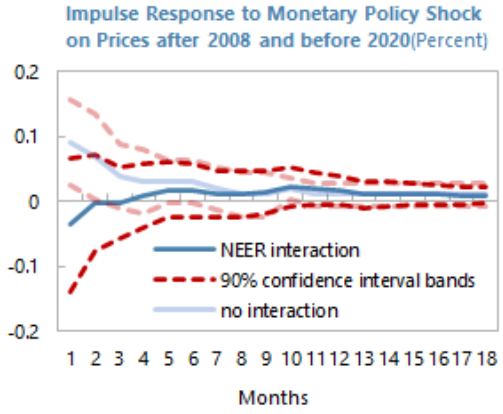
[2] Local projections allow for a more flexible and interpretable analysis of the dynamic response of a variable of interest to a shock and allow for non-linearities. Instead of estimating the joint responses of all variables in the system as in a VAR, local projections estimate the response of a particular variable of interest to a shock in a single equation framework while controlling for the responses of other variables in the system. They also allow for the examination of the heterogeneity in the response of different groups or regions to the same shock, which can provide insights into the channels through which the shock is transmitted.

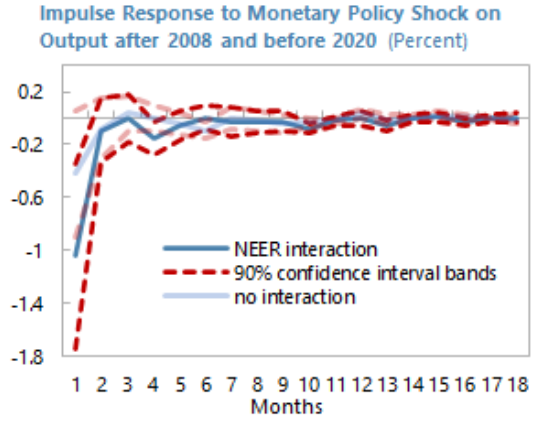
scenario. However, during the sample period, Guatemala's prices accumulated a drop of 0.04 percent in the first three months in the exchange rate scenario, with price coefficients being statistically insignificant.

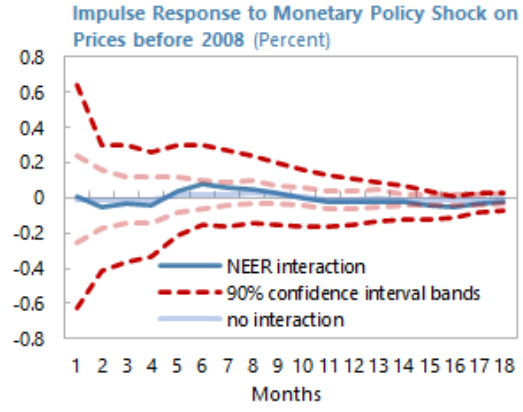
Price and Output Impulse Response Functions

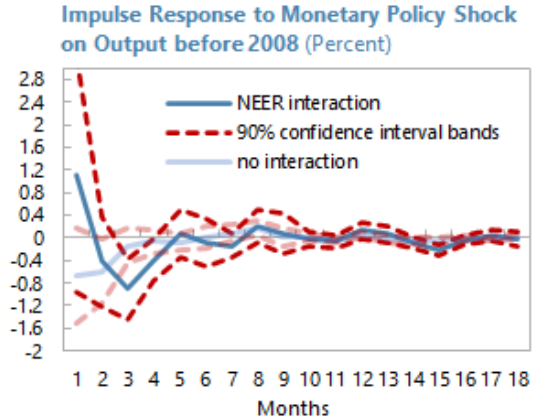












Sources: IMF Staff estimates.

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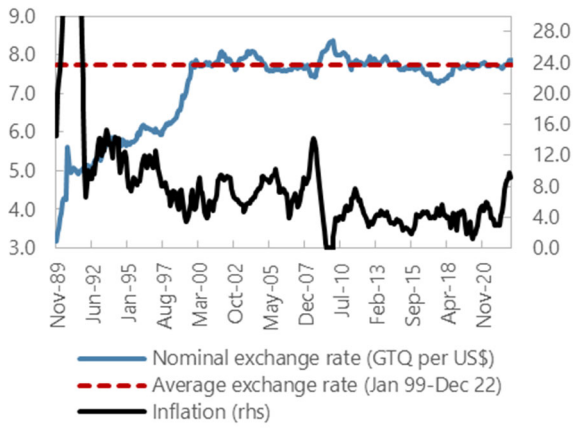
EXCHANGE RATE AND FOREIGN EXCHANGE INTERVENTIONS IN GUATEMALA[1]

1. In 2005, the Bank of Guatemala (Banguat) adopted an IT framework along with a rule-based mechanism for interventions in the Foreign Exchange (FX) market. Following a period of relative disfavor in the late 1980s and early 1990s, many central banks in Emerging Market Economies (EMEs) started to introduce Inflation Targeting (IT) frameworks with *de jure* floating but *de facto* rigid exchange rates. At the outset, fixed, predetermined, or quasi-fixed nominal exchange rates were viewed as an effective device for guiding a disinflation program as it was said it could rapidly generate a convergence toward the country for which the nominal exchange rate is anchored.[2] It was also implied that such arrangement was transitory.[3] Nevertheless, Foreign Exchange Intervention (FXI) has remained a widely used policy instrument. Of those central banks, many continue to use FXI to limit excessive volatility or for reserve adequacy purposes, without targeting any specific level of the exchange rate.[4] Guatemala is no exception. Banguat's monetary framework leverages two instruments: the policy rate and FXI. However, it remains an interest rate-based monetary policy regime (a regime where the interest rate is the main lever that the central bank uses to influence aggregate demand and inflation) as opposed to an exchange rate-based monetary policy regime (a regime where the main lever used to stabilize inflation is the exchange rate).

Nominal Exchange Rate, Nov 1989 – Dec 2022
(GTQ per US$)



2. Since then, Guatemala's nominal exchange rate has continued to be stable with low volatility. The exchange rate has been solidly anchored to around 7.75 GTQ per U.S. dollars since the launch of the IT regime in January 2005. The monthly volatilty, expressed as the monthly percentage change, was contained within a two percent band, reflecting both the natural equilibrium of supply and demand of U.S. dollars as well as daily FXI to mitigate exchange rate

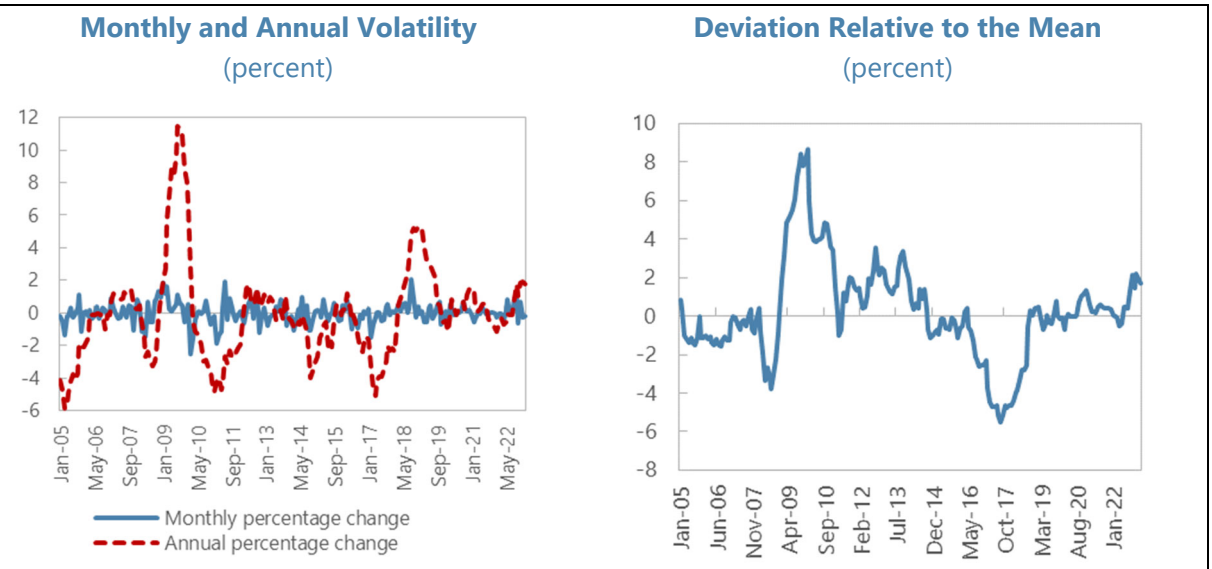
[1] Prepared by Alexandre Nguyen-Duong. Includes extensive discussions with Maria A. Oliva.

[2] This arrangement was behind the stabilization efforts in Argentina, Chile, and Mexico among others.

[3] Many authors argued that in countries with an inflationary problem, after a short initial period with a pegged exchange rate, a more flexible regime should be adopted (Dornbusch 1997, Bruno 1995, Sachs, Tornell and Velasco 1995). In other words, the exchange rate should be a nominal anchor only in the initial phase of inflation stabilization, given the concept of the so-called "impossible trinity" (Obstfeld, Shambaugh and Taylor, 2005 and Aizenman, 2011).

[4] The impact of FXI on the exchange rate is notoriously difficult to measure with econometric techniques, which implies that the effectiveness of FXI could vary greatly overtime and across countries.

volatility. The FXI rule alone would have allowed a maximum monthly fluctuation of 5.4 percent (under the 2005 fluctuation band limit set at 0.5 percent) and 9.7 percent (under the current fluctuation band limit set at 0.9 percent). This indicates that the stability of the exchange rate is also driven by the supply and demand equilibrium. Not surprisingly, the yearly volatility, expressed as the annual percentage change, displays higher peaks which were systematically corrected in about two and half years. Most notably, the largest depreciation observed was between January 2009 and March 2011 (up to 8.7 percent depreciation relative to the mean of 7.7) during the great financial crisis and was gradually reversed, partially aided by FXI to slow the volatility pressure. The largest appreciation observed was between June 2016 and May 2018 (up to 5.5 percent relative to the mean of 7.7), corresponding to the sudden large increase in remittances inflows, and was reversed rapidly, mainly due to sizable FXI. Since January 2005, the average deviation from the mean is about 0.3 percent, thus highlighting the strong stabilty of the exchange rate over the long run.



Source: Banguat; IMF staff calculations.

A. A Review of Guatemala's Foreign Exchange Developments to Date

3. From its creation in 1924 until the mid-1980s, Guatemala's official currency (the quetzal) was fixed at parity with the U.S. dollars. Despite the end of the Bretton Woods system in 1971, which prompted many countries to start adopting more exchange rate flexibility, Guatemala chose to continue with a fixed exchange rate regime. However, imbalances started to mount following the oil price shock of the 1970s, the global economic recession of the early 1980s, and political and fiscal instability in the country. International reserves declined rapidly, forcing Banguat to restrict transactions in U.S. dollars while selling foreign currency to some importers and financial institutions at a subsidized value. This led Banguat to accrue operating losses, which eroded its capital base. Eventually, in 1986, the quetzal started to devaluate as the pressure was no longer sustainable.

4. During the 1989-2005 period, discretionary FXI was used to stabilize the exchange rate. In 1989, at a time of very high inflation, the transition to a flexible exchange rate regime was advanced through a series of structural reforms to both address the pressure on international reserves and reduce inflation, including by promoting greater autonomy to Banguat to conduct its policies. During the period of 1989-1995, the exchange rate flexibility was restricted by fluctuation bands and FXI. The interventions, which were not sterilized in the money market until 1996, were based on expert judgment on the deviations of the nominal exchange rate vis-à-vis its historical moving average. In 1996, the Electronic Currency Negotiation System (SINEDI)[5] was established. SINEDI enabled greater transparency in FX operations, reduced the price uncertainty in the FX market, and increased the volume of transactions significantly. Banguat carried out all FXI transactions via SINEDI. In May 2001, the establishment of the Law of Free Currency Negotiation[6] was the beginning of a series of structural reforms that paved the way for the adoption of the IT regime along with a flexible exchange rate regime. Nevertheless, the exchange rate became *de facto* anchored to the U.S. dollar during that transition period.

Exchange Rate Intervention Rules under the Inflation Targeting Framework

5. In January 2005, the formal regulation of FXI was introduced through the *participation rule* to moderate volatility without affecting the trend[7], but its criteria anchored *de facto* the exchange rate. The rule-based intervention policy aimed at stabilizing excessive exchange rate volatility, independent of monetary policy. The rule aimed at moderating appreciation pressure from larger remittances inflows that had been occurring since 2004 and to boost exports and economic activity that had had low growth since the early 2000s. The rule established three thresholds defined by predetermined exchange rates. The intervention criteria varied at each threshold, such that interventions were more frequent as the exchange rate continued to appreciate. In December 2006, the participation rule was modified to provide greater exchange rate flexibility while moderating volatility. A fluctuation band was defined (between Q7.60 and Q8.05) with different asymmetric deviation margins that resisted appreciation pressure more forcefully than depreciation pressure, whether the exchange rate is outside or inside the fluctuation band.[8] In the end, the rule limited the fluctuations of the exchange rate to a very narrow range. Moreover, the limited permissible fluctuation margin along with the asymmetric properties of the rule suggested a

[5] SINEDI is a software, administered by the Bolsa Nacional de Valores (BNV), which records the amounts and exchange rates of foreign exchange transactions carried out daily between Guatemala's financial institutions.

[6] Ley de Libre Negociación de Divisas. In 2001-02, three financial bills were approved by Congress to legalize the free exchange of foreign currencies, amend the constitutional law of Banguat, and improve the law governing banks and financial institutions. These new laws helped consolidate the liberalization of the capital account and paved the way for the establishment of the inflation-targeting framework.

[7] The adoption of the rules based FXI was also accompanied with the commitment to gradually provide greater flexibility based on the compliance with the following principles: (i) be consistent with a monetary scheme of explicit inflation targets, (ii) based on explicit, transparent, and understandable rules for the markets, (iii) eliminate the discretion of Banguat's participations, and (iv) minimize volatility without affecting the trend.

[8] Interventions to purchase U.S. dollars is triggered under a 0.5 percent deviation margin criterion (or 0.1 percent is the exchange rate is lower than 7.6). Interventions to sell U.S. dollars is triggered under a 1 percent deviation margin (or 0.5 percent if the exchange rate is greater than 8.05).

greater intervention of Banguat during appreciation pressure, thus potentially complicating the implementation of the newly established IT framework.

6. At the same time, Banguat introduced certificates of deposits in U.S. to absorb excess liquidity in U.S. dollars in the financial sector when deemed necessary.[9] The instrument allowed reducing the amount of U.S. dollars in circulation (through auctions) with a view to smoothing the behavior of the exchange rate without affecting its trend.[10] However, contrary to the participation rule, this mechanism only withdraws liquidity temporarily as the certificates will eventually mature. This instrument was used in 2017-2018 in response to substantial remittance inflows and lower imports (due to lower oil prices since mid-2014).[11]

7. Since June 2008, Banguat's authorities have amended the participation rule to enable greater flexibility, along with clearer and more explicit objectives. In its June 2008 decision, the Monetary Board (*Junta Monetaria)* eliminated the fluctuation band and the asymmetry of the FXI triggers and proposed clearer and more explicit objectives. These changes marked the beginning of the gradual transition towards more flexibility. In nearly all subsequent years, the criteria of the participation rule evolved to either expand the volatility trigger (from ±0.50 percent to ±0.90 percent as of January 2023), the maximum amount for interventions (from US$ 8 million per auction to US$ 20 million per auction as of January 2023), or the number of daily auctions (from 3 auctions to 5 auctions as of January 2023). The Monetary Board also explicitly reiterated the possibility to use certificates of deposits in U.S. dollars to withdraw U.S. dollars from the financial system when deemed necessary as well as language to promote a forward market in FX.[12]

8. In 2013, the Monetary Board introduced the possibility to intervene in the FX market to counteract unusual volatility.[13] This new clause enables Banguat to react to exceptional events that impact the spot market by either buying or selling FX, beyond the participation rule. As of December 2022, it was only used once, on March 24, 2020, for a total amount of US$ 111 million (sale).

9. In December 2014, a new FXI instrument (*the reserve accumulation rule*) was added to Banguat's toolkit.[14] Its explicit objective is to accumulate international reserves while considering

[9] Recepción de depósitos a plazo en dólares de los estados unidos de américa (JM-99-2004, September 2004).

[10] Banguat would collect U.S. dollars at a high interest rate and place those U.S. dollars in the international market at a lower rate. In the end, such scheme could be proven counterproductive as it creates incentives for economic agents to borrow U.S. dollars in the international market at the low interest and have them renumerated (risk-free) at Banguat at a higher interest rate, such exacerbating the increase in U.S. dollars inflows.

[11] The use of the instrument was eventually abandoned in favor of the reserve accumulation rule which was proven more efficient at mopping up FX liquidity.

[12] Banks and financial institutions were asked to systematically communicate to Banguat, daily, financial characteristics of forward contracts related to FX. The information would be then published in the Banguat's website (JM-161-2008).

[13] JM-1121-2013.

[14] JM-133-2014

the evolution of the monetary and exchange markets so that the fundamental objective of the central bank is not jeopardized, nor distortions are introduced. Since the great financial crisis in 2009, the net international reserves-to-import ratio was below 4 percent and, in mid-2013, the growth rate of net international reserves started to slow down (0.8 percent y-o-y in December 2014 compared to 9.1 percent on average between 2009 and 2013). This new FXI provided the tool for Banguat to increase its level of reserves for precautionary reasons, if deemed necessary.

10. As of January 2023, Banguat relies on three instruments to conduct its exchange rate policy:

- *The Participation rule*. An intervention is triggered when the weighted average exchange rate of the sell (buy) transactions[15] is less (more) than the five-day moving average reference exchange rate minus (plus) 0.9 percent. If triggered, the central bank currently offers up to a maximum of five daily auctions of US$20 million each in the interbank market.

Evolution of the Participation Rule

Date	Decision	Deviation margin relative to the 5-day moving average	Maximum amount per auction	Maximum number of auctions
Jan-05		Determined at 3 thresholds at Q7.60 and Q7.70 (purchase of US$) No rule for the sale of US$	US$ 10 million	...
Dec-06	JM-168-2006	0.5 percent or 0.1 percent if lower than Q7.6 (purchase of US$) 1 percent or 0.5 percent if greater than Q8.05 (sale of US$)	US$ 8 million	3
Jun-08	JM-60-208	± 0.5 percent	US$ 8 million	3
Dec-08	JM-161-2008	± 0.75 percent	US$ 8 million	3
Sep-09	JM-85-2009	± 0.5 percent	US$ 8 million	3
Oct-09	JM-92-2009	± 0.5 percent	US$ 8 million	4
Dec-10	JM-160-2010	± 0.60 percent	US$ 8 million	4
Dec-11	JM-171-2011	± 0.60 percent	US$ 8 million	4
Dec-12	JM-139-2012	± 0.65 percent	US$ 8 million	4
Dec-13	JM-121-2013	± 0.70 percent	US$ 8 million	4
Dec-15	JM-120-2015	± 0.75 percent	US$ 8 million	4
Dec-16	JM-123.2016	± 0.75 percent	US$ 8 million	5
Dec-17	JM-113-2017	± 0.80 percent	US$ 8 million	5
Dec-19	JM-128-2019	± 0.80 percent	US$ 10 million	5
Dec-20	JM-148-2020	± 0.85 percent	US$ 10 million	5
Dec-21	JM-119-2021	± 0.90 percent	US$ 10 million	5
Dec-22	JM-140-2022	± 0.90 percent	US$ 20 million	5

- *The Reserve Accumulation rule*. Currently, the yearly maximum amount to purchase U.S. dollar under the rule is set at US$ 1.5 billion through three increments of US$ 500 million (each increment must be approved by the Monetary Board).

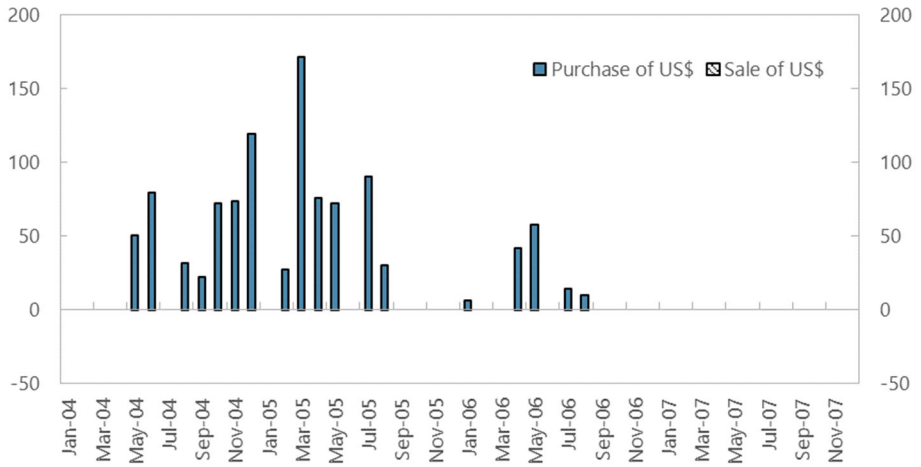
- *The issuance of certificates of deposits in U.S. dollars* to reduce the amount of U.S. dollars in circulation.

[15] Any transactions greater than US$20,000 between a bank and bank or between a bank and a private entity triggers the rule for the day.

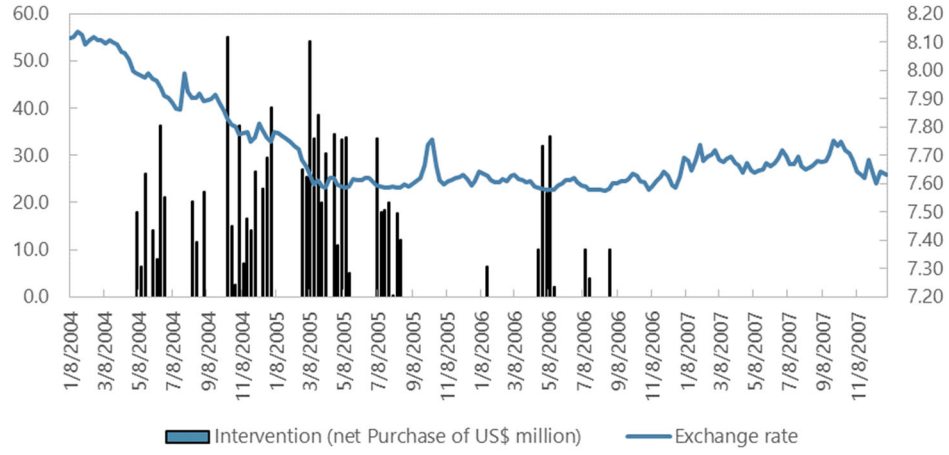
The Exchange Rate and Interventions

11. Between 1996 and 2001, the main objective of Banguat's FXI was to mitigate depreciation pressure, while between 2001 and 2007, the interventions were to reduce appreciation pressure. The depreciation pressure was particularly strong between 1998 and 2000 as remittances inflows decreased and the exchange rate depreciated from Q6.05 to Q7.75 per U.S. dollars (a 28 percent change). Banguat intervened frequently by selling U.S. dollars (up to 73 percent of total volume in the interbank market). After the establishment of the Law of Free Currency Negotiation and a new surge of remittances inflows in 2004, FXI were used to moderate appreciation pressure as well as excessive volatility.

Monthly Foreign Exchange Interventions, 2004-07
(US$ million)



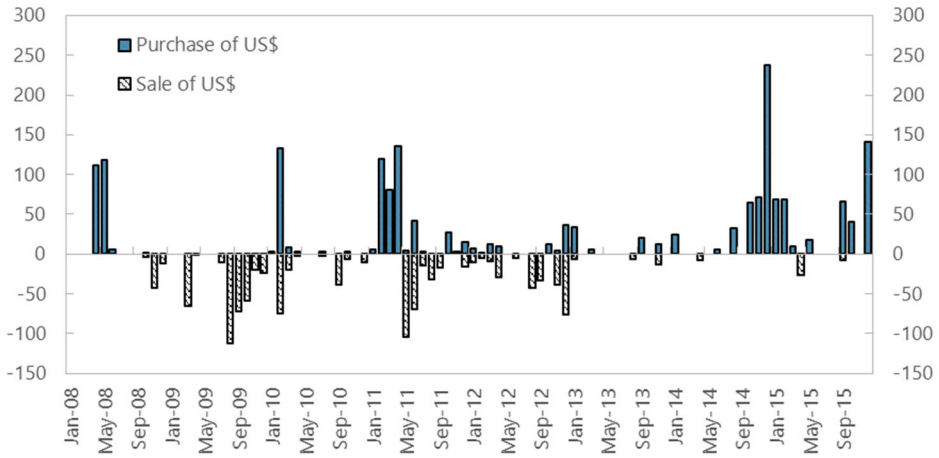
Weekly Interventions and Exchange Rate, 2004-07



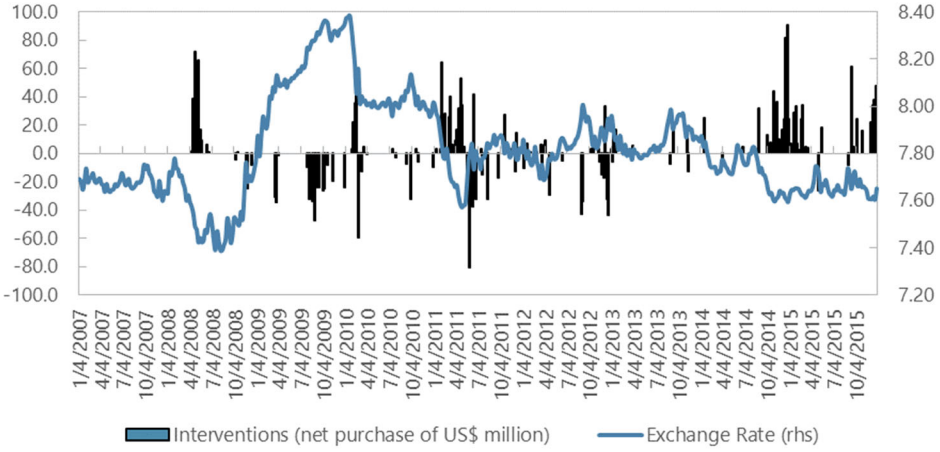
Source: Banguat.

12. Between 2008 and 2015, FXI were frequently used in clusters in response to pressures. The cluster corresponding to the great financial crisis of 2008-2009 is an example of a short-term trend that reversed in early 2010 when appreciation pressures started to materialize again, thus prompting another cluster of interventions in the first quarter of 2011 (purchase of U.S. dollars). Another cluster was in late 2014-early 2015 when appreciation pressures triggered further interventions. Overall, empirical evidence shows that the central bank tends to react more forcefully when leaning against an appreciation, consistent with the threshold effect of the FXI rule.[16]

Monthly Foreign Exchange Interventions, 2008-15
(US$ million)



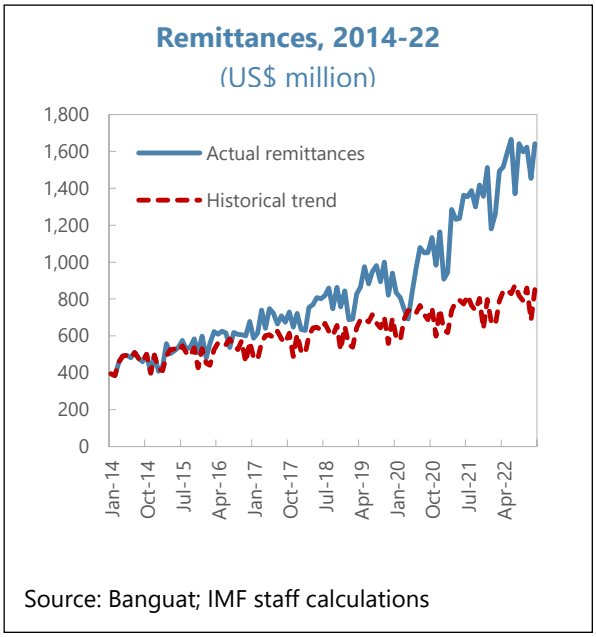
Weekly Foreign Exchange Interventions, 2007-15



Source: Banguat.

[16] See Juan Catalán-Herrera (2016).

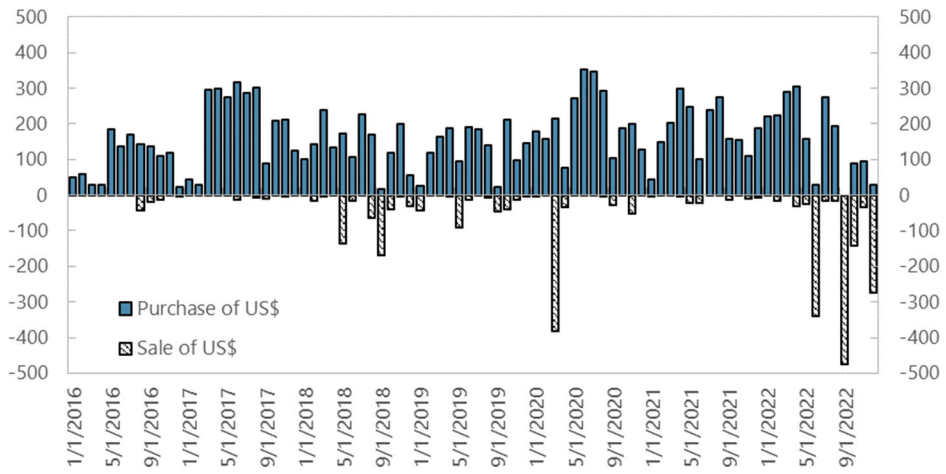
13. Between 2015 and 2022, sizeable interventions coincided with unprecedented increase in remittance inflows. Between 2015 and 2017, a strong appreciation pressure emerged at the same time that import declined driven by lower oil prices, exports increased, and remittance inflows were slightly higher. On February 27, 2017, Banguat reacted by initiating the issuance of certificates of deposits in U.S. dollars to mop up excess FX liquidity (relative to the historical trend).[17] As oil prices started to augment in late 2017, imports increased, but remittance inflows continued to rise. The new equilibrium was considered transitory as oil prices continued their upward trajectory and remittances growth started to show some signs of moderation. Eventually in 2018, Banguat activated its reserve accumulation rule which was deemed more efficient at withdrawing excess FX liquidity. It was considered a more structural operation (compared to the participation rule that deals with daily volatility). After a few months of appreciation, the exchange rate eventually returned to its historical level in mid-2018 and the activation of the reserve accumulation rule stopped in 2019. Then, like many other countries, the COVID-19 shock hit Guatemala in March 2020 with a strong, but temporary, impact on FX liquidity. Banguat immediately addressed the situation by injecting US$ 111 million to the interbank FX market (as part of the unusual volatility clause introduced by Banguat in 2013) in addition to the participation rule and the establishment of a repo facility in U.S. dollars to provide liquidity. When the economy started to rebound in late 2020, remittance inflows accelerated (35 percent y-o-y in 2021), putting greater appreciation pressure on the exchange rate. The reserve accumulation rule was re-activated in 2020-22 and overpowered the participation rule in 2021-22. In late 2022, pressure temporarily eased due to some one-off events related to the U.S. monetary policy tightening (repayments of banks' credit lines).



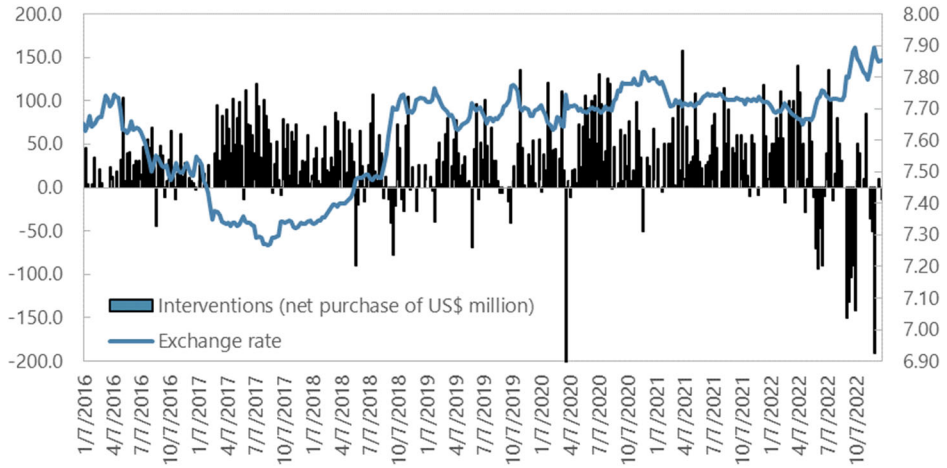
Source: Banguat; IMF staff calculations

[17] Certificates were issued with various maturities (91, 182, and 273 days) for a total of US$ 439 million (44 operations in 2017 and 32 operations in 2018). This instrument was stopped in 2018 as demand for such operations declined overtime and replace with the reserve accumulation rule.

Monthly Foreign Exchange Interventions, 2016-22
(US$ million)



Weekly Foreign Exchange Interventions, 2016-22



Source: Banguat.

14. Over the past 10 years, the exchange rate volatility was largely contained within the participation rule bands. The reference exchange rate ended up breaching the band only 13 times (equivalent to 99.5 percent of the time). Most of the breaches were minor and the COVID-19 shock in March 2020 explains the largest breaches.[18] The activation of the reserve accumulation rule in 2018 also played a significant role as exchange rate volatility narrowed considerably since its application, while at the same time, the participation rule band increased (along with its ceiling for interventions).

[18] Large depreciation pressure on March 24-26 which rebounded (mostly due to the moving average property of the formula) outside the band on March 30-April 1. On March 25, 2020, Banguat directly intervene to sell US$ 111 million.

Monthly Foreign Exchange Interventions, 2019-22

(US$ million)

	2019				2020				2021				2022			
	Purchase		Sell		Purchase		Sell		Purchase		Sell		Purchase		Sell	
	Participation rule	Reserve accumulation	Participation rule	Other	Participation rule	Reserve accumulation	Participation rule	Other	Participation rule	Reserve accumulation	Participation rule	Other	Participation rule	Reserve accumulation	Participation rule	Other
January	27.1	0.0	43.3		178.25	0	5.4	0	44	0	0	0	70	195	0	0
February	118.0	0.0	0.0		156.8	0	0	0	50	150	5	0	42	137.5	17	0
March	165.3	0.0	0.0		238.54	2	270	111.3	107	202.5	0	0	0	290	0	0
April	188.0	0.0	6.0		50	0	35	0	20	147	0	0	50	254	32	0
May	96.0	0.0	87.0		204.08	118	0	0	50	198.2	5	0	20	138.5	76.5	0
June	192.3	0.0	14.0		194	138	0	0	22.9	80.15	21	0	30	0	290.5	0
July	225.0	0.0	0.0		160	183.1	0	0	45	166	23	0	75.4	200	15	0
August	101.0	0.0	8.0		208	58.9	0.5	0	142	168	0	0	7.4	185	15	0
September	24.0	0.0	46.0		50	65	27	0	28.67	129	12	0	0	0	473.8	0
October	211.5	0.0	40.0		80.3	98	0	0	42.34	112.65	10	0	69.2	20.8	142	0
November	96.7	0.0	12.0		154.3	46	52	0	20	90	0	0	49.8	45	35.01	0
December	145.3	0.0	5.0		103	25	0	0	131	56.5	8	0	23.6	6.4	273.5	0
Total	**1,590.2**	**0.0**	**261.3**		**1,777.3**	**734.0**	**389.9**	**111.3**	**702.9**	**1,500.0**	**84.0**	**0.0**	**437.4**	**1,472.2**	**1,370.3**	**0.0**

Source: Banguat; IMF staff calculations.

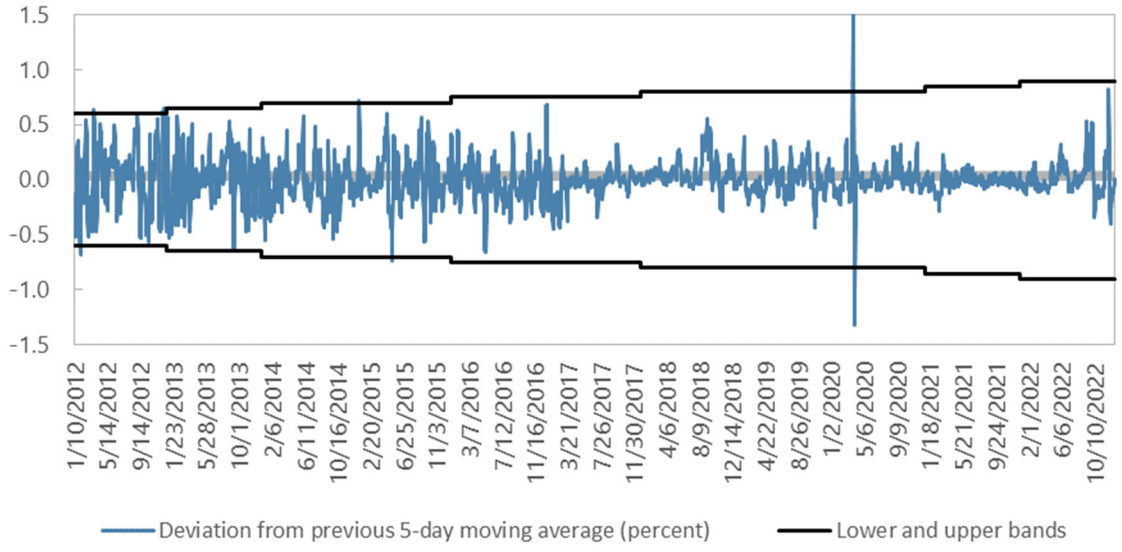
Foreign Exchange Interventions, Net Purchase, 2015-22

	2015	2016	2017	2018	2019	2020	2021	2022
Purchase of US$ (million)	410	1,189	1,285	1,682	1,590	2,511	2,203	1,910
Sale of US$ (million)	35	79	32	476	261	501	84	1,370
Net purchase of US$ (million)	**375**	**1,109**	**1,253**	**1,206**	**1,329**	**2,010**	**2,119**	**539**

Source: Banguat; IMF staff calculations.

Actual Deviation from the Previous 5-day Moving Average and Volatility Band, 2012-22

(percent)



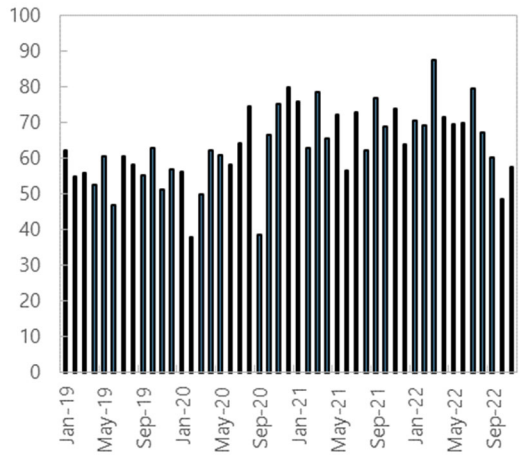
Source: Banguat; IMF staff calculations.

15. The FX interbank market remains shallow and very segmented. Four banks accounted for more than two third of the FX sales (excluding Banguat) and four other banks accounted for nearly two third of the FX purchases (excluding Banguat) in the FX interbank market between 2019

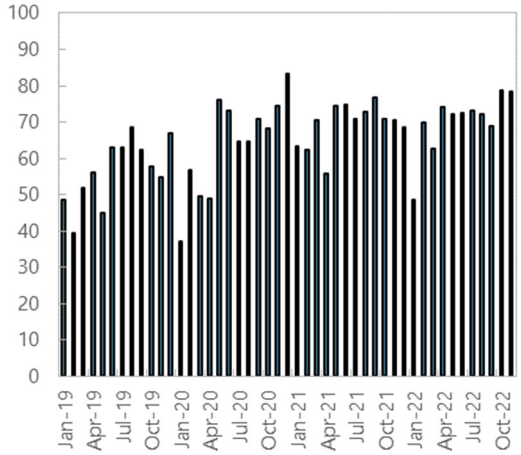
and 2022. The volume of transactions is about US$ 440 million per month on average. Banguat's purchases of FX account for nearly one third of the volume (against less than 5 percent when a seller).

Volume and Share of Foreign Exchange Interbank Market Operations

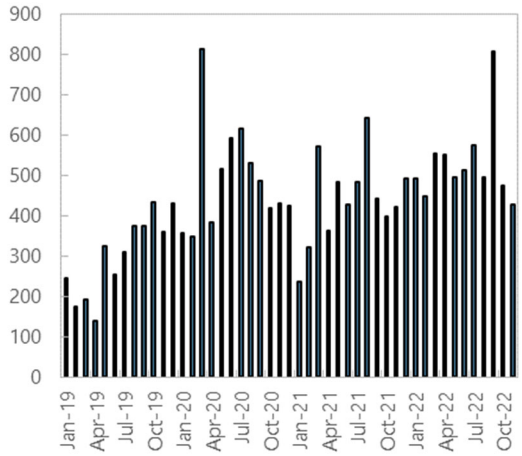
Share of the Four Main Sellers of US$, 2019-22
(Percent or total, excluding Banguat)



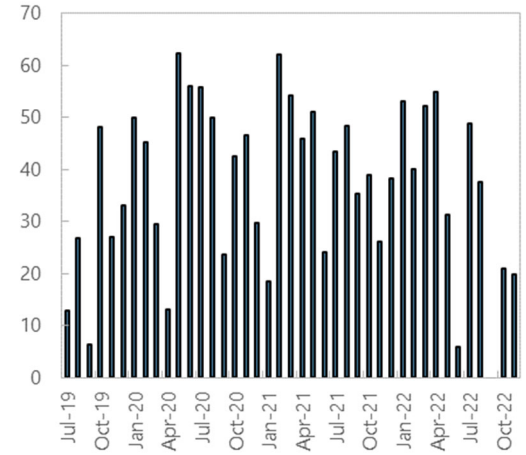
Share of the Four Main Buyers of US$, 2019-22
(Percent or total, excluding Banguat)



Volume of Transactions in the Interbank Market, 2019-22
(US$ million)



Banguat's Share of Purchases in the Interbank Market, 2019-22
(Percent or total)



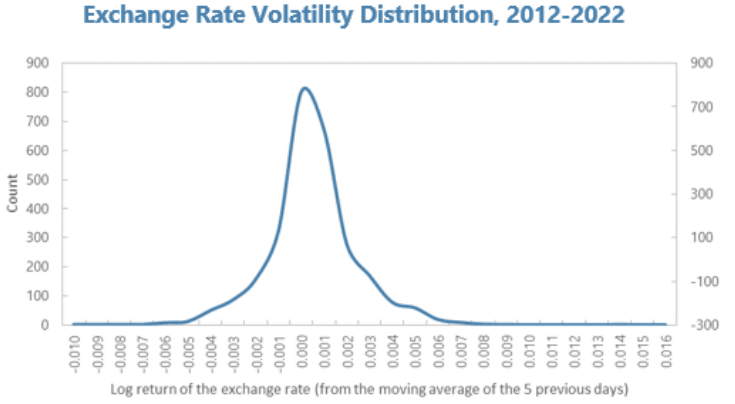
Source: Banguat; IMF staff calculations.

B. Measuring Exchange Rate Volatility in Guatemala

16. There are different methods to measure volatility. Banguat uses the percentage deviation from the previous 5-day moving average**.** Other typical and simple definitions of exchange rate volatility, most followed in the markets, are the day-to-day or intra-day changes. Absence of

timely intra-day information affecting the exchange rate, the day-to-day change indicator is then usually preferred over the other and is often defined as the log return of the exchange rate, $r_t = \log(e_t/e_{t-1})$. The following figure shows the distribution of the log return of the exchange rate for

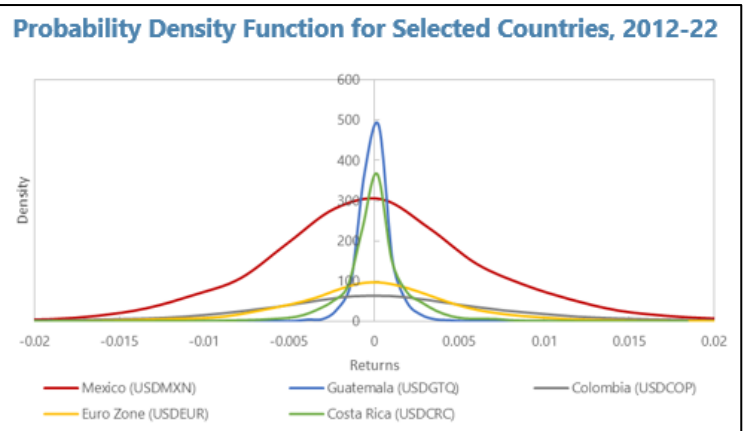
17. Guatemala between 2012 and 2022. The shape of the distribution is a relatively thin bell curve with platykurtic properties (low frequency of outliers), indicating that the returns are clustered around the mean, which illustrates the low exchange rate volatility during the period.



Source: Banguat; IMF staff calculations.

18. There are other measures of volatility.

- **A kernel density estimation** (KDE).[19] The figure below shows the probability density function of daily volatility for selected countries for the period 2012-2022 as well as the probability density function for Guatemala for both day-to-day volatility and the previous 5-day moving average deviation. Both Colombia and Mexico relied on higher fixed intervention threshold during the period (between ± 2 and ± 7 % and between ± 1 and ± 2 % respectively) and display leptokurtic distributions (fat tails). On the other end, Guatemala's distribution is leptokurtic (thin tails), reflecting Banguat's low exchange rate volatility.



Source: Country authorities; IMF staff calculations.

- **A volatility distribution can be derived from the historic distribution conditional on a set of exogenous variables**. History-based triggers are not dynamic, not market-based, and could have strong limitations, especially when volatility is low (see *Lafarguette and Veyrune (2021)*).[20]

[19] A KDE estimates a function defined as the sum of kernel functions on every data point (in this case, the log return of the exchange rate or the percentage deviation from the previous 5-day moving average). The process can be used to estimate the probability density function of historical exchange rate volatility.[19] The analysis uses a gaussian kernel function ($f(x) = \frac{1}{nh}\sum_{i=1}^{n}\frac{e^{-u^2/2}}{\sqrt{2\pi}}\left(\frac{x-x_i}{h}\right)$) with the Silverman's rule of thumb bandwidth ($h = s\left(\frac{4}{3n}\right)^{1/5}$) to estimate the probability density function.

[20] See IMF Working Paper No. 2021/032. The exchange rate at risk model defines the percentile at a given threshold of the conditional distribution of the exchange rate returns (i.e., based on a value-at-risk methodology)

This conditional value-at-risk would depend on a set of variables corresponding to selected "determinants" of exchange rate (such as the VIX, oil prices, bid-ask spreads). The conditional predictive density of exchange rate can then be defined with a vector of explanatory variables. This methodology allows the intervention region to evolve every day as a function of market conditions. Using the determinants proposed for Guatemala, we find that the explanatory power of those variables is very limited.[21]

- **A Monte-Carlo value-at-risk method** can be used to simulate projected exchange rate returns over thousands of possible iterations. However, the probability distribution for the chosen risk factors can be difficult to model beyond the use of normal distributions.

[21] The best fitting shows an R square of 7 percent (compared to 28 percent in the example proposed in the paper for Mexico).

ADDRESSING GUATEMALA'S INFORMALITY CHALLENGE[1]

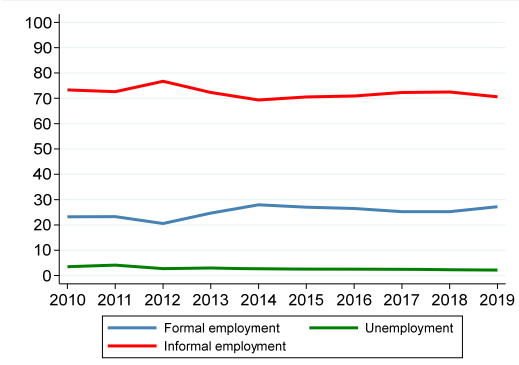
1. The Guatemalan economy is largely informal, limiting its growth and development prospects. There is vast empirical evidence on informality's pernicious economic effects and on the endogenous relation between economic development and informality (Schneider and Enste 2000; Oviedo, Thomas, and Karakurum-Özdemir 2009; Kose, Ohnsorge, and Yu forthcoming). Formalization grants economic agents better access to public services, lower cost insurance schemes, improve production methods and contribute through taxation to the provision of public services, all this fostering economic growth and human capital accumulation. Conversely, sustained economic development with growing income and human capital accumulation allows economic agents to better meet the regulatory requirements of formality.

2. This chapter identifies explanatory variables impacting informality in Guatemala and estimates how related reforms can trigger a virtuous cycle between formalization and economic development. First, the paper discusses the potential costs of informality and describes the main features of informality in Guatemala. Then, it presents its core methodological framework and main results. The methodology helps identify factors related to formalization, not just lower informality; the latter could be done with enforcement measures against informality only and increase unemployment. Guatemala's structural determinants of formality are below the expected levels for its current income per capita level and those of middle-income economies (e.g., Chile or Costa Rica).

A. Informality in Numbers

3. Only a small fraction of Guatemalan workers is formally employed. In the last decade, there has been some progress in formalizing them. Formal employment in 2019 (before Covid) stood at 27 percent of the labor force, above its level at the start of the 2010s. The low labor formality is not a reflection of high unemployment, which ranged between 2 and 4 percent of the labor force throughout the decade, but of very high levels of labor informality, which stood around 70 percent of the labor force.

Labor Force by Employment Status

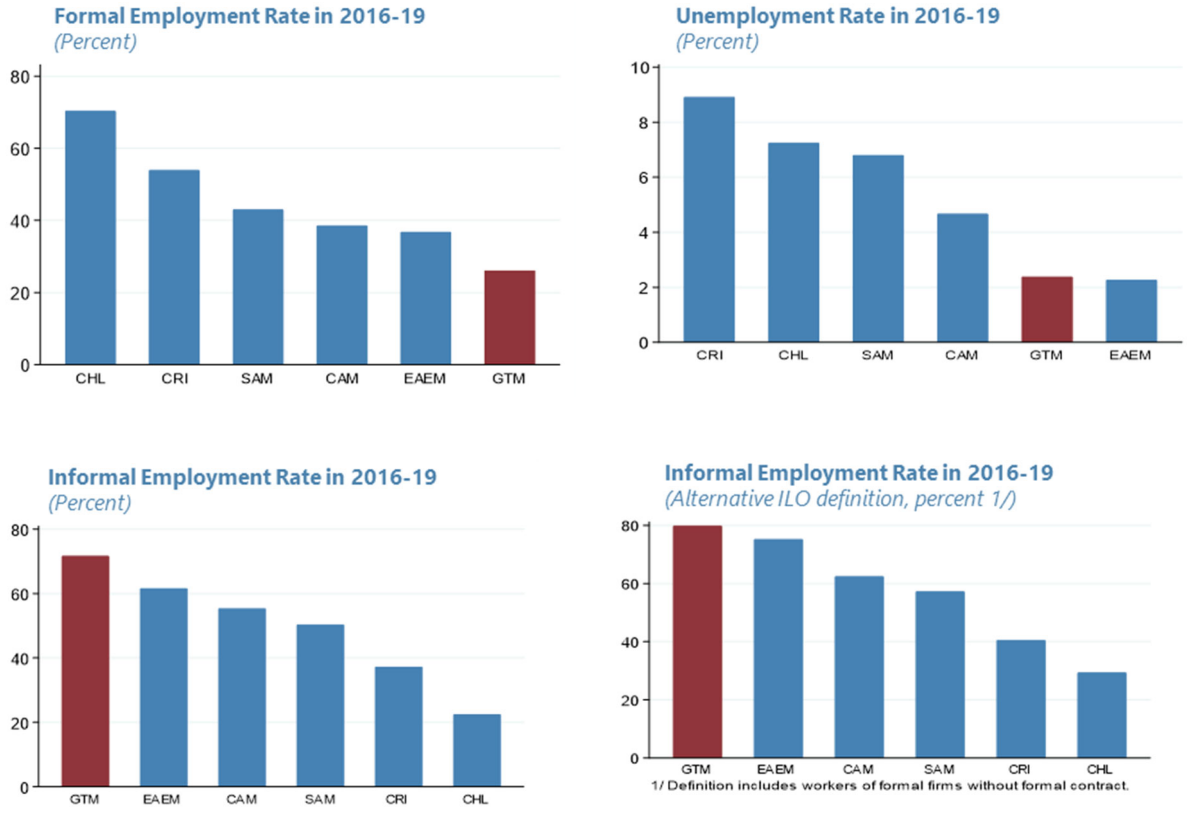


Source: ILOSTAT (International Labor Organization).

[1]Prepared by Gonzalo Salinas. Includes extensive discussions with Maria A. Oliva.

4. Guatemala's labor informality is substantially higher than in comparator countries and regions.[2] While the share of unemployed in Guatemala's labor force is notably low, Guatemala's share of informal workers is much higher than the average in comparators, including in Central America and Mexico. Guatemala's share of formal workers is much lower than in comparators and informality is high as measured by both the rate of workers without formal contract and the rate of workers in informal firms. The results hold across gender and are stronger among the oldest segments of the labor force.

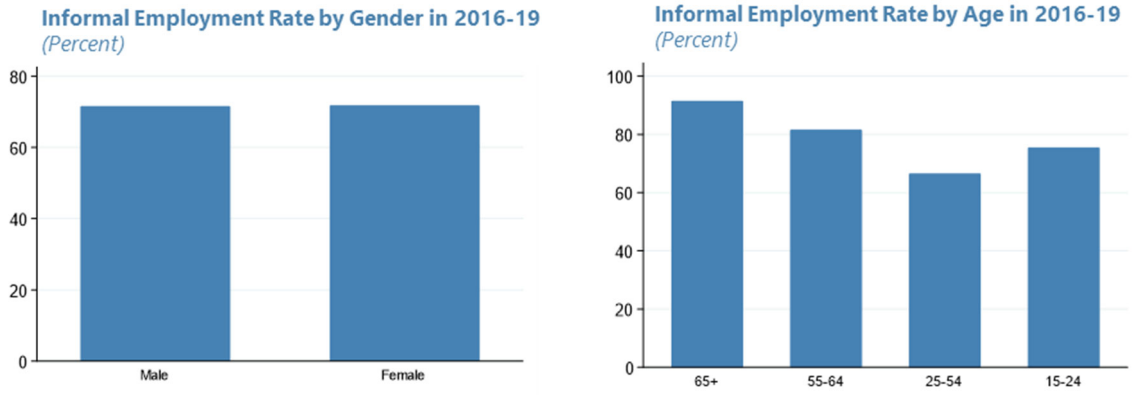
Employment Status in Guatemala and Comparators



Source: ILOSTAT (International Labor Organization).
Note: Acronyms for countries are ISO3. For subregions: CAM=Central America and Mexico; EAEM=East Asia Emerging Markets; SAM=South America. Subregional groupings described in footnote 3.

[2] In the figures and the rest of the paper, Guatemala's indicators are compared to averages of some emerging market regions (Central America and Mexico, East Asia Emerging Markets, and South America) as well as with Chile and Costa Rica, which are Latin American countries that because of their relatively low informality can be considered as role models in this area. Central American and Mexico (CAM) includes Costa Rica, El Salvador, Honduras, and Panama; East Asian and Emerging Markets (EAEM) includes China, Indonesia, Malaysia, Philippines, Thailand, and Vietnam; and South America (SAM) include Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Paraguay, Peru, Uruguay, and Venezuela.

Informality in Guatemala Across Gender and Age



Source: ILOSTAT (International Labor Organization).

B. Informality: Costs and Determinants

Informality Costs

5. The literature identifies several negative economic consequences of informality. [3] Lower firm and labor productivity, and a lower provision of public services induced by informality negatively impact the overall economy.

a. Informality could lead to firms' capacity constraints. Firms without a formal status have less access to some public services (including security and judicial protection) and more limited and costly access to financing. Informal firms tend to be constraint in size and expansion of operations to avoid detection by tax authorities, depriving them of economies of scale. They also face additional costs to conceal their operations and are often forced to use irregular channels (La Porta and Shleifer, 2014).

b. Informality constrains workers from better conditions. Workers without a formal contract could experience more precarious working conditions (overtime work, missed payments, precarious safety, dismissal without proper notification or compensation) and commonly have more restricted access to benefits and social protections (Oviedo and others 2009).

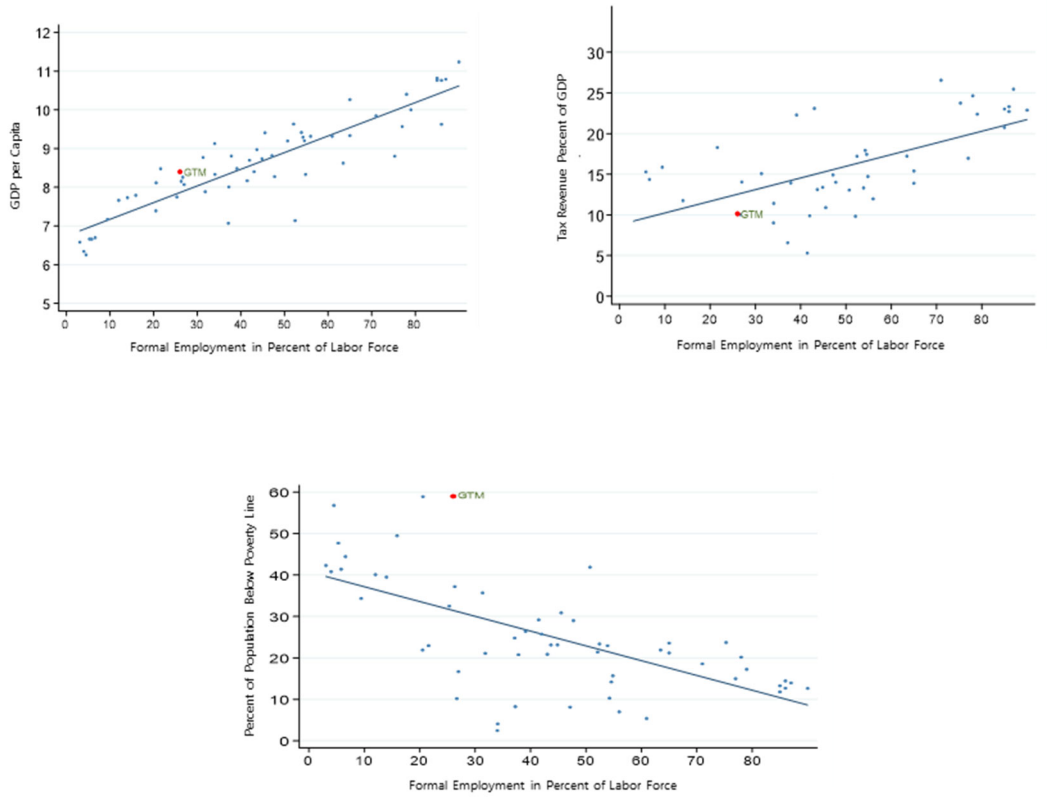
c. Informality prevents healthy tax collection. Governments in countries with high informality typically have lower tax collection and financing public services becomes more challenging (Loayza 1996; Johnson and others 1997). Low tax revenues can further weaken government financing by lowering sovereign debt ratings, as rating agencies factor in not just debt-to-GDP but debt-to-revenue ratios. Credit reports from these agencies do cite a high debt-to-revenue ratio as a weakness for Guatemala.

[3] This section is partly based on Loayza (2018).

6. While its net economic effect is commonly perceived as negative, private incentives to remain informal are ample. Informal firms' gains include those from avoiding the costs imposed by regulation and taxation, more flexibility in hiring and location decisions and on resource management in general. During economic crises or structural adjustment reforms (such as after trade liberalization), the informal sector commonly generates much-needed employment (Fiess and others, 2007; Loayza and Rigolini, 2011; Dix Carneiro and others, 2021).

7. Cross-country work suggests high informality is associated with weak socioeconomic indicators. While the relations suggest the consequences of informality, the relations are also highly endogenous and further analysis is required.

Formal Employment and Selected Socioeconomic Indicators
(fitted line in blue)



Source: ILOSTAT and World Development Indicators.

Determinants

8. A review of the determinants of informality, as identified by the economic literature, appears to explain well the roots of its high prevalence in Guatemala. This literature broadly points to two sets of factors explaining informality: one of them related to low productivity (for example, ILO 2018) and another to bad governance or poor regulation (De Soto, 1986):

- Low productivity. If firms and workers do not have sufficient productivity to comply with basic requirements of formality, such as keeping accounting or meeting safety regulations. Low productivity is seen mainly related to a low educational level or a high share of the rural or young population.

- Poor regulations (De Soto, 1986). If regulations for firms and workers are too costly, economic agents will seek to avoid them.

9. Estimates of the quantitative contribution of each factor for different countries vary widely but could help identify the drivers of Guatemala's high informality. For instance, Loayza and Wada (2010) estimate that the difference in informality rates between Chile and Peru is explained mainly (75 percent) by poor regulations factors. In contrast, the difference in these rates between the Republic of Korea and Indonesia is mainly (75 percent) explained by low productivity. Other studies (e.g., Dabla-Norris and others, 2015; Dougherty and Escobar, 2013; Loayza and others, 2009) have statistically estimated the impact of these factors, including through cross-country regression analysis. Table 1 shows cross-country regression estimates of commonly cited determinants of informality. An important difference with related estimates is the use of formal employment as a dependent variable instead of the informality rate, noting that formal employment is the optimal objective of a strategy to reduce informality.

Determinants of Informality

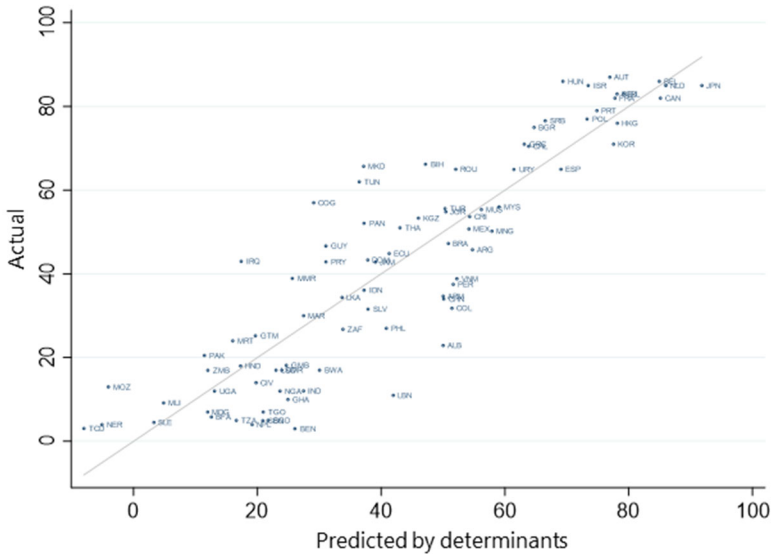
Dependent Variable: Formal employment rate	(1)	(2)	(3)
Minimum wage to GDP	-7.58**	-7.57**	
Fixed contracts allowed	1.73		
3rd-party notification of dismissal	1.58		
Severance pay for redundancy (months)	-0.22*	-0.20*	
Learning-adjusted school years	6.08***	5.93***	6.27***
Governance	4.55	5.27**	5.08**
Income and payroll tax rate	-0.05	0.00	
Business regulation index	0.39	0.00	
Share of rural population	-0.20**	-0.19**	-0.21***
Constant	10.65	13.25	7.28
Observations	82	85	90
R2	0.75	0.76	0.77

Notes: * p<0.1, ** p<0.05, *** p<0.01.

Source: IMF Staff estimates.

10. These statistical estimates find a strong relation between cited determinants of informality and formal employment rates.[4] The most significant determinant is education, with a one standard deviation increase in this indicator being associated with a 15 percentage points increase in the rate of formal employment. Similar improvements in governance and the share of the rural population are associated with five percentage points and a four-percentage point increase in formal employment, respectively. Some specific labor legislations are also important, although much less than education. Increases in severance payments and the minimum wage to GDP per capita ratio (an approximation of minimum unit labor costs) are associated with a three-percentage point decrease in the formal employment rate. Comparing the actual formal employment rate to its regression-predicted level shows a tight fit and a broadly accurate prediction of the labor formality levels in Guatemala.

Actual versus Predicted Formal Employment
(Log of 2019 US$)

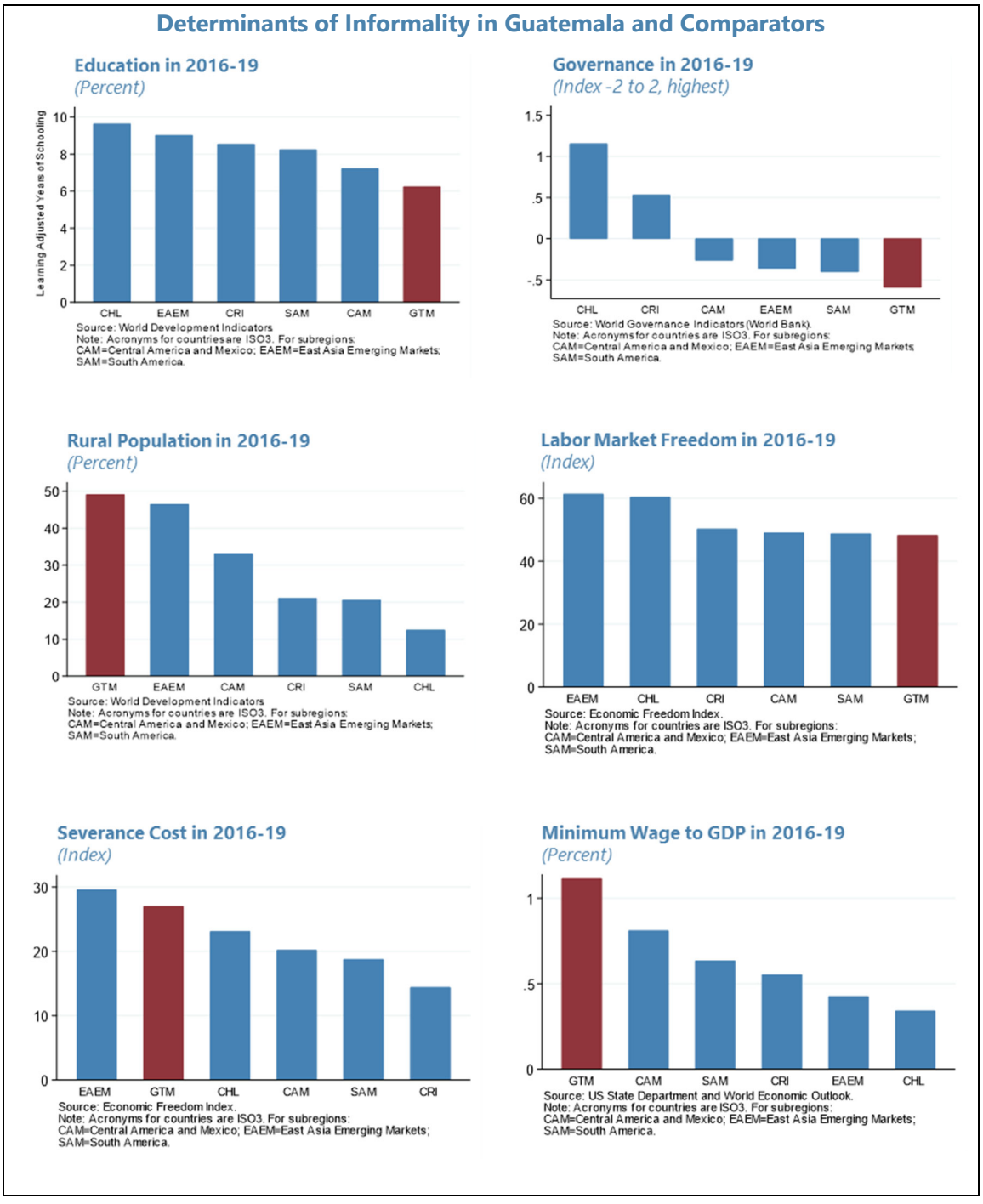


Source: author's estimations.
Note: R-squared=0.76. Country codes from ISO 3 nomenclature.

11. Guatemala's model prediction of a low formal employment rate identifies areas for improvement. Practically in all factors that explain formality, Guatemala could do better. Guatemala appears to be lagging on education (the most significant explanatory variable of informality) and governance. Guatemala is also more rural than comparators, even more than EAEM, which includes highly rural China and Vietnam. And Guatemala has a lower labor market freedom than its comparators, with relatively high severance payments and minimum wage to

[4] Similar regression results are seen in Table AI.1, which use ILO's definition of informality (with formal firms' workers without formal contract) as the dependent variable.

GDP per capita, both being labor policy factors statistically more related to informality in our regressions.



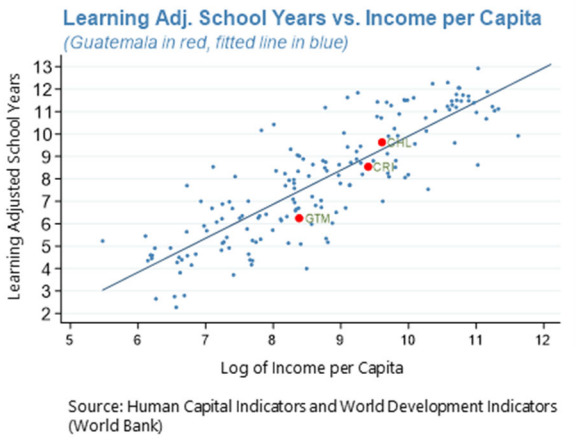
12. Weak governance perceptions reflect weaknesses in a wide range of areas.

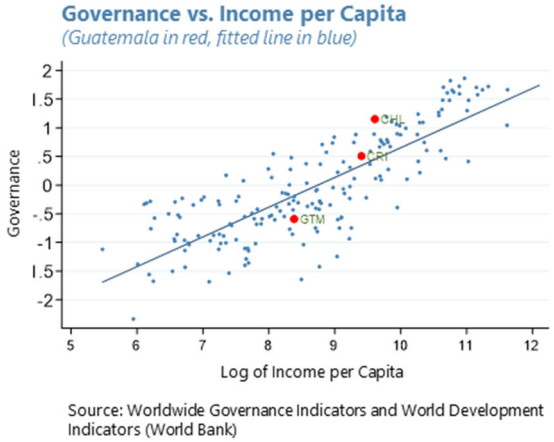
Guatemala ranks low in all subcomponents of the Worldwide Governance Indicators relative to the average in comparator regions except in Voice and Accountability, which ranks above the

EAEM region (which includes China and Vietnam). Low regulatory quality has partly reflected low performance in the World Bank's Ease of Doing Business ranking, especially in the areas of enforcement of contracts, resolution of insolvencies, protection of minority investors, construction permits, and paying taxes. Recent streamlining reforms described in the last section are to help improve Guatemala's early 2020s record. High violence reflects high homicide crime rates (17 per 100,000 population in 2022).

13. The analysis also shows strong gains by strengthening education and governance. The cross-country regression estimates for Guatemala suggest strengthening education by seven percentage points and two percentage points from the strengthening of governance would lead to a nine percent increase (to 35 percent) in the formal employment rate. In other words, Informality would reduce from about 70 to about 60 percent. This reduction in informality would be associated with 45 percent higher GDP per capita, 0.9 percent of GDP higher tax revenues, and 2.5 percentage points lower poverty rate. The chart shows also many countries are above the fitted lines—have higher education and governance levels than countries of similar income per capita. For instance, middle-income Eastern European countries have education levels more like those of advanced economies and low-Income Rwanda has governance performance like those of middle-income countries.

Income versus Governance and Education in Guatemala and Comparators





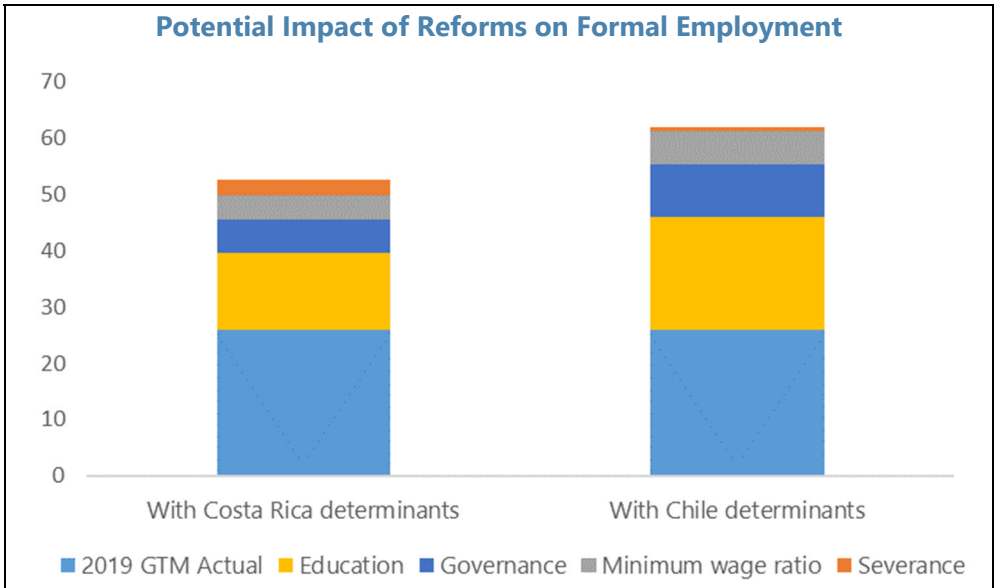
Note: Acronyms are ISO3. Values are averages of years 2016-19.

14. Converging to Costa Rica or Chile's fundamentals would lead Guatemala to reduce its informality levels significantly. Based on the cross-country regression results,

a. Converting to Costa Rica would be associated to 27 percentage points higher formal employment rate, with 14 percentage points corresponding to education strengthening, six percentage points to governance strengthening, four percentage points to a reduction in the minimum wage to GDP per capita, and three percentage points to the reduction in severance

payments. Correspondingly, this increase in the formal employment rate would result in a reduction of Guatemala's informality rate to 45 percent, below the average rate in CAM countries.

b. Converging to Chile would be associated with a 36 percentage points increase in formal employment, with 20 percentage points corresponding to the strengthening of education and nine percentage points due to governance improvements. The reduction in the minimum wage to GDP ratio to Chile's ratio is associated with six percentage points higher formal employment and a reduction in severance costs to Chile's levels with a one percentage point increase in formal employment. Informality would thus come down to 36 percent, significantly below the average for comparator regions.



Sources: ILOSTAT and author's calculations.

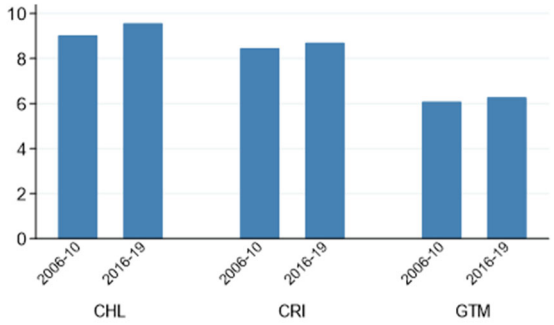
15. Labor market flexibilization to facilitate hiring is defined by the need for adequate social protection. Guatemala's high minimum wage to GDP per capita ratio is among the highest in Latin America and more than twice as high as the international average. The most socially desirable way to lower this ratio is to foster productivity, a long-term objective. The large share of the rural population in Guatemala also challenges applying labor market regulations to those segments, which are commonly designed for urban labor markets. Weak tax revenue may be a limiting factor when tying labor market flexibilization with increased social protection, such as an unemployment benefits program.

16. Guatemala's historical record shows little progress in its determinants of formal employment. Learning-adjusted schooling barely increased between 2006-10 to 2016-20. Governance has broadly remained unchanged during this period. And while rurality has

decreased, it has done so at a much slower pace than Costa Rica (rurality in Chile is already very low).

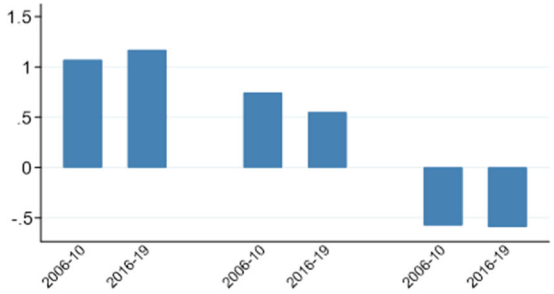
Recent Evolution of Formality Determinants

Education
(Index 0 to 1, highest)



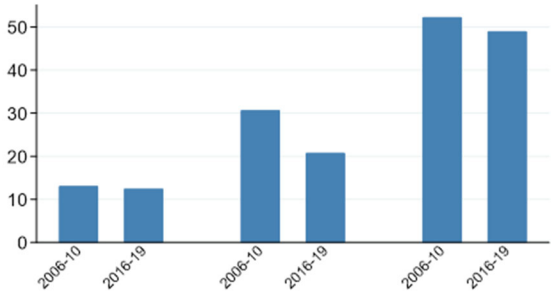
Source: Human Capital Index (World Bank)

Governance
(Index -2 to 2, highest)



Source: Worldwide Governance Indicators (World Bank)

Rural Population
(Percent of total population)



Source: World Development Indicators (World Bank)

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