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Lessons from Haiti's Recent Exchange Rate Developments

Rina Bhattacharya and Neil Shenai

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Lessons from Haiti's Recent Exchange Rate Developments
Rina Bhattacharya and Neil Shenai*Authorized for distribution by Nicole Laframboise
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ABSTRACT: From August to October 2020, the Haitian authorities were successful at bringing about a sharp appreciation in the gourde/U.S. dollar exchange rate. This paper analyzes the factors behind this appreciation and its spillovers on the economy. It finds that foreign exchange surrender requirements had a statistically significant effect on the nominal exchange rate, while foreign exchange intervention by the central bank did not. Surrender requirements were also found to have raised trading costs and volatility in the foreign exchange market and contributed to the development of a wider parallel nominal exchange rate premium. This appreciation contributed to a decline in headline inflation during the episode while delivering some fuel subsidy-related savings to the government. Remittance-dependent households and exporters saw a drop in their purchasing power, and Haiti's net external buffers were adversely affected. Following from these findings, the paper offers recommendations on ways to facilitate foreign exchange management and boost external sustainability while contributing to the central bank's overall policy objectives.

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WORKING PAPERS

Lessons from Haiti's Recent Exchange Rate Developments

Prepared by Rina Bhattacharya and Neil Shenai

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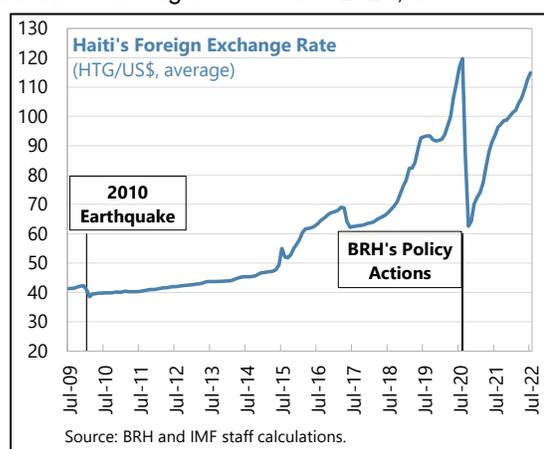
Glossary

| | | |
|--------|---|---|
| ARA-CC | – | Assessing Reserves Adequacy for Credit Constrained economies |
| ARDL | – | Auto regressive distributed lag |
| ARIMA | – | Auto regressive integrated moving average |
| BRH | – | Bank of the Republic of Haiti |
| FCS | – | Fragile and conflict-affected states |
| FMOLS | – | Fully modified ordinary least squares |
| GARCH | – | Generalized autoregressive conditional heteroskedasticity |
| GEE | – | Global Economic Environment |
| INS | – | Information Notice System |
| IPF | – | Integrated Policy Framework |
| MEF | – | Ministry of Economy and Finance |
| NEER | – | Nominal effective exchange rate |
| NOP | – | Net open positions |
| OLS | – | Ordinary least squares |
| REER | – | Real effective exchange rate |
| RM | – | Reserve money programming |
| SEATS | – | signal extraction in ARIMA time series |
| TRAMO | – | Time series regression with ARIMA noise, missing observations, and outliers |
| VECM | – | Vector Error Correction Model |
| WEO | – | World Economic Outlook |

Introduction

1. Haiti is a small, open, fragile, and shock-prone economy. It is also highly dependent on remittances and is undergoing considerable social, political, and economic stress. A protracted political crisis that started in 2015 and included the assassination of the President in 2021 has been a key driver of instability, fragility, and conflict. Related to these exogenous shocks, the country has experienced civil unrest with repeated country lockdowns (known as *peyi-lok*), increasing gang violence and control, COVID-19-related lockdowns, a hurricane, and an earthquake. These shocks hit an economy with considerable pre-existing vulnerabilities, including high rates of informality and poverty, exposure to climate-related natural disasters and earthquakes, dependence on volatile and declining foreign financial assistance, and governance challenges.

2. In mid-2020, the authorities adopted measures that were very successful at halting the slide in the gourde and delivering a sharp exchange rate appreciation. From August – October 2020, the gourde/U.S. dollar rate appreciated by 50 percent in nominal terms from about 124 gourdes to 62 gourdes per U.S. dollar (chart). This appreciation coincided with several policy actions taken by Haiti's central bank, the Bank of the Republic of Haiti (BRH), including the introduction of foreign exchange (henceforth “forex”) regulations on banks and currency traders, forex sales, dollar liability issuances to commercial banks, and enhanced communications, including moral suasion of financial institutions. This period of exchange rate appreciation also coincided with a surge in remittances from the U.S. and reduced imports related to the ongoing domestic crisis (Table 1 and Figure 3).



3. This study explores the policy measures taken to bring about this appreciation and its economic consequences. It examines the quantitative developments and impact of these measures on the economy and financial system and offers policy recommendations drawing on this analysis. The study focuses primarily on policy actions and related developments from August 2020 through mid-2021, and the empirical work uses data available through mid-2021.

4. The rapid nominal exchange rate appreciation in the second half of 2020 had important ramifications on the economy and on Haitians. First, remittance-dependent households, savers, and financial institutions were adversely affected, while the government and large importers with access to credit and the forex market generally benefitted. Indeed, the empirical work in this study indicates that Haiti's net remittance flows, unlike exports and imports of goods, are highly sensitive to movements in the real effective exchange rate (REER), both in the short- and long-run, implying that periods of real exchange rate appreciation would adversely affect remittance-dependent households. Second, forex regulations in the form of surrender requirements led to a decline in forex liquidity and increased volatility in the forex market, impeding the efficient functioning of the market and price discovery while making it more difficult to determine the equilibrium value of the nominal exchange rate. Third, surrender requirements were found to have had a statistically significant impact on the nominal exchange rate in the long run, whereas forex intervention did not, even in the short run. Fourth, the estimated inflation pass-through to the exchange rate suggests that exchange rate volatility contributes to price level volatility, which may have complicated monetary policy implementation.

5. The rest of this paper is organized as follows. Section II surveys the literature on monetary policy frameworks and exchange rate regimes in fragile and conflict-affected states (FCS). Section III provides an overview of Haiti's forex market, with an emphasis on the market and legal infrastructure for forex, the main market participants and their forex needs, how the official exchange rate is determined, and stylized facts on forex market liquidity. Section IV evaluates the 2020-2021 exchange rate appreciation and depreciation episode, elaborating on the key measures taken and analyzing their macroeconomic impacts. Section V summarizes the findings and discusses policy implications. Annexes I-IV present the empirical analysis supporting the paper's findings with the aim of providing insight into: the factors driving the sharp appreciation of the nominal exchange rate in the latter half of 2020 (Annex I); the impact of forex regulations on underlying forex market volatility (Annex II); the pass-through of exchange rate movements to CPI inflation (Annex III); and the sensitivity of exports, imports, and net remittance flows to exchange rate movements (Annex IV).

Review of the Literature

6. The choice of appropriate monetary policy framework and exchange rate regime continues to be highly debated, particularly in low-income countries and FCS. A desirable monetary policy and exchange rate framework is one that “keeps inflation expectations well anchored and minimizes unnecessary fluctuations of economic activity around its trend path in response to shocks” (Minella, Powell, Rebucci, & Souza-Sobrinho, 2009, p. 4). While pegging the exchange rate provides a useful commitment device for the central bank to anchor expectations by disciplining policies, it also limits a country's ability to respond to macroeconomic shocks. Forex regimes that are more rigid help countries anchor inflation expectations, sustain output growth, and foster deeper economic integration. But, as highlighted by Ghosh and Ostry (2009), they also constrain the use of macroeconomic policies, increase vulnerability to crises, and can impede external adjustment given prevailing rigidities (Ghosh & Ostry, 2009). Pegged exchange rate regimes are often associated with the best inflation performance, but growth performance is best enhanced under intermediate exchange rate regimes—i.e., those that maintain relatively rigid exchange rates but do not formally peg to a single anchor currency (Ghosh, Ostry, & Tsangarides, 2010).

7. Caribbean countries have adopted a range of exchange rate regimes. The Caribbean's small, open economies are especially vulnerable to external shocks, including terms of trade and financing shocks, and frequent natural disasters. At the same time, there is considerable heterogeneity across the region, with many countries dependent on tourism, a few major commodity exporters, and a wide range of per capita income levels. Exchange rate regimes thus range from a hard peg to the U.S. dollar (e.g., Bahamas and Barbados) to a soft peg with periodic step adjustments (e.g., Suriname and Trinidad and Tobago) to a managed float with no predetermined level or path for the exchange rate (Jamaica). The classification of Haiti's exchange rate regime was recently changed by the International Monetary Fund from a ‘crawl-like’ arrangement to ‘other managed’ arrangement.¹

8. Identifying an appropriate monetary policy framework and exchange rate regime is challenging for FCS such as Haiti where state capacity is limited and political legitimacy is contested. Many fragile states are jurisdictions where the rule of law has limited traction, the normal functioning of the state can no longer be presumed, and economic, social, and political anarchy prevails.

¹ See (International Monetary Fund, 2020b) background on this classification methodology.

9. State fragility alters the macroeconomic stabilization challenges faced by FCS in three main ways:

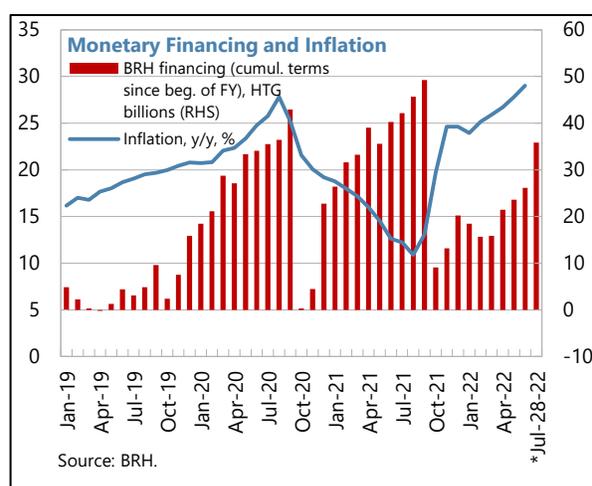
- i. The composition and magnitude of shocks differ from non-FCS.** In addition to terms-of-trade and/or climate related shocks, fragile states are more likely to have shocks that emanate from, and interact with, the risks and consequences of civil or cross-border conflict compared to non-FCS. This factor is particularly relevant in Haiti, where gangs and other organized criminal organizations overwhelm the state and challenge the government's legitimacy.²
- ii. The capacity for countercyclical action is often severely compromised since automatic fiscal stabilizers are absent.** To a large extent this is because access to international private capital markets is generally limited and capital flows to and from fragile states are procyclical, while bilateral official flows have also become more procyclical in recent decades as concerns about corruption and transparency have increased together with aid fatigue, and domestic debt markets tend to be extremely thin. In Haiti's case, official support started to decline around 2012 after the surge following the 2010 earthquake and in the wake of domestic political instability and governance problems. Haiti has weak and declining domestic revenue mobilization, and fiscal policy space remains severely limited as well. Furthermore, Haiti does not have access to international private capital markets, and the IMF has provided by far the largest share of external financing in recent years.³
- iii. Fragility shortens horizons for policymakers and undermines their incentives to balance current against future outcomes.** This dynamic gives rise to temptations to increase borrowing on unattractive terms and to pursue macroeconomic stabilization through short-term political expediency.

10. Monetary and exchange rate policy can be a useful tool to limit the risks of potential fiscal dominance—a key problem facing many FCS, including Haiti. Adam and Wilson argue that fiscal dominance is a major policy challenge in many fragile states. Broadly speaking, fiscal dominance exists when fiscal policy considerations play an overwhelming role in monetary policy decisions, as reflected for example by the extent to which government deficits determine the growth of the money supply or the evolution of interest rates. The impetus toward fiscal dominance often stems from institutionally weak central banks that cannot resist political pressure for provisioning central bank credit to the government, a lack of domestic resource mobilization together with high public funding needs, and general short-termism, among other factors. In Haiti, central bank credit to the government and base money creation more broadly coincided with recent rises in inflation (chart on next page). Thus, adopting a monetary policy and exchange rate framework that constrains excessive central bank money creation (for example, through what Adam and Wilson describe as a *reserve money targeting regime*, see below) can be helpful in restoring fiscal discipline by limiting the government's access to central bank funding (Adam & Wilson, 2021, pp. 383-384).

² See (Abi-Habib & Paultre, 2022) and (Walsh & Gallon, 2022) for recent accounts of the increasing influence of gangs in Haiti.

³ IMF financing includes an emergency loan in 2020 under the IMF's Rapid Credit Facility and the 2021 SDR allocation (combined worth about 2.6 percent of GDP), see (International Monetary Fund, 2020a) and (International Monetary Fund, 2022a, p. 32)

11. Fragile states exposed to a multitude of ‘real’ shocks (both domestic and external) may find it useful to adopt a relatively flexible exchange rate regime. Forex flexibility can help deal with such shocks when complemented by efforts to strengthen liquidity management, develop financial and forex markets, contain fiscal dominance, and continue with structural reforms to enhance competitiveness and promote expenditure-switching. A key element in any exit strategy from poverty, fragility, and conflict is to strengthen control over government finances and address the challenge of fiscal dominance while using monetary policy, such as reserve money (RM) programming, to anchor inflationary expectations. RM programming is an essentially non-discretionary, rule-based approach to monetary policy and is well-designed for anchoring inflation in flexible or managed exchange rate regimes in which government transactions play an important role in the structural generation of liquidity and where fiscal dominance is a major policy challenge. Moreover, as (Adam & Wilson, 2021) note, the RM framework functions well when financial markets are in an embryonic state and are dominated by banks that rely heavily on transactions with central banks for their funding and liquidity. The authors further find that one of the striking themes in the economic history of sub-Saharan Africa is how many of the successful exits from fragility have been built around money-based stabilization programs, complemented with strong fiscal reforms and measures to strengthen public finances on a sustainable basis. Since both conditions are present in Haiti—including embryonic financial markets and banks that are heavily reliant on the central bank—this suggests that more stringent controls on base money creation can be an important tool in anchoring inflation expectations and containing fiscal dominance in Haiti.



An Overview of Haiti's Foreign Exchange Market

12. It is worth emphasizing that macroeconomic policy formulation and execution is exceptionally challenging in Haiti given its fragility, vulnerability to exogenous shocks, and capacity limitations. The protracted political and security crisis have had a major impact on the economy and drastically limited the authorities' ability to respond to shocks, while the security situation deteriorated during 2021 and 2022 to an acute level, significantly affecting the circulation of people and goods and choking off economic activity, akin to the *peyi-loks* of 2019. This fragility has impeded FDI inflows and capital deepening while exacerbating Haiti's acute development needs. This has led to an erosion in human capital and institutions, with the resulting weak administrative and institutional capacity hindering the ability of policymakers to implement basic policies or respond to shocks.

13. The main sources of forex revenue in Haiti are private transfers (remittances) and textiles exports. In 2021, it is estimated that Haiti received about \$4.7 billion in private transfers, equivalent to about 22 percent of GDP, of which \$4.2 billion were remittances sent from abroad, mostly Haitians working in the U.S. (Table 1). Apparel exports, such as knit t-shirts and other clothing articles, accounted in 2021 for about \$1.2

billion in export revenues (5.1 percent of 2021 GDP), in turn constituting about 94 percent of Haiti's goods exports.

14. Haiti's main forex outflows are for goods imports, with fossil fuels being a major component.

In 2021, Haiti imported about \$4.6 billion of imported goods (worth about 22 percent of Haiti's 2021 GDP), of which about \$850 million (4 percent of GDP) were fossil fuels. Net external debt payments from both the public and private sectors are not major contributors to Haiti's balance of payments, with gross public sector and bank outflows amounting to about \$200 million (1 percent of GDP).

Table 1. Haiti: Balance of Payments, 2021 (est.)

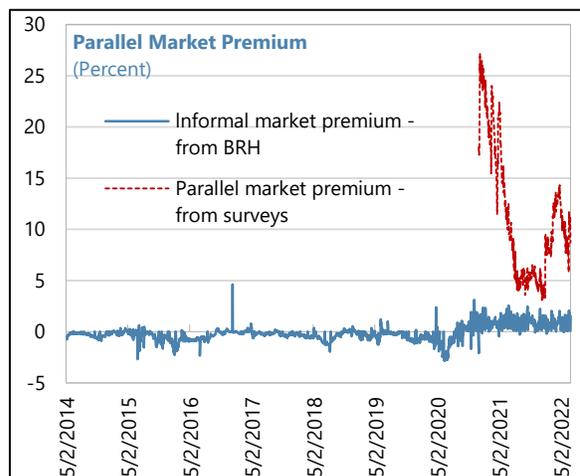
| | USD millions | % 2021 GDP |
|--|--------------|------------|
| Current account | \$ 98 | 0.5% |
| Receipts | \$ 6,113 | 29.1% |
| o/w remittances | \$ 4,196 | 20.0% |
| o/w goods exports | \$ 1,130 | 5.4% |
| Expenditures | \$ (5,890) | -28.0% |
| o/w fossil fuel imports | \$ (643) | -3.1% |
| o/w food imports | \$ (815) | -3.9% |
| Capital and financial account (non-reserve) | \$ (72) | -0.34% |
| Overall balance | \$ (4) | -0.02% |

Source: BRH.

15. Haiti's spot forex market participants are comprised of eight commercial banks and several non-deposit taking money transfer operators. Prior to August 2020, commercial banks quoted bid and offer prices for clients reflecting market supply and demand for forex, with transactions settled in a BRH-operated clearinghouse. Haiti did not maintain restrictions on current account transactions and residents were permitted to hold forex accounts with Haiti's eight licensed commercial banks. Exporters and households, such as remittance receivers, could hold forex accounts as well. These accounts were credited with proceeds such as export receipts and transfers received from money transfer operators. Due in part to Haiti's dependence on worker remittances, Haiti's financial system remains highly dollarized, with forex deposits accounting for about two thirds of total banking sector deposits (Box 2). Moreover, there is no forex futures market in Haiti.

16. The BRH was involved in the forex market in several ways. It set forex-related macroprudential requirements, intervened in the market, and served as the fiscal agent for the Ministry of Economy and Finance (MEF) for certain transactions, including those with international financial institutions (IFIs). Bank lending in forex could not exceed 50 percent of total forex liabilities, while reserve requirements on U.S. dollar deposits are 50 percent for commercial banks and 40 percent for savings and housing banks. Net open positions (NOP) in forex were limited to 0.5 percent of equity for banks and money transfer companies, which is low by international and regional standards. The BRH periodically intervened in the forex market by buying and selling forex directly with licensed banks. Prior to late-2021, the government had a fuel import monopoly and made international payments via an MEF-designated account at the BRH.

17. Since the 2020 appreciation episode, Haiti has had two exchange rates: the bank rate and the informal rate. Banks and non-deposit taking money changers transact at the interbank rate, while the informal rate reflects supply and demand conditions for forex in the sizeable informal economy. There are two informal rates: the rate as reported by the BRH (via its website) and the parallel market rate obtained from informal surveys (chart). The BRH's daily reference forex rate (*taux de référence*) is determined by a 60 percent-40 percent weighted average of the bank rate and informal rate, respectively. Since the emergence of the parallel rate in late-2020, the spread between the bank and informal rates has ranged from 5 to 25 percent (chart).



18. Forex market turnover has remained stable since 2015. Forex market turnover—the sum of forex purchases and sales by commercial banks—averaged about \$400 million per month since 2015, equivalent to about 3 percent of 2020 nominal GDP. Forex liquidity in both the official and parallel markets declined in 2020, as measured by proportional bid-offer spreads, while median proportional bid-offer spreads rose from about 35 to 65 basis points in 2020 (Figures 1 and 2).

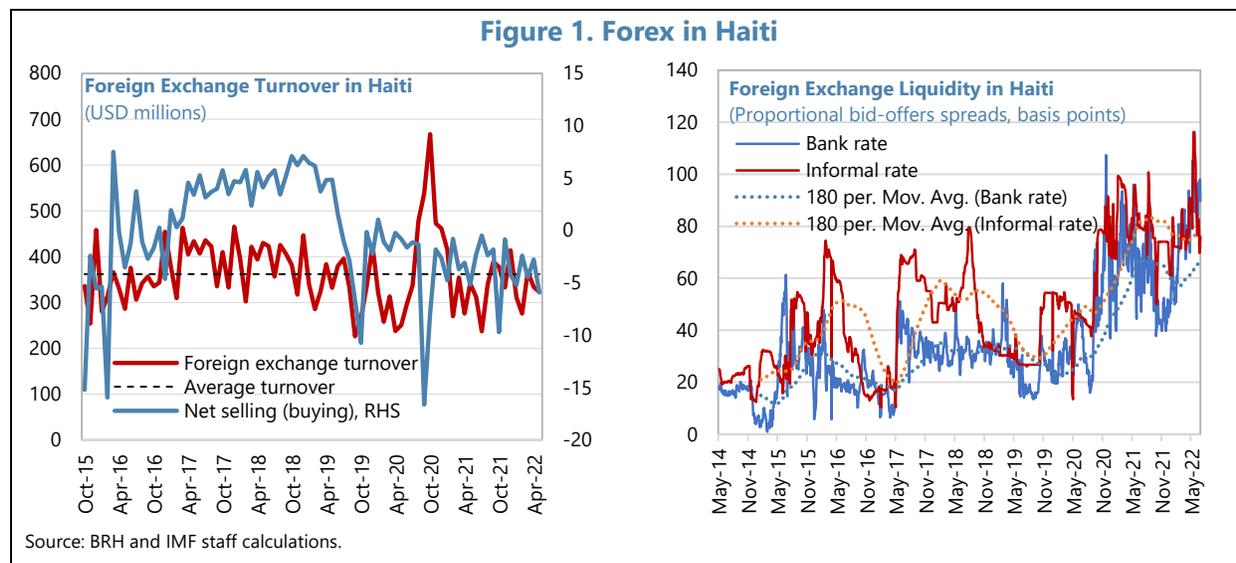
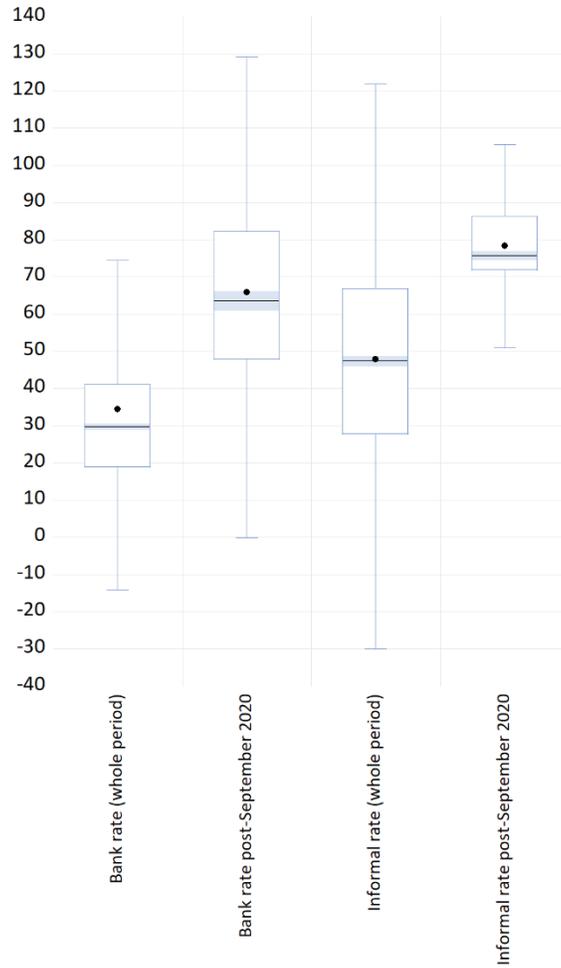


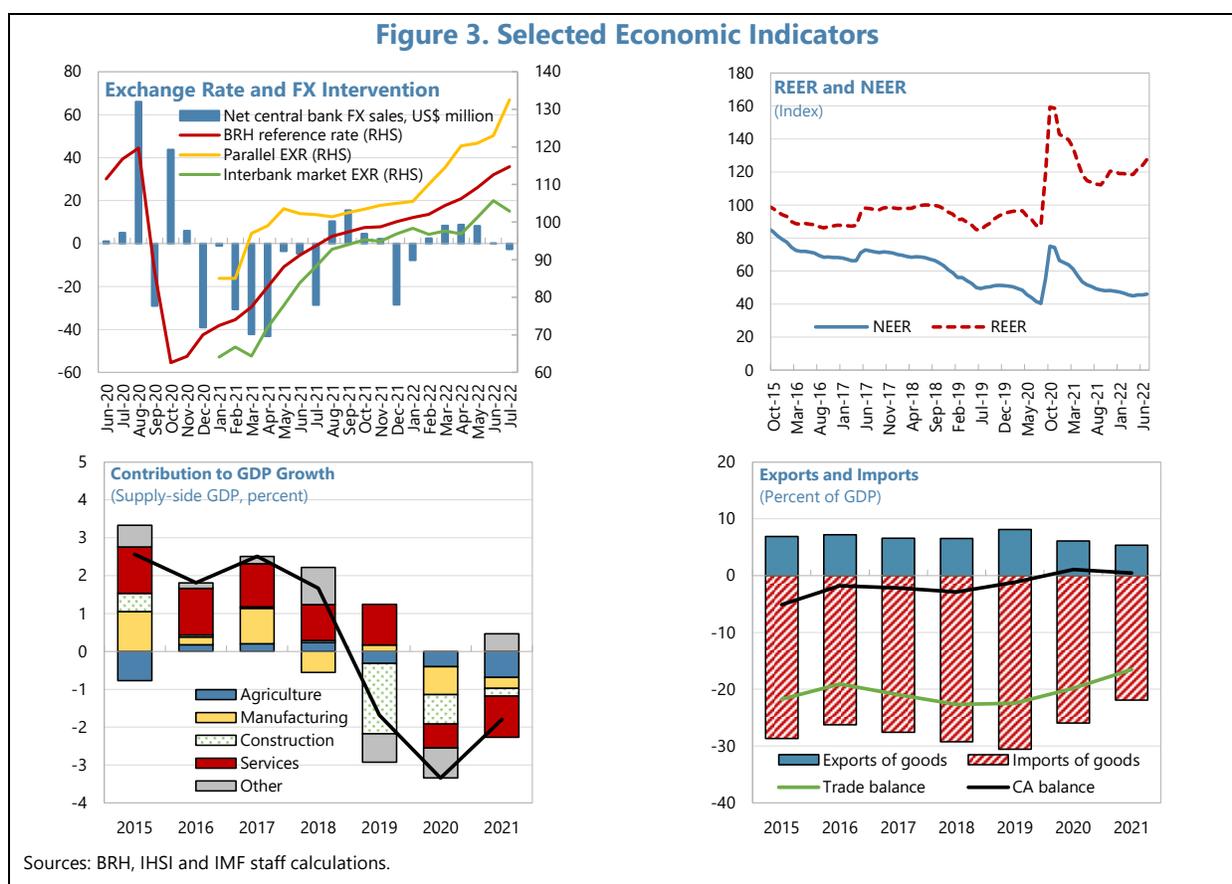
Figure 2. Volatility of Trading Costs in Various Periods
 (Proportional bid-offer spreads, basis points)



Source: BRH, Author calculations.

Understanding the 2020-2021 Episode

19. After an extended period of depreciation, the BRH launched a strong defense of the currency in August 2020. During 2019 and the first half of 2020, the gourde/U.S. dollar rate depreciated steadily, driven by inflationary financing of the deficit in 2019/20, supply shortages in 2019-2020 related to social unrest and gang activity that resulted in repeated *peyi-loks*, and to a lesser extent by COVID-19 containment measures. Starting in August 2020, the gourde/U.S. dollar rate appreciated by nearly 50 percent through October 2020. The nominal effective exchange rate (NEER) appreciated by about 50 percent over this period, while the REER appreciated by 78 percent (Figure 3). This appreciation took place against a backdrop of declining growth momentum across sectors due mostly to COVID-19 related lockdowns, an upsurge in violence and social unrest, and the continued political crisis. As a result, domestic expenditures were compressed, and total imports fell as a percentage of GDP from about 31 percent in FY2019 to 26 percent in FY2020. This decline in import demand, coupled with surging remittance inflows, helped turn the current account deficit of about 2.4 percent of GDP in 2019 into a small surplus of 0.2 percent of GDP in 2020. This improvement on net in the balance of payments contributed to the strength of the gourde in the latter half of 2020.



20. Between its October 2020 peak and end-April 2022, the gourde depreciated steadily. This was reflected in the NEER and REER, which depreciated about 20 percent and 33 percent respectively from their October 2020 highs. Some of this depreciation may have been due to equilibrating market forces: as of November 2020, IMF staff assessed that Haiti's REER was overvalued by about 40 percent based on the 2020 External Balance Assessment (EBA)-Lite REER model-based results. A subsequent review conducted in April 2022 found that this gap had narrowed to about 5 percent.⁴

Drivers of the 2020-2021 Exchange Rate Developments

21. The BRH was able to exercise its considerable market power to deliver a large nominal exchange rate appreciation. Key steps taken include:

- **Forex regulations:** The BRH introduced new regulations governing international money transfers (Box 1), which had the effect of requiring financial institutions to surrender forex to the BRH. Transfer-receiving financial institutions, including money transfer operators and banks, were required to surrender 30 percent of their forex receipts to the BRH in exchange for gourdes as settled at the daily BRH reference rate, which was lower than the prevailing parallel market rate for sellers of U.S. dollars. (Some of these rules were relaxed via circular 114-3 on September 5, 2022. The announcement of circular 114-3 coincided with circular 118-1, which increased the reporting requirements related to international transfers and forex transactions (Box 1). At time of publication of this study, it is too soon to assess the impact circulars 114-3 and 118-1 would have on the forex market.)
- **Forex sales and balance of payments developments:** In August 2020, the authorities announced plans to intervene in the forex market by up to \$150 million to defend the value of the gourde against the U.S. dollar. From August 2020 through end-December 2021, the authorities sold about \$100 million in forex. This took place at a time when balance of payments receipts, namely from remittances, had risen considerably, as witnessed across the region and following the deployment of public pandemic support and recovery spending by the U.S. government, the main source country of remittances to Haiti. The authorities sold dollars directly to corporate clients in competition with commercial banks in what the authorities described as an already-thin forex market.
- **Enhanced communication and possible moral suasion:** Also in August 2020, the authorities announced that they would levy sanctions on two commercial banks of about \$14 million in total because of violations in forex market regulations. Feedback from banks indicated that one of the sanctioned banks allegedly had to unwind a long U.S. dollar position, which could have contributed to the strengthening of the gourde against the U.S. dollar. Reportedly banks were also encouraged to provide dollars to clients only for essential reasons, such as necessary imports or debt service payments. The BRH's announcements of its intervention plans may have also anchored expectations of the future path of the nominal exchange rate among market participants.

⁴ For more on the IMF's EBA methodology, see (International Monetary Fund, 2016) and (International Monetary Fund, 2019). For Haiti's most recently completed External Sector Assessment, see (International Monetary Fund, 2022a, pp. 57-61).

The analysis that follows finds that the following factors also affected the outcome:

- A rise in GDP in the U.S. relative to that in Haiti is found to have had the impact of depreciating the Haitian gourde over the long run, while a rise in money supply in the U.S. relative to that in Haiti had the opposite effect.
- A rise in interest rates in the U.S. relative to those in Haiti led to an appreciation, rather than depreciation, of the Haitian gourde relative to the U.S. dollar, both in the long-run and in the short-run, and the effects of interest rate differentials are statistically significant. One potential explanation of this counterintuitive result could relate to the shallow nature of the financial system, which impedes the intermediation of funds and the efficient functioning of market forces, including those which would help achieve (uncovered) interest rate parity, thereby weakening the monetary policy transmission mechanism.
- Short-run analysis of relative growth rates of real GDP and money supplies for the second half of 2020 do not suggest that GDP growth and money supply growth differentials played a significant role in driving the sharp appreciation of the gourde.
- The forex regulations that came into effect in the fourth quarter of 2020 are found to have led to a statistically significant and relatively long-lasting appreciation of the gourde.
- Central bank intervention in the forex market does not seem to have affected the exchange rate significantly over the sample period, even in the short run. A potential driver of this result could be a negative reaction to the signaling effect of forex sales and/or the announcement of forex sales, whereby the loss or expected loss of external buffers (reserves) and concomitant loss of policy space hindered the effectiveness of intervention by raising expectations of further depreciation (chart on GIR and NIR).

21. Based on empirical estimates, several variables highlighted in the theoretical literature turn out to be important determinants of the nominal exchange rate in Haiti (Annex I). These results draw on a monetary model of the exchange rate approach, as explained by, *inter-alia*, (Genberg, 1981) and (Suss E. , 1980). The spot exchange rate was modeled using a standard vector error correction model (VECM). Key explanatory variables in the model include: (i) the differential between growth in broad money in the U.S. and Haiti; (ii) the differential in real GDP growth in the two countries; (iii) the differential in short-term interest rates; (iv) the level of remittances received by Haiti as a percentage of GDP; and (v) the level of forex intervention by the BRH. The model also included a dummy variable to capture the impact of new forex regulations noted above that came into effect in October 2020. Long- and short-run specifications were considered.

22. The results suggest that, indeed, forex regulations, enhanced communications and moral suasion helped drive the rapid nominal appreciation in the second half of 2020. Actual forex intervention seems to have been relatively less important in determining short- and long-run exchange rate movements when compared with the introduction of the forex regulations. That said, these results should be interpreted with caution as the authorities announced their intervention strategy prior to intervening. Thus, it is possible that market participants incorporated these planned forex sales into their price expectations prior to the actual interventions. Ultimately, data availability prohibited a more granular assessment of the impact of the announcement and actual forex intervention on the nominal exchange rate.

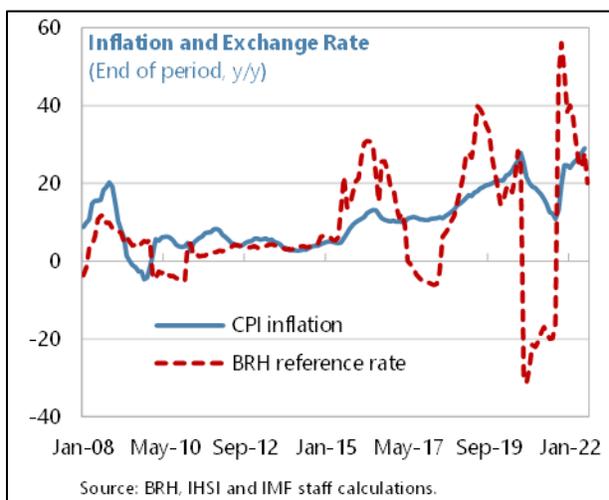
Implications of Exchange Rate Developments

23. The findings show that liquidity declined following the introduction of forex regulations and forex sales, while surrender requirements may have led to higher exchange rate volatility. Data on proportional bid-ask spreads (Figures 1 and 2) show that liquidity in the forex market declined after the introduction of forex surrender requirements, forex sales, and central bank communications, although the analysis does not permit definitive identification of which of these factors was decisive in reducing liquidity and increasing volatility. Reduced liquidity could have resulted from the inability of market participants to hold stocks of forex on their balance sheet due to the forex regulations and limits on NOPs, in turn reducing their ability to make two-way markets.

24. The results of a generalized autoregressive conditional heteroskedasticity (GARCH) model of exchange rate volatility show how forex regulations increased nominal exchange rate volatility. In the GARCH model, the return on the nominal daily average exchange rate is determined by an auto-regressive equation. This equation makes it possible to estimate the conditional variance of the nominal exchange rate, which itself is a weighted average function of the squared residual from the mean equation from the prior period and the long-term variance. A dummy variable was included for days when the surrender requirements were made effective (Annex II). The results show that the sign on the dummy variable is positive and statistically significant, indicating that the surrender requirements increased the volatility of the nominal exchange rate. These results are paradoxical insofar as the surrender requirements were reportedly adopted, in part, to smooth excess volatility in the nominal exchange rate.

25. These policy actions also appear to have contributed to a widening of the parallel forex market premium. The actions noted above coincided with a widening of the parallel market premium to an estimated 25 percent in March 2021 before falling to about 10 percent by June 2022 (Figure 3). The sharp rise in the parallel premium implies a supply-demand imbalance and mispricing of the official exchange rate for the gourde that would have cleared the market.

26. The nominal exchange rate appreciation in 2020 helps explain the decline in headline inflation in 2020-2021 (chart). The dynamics between the nominal rate and headline inflation is reflected in the relatively high estimates of exchange rate pass-through to CPI inflation in Haiti. The pass-through of forex changes to CPI inflation was estimated by a bivariate auto regressive distributed lag (ARDL) model and a more model-based vector error correction model (VECM), both using monthly data. In the ARDL model, a bivariate model is estimated by regressing month-on-month CPI inflation on month-on-month movements in the NEER and twelve lags of both variables. For the VECM, in addition to the NEER and the CPI index, the interest rate (3-month treasury bill rate) and the money supply (broad money) were included in an attempt to incorporate a monetary policy reaction function and the monetary policy transmission mechanism. The key empirical finding in both models is that movements in the NEER have a higher pass-through to prices in Haiti compared to other Caribbean and Central American countries (Annex



III). This high level of pass-through also illustrates that higher exchange rate volatility can feed through to higher volatility of inflation, making it more difficult to anchor inflation expectations and achieve monetary policy objectives.

27. Oil importers, including the central government, benefitted from the nominal exchange rate appreciation initially. Driven partly by the impact of appreciation on fuel subsidy costs, the overall deficit (after grants) fell from 3.2 percent of GDP in FY2020 to 2.4 percent of GDP in FY2021 (ending September 30), with transfers to the state electricity company EDH and direct fuel subsidies to oil companies declining from 1.4 percent to 1.1 percent of GDP. Thus, the appreciation in the nominal exchange rate contributed to near-term fuel subsidy savings worth about 0.3 percent of GDP. However, fuel subsidy costs subsequently rose again by an estimated 0.5 percent of GDP in FY2022 due to higher world prices and the steady but gradual depreciation of the nominal exchange rate, indicating that any fiscal savings associated with the exchange rate appreciation may have been temporary. Exchange rate appreciation in FY2021 also helped to lower debt service costs, with external amortization costs falling by 0.2 percentage points of GDP compared to FY2020. Haiti's debt-to-GDP ratio also decreased from about 26 percent in FY2019 to about 21 percent in FY2020, partly reflecting the appreciation of the nominal exchange rate (in addition to a GDP rebasing in October 2020).

28. By contrast, remittance-dependent households and exporters saw their purchasing power in gourdes fall. Although both net private transfers and exports of goods increased in nominal U.S. dollar terms, as a share of U.S. dollar GDP, the former declined from 20.0 percent to 16.7 percent from FY2020 to FY2021 and the latter from 6.1 percent to 5.4 percent over the same period. Equations of exports, imports, and net remittance inflows were estimated using the Engle-Granger approach with annual data over the period 1996 to 2020 (Annex IV). The analysis shows that exports of goods are mostly affected by output growth in key trading partner countries but are not sensitive to movements in the REER, either in the short or long run. Hence, the decline in exports in FY2021 is likely explained mostly by the impact of the global recession following the COVID-19 pandemic. Moreover, the empirical results show that Haiti's imports of goods are not sensitive to movements in the REER. Like exports of goods, net remittance inflows are also shown to be strongly and positively correlated with economic activity in partner trading countries. However, in contrast to exports and imports, they are highly sensitive to movements in the REER; specifically, and counterintuitively, a depreciation of the REER is associated with an increase in net remittance inflows, both in the short run and in the long run.

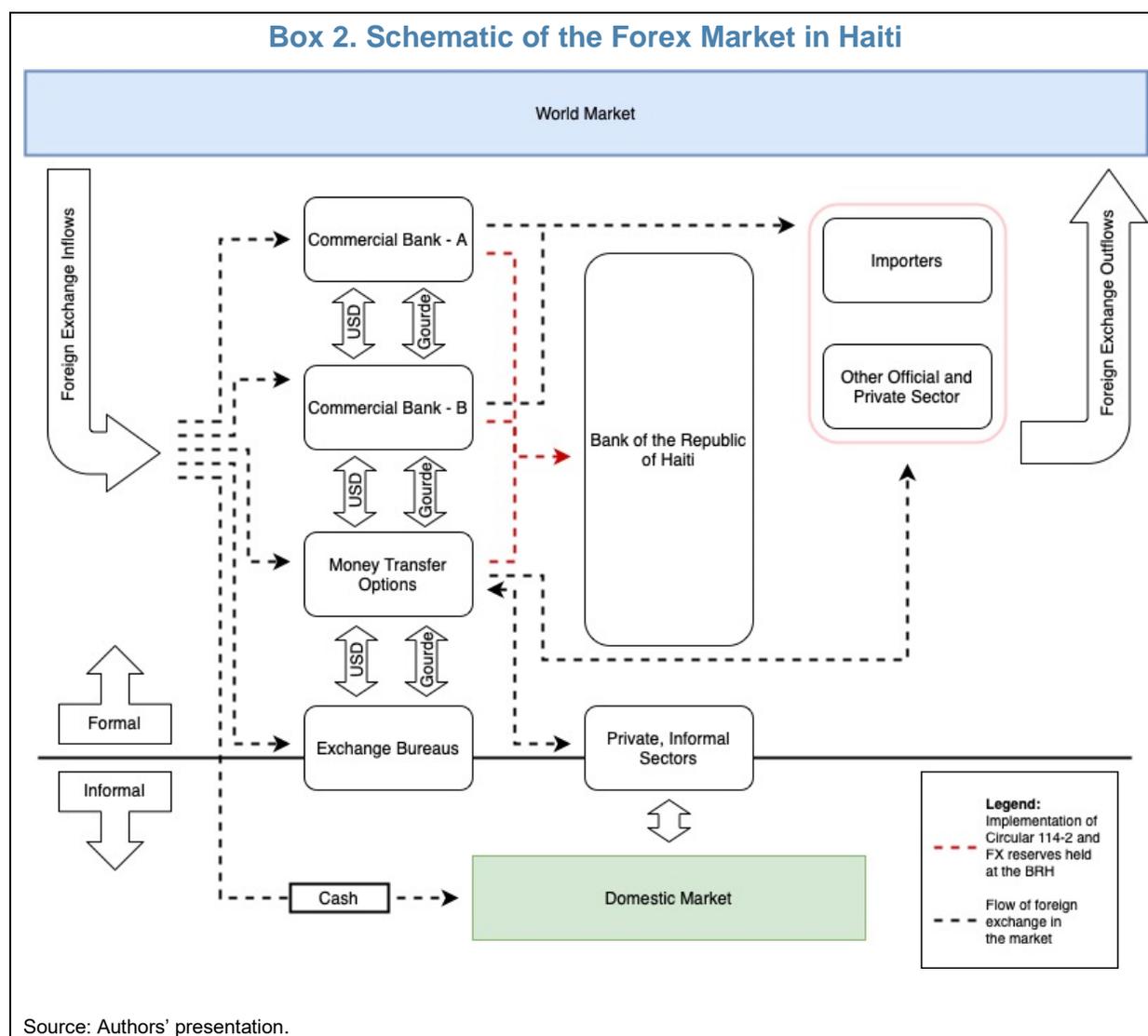
Box 1. Haiti's Forex Regulations

The authorities introduced new regulations in mid-2020 governing international money transfers and instituted several forex regulations targeted at banks and money transfer agencies engaged in international transfers. The most binding regulation was circular 114-2, announced in September 2020. This circular mandated that banks and money transfer companies exchange dollar remittances into gourdes for persons not holding U.S. dollar bank accounts; convert all dollar remittances into gourdes at the BRH reference rate, which was less favorable than the parallel exchange rate for dollars; and required banks and money transfer companies to sell 30 percent of the forex received from remittance inflows to the BRH at the reference rate and 40 percent to banks (which themselves are not allowed to keep a net open forex position above 0.5 percent of equity). The table below summarizes the key directives introduced by the BRH that had implications on Haiti's forex market. As noted above, several of the measures introduced in 2020 were reversed in the latter half of 2022, though the impact of the relaxation of these measures on the forex market is beyond the scope of this paper.

Summary table of Haiti's forex regulations

| Regulation | Reference | Regulated entity | Announcement | Effectiveness |
|------------------------------|--|--|--------------|------------------------|
| circular 114 | - | standards for international unrequited funds transfers | 10-Jul-19 | 26-Aug-19 |
| Guidelines for Stockbrokers | law 28 September 2016 | money laundering and financing of terrorism | 27-Aug-20 | <i>at announcement</i> |
| circular 114-2 | decree 5 June 2010 | standards for international unrequited funds transfers | 18-Sep-20 | 1-Oct-20 |
| circular 114-3 | circular 114-2 | Additional standards for international unrequited funds transfers | 23-Aug-22 | 5-Sep-22 |
| circular 118 | circular 114-2 | Submission of reports relating to intermediate transfer and forex transactions | 11-May-21 | 19-May-21 |
| circular Additional Note 118 | circular 114-2 | Daily sale of 30% of transfers received by transfer houses | 8-Oct-21 | <i>at announcement</i> |
| circular 118-1 | circular 118 | Banks and money transfer companies | 23-Aug-22 | 5-Sep-22 |
| circular 119 | decree of 25 November 2020 on forex intermediation | Exchange intermediaries | 11-May-21 | 1-Jun-21 |

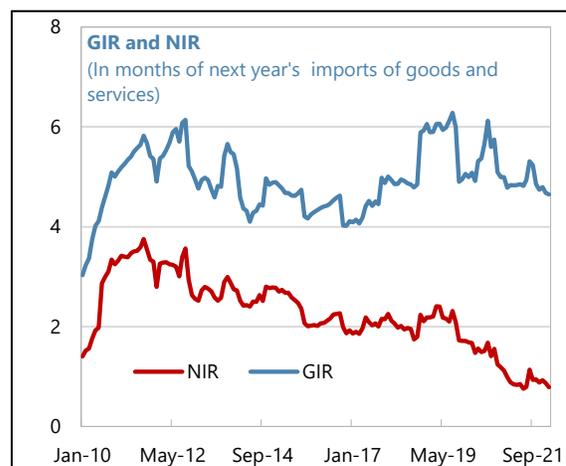
Source: Authors' presentation and the authorities.



29. Forex regulations also had an impact on the functioning of the domestic financial system while increasing its exposure to sovereign risks. Limits on banks' NOPs in forex at 0.5 percent meant that banks would carry a low inventory of dollars on the balance sheet and that would in turn make it difficult to meet the forex needs of customers. This could have also hampered the development of the interbank forex market, as the lack of space for dollar-related balance sheet expansion could have limited the preference of banks to absorb liquidity shocks from counterparties. Additionally, the increase in commercial bank forex deposits at the central bank, brought about by Circular 114-2 and related measures, may have posed an operational risk to commercial banks if they faced restrictions on dollar redemptions from the BRH. Finally, the interest rate offered by the BRH on banks' deposits was lower than the risk-adjusted return available to banks in the open market.

30. The 2020 exchange rate appreciation adversely affected external sustainability. For instance, Haiti's total exports declined about 42 percent year-over-year in 2020, due in part to the erosion in competitiveness caused by the sudden appreciation in Haiti's nominal exchange rate as well as the broader COVID-19 related global slowdown, though disambiguating between these factors is challenging. Textile

exports were particularly hard-hit, declining about 27 percent over the same period. As noted previously, IMF staff analysis in 2020 concluded that the REER was about 40 percent overvalued. As is well discussed in the literature, excessive REER overvaluation can pose challenges to structural transformation and hurt competitiveness and market share. Since 2020, this gap has since narrowed after the nominal exchange rate entered a long depreciating path. Moreover, gross international reserves coverage remained steady in FY2021, adequate to finance more than five months of imports, implying gross reserve adequacy when benchmarked against the three-month import coverage rule of thumb and the model-based results of the IMF's Assessing Reserves Adequacy for Credit Constrained economies (ARA-CC) metric. However, net external buffers declined steadily during this episode, implying that this policy could have exposed the country to external sustainability risks would Haiti have been unable to roll over external reserve-related liabilities. Efforts to defend the nominal value of the gourde, including through the continued accumulation of reserve-related liabilities, could have heightened vulnerabilities given the limited buffers and the absence of a strong export sector.



Policy Considerations

31. The analysis presented suggests that a gradual move toward a more flexible exchange rate regime may be appropriate. Haiti's lack of fiscal policy space, the absence of alternative instruments for absorbing shocks, and structural impediments to effective expenditure-switching measures reinforce the appropriateness of a flexible exchange rate regime. It also underscores the importance of undertaking key policy reforms over the medium term. Firstly, the authorities should focus on growth-promoting structural reforms, further domestic revenue mobilization, and public expenditure rationalization and controls to address the challenge of fiscal dominance. The second set of priorities would be reforms to strengthen the monetary policy transmission mechanism, develop effective monetary policy instruments (money supply- or interest rate-based), and strengthen the central bank's capacity for liquidity management and forecasting. These would facilitate development and deepening of domestic financial and forex markets and would: (i) allow the BRH to pursue a more independent monetary policy, with the primary objective of containing inflationary pressures and inflation expectations, and (ii) facilitate a gradual shift towards a more flexible exchange rate regime that would allow the exchange rate to play an increasingly effective role as a shock absorber, without having major repercussions for price stability.

32. In the transition to a more flexible regime, however, a nominal exchange rate anchor could be complemented with reserve money programming (RM) to anchor inflation expectations and manage forex reserves. As Adam and Wilson (2021) note, many FCS have used RM programming to contain fiscal dominance and anchor inflation expectations as part of a successful exit strategy from poverty, fragility, and conflict. Given high rates of inflation pass-through, there could be benefits to using the exchange rate as a nominal anchor to contain inflationary pressures and inflation expectations, something that can be complemented by a RM framework.

33. Additionally, Haiti could benefit from streamlining some of the measures adopted in the 2020 episode based on the above findings. This could include: 1) reducing forex surrender requirements and limits on banks' NOPs to reduce forex volatility and increase market depth; 2) refraining from forex intervention, given issues related to external sustainability and the low empirical impact of forex sales on the level of the exchange rate; and 3) continuing with structural policies to improve the functioning of the forex market. Doing so could allow the authorities to better manage limited net external buffers, unify the official and parallel exchange rates, and improve forex availability to the private sector to facilitate capital deepening and structural transformation.

Conclusion

34. The purpose of this study is to examine the relatively unusual case of Haiti's policy-driven sharp exchange rate appreciation and its impact on the economy. The study finds that, using forex intervention announcements, regulations, and moral suasion, the BRH was highly effective during August-October 2020 at halting the slide in the gourde/U.S. dollar rate and bringing about a rapid appreciation of about 50 percent. This episode also coincided with rising balance of payments receipts, especially remittances from the U.S., as well as a contraction in imports relating to COVID-19 and the ongoing political and security crisis. This paper analyzed the methods and impact of this episode on the economy, financial sector, and Haitians. The findings aim to shed light on the functioning of the market and better inform the design and conduct of exchange rate policy in Haiti going forward. This stock-taking also contributes to the broader literature of monetary policy and exchange rate management in FCS.

35. The key factors behind the gourde appreciation in 2020 derived more from forex regulations and its impact on money supply growth than from intervention. Data on relative growth rates of real GDP and money supplies for the second half of 2020 for the U.S. and Haiti suggest that money supply growth differentials played a role in driving the sharp appreciation of the gourde, with higher annual money supply growth in the U.S. relative to Haiti. The empirical results suggest that the forex regulations announced in September 2020 contributed more to the strengthening of the gourde in the second half of 2020 than did forex intervention by the central bank.

36. The episode had important and mostly negative spillovers on the economy. The nominal exchange rate appreciation contributed to a decline in headline inflation in 2020-2021. However, this was unwound in 2021-2022 as oil prices rebounded and the nominal exchange rate reverted to pre-2020 levels. Forex intervention reduced external buffers and led to a broadly misaligned exchange rate that was inconsistent with macroeconomic fundamentals, with the appreciation being subsequently and gradually reversed and the nominal and real exchange rates adjusting to better reflect fundamentals. Meanwhile, remittance-dependent households, savers, and financial institutions were adversely affected while the government and importers with access to the forex market benefitted. The forex surrender requirements decreased liquidity in the forex markets while increasing exchange rate volatility, hampering the smooth functioning of the forex market while contributing to greater volatility in inflation. Importantly, these policies also contributed to a sharp widening of the parallel forex market premium. Finally, the authorities' efforts to bring about an appreciation contributed to a worsening of external sustainability.

37. A more cautious approach to exchange rate management may be beneficial. Haiti's shock-prone nature and urgent development needs magnify the importance of having a sustainable monetary and exchange rate policy suited to economic and institutional conditions. It proved difficult for the authorities to sustain a

nominal exchange rate that was not consistent with macroeconomic fundamentals and without the fiscal policy stance or market instruments to support such a regime. Given the costs of the 2020 episode to the economy and to Haitians, further streamlining of regulations could usefully be implemented and potentially complemented by a RM framework for monetary policy. Doing so would permit the market to allocate scarce foreign exchange reserves more efficiently, help eliminate the parallel exchange rate premium, reduce the impetus toward fiscal dominance, and help catalyze structural transformation.

Annex I. Estimation of an Exchange Rate Model Calibrated for Haiti

Annex I presents an analysis of the key drivers of exchange rate movements of the Haitian gourde against the U.S. dollar. These results suggest that the forex regulations announced in September 2020 contributed more to the strengthening of the gourde in the second half of 2020 than did forex intervention by the central bank. GDP growth, interest rate, and money supply growth differentials have a significant effect on the exchange rate over the long run. As exchange rate theory would predict, a rise in GDP in the U.S. relative to Haiti has the impact of depreciating the Haitian gourde over the long run, while a rise in relative money supplies in the U.S. and Haiti has the opposite effect. Forex regulations that came into effect in 2020Q4 had a statistically significant and long-lasting appreciation effect on the Haitian gourde. However, the results suggest that a rise in relative interest rates in the U.S. leads to an appreciation, rather than a depreciation, of the Haitian gourde relative to the U.S. dollar, both in the long-run and in the short-run, and the effects of interest rate differentials are statistically significant. This could possibly be due to the nature of the financial system in Haiti and could have the effect of impeding the effective functioning of the monetary policy transmission mechanism. Forex intervention does not seem to impact the exchange rate, even in the short run, possibly due to signaling effects of the authorities' policy that run counter to the goals of intervention.

Model Details

A VECM of Haiti's Nominal Exchange Rate

Drawing on the methodology employed by (Genberg, 1981) and (Suss E. C., 1980)—who present a *monetary model* of exchange rates—the nominal exchange rate in Haiti, s_t , is modelled as a function of several variables using quarterly data (below and equation (1)). Data is from the IMF's World Economic Outlook database, the Federal Reserve Bank of St. Louis website, and the Haver database.⁵

Prior to estimating the exchange model, unit root tests and tests for co-integration were carried out to examine the time series properties of the underlying data. Unit root tests suggested the following variables were non-stationary, i.e. $I(1)$:

- **LNEXRPA**: the log of Haiti's nominal exchange rate against the U.S. dollar (Haitian gourdes per U.S. dollar, period average)
- **LNGDPDIFF**: the differential between the log of U.S. real output and the log of Haitian real output, where a quarterly output series was interpolated for Haiti from annual data following the Chow-Lin methodology⁶
- **LNMONDIF**: the differential between the log of the U.S. money supply and the log of the Haitian money supply
- **LNINTDIFF**: the differential in short-term interest rates, calculated by: $\text{Log}(1 + \text{U.S. three-month T-bill rate}) - \text{Log}(1 + \text{Haiti's three-month T-bill rate})$
- **LNHTIREMS**: the log of net inflows of remittances to Haiti as a percent of GDP, seasonally adjusted using the TRAMS methodology. Note that remittances turned out to be on the borderline of having a

⁵ See (International Monetary Fund, 2022b), (Federal Reserve Economic Data, 2022), and (Haver Analytics, n.d.).

⁶ See (Chow & Lin, 1971).

unit root and was thus not included in the long-run co-integrating vector, but its first difference was included in the short-run VECM equation.

The following variable was stationary:

- **CBFXINT:** The volume of intervention by the Central Bank in the forex market (i.e., net purchases of forex by the BRH in percent of GDP)

In addition, two dummy variables were included in the regressions:

- **DUM2020Q4:** a dummy variable equal to zero prior to 2020q4, and to 1 in subsequent quarters to capture the long-run impact on the exchange rate of the new forex regulations that came into effect in October 2020
- **DUM2020Q2:** a dummy variable equal to 1 in 2020Q2 and to zero otherwise, included in the short-term VECM equation to capture the immediate temporary repercussions on Haiti from the onset of the COVID-19 pandemic.

Johansen-Juselius trace and maximum eigenvalue co-integration tests indicate that the four variables LNEXRPA, LNGDPDIFF, LNMONDIFF, and LNINTDIFF are co-integrated. This indicates that these (non-stationary) variables move together in the long-run and thus there is a stable long-run relationship between them. Hence, the use of a VECM model is appropriate.

The first step was to estimate a long-run co-integrating relationship using Fully Modified Least Squares (FMOLS) of the below form:

$$(1) LNEXRPA_t = \alpha_0 + \beta_1 LNGDPDIFF_t + \beta_2 LNMONDIFF_t + \beta_3 LNINTDIFF_t + \beta_4 DUM2020Q4_t + u_t$$

where the variables are as defined above.

Estimation of the long-run equation covered the period 2008Q1 to 2021Q1 (54 quarterly observations).

Results

Estimated results are presented in Annex I – Table 1 below. They indicate that differentials in GDP growth, money supply growth, and short-term interest rates (three-month T-bill rates) have a significant effect on the exchange rate over the long run. Consistent with standard exchange rate theory, a rise in GDP in the U.S. relative to Haiti would have the impact of depreciating the Haitian gourde over the long run, while a rise in money supply in the U.S. relative to Haiti would have the opposite effect. Also, the forex regulations that came into effect in 2020Q4 appear to have led to a statistically significant and long-lasting appreciation of the Haitian gourde. However, and surprisingly, the results suggest that a rise in relative interest rates in the U.S. leads to an appreciation, rather than a depreciation, of the Haitian gourde relative to the U.S. dollar in the long-run, and the effect is statistically significant. One potential explanation for this result could be the nature of the financial system in Haiti, which could have the effect of impeding the effective functioning of the monetary policy transmission mechanism.

Annex I – Table 1: Haiti: Long-run Determinants of Haiti's Nominal Exchange Rate

Dependent Variable: LNEXRPA

Method: Fully Modified Least Squares (FMOLS)

Date: 07/21/22 Time: 11:53

Sample (adjusted): 2008Q1 2021Q2

Included observations: 54 after adjustments

Cointegrating equation deterministics: C DUM2020Q4

Long-run covariance estimate (Bartlett kernel, Newey-West fixed bandwidth = 4.0000)

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|--------------------|-------------|--------------------|-------------|----------|
| LNGDPDIFF | 0.013235 | 0.006633 | 1.995240 | 0.0516 |
| LNMONDIFF | -0.831893 | 0.126117 | -6.596220 | 0.0000 |
| LNINTDIFF | -2.442655 | 0.687944 | -3.550663 | 0.0009 |
| C | 10.11123 | 1.340895 | 7.540663 | 0.0000 |
| DUM2020Q4 | -0.337897 | 0.154827 | -2.182422 | 0.0339 |
| R-squared | 0.866033 | Mean dependent var | | 3.981585 |
| Adjusted R-squared | 0.855097 | S.D. dependent var | | 0.310064 |
| S.E. of regression | 0.118029 | Sum squared resid | | 0.682617 |
| Long-run variance | 0.021948 | | | |

Short-Run Dynamics

Next the short-run dynamics of the U.S. dollar – Haitian gourde exchange rate are investigated, as presented in Annex I – Table 2. Note that in the short-run specification, first differences (i.e., $D(x)$, which represents the first difference of a given variable x) are used to account for non-stationarity in the relevant variables. Among the key variables, only changes in the interest rate differential appear to be statistically significant. However, as with the estimated long-run equation, the sign of the co-efficient is puzzling as it suggests that higher interest rates in the U.S. is associated with an appreciation of the Haitian gourde. Movements in the volume of net remittance inflows as a percent of GDP do not seem to have a significant impact on exchange rate movements in the short run, nor does the amount of forex intervention by the BRH. The co-efficient on the lagged residuals from the long-run equation, **RES13**, is statistically significant and implies that about a third of any disequilibrium in the forex market is corrected each quarter—in other words, it takes about three quarters for the exchange rate to move to its long-run equilibrium level following a disturbance.

Annex I – Table 2: Haiti: Short-term Exchange Rate Dynamics

Dependent Variable: D(LNEXRPA)

Method: Least Squares

Date: 07/21/22 Time: 12:11

Sample (adjusted): 2008Q2 2021Q2

Included observations: 53 after adjustments

HAC standard errors & covariance (Bartlett kernel, Newey-West fixed
bandwidth = 4.0000)

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|------------------------|-------------|-----------------------|-------------|-----------|
| C | -0.012647 | 0.014741 | -0.857956 | 0.3955 |
| D(LNGDPDIFF) | 0.001950 | 0.005976 | 0.326246 | 0.7458 |
| D(LNMONDIFF) | -0.305731 | 0.276300 | -1.106518 | 0.2744 |
| D(LNINTDIFF) | -0.868672 | 0.229474 | -3.785492 | 0.0005 |
| DLNHTIREMS | 0.006328 | 0.004769 | 1.326872 | 0.1912 |
| CBFXINT | -0.007011 | 0.032138 | -0.218143 | 0.8283 |
| RES13(-1) | -0.344654 | 0.143299 | -2.405131 | 0.0203 |
| DUM2020Q2 | 0.140581 | 0.067483 | 2.083202 | 0.0429 |
| R-squared | 0.459885 | Mean dependent var | | 0.015860 |
| Adjusted R-squared | 0.375867 | S.D. dependent var | | 0.080363 |
| S.E. of regression | 0.063489 | Akaike info criterion | | -2.537652 |
| Sum squared resid | 0.181387 | Schwarz criterion | | -2.240250 |
| Log likelihood | 75.24779 | Hannan-Quinn criter. | | -2.423286 |
| F-statistic | 5.473647 | Durbin-Watson stat | | 2.079737 |
| Prob(F-statistic) | 0.000136 | Wald F-statistic | | 42.29437 |
| Prob(Wald F-statistic) | 0.000000 | | | |

Annex II. Modeling the Volatility of Haiti's Nominal Exchange Rate

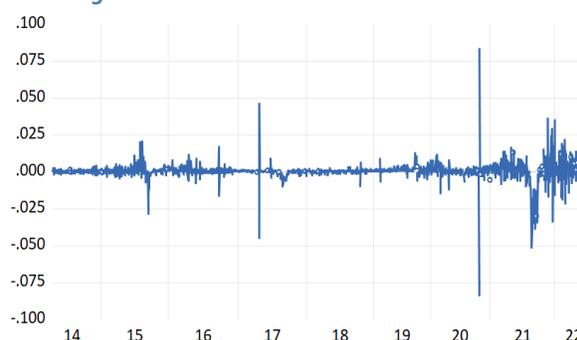
Annex II presents a model of estimating the impact of forex surrender requirements of the volatility of Haiti's nominal exchange rate. The results show that the surrender requirements had a statistically significant and positive impact on Haiti's forex volatility.

Model Details

A GARCH(1,1) Model of Haiti's Nominal Exchange Rate

This study analyzed the volatility in Haiti's nominal exchange rate. To do so, a GARCH methodology was employed as set forth in, inter-alia, (Bollerslev, 1986), (Engle, 1982), and (Engle, 2001). Drawing on data provided by the BRH, the BRH's Gourde reference rate, which is a 60 percent/40 percent weighted average of the prevailing official and informal market respectively, were analyzed. Daily observations from May 2, 2014 through June 30, 2022 were transformed to a daily return series using logs. Based on a visual inspection of the data, the daily returns exhibit ARCH effects, insofar as the amplitude of the returns varies over time (Annex II – Figure 1). ARCH effects are further confirmed by the autocorrelations of the returns of the daily nominal exchange rate (Annex II – Table 1). The first- and second-order autocorrelations are 0.034 and 0.331, respectively, gradually declining to 0.03 after twenty-two lags. Small p-values for the lags indicate that the “no ARCH” effects null hypothesis can be broadly rejected.

Annex II – Figure 1: Log Daily Returns of the BRH Nominal Exchange Rate



This model design follows from (Yiu, 2011), who studied the effects of capital flow management measures on the volatility in several Asian economies. Similar to Yiu and (Hoshikawa, 2008), the model shows changes in the volatility of the nominal exchange rate as a function of its own lags while omitting external shocks from the mean equation of the GARCH model. Such a specification allows the researcher to focus on the impact of changes in forex regulations on forex volatility, as the modeling of the determinants of the nominal exchange rate in the mean equation of the GARCH is considered secondary to answering the question about the impact of the surrender requirements on forex volatility.

The GARCH(1,1) model used to represent the impact of Haiti's forex surrender requirements on the volatility of Haiti's exchange rate is as follows:

$$(2) R_t = c + \sum_{i=1}^p \gamma_i R_{t-i} + \delta SR + \varepsilon_t$$

$$\varepsilon_t \sim N(0, h_t^2)$$

$$(3) h_t^2 = \omega + \alpha \varepsilon_{t-1}^2 + \beta h_{t-1}^2 + \delta SR \mid_{\omega > 0; \alpha \geq 0; \beta \geq 0; (\alpha + \beta) < 1}$$

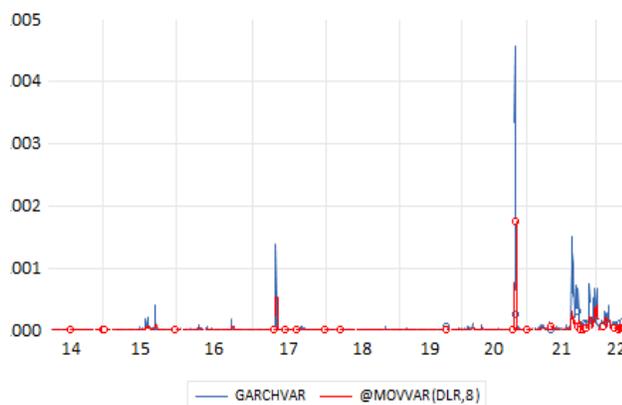
Where R_t is the return on the nominal daily average exchange rate, which is determined by the auto-regressive mean equation (2). Variable SR is a dummy variable that takes on a value of 1 for all dates after the introduction of Circular 114-2 (i.e., September 1, 2020 onward) and 0 for all other dates. The conditional variance, h_t^2 , is estimated by a GARCH(1,1) variance equation (3), which itself is a weighted average function of the squared residual from the mean equation from the prior period (ε_{t-1}^2) and the long-term variance (h_{t-1}^2), as well as the dummy variable SR with parameter δ for days when the surrender requirements were made effective. The intuition of this model is that if the estimated parameter δ is statistically significant, then it could be inferred that the surrender requirements impacted the volatility of Haiti's nominal exchange rate: a positive value of δ would imply that the surrender requirements increased the volatility of Haiti's nominal exchange rate, while a negative δ would show that surrender requirements decreased volatility.⁷ Finally, in the GARCH(1,1) model, the sum of the parameters α and β indicate the speed at which the variance process mean reverts. Sums closer to 1 indicate a slower mean-reverting process compared to sums closer to 0.

Results

The results of the estimated GARCH(1,1) model are presented in Annex I – Table 2. They show that that Haiti's nominal exchange rate volatility increased after the authorities introduced the forex surrender requirements.

The mean equation included 9 autoregressive terms per standard lag selection criteria. The variance equation included a constant, estimators on moving average lags and autoregressive variance lags (α and β , respectively), and a dummy variable for the day the authorities announced their forex surrender requirements via Circular 114-2 on September 18, 2020 estimated by parameter δ . The results show that the four coefficients of the variance equation sum up to less than 1, which implies the existence of a mean reverting variance process. The coefficient on the dummy is both positive and statistically significant, indicating

Annex II – Figure 2: GARCH Volatility vs. 8-day Rolling Variance



that the surrender requirements increased the variance in the daily returns of the nominal exchange rate. The GARCH modeled exchange rate volatility and 8-day moving average variance are presented in Annex II – Figure 2. Note that standardized residuals from this estimation pass standard GARCH robustness checks, as the residuals do not show autocorrelation as referenced by the large p-values presented in Annex II – Table 3.

Discussion

Several factors may account for heightened exchange rate volatility after the introduction of the surrender requirements. The surrender requirements were introduced when the authorities took additional actions in the

⁷ For instance, using this method, (Yiu, 2011) shows that various capital flow measures adopted by Asian economies around the global financial crisis had a statistically significant and negative impact on the GARCH-implied volatility of Asian nominal exchange rates.

forex market, including forex sales, sanctions on financial institutions, and policy communications. It is possible that these additional factors contributed to a rise in the volatility of the nominal exchange rate. Additionally, the surrender requirements reduced market liquidity for dollars in Haiti as financial institutions pulled back from the market. This reduced liquidity is evidenced in higher bid-offer spreads observed in both the bank and informal forex market (Figure 1). Lower liquidity may have made smooth functioning of the forex market more challenging, in turn increasing volatility of the nominal exchange rate.

Annex II – Table 1: Autocorrelations of the Daily Nominal Exchange Rate Returns

| <i>Lag</i> | AC | PAC | Q-Stat | Prob |
|------------|-----------|------------|---------------|-------------|
| 1 | 0.034 | 0.034 | 2.0068 | 0.157 |
| 2 | 0.331 | 0.33 | 189.86 | 0 |
| 3 | 0.312 | 0.329 | 356.71 | 0 |
| 4 | 0.255 | 0.207 | 468.7 | 0 |
| 5 | 0.281 | 0.155 | 603.79 | 0 |
| 6 | 0.227 | 0.068 | 692.67 | 0 |
| 7 | 0.275 | 0.093 | 822.77 | 0 |
| 8 | 0.182 | -0.004 | 879.98 | 0 |
| 9 | 0.239 | 0.025 | 978.31 | 0 |
| 10 | 0.212 | 0.033 | 1055.9 | 0 |
| 11 | 0.161 | -0.026 | 1100.3 | 0 |
| 12 | 0.233 | 0.043 | 1193.7 | 0 |
| 13 | 0.135 | -0.021 | 1225.2 | 0 |
| 14 | 0.186 | 0.002 | 1285.2 | 0 |
| 15 | 0.165 | 0.017 | 1332.3 | 0 |
| 16 | 0.105 | -0.055 | 1351.5 | 0 |
| 17 | 0.136 | -0.042 | 1383.7 | 0 |
| 18 | 0.082 | -0.064 | 1395.3 | 0 |
| 19 | 0.109 | -0.033 | 1416 | 0 |
| 20 | 0.025 | -0.089 | 1417.1 | 0 |
| 21 | 0.081 | -0.037 | 1428.3 | 0 |
| 22 | 0.03 | -0.038 | 1429.9 | 0 |
| 23 | 0.032 | -0.013 | 1431.8 | 0 |
| 24 | 0.029 | -0.013 | 1433.2 | 0 |
| 25 | 0.012 | 0.001 | 1433.5 | 0 |

Annex II – Table 2: GARCH(1,1) Results

Dependent Variable: DLR

Method: ML - ARCH

Sample (adjusted): 5/15/2014 6/30/2022

Included observations: 1702 after adjustments

Convergence achieved after 29 iterations

Coefficient covariance computed using outer product of gradients

Presample variance: backcast (parameter = 0.7)

GARCH = C(2) + C(3)*RESID(-1)^2 + C(4)*GARCH(-1) + C(5)*DUMMY

| Variable | Coefficient | Std. Error | Prob. |
|----------|-------------|------------|--------|
| AR(9) | 0.069638 | 0.017906 | 0.0001 |

Variance Equation

| | | | |
|-------------|----------|----------|---|
| C | 2.81E-06 | 1.38E-07 | 0 |
| RESID(-1)^2 | 0.389933 | 0.025856 | 0 |
| GARCH(-1) | 0.373933 | 0.03046 | 0 |
| DUMMY | 3.26E-05 | 1.72E-06 | 0 |

| | | | |
|--------------------|----------|-----------------------|-----------|
| R-squared | 0.024821 | Mean dependent var | 0.000396 |
| Adjusted R-squared | 0.024821 | S.D. dependent var | 0.006107 |
| S.E. of regression | 0.00603 | Akaike info criterion | -8.515823 |
| Sum squared resid | 0.06182 | Schwarz criterion | -8.499835 |
| Log likelihood | 7247.707 | Hannan-Quinn criter. | -8.509905 |
| Durbin-Watson stat | 1.976078 | | |

Annex II – Table 3: Standardized Residuals of GARCH(1,1)

| <i>Lag</i> | AC | PAC | Q-Stat | Prob |
|------------|-----------|------------|---------------|-------------|
| 1 | 0.004 | 0.004 | 0.0268 | 0.87 |
| 2 | -0.003 | -0.003 | 0.0412 | 0.98 |
| 3 | -0.003 | -0.003 | 0.0561 | 0.997 |
| 4 | -0.003 | -0.003 | 0.0743 | 0.999 |
| 5 | -0.003 | -0.003 | 0.094 | 1 |
| 6 | -0.002 | -0.002 | 0.0998 | 1 |
| 7 | -0.002 | -0.002 | 0.1086 | 1 |
| 8 | -0.002 | -0.002 | 0.1182 | 1 |
| 9 | 0.003 | 0.003 | 0.1344 | 1 |
| 10 | 0 | 0 | 0.1346 | 1 |
| 11 | -0.003 | -0.003 | 0.1457 | 1 |
| 12 | -0.003 | -0.003 | 0.1626 | 1 |
| 13 | -0.002 | -0.002 | 0.1716 | 1 |
| 14 | -0.004 | -0.004 | 0.1944 | 1 |
| 15 | -0.003 | -0.003 | 0.2149 | 1 |
| 16 | -0.003 | -0.003 | 0.2258 | 1 |
| 17 | -0.003 | -0.003 | 0.2381 | 1 |
| 18 | -0.001 | -0.001 | 0.2389 | 1 |
| 19 | -0.004 | -0.004 | 0.2626 | 1 |
| 20 | 0 | 0 | 0.2629 | 1 |
| 21 | -0.003 | -0.003 | 0.274 | 1 |
| 22 | -0.004 | -0.004 | 0.2954 | 1 |
| 23 | -0.004 | -0.004 | 0.3218 | 1 |
| 24 | -0.004 | -0.004 | 0.3518 | 1 |
| 25 | -0.002 | -0.002 | 0.3576 | 1 |

Annex III. Estimating Exchange Rate Pass-Through to Inflation in Haiti and Regional Peers

This Annex provides an analysis of the exchange rate pass-through to inflation in Haiti. It confirms that the exchange rate pass-through coefficient has increased in Haiti over the past decade, from about -0.45 over the period of January 1995 to September 2021 to about -0.64 over the period from January 2009 to September 2021. Pass-through estimates during the more recent period suggest that the exchange rate pass-through coefficient in Haiti is among the highest in the Caribbean and Central America and much higher than the regional average. Using a more model based VECM, which takes into account a simple monetary policy reaction function and the monetary policy transmission mechanism, as well as the time series properties of the data, yields similar estimates of the exchange rate passthrough to inflation, in the range of -0.66 to -0.74. The empirical results indicate that a unit shock to the nominal effective exchange rate (i.e., an appreciation) has a cumulative (negative) impact on the CPI price level of about 0.25 percentage points after one year.

Model Details

Model 1: the Auto Regressive Distributed Lag (ARDL) Model of Exchange Rate Pass-through

First a bivariate ARDL model is estimated by regressing month-on-month CPI inflation on month-on-month movements in the NEER and twelve lags of both variables, as represented in equation (4). The results of this regression are presented in Annex III – Table 1 and suggest a significant rise in the exchange rate pass-through coefficient, from about -0.45 over the period 1995M1-2021M9 to about -0.64 over the period 2009M1-2021M9.⁸ Estimates for other countries in the region over the more recent period suggest that the exchange rate pass-through coefficient is among the highest in the Caribbean and Central America and much higher than the regional average (Annex II –Table 2).

$$(4) \Delta \ln HTICPI_t = \alpha_0 + \sum_{i=1}^p \beta_i \Delta \ln HTICPI_{t-i} + \sum_{j=0}^q \gamma_j \Delta \ln HTINEER_{t-j} + \varepsilon_t$$

Model 2: A VECM Estimation of Exchange Rate Pass-through

Note the above ARDL methodology only looks at the relationship between the NEER and prices, without considering the role of monetary policy in targeting inflation. A VECM estimation method allows us to include a monetary policy reaction function and monetary policy transmission mechanism, as well as the time series properties of the data.

Unit root tests suggested the following variables were non-stationary, i.e. I(1):

- **LNCPI** – log of Haiti's CPI index

⁸ Long-run pass-through coefficients that relate changes in domestic prices (i.e., the CPI) to changes in the nominal exchange rate are estimated via the below formula, where the numerator is the sum of the estimators on lags 1-12 (i.e., q = 12) of the month-on-month change in the natural log of the CPI and the denominator is one less the sum of the estimators on lags 0-12 (i.e., p = 12) of the month-on-month change in the natural log of the NEER, see below. This technique draws on the approach put forth by, inter-alia, (Aisen, Manguinhane, & Simone, 2021).

$$\text{Pass-through coefficient} = \frac{\sum_0^q \hat{\gamma}_j}{1 - \sum_1^p \hat{\beta}_i}$$

- **LNNEER** – log of the nominal effective exchange rate, period average
- **LNBRMNY** – log of broad money

Unit root tests for the interest rate variable **TBILLRATE91** (defined as 1 + the three-month treasury bill rate) were stationary on the borderline at the 5 percent significance level. Furthermore, the Johansen-Juselius trace and maximum eigenvalue co-integration tests indicate that these variables are co-integrated over the long-run. Thus, these results indicate that these (non-stationary) variables move together in the long-run and thus there is a stable long-run relationship between them. Hence use of a VECM model is appropriate.

Estimation of the VECM covered the period of January 2009 to October 2020 (comprising 142 monthly observations). The lag length was determined on the basis on the Likelihood Ratio (LR) statistic for lag length criteria, which suggested using one lag was the appropriate lag length for this VECM estimation. The results show that a one-unit shock to the NEER (an appreciation) has a cumulative (negative) impact on the CPI price level of around 0.25 percentage points after 12 months. Estimates of the long-run exchange rate pass-through to CPI inflation co-efficient decline slowly, from a peak of around -0.75 after twelve months to around -0.66 after 20 months.⁹ The cumulative impulse responses are shown in Annex III – Figure 1.

Discussion

The relatively high exchange rate pass-through to inflation has important implications for monetary policy and the use of the exchange rate as a nominal anchor for price stability. A high rate of exchange rate passthrough to inflation makes it more difficult to control inflation through interest rates or monetary aggregates and thus makes the nominal exchange rate a potentially more effective anchor to attain price stability. However, several country cases, such as South Africa and Poland, show that exchange rate passthrough to inflation can significantly fall over time as the interest rate channel of monetary policy strengthens and inflation expectations become better anchored if the central bank succeeds in increases its credibility. These results also suggest that exchange rate volatility passes through to volatility in price levels and inflation rates, complicating the conduct of monetary policy.

⁹ The exchange rate pass-through coefficient from the VECM model is defined as: *Pass-through coefficient* = $\frac{P_{t+j}}{E_{t+j}}$, where P_{t+j} is the cumulative change in the price level and E_{t+j} is the cumulative change in the nominal effective exchange rate between months t and $t+j$.

Annex III – Table 1: Haiti: ARDL Estimate of Exchange Rate Pass-through to Inflation

Dependent Variable: DLNHTICPI

Method: Least Squares

Date: 12/13/21 Time: 20:09

Sample: 2009M01 2021M09

Included observations: 153

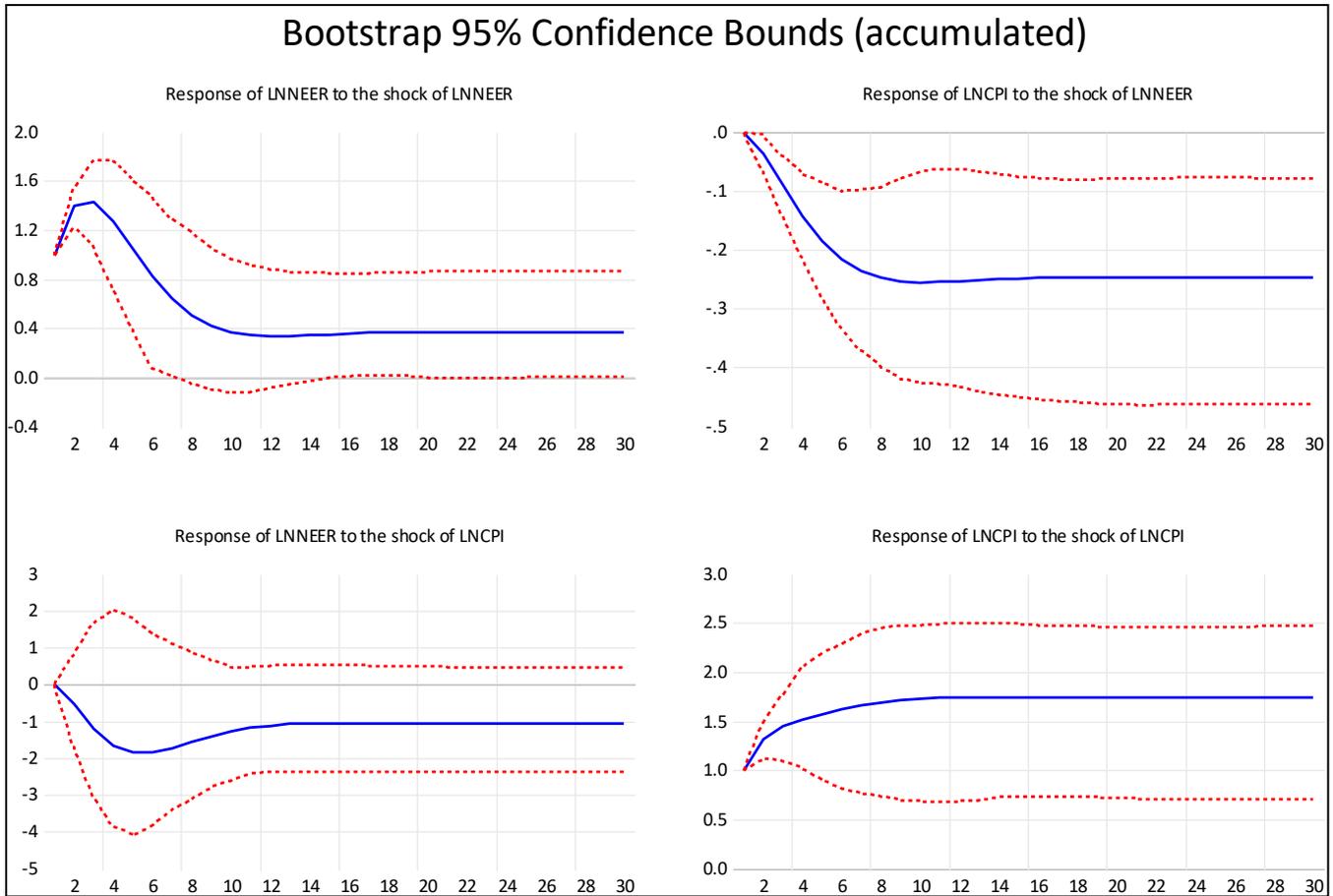
Huber-White-Hinkley (HC1) heteroskedasticity consistent standard errors
and covariance

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|------------------------|-------------|-----------------------|-------------|--------|
| C | 0.1204 | 0.104644 | 1.150568 | 0.2521 |
| DLNHTICPI(-1) | 0.341949 | 0.262584 | 1.302245 | 0.1952 |
| DLNHTICPI(-2) | 0.292682 | 0.110212 | 2.655627 | 0.0089 |
| DLNHTICPI(-3) | 0.045232 | 0.115289 | 0.392334 | 0.6955 |
| DLNHTICPI(-4) | 0.007923 | 0.07128 | 0.111146 | 0.9117 |
| DLNHTICPI(-5) | 0.037025 | 0.084714 | 0.437059 | 0.6628 |
| DLNHTICPI(-6) | 0.010014 | 0.062964 | 0.159047 | 0.8739 |
| DLNHTICPI(-7) | 0.017958 | 0.050581 | 0.355035 | 0.7232 |
| DLNHTICPI(-8) | -0.053803 | 0.054717 | -0.983289 | 0.3273 |
| DLNHTICPI(-9) | -0.13697 | 0.132731 | -1.031939 | 0.3041 |
| DLNHTICPI(-10) | 0.157452 | 0.096947 | 1.624103 | 0.1068 |
| DLNHTICPI(-11) | 0.009028 | 0.110309 | 0.081841 | 0.9349 |
| DLNHTICPI(-12) | 0.031759 | 0.078152 | 0.406379 | 0.6851 |
| DLNHTINEER | -0.061956 | 0.021015 | -2.948202 | 0.0038 |
| DLNHTINEER(-1) | -0.012349 | 0.032008 | -0.385811 | 0.7003 |
| DLNHTINEER(-2) | 0.005926 | 0.017416 | 0.340261 | 0.7342 |
| DLNHTINEER(-3) | -0.012994 | 0.014486 | -0.897007 | 0.3714 |
| DLNHTINEER(-4) | 0.002692 | 0.013662 | 0.197061 | 0.8441 |
| DLNHTINEER(-5) | -0.005231 | 0.012745 | -0.410439 | 0.6822 |
| DLNHTINEER(-6) | -0.026187 | 0.010111 | -2.590077 | 0.0107 |
| DLNHTINEER(-7) | 0.00621 | 0.012425 | 0.499846 | 0.618 |
| DLNHTINEER(-8) | -0.029663 | 0.008631 | -3.436724 | 0.0008 |
| DLNHTINEER(-9) | -0.011761 | 0.013866 | -0.848166 | 0.3979 |
| DLNHTINEER(-10) | -0.003975 | 0.013096 | -0.303542 | 0.762 |
| DLNHTINEER(-11) | -0.003872 | 0.011495 | -0.336871 | 0.7368 |
| DLNHTINEER(-12) | -1.16E-05 | 0.011077 | -0.001047 | 0.9992 |
| R-squared | 0.580277 | Mean dependent var | 0.70589 | |
| Adjusted R-squared | 0.497654 | S.D. dependent var | 0.74243 | |
| S.E. of regression | 0.526212 | Akaike info criterion | 1.70739 | |
| Sum squared resid | 35.16613 | Schwarz criterion | 2.22236 | |
| Log likelihood | -104.6155 | Hannan-Quinn criter. | 1.91658 | |
| F-statistic | 7.023223 | Durbin-Watson stat | 2.24105 | |
| Prob(F-statistic) | 0 | Wald F-statistic | 21.5965 | |
| Prob(Wald F-statistic) | 0 | | | |

**Annex III – Table 2: Estimated Exchange Rate Pass-Through to Inflation
– Selected Central American and Caribbean Countries**

| Central America and the Caribbean: | | | 2009M1-2021M9 |
|---|---------|---------------|----------------------|
| Guyana | -0.3898 | 1995M1-2021M9 | -0.5508 |
| Haiti | -0.4451 | 1995M1-2021M9 | -0.6389 |
| Bahamas | -0.0827 | 1995M1-2021M9 | -0.7705 |
| Jamaica | -0.8200 | 1995M1-2021M9 | -0.4221 |
| Trinidad and Tobago | -0.4646 | 1995M1-2021M9 | -0.2549 |
| Barbados | 0.3793 | 1995M1-2021M9 | -0.4534 |
| Dominican Republic | -0.6441 | 1995M1-2021M9 | -0.4509 |
| Costa Rica | -0.5577 | 1996M1-2021M9 | -0.1431 |
| Panama | -0.2277 | 1995M1-2021M9 | -0.1133 |
| Guatemala | -0.2071 | 1995M1-2021M9 | -0.0109 |
| El Salvador | -0.9268 | 1995M1-2021M9 | -0.5904 |
| Nicaragua | -0.9425 | 1995M1-2021M9 | -0.4100 |
| Honduras | -0.6105 | 2001M9-2021M9 | -0.3628 |
| Dominica | -0.3181 | 1995M1-2021M9 | -0.1815 |
| Suriname | -0.6253 | 1995M1-2021M9 | -0.5336 |
| Antigua and Barbuda | -0.1399 | 1996M1-2021M9 | -0.1338 |
| Grenada | -0.4293 | 1995M1-2021M9 | -0.3967 |
| St. Kitts and Nevis | -0.3525 | 1995M1-2021M9 | -0.2399 |
| St Vincent and the Grenadines | -0.6516 | 1995M1-2021M9 | -0.5829 |
| Regional Average | -0.4450 | | -0.3811 |

Annex III – Figure 1 : (Accumulated) Impulse Responses to Exchange Rate and Price Level Unit Shocks



Annex IV. Assessing the Sensitivity of Exports and Remittances to Exchange Rate Movements

This Annex IV the sensitivity of Haiti's exports, imports, and net remittance inflows to movements in the REER. The results suggest that Haiti's net remittance flows, unlike exports and imports of goods, are highly sensitive to movements in the REER, both in the short-run and in the long-run.

Model Details

Data to estimate the export equations were taken from the World Economic Outlook (WEO), Information Notice System (INS), and Global Economic Environment (GEE) databases. Variables are defined as follows:

- **LNCPI** – log of Haiti's CPI index
- **LNEXPG\$** – log of Haiti's exports of goods, in US dollars, deflated by the export price deflator for Haiti's exports of goods.
- **LNIMPG\$** – log of Haiti's imports of goods, in US dollars, deflated by the import price deflator for Haiti's imports of goods.
- **LNGDPRPC** – log of an index of real GDP for Haiti's trading partner countries (export-weighted averages, constructed from GEE assumptions for Haiti).
- **LNGDPRHTI** – log of an index of real GDP for Haiti.
- **LNREER** – log of the real effective exchange rate for Haiti.
- **LNREMGDP\$** – log of net remittance inflows into Haiti, in U.S. dollars, divided by Haiti's GDP in U.S. dollars, and seasonally adjusted using the TRAMO-SEATS methodology.¹⁰
- **D(x)** – first difference of the variable x

Augmented Dickey-Fuller tests and Phillips-Perron tests for the stationarity of the variables used in the equations were conducted. The former indicated that all the variables used in the long-run regressions presented below are non-stationary. The Johansen co-integration test results further indicate that the three variables **LNEXPG\$**, **LNGDPRPC**, and **LNREER** are co-integrated, as are **LNREMGDP\$**, **LNGDPRPC**, and **LNREER**, and the four variables **LNIMPG\$**, **LNGDPRPC**, **LNREER**, and **LNREMGDP\$**.¹¹ Given the relatively short sample size, it was decided to follow the Engle-Granger approach (rather than the Johansen procedure) in estimating the long-run sensitivity of exports and imports of goods and of net remittance inflows to movements in the real effective exchange rate.¹² Estimation of equations for exports of goods and services were also carried out but turned out not to be robust and are therefore not presented.

¹⁰ TRAMO-SEATS is a model-based seasonal adjustment method developed by Victor Gómez and Agustin Maravall. It consists of two linked programs: TRAMO and SEATS. TRAMO (Time Series Regression with ARIMA Noise, Missing Observations, and Outliers) performs estimation, forecasting, and interpolation of regression models with missing observations and ARIMA errors, in the presence of possibly several types of outliers. SEATS (Signal Extraction in ARIMA Time Series) performs an ARIMA-based decomposition of an observed time series into unobserved components, see (Gómez & Maravall, 1997).

¹¹ The unit root tests and co-integration results are not presented here for the sake of brevity but are available from the authors on request.

¹² See (Engle & Granger, 1987).

Model 1: Exports and the REER

The empirical evidence suggest that Haiti's exports are not sensitive to movements in the real effective exchange rate, both in the long-run and in the short-run. Annex IV – Table 1 shows the results from estimating a long-run equation for exports of goods using Fully Modified Ordinary Least Squares (FMOLS). The results suggest that Haiti's exports are significantly and positively affected by stronger output growth in its main trading partners but are not significantly affected by the real effective exchange rate. Annex IV – Table 2 uses the residuals from the estimated long-run equation, **RES1**, to analyze the short-run dynamics of Haiti's exports. As in the long run, the results indicate that Haiti's exports are significantly and positively affected by growth of output in its main trading partners in the short run but not by movements in the real effective exchange rate. The co-efficient on the lagged residual from the long-run equation, RES1, is statistically significant and indicates that almost two-thirds of any disequilibrium in Haiti's export market is corrected within a year.

Annex IV – Table 1: Haiti: Long-run Determinants of Exports of Goods

Dependent Variable: LNEXPG\$

Method: Fully Modified Least Squares (FMOLS)

Date: 07/21/22 Time: 10:47

Sample (adjusted): 1996 2020

Included observations: 25 after adjustments

Cointegrating equation deterministics: C

Long-run covariance estimate (Bartlett kernel, Newey-West fixed bandwidth = 3.0000)

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|--------------------|-------------|--------------------|-------------|----------|
| LNGDPRPC | 2.518306 | 0.213927 | 11.77180 | 0.0000 |
| LNREER | 0.401637 | 0.312290 | 1.286100 | 0.2118 |
| C | -8.215296 | 1.516277 | -5.418072 | 0.0000 |
| R-squared | 0.886749 | Mean dependent var | | 6.147443 |
| Adjusted R-squared | 0.876454 | S.D. dependent var | | 0.439490 |
| S.E. of regression | 0.154477 | Sum squared resid | | 0.524988 |
| Long-run variance | 0.027249 | | | |

Annex IV – Table 2: Haiti: Short-run Dynamics of Exports of Goods

Dependent Variable: D(LNEXPG\$)

Method: Least Squares

Date: 07/21/22 Time: 10:51

Sample (adjusted): 1997 2020

Included observations: 24 after adjustments

HAC standard errors & covariance (Bartlett kernel, Newey-West fixed bandwidth = 3.0000)

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|------------------------|-------------|-----------------------|-------------|-----------|
| C | -0.018596 | 0.025578 | -0.727022 | 0.4756 |
| D(LNGDPRPC) | 4.574370 | 1.161040 | 3.939889 | 0.0008 |
| D(LNREER) | -0.144777 | 0.167380 | -0.864959 | 0.3973 |
| RES1(-1) | -0.627319 | 0.112660 | -5.568239 | 0.0000 |
| R-squared | 0.515375 | Mean dependent var | | 0.060679 |
| Adjusted R-squared | 0.442681 | S.D. dependent var | | 0.152274 |
| S.E. of regression | 0.113678 | Akaike info criterion | | -1.359879 |
| Sum squared resid | 0.258455 | Schwarz criterion | | -1.163536 |
| Log likelihood | 20.31854 | Hannan-Quinn criter. | | -1.307789 |
| F-statistic | 7.089667 | Durbin-Watson stat | | 2.117980 |
| Prob(F-statistic) | 0.001976 | Wald F-statistic | | 28.49620 |
| Prob(Wald F-statistic) | 0.000000 | | | |

Model 2: Imports and the REER

The empirical results presented below suggest that Haiti's imports of goods are also not sensitive to movements in the real effective exchange rate, both in the long-run and in the short-run. Rather, real GDP growth is the only variable that has a statistically significant impact on imports in the long-run. Annex IV – Table 3 shows the results from estimating a long-run equation for imports of goods using FMOLS. The results suggest that Haiti's imports are significantly and positively affected by stronger output growth but are not significantly affected either by the real effective exchange rate or by the level of inflows of remittances as a share of GDP. Annex IV – Table 4 uses the residuals from the estimated long-run equation, **RES5**, to analyze the short-run dynamics of Haiti's imports of goods. As in the long run, the results indicate that Haiti's imports are not significantly affected by movements in the real effective exchange rate (or by any of the other macro-economic variables in the model) in the short run. The co-efficient on the lagged residual from the long-run equation, RES5, is statistically significant and indicates that over 70 percent of any disequilibrium in Haiti's import market is corrected within a year.

Annex IV – Table 3: Haiti: Long-run Determinants of Imports of Goods

Dependent Variable: LNIMPG\$

Method: Fully Modified Least Squares (FMOLS)

Date: 08/26/22 Time: 10:41

Sample (adjusted): 1996 2020

Included observations: 25 after adjustments

Cointegrating equation deterministics: C

Long-run covariance estimate (Bartlett kernel, Newey-West fixed bandwidth = 3.0000)

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|--------------------|-------------|--------------------|-------------|----------|
| LNGDPRHTI | 3.978382 | 0.266334 | 14.93757 | 0.0000 |
| LNREER | 0.243522 | 0.236481 | 1.029777 | 0.3148 |
| LNREMGDP\$ | 0.049943 | 0.076732 | 0.650873 | 0.5222 |
| C | -13.03502 | 0.941182 | -13.84963 | 0.0000 |
| R-squared | 0.961021 | Mean dependent var | | 7.535431 |
| Adjusted R-squared | 0.955452 | S.D. dependent var | | 0.579046 |
| S.E. of regression | 0.122216 | Sum squared resid | | 0.313670 |
| Long-run variance | 0.009419 | | | |

Annex IV – Table 4: Haiti: Short-run Dynamics of Imports of Goods

Dependent Variable: D(LNIMPG\$)

Method: Least Squares

Date: 08/26/22 Time: 10:46

Sample (adjusted): 1997 2020

Included observations: 24 after adjustments

HAC standard errors & covariance (Bartlett kernel, Newey-West fixed bandwidth = 3.0000)

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|------------------------|-------------|-----------------------|-------------|-----------|
| C | 0.037487 | 0.031716 | 1.181963 | 0.2518 |
| D(LNGDPRHTI) | 1.057968 | 1.199800 | 0.881787 | 0.3889 |
| D(LNREER) | -0.017090 | 0.172603 | -0.099011 | 0.9222 |
| D(LNREMGDP\$) | 0.109679 | 0.092363 | 1.187470 | 0.2497 |
| RES5(-1) | -0.728172 | 0.147974 | -4.920955 | 0.0001 |
| R-squared | 0.499071 | Mean dependent var | | 0.070893 |
| Adjusted R-squared | 0.393613 | S.D. dependent var | | 0.115603 |
| S.E. of regression | 0.090021 | Akaike info criterion | | -1.794497 |
| Sum squared resid | 0.153972 | Schwarz criterion | | -1.549069 |
| Log likelihood | 26.53396 | Hannan-Quinn criter. | | -1.729385 |
| F-statistic | 4.732387 | Durbin-Watson stat | | 1.483762 |
| Prob(F-statistic) | 0.008070 | Wald F-statistic | | 10.15536 |
| Prob(Wald F-statistic) | 0.000143 | | | |

Model 3: Remittances and the REER

Annex IV – Table 5 shows the results from estimating a long-run equation for net remittance flows into Haiti using FMOLS, and Annex IV – Table 6 presents estimates of the short-run dynamics of net remittance flows using the residuals from the estimated long-run equation, RES3. As with exports, the results suggest that remittances are significantly and positively affected by stronger output growth in its main trading partners. However, unlike exports, the real effective exchange rate also has a significant influence on remittances. More specifically, a depreciation of the real effective exchange rate is associated with a significant increase in net remittance inflows, both in the long run and in the short run. Note that the co-efficient on the lagged residual from the long-run equation, **RES3**, is statistically significant and indicates that around 45 percent of any disequilibrium in net remittance inflows is corrected within a year.

Annex IV – Table 5: Haiti: Long-run Determinants of Net Remittance Flows

Dependent Variable: LNREMGDP\$

Method: Fully Modified Least Squares (FMOLS)

Date: 07/21/22 Time: 11:07

Sample (adjusted): 1996 2020

Included observations: 25 after adjustments

Cointegrating equation deterministics: C

Long-run covariance estimate (Bartlett kernel, Newey-West fixed bandwidth = 3.0000)

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|--------------------|-------------|--------------------|-------------|----------|
| LNGDPRPC | 2.649144 | 0.394967 | 6.707261 | 0.0000 |
| LNREER | -1.642168 | 0.576572 | -2.848159 | 0.0094 |
| C | -3.388010 | 2.799453 | -1.210240 | 0.2390 |
| R-squared | 0.825392 | Mean dependent var | | 2.371998 |
| Adjusted R-squared | 0.809519 | S.D. dependent var | | 0.450533 |
| S.E. of regression | 0.196632 | Sum squared resid | | 0.850608 |
| Long-run variance | 0.092885 | | | |

Annex IV – Table 6: Haiti: Short-run Dynamics of Net Remittance Flows

Dependent Variable: D(LNREMGP\$)

Method: Least Squares

Date: 07/21/22 Time: 11:11

Sample (adjusted): 1997 2020

Included observations: 24 after adjustments

HAC standard errors & covariance (Bartlett kernel, Newey-West fixed bandwidth = 3.0000)

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|------------------------|-------------|-----------------------|-------------|-----------|
| C | 0.058346 | 0.049832 | 1.170853 | 0.2554 |
| D(LNGDPRPC) | 1.604820 | 1.667515 | 0.962402 | 0.3473 |
| D(LNREER) | -0.797660 | 0.293678 | -2.716108 | 0.0133 |
| RES3(-1) | -0.449773 | 0.152472 | -2.949879 | 0.0079 |
| R-squared | 0.476985 | Mean dependent var | | 0.078556 |
| Adjusted R-squared | 0.398533 | S.D. dependent var | | 0.145380 |
| S.E. of regression | 0.112749 | Akaike info criterion | | -1.376300 |
| Sum squared resid | 0.254245 | Schwarz criterion | | -1.179958 |
| Log likelihood | 20.51560 | Hannan-Quinn criter. | | -1.324211 |
| F-statistic | 6.079948 | Durbin-Watson stat | | 0.872742 |
| Prob(F-statistic) | 0.004101 | Wald F-statistic | | 6.162610 |
| Prob(Wald F-statistic) | 0.003856 | | | |

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