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Till Geography Do Us Part?

Prolegomena to an Economic and Monetary Union between the Dominican Republic and Haiti

Emmanuel Pinto Moreira

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Abstract

This paper offers a preliminary assessment of the potential benefits and costs of an economic and monetary union (EMU) between the Dominican Republic and Haiti—two countries sharing the same island but whose history is one of conflict and divergent economic prospects in recent decades. After a brief review of the historical context, it examines the nature of these potential benefits and costs. It then conducts a preliminary analysis (using basic statistical techniques) of some key criteria for the formation of an economic and monetary union between the two countries. A more formal analysis of business cycle synchronization, based on basic and extended integrated vector auto-regression models with exogenous variables (VARX), is developed next. Overall, the analysis suggests that at this stage several economic criteria are not satisfied for the two countries to fully benefit from an economic and monetary union. At the same time, however, the endogeneity of most of these criteria (including the degree of business cycle synchronization) militates in favor of an aggressive medium-term agenda for integration between them.

This paper—a product of the Poverty Reduction and Economic Management, Latin American and the Caribbean Region—is part of a larger effort in the department to understand the issues associated with economic and monetary unions between developing countries in the region. Policy Research Working Papers are also posted on the Web at http://econ.worldbank.org. The author may be contacted at epintomoreira@worldbank.org or epintomoreira@imf.org.

Till Geography do us Part? Prolegomena to an Economic and Monetary Union between the Dominican Republic and Haiti

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I. INTRODUCTION

Haiti and the Dominican Republic opened bilateral trade only 20 years ago with the hope of creating economic integration. Trade and migration have increased significantly, and the two nations are now taking steps to establish systems and structures to manage this relationship, with support from various quarters. In July 2008 for instance, the U.S. government and the Organization of American States provided funding for a new program aimed at increasing economic growth and cooperation along the 193-mile border between Haiti and the Dominican Republic. The program, called "Fwontye Nou/Nuestra Frontera" in Creole and Spanish ("Our Border" in English), aims to provide training, technical assistance, and conditions to foster cross-border projects and productive investments for both countries. The European Union has also begun to finance joint projects along the border.

The remainder of the paper is organized as follows. Section II provides a review of the historical context. Section III discusses the potential benefits and costs of an economic and monetary union between the two countries. Section IV offers a preliminary analysis of some key EMU criteria, using basic statistical techniques (unconditional correlations), as in some other contributions (see for instance Karras (2007) and Furceri and Karras (2008)). Section V develops a more formal analysis of business cycle synchronization based on two integrated (two-country) VARX models: A "basic" model involving output gaps and inflation (measured in terms of deviations with respect to US inflation) in the two countries, and the US output gap, and an extended model, which adds other "external" variables (the world price of oil and the US real interest rate) and domestic variables (bank credit to the private sector as a share of GDP and bilateral real exchange rates). The models are used to analyze the response of domestic output and inflation to external and domestic shocks. Section VI draws together the policy implication of the analysis and offers some concluding remarks.

II. HISTORICAL BACKGROUND

History and geography bind the Dominican Republic and Haiti. On December 6, 1492, Christopher Columbus discovered an island that he qualified as "marvelous" and named it Hispaniola. The formation of these two states and their accession to independence is a long story marked by wars and reconciliations, open or hidden hostility and alliances against common dangers. History shows many attempts of unification of these two states, though unsuccessful.

On October 1st 1798, Toussaint Louverture took control of the whole island after ousting foreign troupes, both English and French[1]. On August 1st 1800, he became the only

[1] On October 1st 1798, English troupes left the place "Mole Saint Nicolas", last area under their control. On October 22, 1798, Toussaint Louverture obliged French Governor General Hedouville to leave the island for France.

master of the French part of Santo Domingo after defeating his rival, General Rigaud. On January 26, 1801, he took control of the Spanish part of Santo Domingo and became the only commander in chief of the entire island. He legitimized his power by elaborating a constitution, approved on July 7, 1801, which gave him all the powers, legislative and executive and allow him to serve as Governor for his lifetime.

But Toussaint Louverture's power was short lived. The French troups sent by Napoleon Bonaparte, under the commandment of his brother-in-law General Victoire-Emmanuel Leclerc, entered in a two-year war with Toussaint Louverture's army. The war ended with the death of General Victoire-Emmanuel Leclerc on November 2nd, 1802 and the captivity, deportation, and death in prison of Toussaint Louverture on April 7th 1803. These events were followed by the granting of independence to Haiti on January 1st, 1804.

After a year of peaceful relationships, in 1805, General Jean-Jacques Dessalines, first President of Haiti after the country gained its independence, launched a new war against the East cost of the island (Santo Domingo). But the war was short-lived as General Dessalines feared retaliation by the French Government.

In 1820, a new unification attempt was launched by President Jean-Pierre Boyer. At that time, Spanish people of Santo Domingo were divided between two groups on the choice of their political regime. One group was in the view that independence of the Spanish part of the island was illusory because of the small population. Some advocated a union with Colombia, which had just gained independence. Others called for a fusion with Haiti.
In this context, President Boyer used his diplomatic skills to convince Dominicans to go with the unification of the island. On February 1822, his troups entered in Santo Domingo. However, his policy of "Haitianization" of the whole island disappointed many inhabitants of the island including Haitians themselves. In January 1843, a revolution called "Revolution Praslin" under the commandment of Riviere Herard took place. After being defeated, President Boyer left the country on March 13, 1843, after 25 years of power. Dominicans ultimately proclaimed their independence on February 1844, following Riviere Herard's decision to close all ports of the East Coast to external trading.

After a war launched by Riviere Herard to constrain Dominicans to renounce to independence in 1845, and the invasion of the Dominican Republic in March 1849 by Faustin Soulouque (who succeeded President Jean Baptiste Riche), the Dominican Republic reinforced its independence by approving a national constitution.

The following years were marked by attempts to sign agreements between the two countries. On November 9, 1874, the two countries signed the first treaty of peace, friendship, trade, and extradition of criminals between them. This treaty established the principle of a customs union between the two countries. It also confirmed the economic and trade dominance of Haiti over its East neighbor. This resulted in Dominicans using Haitian trade and port services for their external trade. The treaty also entailed a financial support of the Haitian Government to the Dominican Republic, with a view to avoid that DR search for financial assistant to compensate for land losses.

However, these trade union efforts were stopped by the US occupation of the island for 19 years on the Haitian side (July 28, 1915 to August 21st, 1934) and 8 years on the Dominican side (October 29, 1916 to October 21, 1924).

Following the departure of the US from the DR and the election of President Horacio Vasques on March 15, 1924 and Louis Borno on April 10, 1922, the issue of borders was sorted out. A treaty was signed on January 21st 1929 and approved by Congress in the Dominican Republic on February 7, 1929, which establishes the borders between the two countries. The treaty was ratified by Haiti on February 15, 1929 and by the Dominican Republic on February 25, 1929.

Despite being independent countries, DR and Haiti share common characteristics. They share the same island space (Quisqueya or Hispaniola 76 780 km^2, the second largest in the Caribbean). They display similarities in natural resources endowments and exhibit clear common traits, both cultural and socio-economic. The two countries have always maintained intense commercial exchanges and cultural ties, whether formal or informal, legal or illegal. Haiti is the third largest export market for the Dominican Republic; conversely, the DR is the first export market for Haiti. Haiti is the primary source of migrants for the DR. For thousands of Haitians, migration provides the way to employment in the DR as well as an escape valve for the pressure created by overpopulation and land scarcity at home; for others, political instability at home (n addition to economic needs) has led to voluntary exile in the DR. During the 1990s, some 30,000 Haitians were entering the DR each year, and about half that number was repatriated. Some 150,000 Haitian who remained from the previous 20 years would make a total of 250,000-300,000 *emigrés*, and these would join the estimated 100,000 Dominicans born of Haitian parents. The *presencia haitiana* in Dominican society could therefore involve, by this reckoning, some 350,000-400,000 persons of Haitian descent, whether born in Haiti or in the DR. Cultural and intellectual exchanges between the two countries have always been intense, especially along the border as well as among the elites at the national level.

The Dominican economy needs Haitian labor and its industry depends largely on this source of manpower. A scarcity of land on the Haitian side continues to push peasants toward the east and to the north. The frontier markets and contraband trade indicate that, despite the stereotypes and notwithstanding the barriers to immigration, a vigorous economic life has created borderland 'communities", which offer a flexible pattern of culture more accommodating of otherness than that of the interior zones. There is a fluidity and seeming ease with social interactions, including exchange of language (Haitian Kreyol and Spanish). Another type of exchange involves money, the Haitian gourde being valued here as is the Dominican peso. Intermarriages occur frequently, mostly of Dominican men with Haitian women. The exchanges of the borderlands remind people of the two countries that they share a background that embraces the history of colonialism, the experience of underdevelopment, and the struggle to survive.

Despite similarities and common traits, however, the growth patterns and outcomes achieved by the countries in recent decades have been widely different. The DR has gone successfully through a transition to lower middle-income status with substantial economic growth. Haiti has lagged behind in all aspects of socio-economic development.

However, articulations and interdependencies are already a fact. With such interdependencies in mind, Muñoz (1995) correctly states that the "superstructural frame" that integrates countries into multinational blocs is not nationalities, but rather markets. Although "national identity and consciousness, by their own nature, cannot be negotiable"- in the sense that they have their own dynamic coherence – they do have functions within the nation-state system articulated by economics and migration.[2] In fact, it may be argued that the sheer differences between the two countries create mutually beneficial situations building on their individual comparative advantages. Hence, by acting jointly and/or in a coordinated fashion in key areas, individual growth outcomes can be enhanced.

Interdependence and cultural exchange continue within the asymmetrical frame of the Haitian and Dominican Republics. The problem of their contiguous coexistence, together with the flow of migrants across the shared border, expresses the situation of two states whose populations must seek the *ad hoc* solutions to social ills by mean of emigration.

Integration could be realized in a fair and efficient regulation of the commercial traffic between the two countries. Such regulation would facilitate trade while providing for the revenue needed to develop each country's infrastructure. Thriving commerce in the frontier towns already indicates ways in which a less encumbered cross-border trade can profit the two national economies. In the Haitian southeast, Haitians and Dominicans come to do business at the rural market of Fonds-Verettes, Situated at a crossroads of major access routes. The market draws farmers, hawkers, and retail dealers from towns like Perdernales, Saltrou, Neiba, and Barahona. As illustrated in the example of Fonds-Verettes, informal linkages of commerce and culture have blurred the division between nations. They also point to the fact that Haitian and Dominican "sister towns" have become interdependent. Such pairings include not only Dajabón and Ouanaminthe, but also Elías Piña and Belladères; Jimani and Fonds Parisien; and Pedernales and Anses-à-Pitres.

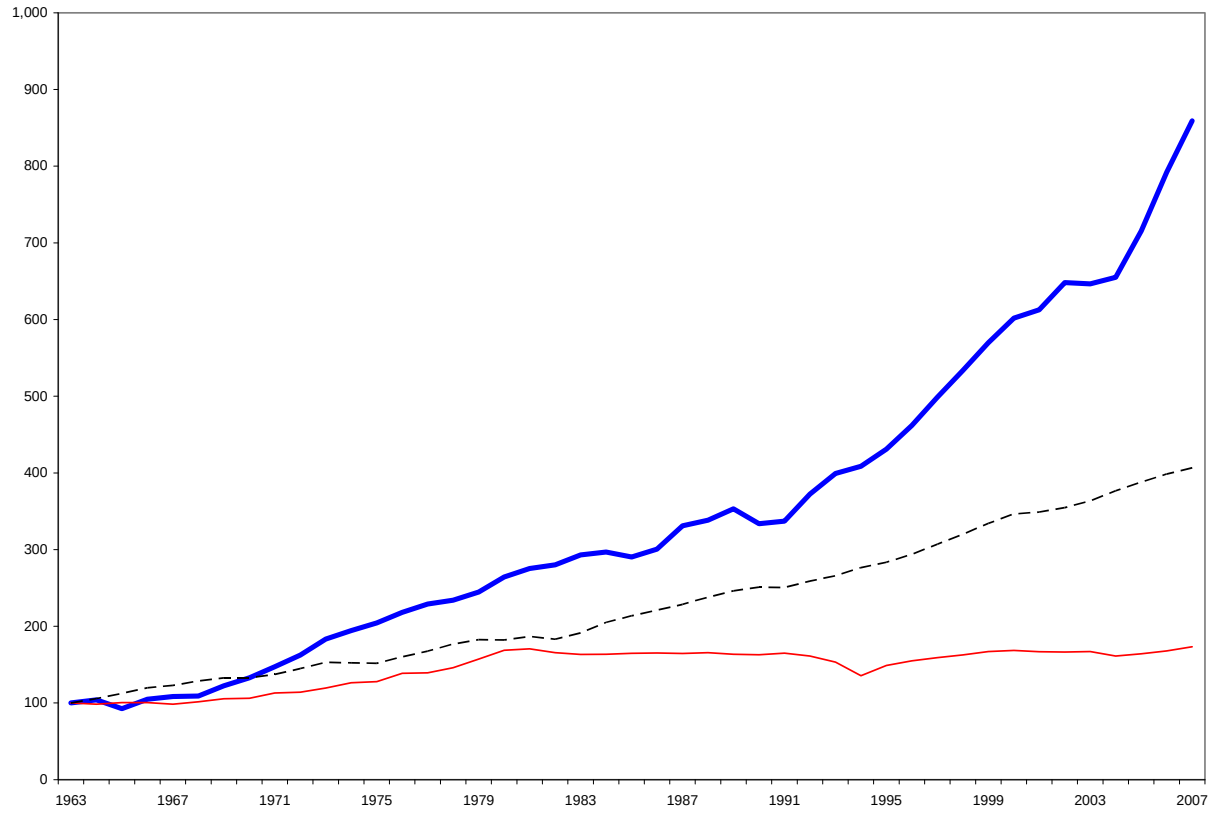
By transcending the limits of sovereign states, the two countries could define a new, holistic mapping of Hispaniola which could serve as a new paradigm of cooperation, interdependence, and collaboration between nations. Its articulation of insular counterpoints can legitimate and support initiatives for joint plans and projects for expanding commerce between Haiti and the Dominican Republic.

[2] Muñoz, Maria Elena. Las Relationes Dominico-Haitianas: Geopolitica y Migracion. Santo Domingo:

III. BENEFITS AND COSTS OF AN EMU BETWEEN THE DOMINICAN REPUBLIC AND HAITI

During the past few decades, the economic performance of the Dominican Republican and Haiti has diverged markedly. As shown in Figure 1, using 1963 as a base year, by 2007 real output in the Dominican Republic had increased almost ninefold (more than twice the increase in the United States during the same period), compared to quasi stagnation in Haiti. In per capita terms, real GDP tripled to about US$2,500 between 1960 and 2005 in the Dominican Republic, whereas it halved to US$430 in Haiti (Jaramillo and Sancak (2007)). This divergence in economic performance has put the two countries at the opposite ends of the spectrum in Latin America and the Caribbean.

Figure 1
Dominican Republic and Haiti: Real GDP Index, 1963–2007
___ Dominican Republic ___ Haiti --- United States



Source: World Bank.

Editora Alfa & Omega, 1995.

In the last three years, the governments of the Dominican Republic and Haiti have taken several steps to strengthen their commercial ties and set up a bilateral commission on trade. Indeed, there appears to be greater recognition now on both sides of the benefits of regional economic integration.

After defining the nature of an economic and monetary union (EMU), this section offers a brief overview of the potential benefits and costs that such a union could bring two countries that are geographically as close as the Dominican Republic and Haiti. The next section will examine the various economic criteria that have been proposed to assess whether these countries should form an EMU.

1. Nature of an Economic and Monetary Union

An EMU between two countries can be defined as a single market with a common currency, managed by a single monetary authority. In turn, the adoption of a common currency is generally considered to be the final stage of a gradual process of economic integration, which typically involves the following stages:

a) the elaboration of a *preferential trading area* (PTA), which usually allows preferential access to select goods within the block via a reduction in tariffs, but not necessarily by abolishing them;

b) a *free trade area* (FTA), which involves removing tariffs and quantitative restrictions for trading of most goods amongst members themselves, if production structures are largely complementary;

c) a *customs union*, which involves the formation of a common trade area with a common external tariff policy (and possibly import quotas and a common competition policy);

d) a *common market*, which is formed with the objective of removing barriers for the free movement of capital, goods, services and labor, while retaining a common external trade policy.

Once a single market has adopted a common currency, it is termed an EMU.[3] Put differently, an EMU differs from a mere currency union because it involves a single market. The adoption of a single currency requires free movement of capital across member states, and the creation of an independent and supranational central bank responsible for implementing a common monetary policy. An EMU also involves harmonizing taxation and

[3]The final stage of economic integration, often referred to as "complete economic integration," leads to a near complete harmonization of fiscal and monetary policies among members. It also amounts to a loss of political independence of member nations as they are unable to use the monetary and fiscal policies independently.

technical standards, with the objective of bringing in greater efficiency in resource allocation and enhancing competition.

2. Benefits and Costs of an Economic and Monetary Union

The fundamental reason for creating an EMU is to bring in greater efficiency in resource allocation and enhanced competition. This is a particularly important consideration for the Dominican Republic and Haiti, given the small size of these economies taken individually. For instance, the formation of a PTA or an FTA could allow firms in the two countries to spread the costs of research and development over a larger market, thus reducing unit costs and encouraging greater innovation and technical progress. This could, in turn, generate positive spillovers as successful innovations are applied more broadly.

Integration could boost productivity growth by allowing increased specialization, whereas increased competition could increase efficiency gains—possibly reinforced by foreign direct investment between the two countries. These benefits are further increased with a customs union and especially a common market (through the free movements of factors), although the use of a common external tariff policy may reduce scope for discretionary policy.

At the same time, it is well recognized that PTAs and FTAs can entail some costs (see Bhagwati and Panagariya (1996)). In particular, they may lead to trade creation, by replacing relatively high-cost domestic production with lower-cost imports from partner countries. They may also lead to trade diversion, which occurs when imports are switched from efficient nonmember suppliers to less efficient member countries benefiting from tariff preferences. Higher trade volumes between member countries that result from the agreement may also lead to greater, not smaller, losses to an individual member A who joins the agreement from a higher initial set of tariffs, because joining the agreement at a common lower tariff leads to a redistribution of tariff revenues from A to other member countries with initially lower tariffs. Nevertheless, it has been recognized that PTAs and FTAs are worth pursuing for countries whose ultimate goal is complete dismantling of barriers to labor and capital mobility, and complete economic integration with the formation of an EMU.

The benefits and costs associated with the final stage of an EMU, the creation of a currency union, has been the focus of much debate. As discussed in more detail in Appendix A, the traditional literature has focused on the reduction in transactions costs and reduced exchange rate uncertainty as the main benefits of a monetary union. Such a union entails a reduction of transaction costs, a reduction in uncertainty about financial variables and macroeconomic policy, and promotes integration of both financial and goods markets.

At the same time, however, the formation of an EMU has important implications for national economic policies. It entails the loss of the exchange rate as an adjustment mechanism to combat any deterioration in competitiveness. Members are therefore deprived of one instrument to respond to shocks. At the same time, monetary policy autonomy is

"surrendered" to the common Central Bank. Fiscal management and the degree of labor mobility become therefore key factors in the response to adverse shocks.

IV. CRITERIA FOR AN EMU: PRELIMINARY DATA ANALYSIS

The conditions under which two countries should form an EMU and reap the associated efficiency gains have led over the years to a number of broad economic criteria. For the last stage of an EMU, in particular, these criteria relate to whether these countries can or should form a Common Currency Area (CCA) or a currency union.[4] These criteria include the volatility of bilateral exchange rates, the similarity of inflation rates, the degree of correlation between economic shocks across countries, the degree of price and wage flexibility, the degree of labor mobility, and the scope for discretionary fiscal policy.[5]

In what follows we examine some of the these criteria especially the behavior of some of these variables in the context of the Dominican Republic and Haiti, especially inflation, business cycle synchronization, fiscal policy and public debt, exchange rates, and bilateral trade. Of course, the examination of historical data may provide a misleading indication of suitability of membership in a CCA, given that some of the criteria listed above are interrelated—or endogenous, as discussed later. Nevertheless, this discussion still provides valuable insights and will be complemented in the next section by a more formal analysis.

1. Volatility of Bilateral Exchange Rates

It is now well recognized that exchange-rate volatility can be as harmful for intraregional trade (if not more) than tariff barriers. By blurring signals associated with relative price changes, exchange rate volatility (whether nominal or real) may hamper the ability of producers to reallocate resources production. Thus, the formation of a CCA can help to foster trade integration.[6]

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[4]The criteria are generally grouped under the header "theory of optimum currency areas" (or OCAs). Essentially, the theory of OCAs—first presented by Mundell (1961), in the context of the debate between fixed and flexible exchange rates of the 1960s. Note that a currency area is typically defined as a group of countries that undertake to fix their exchange rates, at least within narrow bands. In contrast, a currency union is typically defined as an area where a single currency circulates. The bilateral exchange rates are fixed and cannot be changed without a country quitting the union and reintroducing its own currency. In practice, however, the difference between a currency union and a currency area is probably smaller than in principle, given that in both regimes capital mobility constrains monetary policy independence.

[5]Ishiyama (1975) provides an early review of the literature. Subsequent discussions include Masson and Taylor (1992), Tavlas (1993), Mongelli (2002), and De Grauwe (2007). See Appendix A for a more detailed review of the costs and benefits of a monetary union.

[6]As an example of this growing awareness, in January 2008 members of the East African Community (consisting of Kenya, Tanzania, Uganda, as well as Burundi and Rwanda since July 2007) announced their intention to bring forward, to 2012 from 2015, the formation of their planned monetary union, in an effort to

Figure 2 shows the evolution of the bilateral nominal exchange rate between the Dominican Republic and Haiti during the period January 1979-September 2007, using monthly data. It suggests that the exchange rate between the two countries has been quite volatile—especially after the countries switched to a flexible exchange rate (19- for the Dominican Republic and 19- for Haiti) and during periods of financial crisis.[7] Thus, the reduction in exchange rate volatility and transactions costs in foreign exchange that a CCA could bring would entail substantial benefits for the two countries.

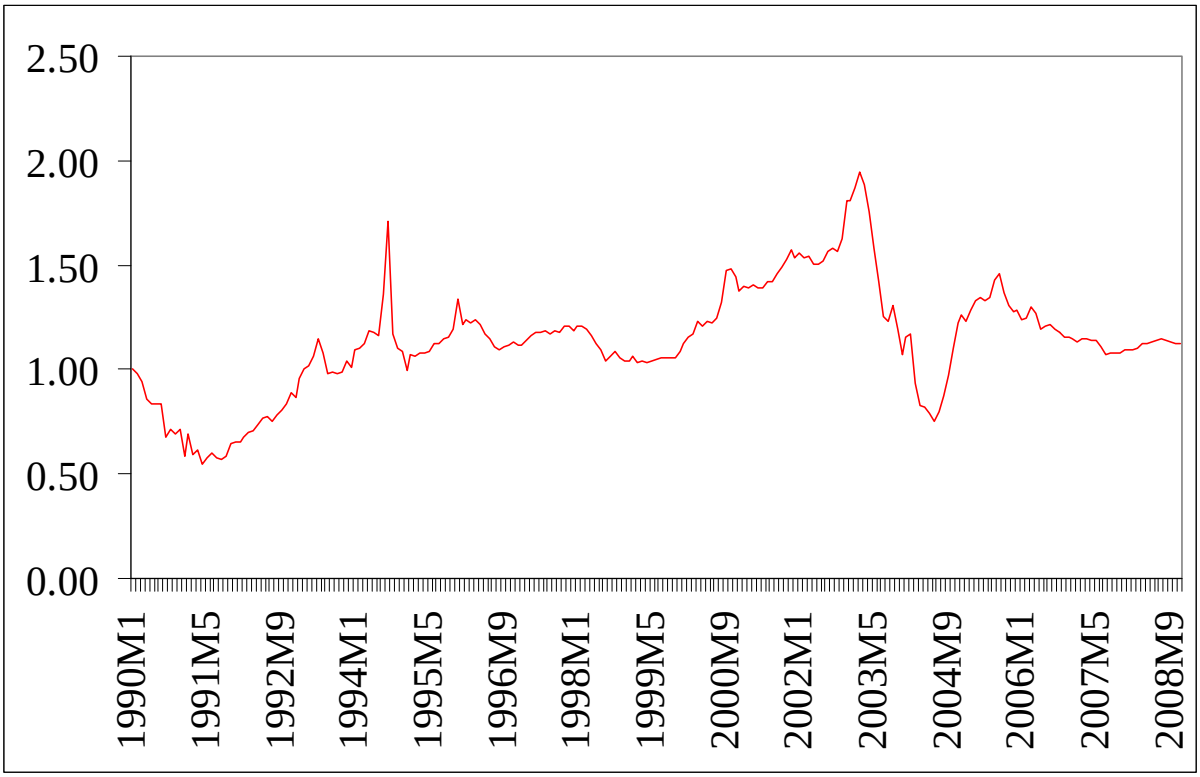
2. Similarity of Inflation Rates

The similarity of inflation rates (at levels consistent with overall macroeconomic stability) is one of the most common criteria used to evaluate the viability of a CCA. If inflation rates diverge too much between two potential members of a union, the ability to implement a common monetary policy (which follows from the adoption of a common currency and the shared goal of price stability) may be significantly hampered.

bring about greater exchange rate stability among themselves and boost intraregional trade.

[7]With higher frequency data (weekly or daily), the data would show even higher volatility during certain periods.

Figure 2
Dominican Republic and Haiti: Bilateral Exchange Rate, 1979–2007
(Dominican pesos per gourde)

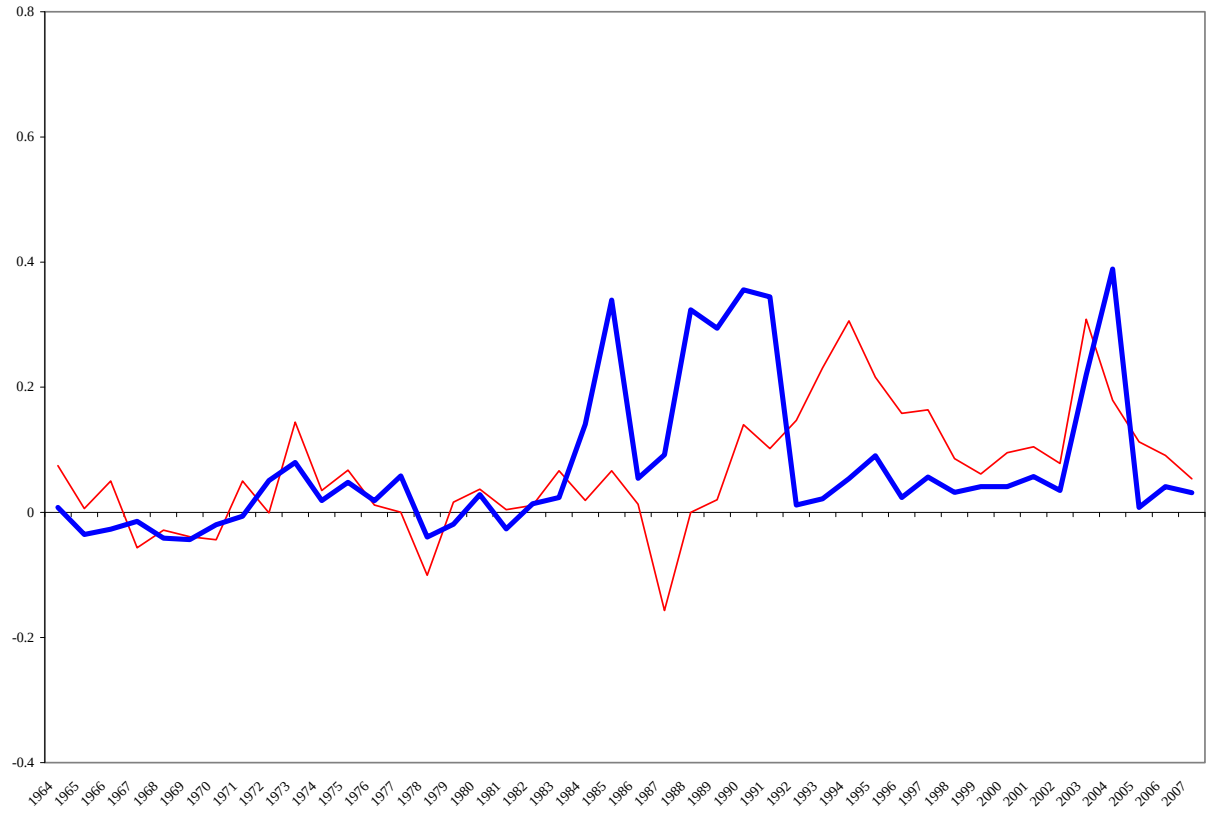


Source: International Monetary Fund.

Figure 3 shows the behavior of annual inflation—measured in terms of the consumer price index—in the Dominican Republic and Haiti during the period 1963-2007, measured as deviations from US inflation. The figure shows that inflation has displayed significant spikes and considerable volatility at times in both countries—for the Dominican Republic for instance, most recently following the financial crisis and sharp exchange rate depreciation in 2003-04. The correlation between the two series is also quite high at times. These results suggest that although both countries could gain from a CCA in terms of price stability, their medium- and long-term performance in that regard does not appear to have been sufficiently effective and comparable to envisage a rapid transition toward such an arrangement.

At the same time, however, it is important to note that convergence in inflation does not need to be complete (in the sense of very narrow differentials among members) before adopting a CCA; as discussed later, the very process of union formation may bring about greater similarity in inflation between member countries—in part through greater integration in goods markets.

Figure 3
Dominican Republic and Haiti: Consumer Price Inflation
Deviations from US Inflation, 1964-2007
___ Dominican Republic ___ Haiti



Source: World Bank.

3. Degree of Symmetry of Shocks

As noted earlier, when a country joins a CCA or a currency union in the last stage of an EMU, the exchange rate becomes unavailable to act as a buffer when shocks hit the economy. A key issue is therefore the extent to which the exchange rate is, to begin with, a "shock absorber." In general, the larger the degree of asymmetry of shocks across a potential currency union the greater the need to absorb shocks at the country level. Put differently, if the potential partners to a CCA have a common business cycle (in the sense that they tend to be affected by shocks in similar ways) rather than divergent business cycles, the costs of fixing the exchange rate across the union will be smaller. By contrast, if members of a currency union are often at different stages of the business cycle, then a common monetary

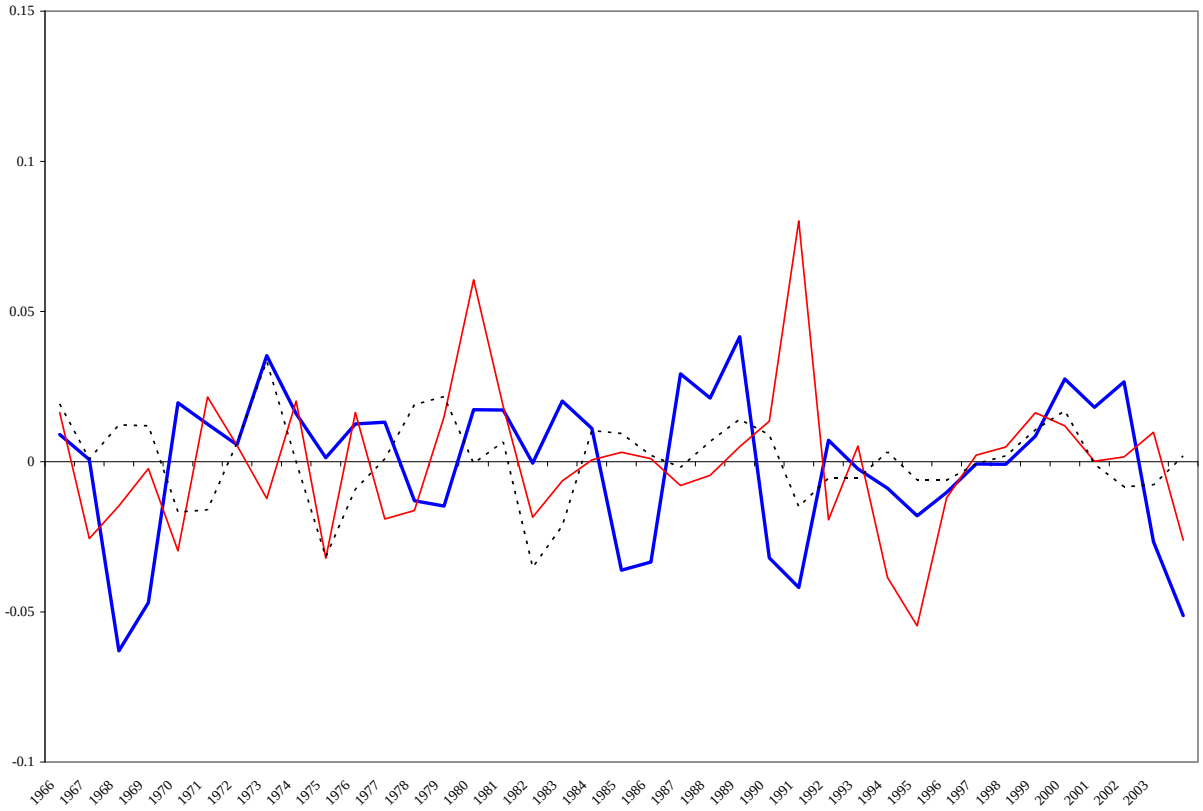
policy for the entire area would not be appropriate to all of them and could be very costly for some of them.[8]

A reason why countries may face asymmetric (or idiosyncratic) shocks is that they have different commodity export baskets. The likelihood of asymmetric shocks tends to be smaller if a potential union partner is, to begin with, a key bilateral trading partner. This is because a boom in the union partner B will tend to increase demand for country A's exports, while rising demand in country B will also tend to reduce their exports to country A. More generally, a high ratio of bilateral trade to total trade implies that the exchange rate is a relatively ineffective means of securing macroeconomic adjustment, so that foregoing its use (as required in a CCA) is relatively less costly. Put differently, if two countries trade a lot with each other, they are likely to benefit from low transaction costs and the elimination of exchange rate risk. Thus, the extent of bilateral trade is an important consideration in any assessment of the net benefits associated with a CCA.

To examine the degree of symmetry of shocks between the Dominican Republic and Haiti, a preliminary approach is therefore to look at the correlations of output gaps in the two countries, the extent of bilateral trade between them, and the behavior of their terms of trade. Figure 4 shows the behavior of the output gap in the two countries during the period 1963-2007. The output gap is measured by the logarithm of the ratio of real GDP and its trend value, measured itself by the modified Baxter-King filter (see Christiano and Fitzgerald (2003)). The figure does not suggest much correlation between the output gap in the two countries; the actual correlation coefficient is only 0.03. In fact, the correlation between output gaps in the Dominican Republic and the United States is in fact higher, reflecting a greater degree of synchronization between them.

[8]The idea that different regions within a currency union will sometimes be subject to shocks that cause their business cycles to diverge is hard to dispute; the key issue, however, is how often divergences occur and how significant they are. This is an empirical issue, which is discussed further later, in the context of Latin America and the Caribbean.

Figure 4
Dominican Republic and Haiti: Output Gap, 1963–2007
___ Dominican Republic ___ Haiti --- United States



Source: Author's calculations based on World Bank data. See Appendix B for calculation method.

The evolution of bilateral trade between the Dominican Republic and Haiti, using the IMF's *Directions of Trade* statistics, suggests that measured trade between the two countries remains very low. There are a number of factors that may help to account for this. The first is that any assessment of the extent of trade between Haiti and DR faces a major problem—the coverage of the data. Frontiers between the two countries are highly permeable and informal trade is of great significance, being equivalent according to some estimates to as much as total recorded trade. Nevertheless, even allowing for such effects, the consensus remains that trade between the two countries accounts for only a small fraction of their total trade.

One reason why this may be so is related to the non-complementary production structures of these economies, with exports consisting of goods and services (primary products, tourism in the case of the Dominican Republic) heavily in demand by the industrial countries, whereas imports consist mainly of raw materials and finished investment and consumer goods that are not produced domestically. Alternatively, the low level of trade may be explained by the relatively poor transportation and communications networks between the

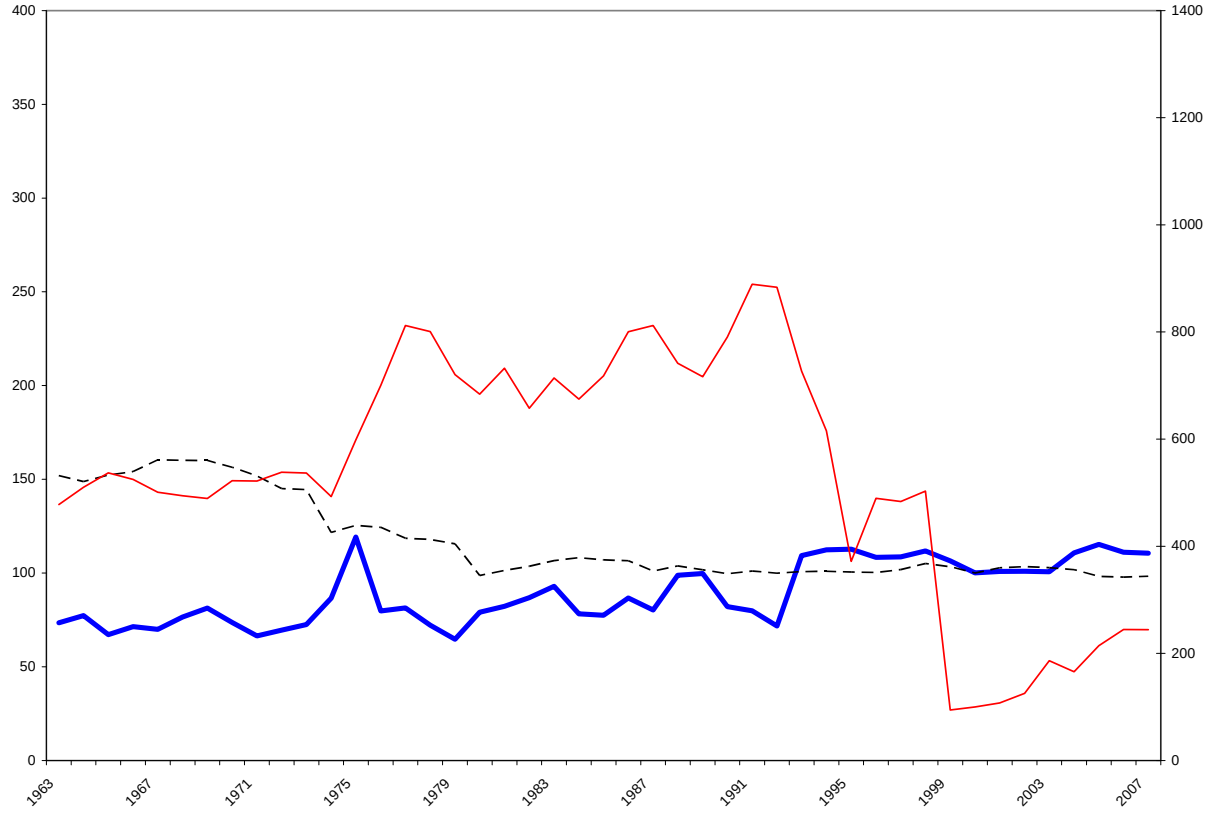
two countries; these networks are mainly geared toward maintaining links with each country's main partner, the United States, rather than between them. There are also historical reasons, as well as language and cultural barriers that may be relevant.

However, while the level of trade between the two countries may be undoubtedly lower than one would expect based on their degree of proximity, from a normative standpoint it does not follow that it is somehow too low. Clearly, to make such a judgment requires an assessment of the optimal level of bilateral trade, based on the relevant structural and economic characteristics of the two countries. Although there are no formal studies focusing on this issue, standard trade models would suggest that in fact the level of trade between the Dominican Republic and Haiti is no lower than would be predicted given their structural characteristics. Indeed, it is probable that the low level of bilateral trade is well explained by the low trade potential of these countries, which in turn is a reflection of their very small economic size.[9]

Figure 5 shows the behavior over the past four decades of the terms of trade for the two countries. Clearly, there does not appear to be any sizable degree of correlation between the behavior of these variables. This reflects to a large extent differences in the composition of exports of the two countries, rather than the structure of their imports.

[9]It should also be kept in mind that the overall degree of openness (as measured by total trade ratios) also matters from the perspective of a CCA. The reason is that the more open an economy, the more devaluation becomes a source of imported inflation; this may reduce significantly the benefits associated with an adjustment via currency changes because domestic inflation will then mitigate the initial effect of a nominal depreciation on the real exchange rate.

Figure 5
Dominican Republic and Haiti: Terms of Trade Index (2000=100), 1963–2007
___ Dominican Republic ___ Haiti --- United States



Source: IMF and World Bank.

All three indicators suggest therefore that the Dominican Republic and Haiti are in general affected by asymmetric shocks. By itself, this would suggest that the formation of a CCA between these countries would not be advisable. However, before reaching this conclusion, there are two issues worth highlighting. First, in general two countries might exhibit low business cycle synchronicity not because using different currencies creates underlying structural asymmetries, but simply because the two monetary authorities are following different policies. Conversely, two countries might exhibit a relatively high level of synchronicity only because they are subject to common external shocks. What is needed therefore is to look at *conditional* business cycle correlations, instead of simple correlation coefficients; this is what is done in the next section.

Second, the existence of asymmetric shocks (which are likely to remain, even in a well integrated union) is not sufficient to establish the case for retaining a separate currency. A CCA may still be viable in the presence of asymmetric shocks as long as there are alternative adjustment mechanisms available to deal with them. These mechanisms include most notably the degree of wage and price flexibility, the degree of labor mobility, and the scope for discretionary fiscal policy—as discussed next.

4. Degree of Price and Wage Flexibility

Adjustment to asymmetric shocks requires in general an adjustment of the *real* exchange rate. If, as is the case in a currency union, the nominal exchange rate cannot adjust to cope with these shocks, a real exchange rate adjustment may come through movements in prices and wages.

If wages are perfectly flexible, a reduction in nominal wages is essential similar to a nominal depreciation in its adjustment role. By contrast, when wages are rigid downward (as a result, for instance, of government interference through minimum wages, or the existence of trade unions), adjustment through wage reductions is much slower and more costly, to the extent that it may be accompanied by periods of high unemployment. Thus, a high degree of wage rigidity makes preserving nominal exchange rate flexibility and monetary independence more desirable. Price flexibility may also bring about an adjustment in the real exchange rate. However, in practice the degree of price flexibility is often limited. The slow response of prices to shocks may be caused by, for instance, price-setting behavior by firms and backward-looking expectations.

More generally, it is often difficult in practice to judge whether a country has a sufficient degree of price and wage flexibility to facilitate smooth adjustment to idiosyncratic shocks. In the case of the Dominican Republic and Haiti, there are few studies documenting directly the degree of flexibility. In the case of the Dominican Republic for instance, estimation results by Hernández (2008) suggest that there is some significant degree of nominal inertia in price setting. At the same time however, both countries have a sizable informal sector; According to estimates by Gasparini and Tornarolli (2007, Table 3.2) for instance, informal employment as a share of total employment represented 51.3 in the Dominican Republic in 2004, 82.1 percent in Haiti in 2001. This suggests a high degree of nominal wage flexibility, at least for unskilled workers.

5. Degree of Labor Mobility

When labor is mobile across union borders, asymmetric shocks to any individual member can in principle be absorbed through migration, without requiring relative price changes. Labor mobility may thus be particularly important in the presence of wage rigidities. For instance, if the real exchange rate does not adjust following a shift in relative demand across countries, unemployment may increase in the country where demand has been reduced; migration toward the other country where demand has increased may mitigate the problem.[10]

[10]In the United States, labor mobility has been identified as the key regional adjustment mechanism for adjusting to regional unemployment, although migration does not seem to occur only in response to wage differentials. In contrast, labor movements across Europe are very limited compared to those across United

In the case of the Dominican Republic and Haiti, there has always been quite a significant degree of labor mobility at the border—although mostly illegal. In addition, mobility has taken the form of mostly unskilled labor flows. However, beyond that mobility has been limited, to a large extent for cultural and historical reasons. There is also evidence that the formal labor market in these countries suffers from a number of imperfections and distortions—including labor regulations that raise the cost of hiring and firing workers (see Inter-American Development Bank (2003)). Thee are also challenges related to youth unemployment, the mismatch between the educational system and the needs of the labor market, the creation of jobs, low levels of productivity coupled with relatively high wages, and sustained emigration flows of skilled labor from the region. This "brain drain" has helped to strengthen the economic links between each country and the United States. In addition, language is likely to remain a persistent barrier between the two countries. Labor mobility is therefore unlikely to provide much scope for absorbing shocks, thereby making wage flexibility and fiscal policy all the more important.

6. Scope for Discretionary Fiscal Policy

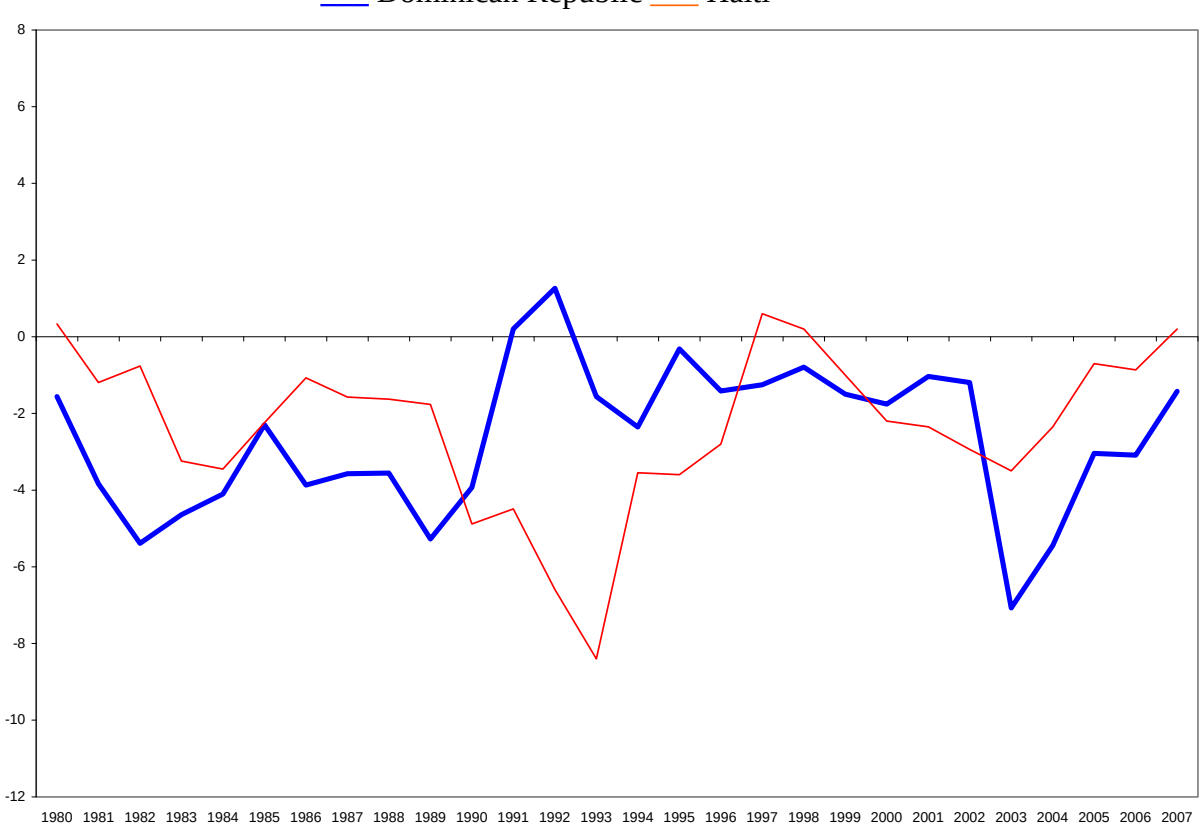
As noted earlier, countries participating in a CCA must give up the use of monetary policy and the exchange rate. But when a country is subjected to an asymmetric shock, automatic fiscal stabilizers "kick in" and may ease the burden. In addition, discretionary fiscal policy (involving borrowing or lending) within nations could be as effective as centralized institutions in cushioning external shocks.

Figure 6 shows the evolution of the overall fiscal balance in the Dominican Republic and Haiti over the period 1960-2007. The figure suggests that neither one of these countries has managed to maintain surpluses for long; on the contrary, both countries have experienced persistent periods of high deficits, which have fueled the accumulation of public debt. This discrepancy between fiscal outcomes makes it difficult to envisage a CCA between the two countries; limits are typically built in CCAs on debt levels and deficits. For instance, the Maastricht Treaty criteria required a 3 percent maximum fiscal deficit and a ratio of public debt to GDP inferior to 60 percent.

There are also divergent domestic medium-term considerations that may guide fiscal policy in both countries, such as the need to engage in fiscal consolidation in order to reduce constraints on the financing of private investment, or the need to satisfy qualitative criteria, such as improving tax collection (a key issue in both countries) and/or implementing a better arbitrage between current and investment expenditure. These considerations may severely reduce the scope for discretionary policy actions in response to shocks.

States regions.

Figure 6
Dominican Republic and Haiti: Overall Fiscal Balance (percent of GDP), 1960-2007



Source: IMF.

The foregoing discussion provides only mixed evidence (at best) in support of a CCA between the Dominican Republic and Haiti. However, it must be kept in mind, as noted earlier, that simple (unconditional) correlations can be misleading for assessing the degree of comovements between variables. In the short run, unconditional correlation coefficients can vary in response to a wide variety of macroeconomic factors. The analysis performed in the next section (which introduces a number of control variables in a multivariate framework) provides more accurate measures of business cycle synchronicity. More importantly, the criteria used may be *endogenous*, as a result of the very existence, and induced effects, of a CCA. For instance, it has been argued that similarity of inflation rates may be promoted by participating in a currency union. Hoffman and Remsperger (2005) for instance have found that, for the Euro area, the degree of persistence in inflation differentials fell significantly following the adoption of the common currency in 1999. Similarly, once two countries choose to form a CCA, their business cycle may become more synchronized, as the elimination of currency fluctuations may spur trade between them. There is also evidence suggesting that the

formation of a monetary union may foster macroeconomic integration.[11] We will return to this issue in the concluding section of the paper.

V. DEGREE OF SYMMETRY OF SHOCKS: A VARX ANALYSIS

The foregoing discussion has provided a conceptual and preliminary statistical analysis of the various criteria that may be relevant in considering whether the Dominican Republic and Haiti could form an EMU. We now turn to a more formal analysis, based on vector autoregression (VAR) models, with a focus on understanding how the two countries respond to external and domestic shocks. We begin with ha description of the VARX methodology. We then present and analyze two VARX models, which differ by their degree of complexity.

1. VAR and VARX Methodology

In general, a standard linear VAR model can be written in the structural form[12]

$$AY_t = B(L)Y_{t-1} + C \cdot X_t + u_t, \tag{1}$$

where

$Y_t = [y_{1t} \ldots y_{nt}]'$ is a vector of n endogenous variables;

$X_t = [1\ x_{2t} \ldots x_{pt}]'$ is a vector of p exogenous variables (the first of which is a constant term);

[11] See Fielding and Shields (2005) for the CFA franc Zone and Gil-Pareja, Llorca-Vivero, and Martínez-Serrano (2008) for the Euro Zone.

$u_t = [u_{1t} \ldots u_{nt}]'$ is a vector of n random shocks that are uncorrelated over time and mutually uncorrelated, with a (diagonal) variance matrix Λ.

To simplify, we will assume that all variables in this system are stationary, and that the exogenous variables only enter contemporaneously (that is, they are dated at period t). The elements of matrix A, of order n×n (respectively C, of order n×p) are the structural parameters related to endogenous variables (respectively, exogenous) and B(L) is a matrix polynomial which depends on the lag operator L, defined so that $L^k z_t = z_{t-k}$, that is

$$B(L) = B_0 + B_1 L + \ldots + B_m L^m,$$

where m+1 is the number of lags and the matrices B_i are of order n×n. Matrix A captures instantaneous causality links (or, more generally, contemporaneous interactions) between endogenous variables.

A reduced form of the above system is given by

$$Y_t = D(L) Y_{t-1} + E \cdot X_t + \varepsilon_t \tag{2}$$

where

$$D = A^{-1}B(L), \quad E = A^{-1}C, \quad \varepsilon_t = A^{-1}Cu_t.$$

The matrices D, of order n×n, and E, of order n×p, are nonlinear functions of the structural parameters on the contemporaneous endogenous variables, A, and the contemporaneous response of endogenous variables to the exogenous variables, C. Let Φ denote the variance-covariance matrix of the reduced-form shocks ε_t; exact identification of the parameters of the structural form equations from the estimated parameters of the reduced-

[12]See for instance Lütkepohl (2006) for a detailed presentation of standard VAR models and their properties.

form equation requires that the number of "free" parameters in A and Λ be equal to the number of independent parameters in Φ. It can be shown that, if the diagonal elements of A are normalized to unity, n(n-1)/2 restrictions on the coefficients of A are needed to achieve exact identification (see for instance Lütkepohl (2006)).

Consider for instance the case where n = 3, p = 2, and m = 0; the reduced-form VAR is therefore given by

$$\begin{bmatrix} y_{1t} \\ y_{2t} \\ y_{3t} \end{bmatrix} = \begin{bmatrix} d_{11} & d_{12} & d_{13} \\ d_{21} & d_{22} & d_{23} \\ d_{31} & d_{32} & d_{33} \end{bmatrix} \begin{bmatrix} y_{1t-1} \\ y_{2t-1} \\ y_{3t-1} \end{bmatrix} + \begin{bmatrix} e_{11} & e_{12} \\ e_{21} & e_{22} \\ e_{31} & e_{32} \end{bmatrix} \begin{bmatrix} 1 \\ x_{2t} \end{bmatrix} + \begin{bmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \\ \varepsilon_{3t} \end{bmatrix}, \tag{3}$$

If there are no restrictions on the coefficients d_{ij} and e_{ij} in matrices D and E, we must estimate $3^2 + 3\times2 = 15$ parameters. The problem this number rises rapidly with the number of variables and the number of lags, thereby leading quickly to problems of degrees of freedom and eventually preventing estimation. For instance, with two lags on all endogenous variables (m = 1), 24 parameters should be estimated, and with 3 lags, 33 parameters. Thus, even a parsimonious VAR may quickly exhaust the number of degrees of freedom available in a typical time-series application.

A VARX model is an attempt to alleviate this problem. It involves imposing restrictions on the interactions, static and dynamic, between variables in a VAR, on the basis of a priori economic reasoning. Suppose that the model builder "knows" that variables y_{1t} and y_{2t} can interact between themselves (as well as possibly with other variables), but that they do not have any effect on variable y_{3t}, which is itself determined only by its past values (here, the one-period lag), without a constant term. There is therefore an asymmetry between the model's endogenous variables; causality is unidirectional.

A VARX system allows the modeler to exploit this asymmetry (or *ex ante* information) in order to reduce the number of parameters to be estimated, compared to a standard VAR; the resulting increase in the number of degrees of freedom may not only make estimation feasible, but it will also lead to improved efficiency of those parameters that are estimated.

In the example being considered, the reduced form can now be written as

$$\begin{bmatrix} y_{1t} \\ y_{2t} \\ y_{3t} \end{bmatrix} = \begin{bmatrix} d_{11} & d_{12} & d_{13} \\ d_{21} & d_{22} & d_{23} \\ 0 & 0 & d_{33} \end{bmatrix} \begin{bmatrix} y_{1t-1} \\ y_{2t-1} \\ y_{3t-1} \end{bmatrix} + \begin{bmatrix} e_{11} & e_{12} \\ e_{21} & e_{22} \\ 0 & 0 \end{bmatrix} \begin{bmatrix} 1 \\ x_{2t} \end{bmatrix} + \begin{bmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \\ \varepsilon_{3t} \end{bmatrix} \quad (4)$$

The system becomes therefore recursive; the four restrictions that have been imposed ($d_{31} = d_{32} = 0$, and $e_{31} = e_{32} = 0$) imply that only $3^2-2+2\times2 = 11$ parameters must be estimated, instead of 15 with the standard VAR. The gain in terms of degrees of freedom is thus quite significant.

Equally important, the VARX specification allows the modeler to calculate impulse response functions associated with innovations on those variables that are "partially" endogenous, such as y_{3t} here. By treating y_{3t} as a purely exogenous variable (such as those included in the vector X_t), such calculations would not be feasible. A similar argument holds for variance decompositions.

In general, restrictions imposed on the structural form are not always sufficient to guarantee that all structural parameters are identified. Thus, a VARX model is not synonymous to a structural VAR, which requires a specific number of exclusion restrictions (including those associated with the normalization of the system) to achieve exact identification, as discussed earlier. At the same time, the exclusion restrictions typically imposed in a VARX (that domestic variables do not affect foreign variables, for instance) are often used in structural VAR models, given their plausibility.[13]

Structural VARs have been used by a number of authors to discuss convergence issues in CCAs; among developing countries, these studies (which are based on the Blanchard-Quah technique or some variant of it) include Ahumada and Martinera (2001), Fielding and Shields (2001, 2005), Buigut and Valev (2005), and Saxena (2005), and Allegret and Sanc-Zantman (2009).[14] A common criticism of structural VARs, however, is that the restrictions used are quite arbitrary. In this case, applying the Blanchard-Quah technique is particularly problematic: it assumes that aggregate demand shocks have a temporary impact on output,

[13]Note that, in the formulation (4), restrictions are imposed directly on the reduced form; equivalently, they could be imposed on the structural form. In the present example, matrices A and B_0 (given that m = 0) would become, using the normalization $a_{ii} = 1$,

$$A = \begin{bmatrix} 1 & a_{12} & a_{13} \\ a_{21} & 1 & a_{23} \\ 0 & 0 & 1 \end{bmatrix}, \quad B_0 = \begin{bmatrix} b_{11} & b_{12} & b_{13} \\ b_{21} & b_{22} & b_{23} \\ 0 & 0 & b_{33} \end{bmatrix}$$

[14]As an alternative approach, Houssa (2008) uses dynamic factor models.

whereas aggregate supply shocks are have a permanent effect. But casual observation suggests that many of the shocks that affect the two countries here are *temporary supply disturbances*, related for instance to climatic shocks (hurricanes, etc.) or terms-of-trade shocks. We therefore do not attempt to identify the characteristics of structural shocks to these economies and focus instead on a reduced-form VARX approach.

2. A Basic VARX Model

We consider first a basic VARX model consisting of five variables, which were defined in the previous section: output gaps in the Dominican Republic and Haiti, with trend values measured by the modified Baxter-King filter; inflation rates (measured as deviations from US inflation) in the two countries; and the US output gap, which is not only an indicator of activity abroad and demand for domestic exports for both countries, but also an indicator of capital flows associated with remittances from nationals abroad; indeed both countries have sizable diaspora outside the national territory and benefit from sizable unrequited transfers. By using an integrated model instead of separate models, we are able to analyze directly how domestic variables in each country respond to shocks to variables in the other country, while at the same time accounting for possible interactions between variables in both countries induced by external shocks (in this case, shocks to the US output gap).

All five variables are stationary at a standard significance level of 5 percent, as documented by the unit root tests reported in Appendix B. Thus, we can exclude any cointegration relationship between them and, instead of a VECM, we can proceed but a VAR in levels. The first four variables are considered fully interactive in the model (in the sense that the associated parameters are not subject to restrictions), whereas the US output gap is treated as a partially interactive endogenous variable, which is subject to restrictions on its instantaneous causality and interdependence links. The constant term is the only strictly exogenous variable.

Suppose that the five variables defined earlier are numbered according to the order in which they were presented, that is, variables 1 to 4 are the fully interactive variables (y_{1t} and y_{2t} being the output gaps in Haiti and the Dominican Republic, and y_{3t} and y_{4t} inflation rates in both countries) and 5 is the partially interactive variable (the US output gap). It is totally plausible to assume that output fluctuations in the U.S. affects output gaps and inflation in the Dominican Republic and Haiti, but it is unlikely that activity and inflation in these two countries have much effect on fluctuations in U.S. output. This variable is taken to depend solely on its past value(s).

The strictly exogenous variable (the constant term) is numbered 1. In addition, suppose that the model considers uniformly only one lag, so that m = 0. In matrix form, the VARX model can then be written as

$$\begin{bmatrix} \mathbf{Y}_{1t} \\ y_{5t} \end{bmatrix} = \begin{bmatrix} \mathbf{d}_{11} & \mathbf{d}_{12} \\ \mathbf{0} & d_{55} \end{bmatrix} \begin{bmatrix} \mathbf{Y}_{1t-1} \\ y_{5t-1} \end{bmatrix} + \begin{bmatrix} \mathbf{e}_1 \\ e_5 \end{bmatrix} + \begin{bmatrix} \boldsymbol{\epsilon}_{1t} \\ \varepsilon_{5t} \end{bmatrix},$$

where

$$\mathbf{Y}_{1t} = [y_{1t} \ldots y_{4t}]', \quad \boldsymbol{\epsilon}_{1t} = [\varepsilon_{1t} \ldots \varepsilon_{4t}]',$$

and $\mathbf{e}_1$, $\mathbf{d}_{11}$ and $\mathbf{d}_{12}$ are submatrices defined as

$$\underset{(4\times4)}{\mathbf{d}_{11}} = [d_{ij}]_{i,j=1,\ldots4}, \quad \underset{(4\times1)}{\mathbf{d}_{12}} = [d_{i5}]_{i=1,\ldots4}, \quad \underset{(4\times1)}{\mathbf{e}_1} = [e_i]_{i=1,\ldots4},$$

We can infer from this system that the gain in terms of degrees of freedom associated with the VARX relative to a standard VAR with no restrictions of any sort is given by 5*(5+1) – 4*(4+1+1) - 1*(1+1) = 4. If, instead, the model has uniformly two lags, so that m = 1, the gain is 5*(10+1) – 4*(10+1) - 1*(2+1) = 8.

The variance decompositions obtained with two lags are shown in Table 1, using the Cholesky ordering: the US output gap, the output gap in the Dominican Republic, the output gap in Haiti, inflation deviation for the Dominican Republic, and the inflation deviation for Haiti. We therefore take the US output gap to be the most "exogenous" variable, followed by the variables for the Dominican Republic (the bigger of the two island countries), and last the two variables for Haiti.[15] In the context of our analysis, variance decomposition tells us the extent to which variability in real output and inflation in each of the two countries is influenced by shocks to common factors—in this basic case, shocks to US output. This is important because differences in the cause of variability in the countries could be indicative of underlying differences in the transmission mechanism and the policy strategies in both countries, which could be an obstacle to monetary integration.

[15]The order in which the variables for the Dominican Republic and Haiti was also inverted, to check for robustness; this did not affect significantly the results.

Table 1
Basic VARX Model: Variance Decompositions

Variance Decomposition of GAP_HT_BK:

Period	S.E.	GAP_HT_BK	GAP_DR_BK	DLINFL_DUS_HT	DLINFL_DUS_DR	GAP_US_BK
1	0.024	100.000	0.000	0.000	0.000	0.000
2	0.025	96.484	1.521	1.080	0.647	0.269
3	0.028	79.095	3.499	11.022	4.016	2.368
4	0.028	75.700	3.612	13.209	5.020	2.459
5	0.029	72.533	3.580	15.659	5.053	3.174
6	0.029	71.021	3.491	16.930	4.952	3.606
7	0.030	70.694	3.479	17.256	4.982	3.589
8	0.030	70.446	3.471	17.374	5.033	3.676
9	0.030	70.300	3.469	17.487	5.039	3.704
10	0.030	70.224	3.470	17.569	5.037	3.700
			Variance Decomposition of GAP_DR_BK:			
1	0.025	0.000	100.000	0.000	0.000	0.000
2	0.028	3.934	94.649	0.038	0.371	1.008
3	0.028	3.792	92.035	0.969	2.156	1.048
4	0.030	3.791	87.786	3.772	2.196	2.454
5	0.031	3.778	85.400	4.859	2.128	3.835
6	0.031	3.840	85.031	5.106	2.186	3.837
7	0.031	3.823	84.319	5.089	2.157	4.612
8	0.031	3.816	84.070	5.080	2.280	4.754
9	0.031	3.833	83.818	5.064	2.407	4.878
10	0.031	3.825	83.579	5.061	2.413	5.121
			Variance Decomposition of DLINFL_DUS_HT:			
1	0.083	0.697	4.207	95.097	0.000	0.000
2	0.095	1.214	5.121	93.185	0.416	0.064
3	0.107	2.522	5.431	91.126	0.586	0.334
4	0.112	2.796	5.514	90.544	0.697	0.449
5	0.115	2.886	5.341	90.431	0.911	0.431
6	0.116	2.887	5.240	90.232	1.200	0.441
7	0.117	2.858	5.213	89.971	1.517	0.441
8	0.117	2.837	5.238	89.691	1.728	0.505
9	0.117	2.826	5.255	89.545	1.816	0.558
10	0.117	2.823	5.255	89.509	1.850	0.564
			Variance Decomposition of DLINFL_DUS_DR:			
1	0.100	0.108	5.524	5.732	88.637	0.000
2	0.119	0.573	5.704	6.318	87.265	0.140
3	0.138	2.218	11.025	4.735	79.468	2.553
4	0.145	2.376	11.664	4.266	75.545	6.149

5	0.146	2.470	11.492	4.210	74.999	6.828
6	0.147	2.481	11.591	4.243	74.776	6.909
7	0.147	2.479	11.560	4.278	74.575	7.108
8	0.147	2.518	11.550	4.315	74.520	7.096
9	0.148	2.549	11.556	4.325	74.306	7.265
10	0.148	2.550	11.551	4.327	74.253	7.319

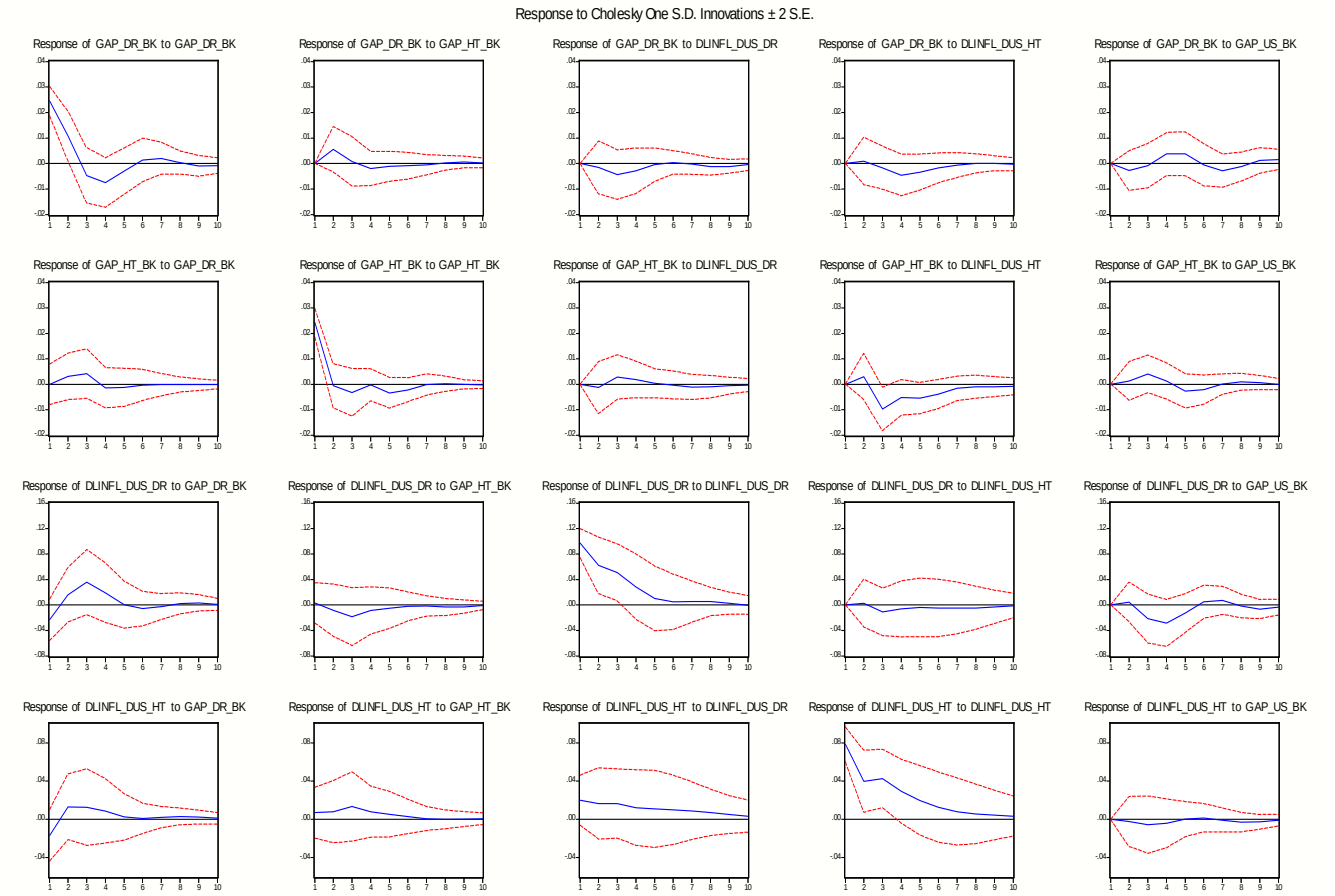
Source: Author's calculations

Notes: GAP_DR_BK is the output gap for the Dominican Republic, GAP_HT_BK the output gap for Haiti, DLINFL_DUS_DR the inflation differential with respect to the US for the Dominican Republic, DLINFL_DUS_HT the inflation differential with respect to the US for Haiti, and GAP_US_BK the output gap for the United States. The Choleski ordering of the variables is as described in the text.

The results indicate that at a horizon of 10 periods, fluctuations in the output gap in the Dominican Republic are explained mostly by its own innovations (more than 80 percent). This is less so for Haiti, with own innovations accounting for about 70 percent, and innovations in domestic inflation accounting for about 21 percent of output gap fluctuations. In both countries fluctuations in inflation are accounted for mostly by their own innovations (about 80 percent), with a somewhat more significant effect of the domestic output gap in the case of the Dominican Republic. In neither case does the US output gap play a significant role in domestic fluctuations. There are also no significant cross-country effect between the Dominican Republic and Haiti. This could reflect the fact that economic fluctuations in both countries are subject to large temporary supply shocks; although these shocks can be correlated (as is the case with hurricanes), this is not always the case.

We examine next the impulse response function to an innovation in the US output gap and the response functions of domestic variables in response to shocks in the other country. The objective is to examine if and how each country's domestic macroeconomic variables respond to the same external shock, and if and how they respond to shocks in the other country. To the extent that both countries respond in a similar way to the first shock (that is, by displaying a high degree of symmetry), are better potential candidates for a CCA. Moreover, the speed of response matters also; in general, the slower is the adjustment after disturbances, the larger will be the cost of maintaining a single currency.

Figure 7
Basic VARX: Impulse Response Functions



Source : Author's calculations.

Figure 7 shows the response of domestic variables in the two countries to an innovation in all the variables at a horizon of 10 periods and using the ordering described earlier. The solid lines (in blue) in the figures represent the impulse responses themselves, whereas the dotted lines (in red) are the associated 95 percent upper and lower confidence bands.[16] The results suggest that domestic variables do not respond significantly to shocks to the US output gap. In addition, domestic variables in one country do not respond either to shocks to domestic variables in the other countries. Thus, these results appear to corroborate the preliminary analysis, based on unconditional correlations, which suggested limited business cycle synchronization between the two countries. At the same time, however, it is possible that the small number of variables included in the VARX does not allow one to properly capture the transmission process of these shocks. To investigate further this potential misspecification problem, we now turn to a more extended model.

[16]The impulse responses and their associated confidence intervals are computed using Monte Carlo simulations employing 1,000 draws. Eviews 3.1 was used to perform all computations.

3. An Extended VARX Model

We now extend the basic VARX model to consider, in addition to the five variables above (the output gaps and inflation deviations in the two countries, and the US output gap), the following variables:

a) the ratio of credit to GDP in the two countries;

b) the rate of change of the real bilateral exchange rate (with respect to the US dollar) in both countries;[17]

c) the rate of change of the price of oil in US dollars;

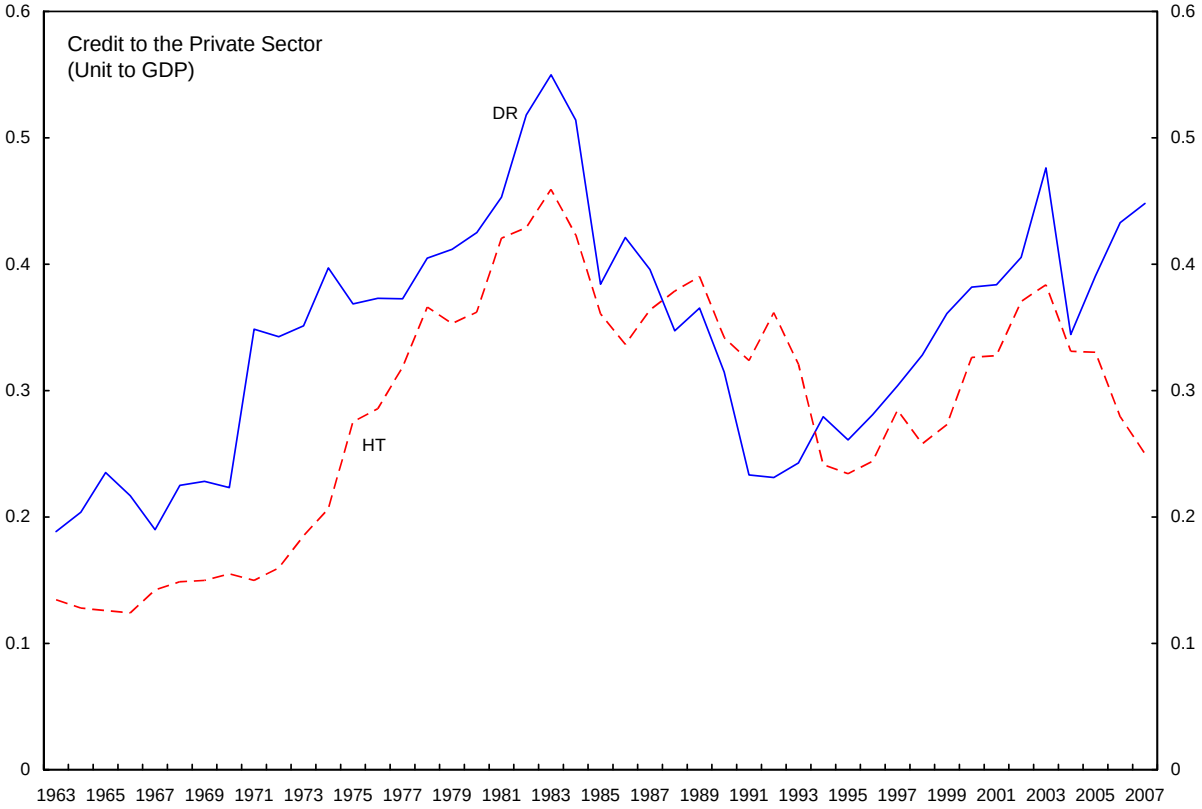
d) the real US Treasury bill rate, given by the nominal rate deflated by the US inflation rate in consumer prices.

Given what is known about the importance of banks in financing domestic activity in developing countries (see for instance Agénor and Montiel (2008)), one would expect the ratio of credit to the private sector to GDP to play an important role in the transmission of a variety of shocks to output and inflation in the two countries: it can be viewed as measuring the availability of loanable funds, and thus possibly a constraining factor on economic activity. As shown in Figure 8, these ratios have fluctuated significantly during the sample period. Similarly, the real exchange rate, being a key relative price, is also expected to play an important role in the transmission mechanism of both domestic and international shocks. The behavior of these rates is shown in Figure 9, with a rise denoting a depreciation.[18]

[17]We constructed a bilateral real exchange rate index because standard measures, such as the IMF's real *effective* exchange rate, were not available for the whole sample period. Details of our calculations are provided in Appendix B.

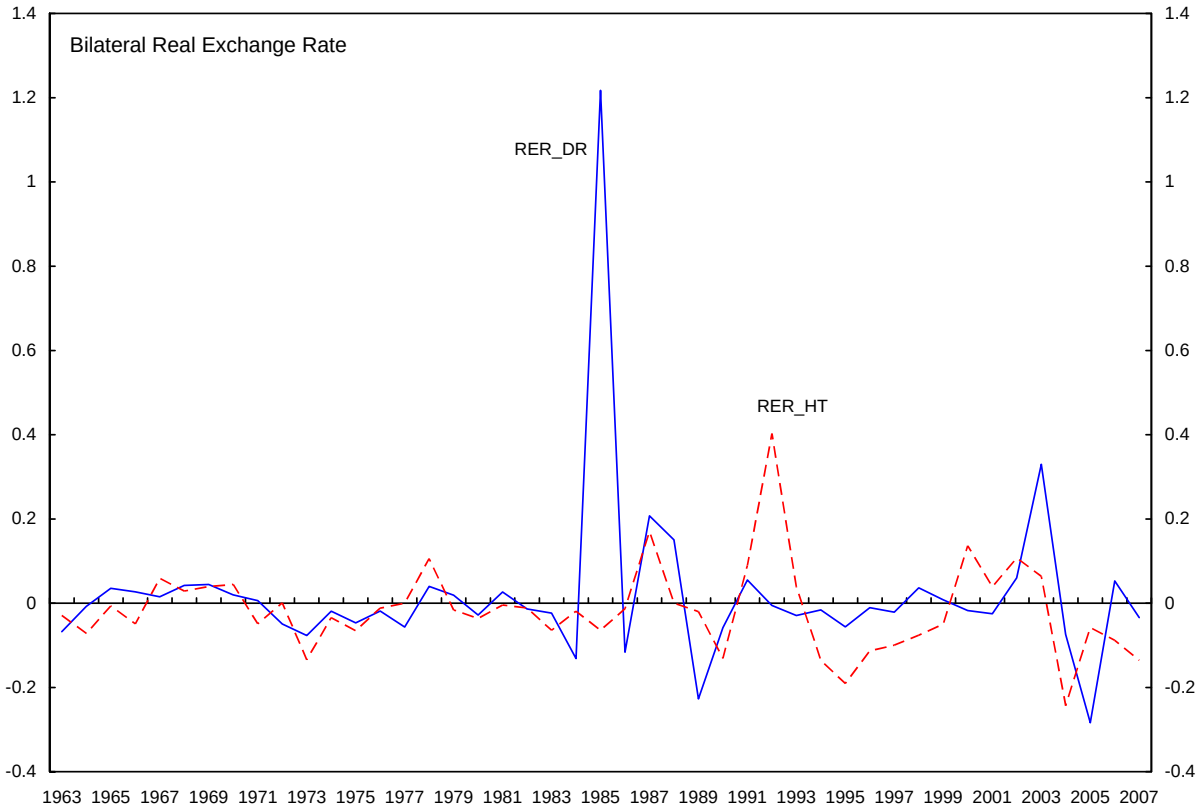
[18]In estimating the model, we introduced two dummy variables, taking the value 1 in 1985 and 2003 for the Dominican Republic, and 1992 for Haiti, to account for the financial crises (and large nominal depreciations) that were recorded in both countries during these periods. These "spikes" can be clearly identified in Figure 9.

Figure 8
Dominican Republic and Haiti: Credit to the Private Sector, 1963-2007
___ Dominican Republic _ _ _ Haiti



Source: IMF.

Figure 9
Dominican Republic and Haiti: Bilateral Real Exchange Rates, 1963-2007
___ Dominican Republic _ _ _ Haiti



Source: Author's calculations based on IMF data (see Appendix B).

Given that the Dominican Republic and Haiti are both oil importers, accounting for changes in the price of oil, and studying its potential impact on both countries, is also important. In the absence of sufficiently long time-series on the domestic-currency retail price for each country (which would have the advantage of taking into account changes in subsidies and taxes), we use a common price index in foreign prices.[19] While the US output gap captures (as before) "trade" and "remittance" channels, the US interest rate captures a "financial" channel, that is, a measure of borrowing conditions on world capital markets. This is more appropriate for the Dominican Republic (given its ability to borrow on world capital markets in normal times) as opposed to Haiti, which cannot borrow on these markets.[20]

[19]See Appendix B for an exact definition of the index.

[20]Ideally, what would be more appropriate to measure financial shocks for the Dominican Republic would be a country-specific measure of borrowing costs on world capital markets, which would account for the country-specific spread above and over the risk-free US Treasury rate. Unfortunately, such a variable is not available for the whole period under study.

As shown in Appendix B, all of these new variables are also stationary at a significance level of 5 percent, except for the US real interest rate, which is significant at a 10 percent significance level; we therefore specify again the VARX in levels. For convenience, we rename the US output gap variable as y_{11t}. The degree of endogeneity of the new variables, numbered now 5 to 10, is as follows. Variables y_{5t} and y_{6t}, the real exchange rates in Haiti and the Dominican Republic, respectively, are taken to be fully interactive, just like the output gaps and inflation rates.

All the other variables are taken to be partially interactive. Variables y_{7t} and y_{8t},, the private sector credit variables in Haiti and the Dominican Republic, respectively, are taken to affect directly only the output gap in the respective country; they have no direct effect on the other fully interactive variables, inflation and the real exchange rates. In addition, these variables are also taken to depend only on their own lagged value and the lagged output gap, to capture possible bidirectional causality between credit and economic activity. Variable y_{9t}, the rate of change of the price of oil, depends only on its past value; it can affect all domestic variables in the fully interactive block. Variable y_{10t}, the US real interest rate, is assumed to depend not only on its past value but also depend on lagged value of the US output gap, which is now y_{11t}. Conversely, the US output gap is also assumed to depend now not only on its lagged value but also on the lagged value(s) of the real US interest rate and oil prices. Thus, the model now accounts for interactions between the US variables themselves, and between oil prices and US activity—while maintaining the unidirectional causality between US variables and domestic variables in Haiti and the Dominican Republic (y_{10t} and y_{11t} can affect all domestic variables). Just as before, all of the partially endogenous variables can affect the fully interactive variables.

Given the increase in the number of variables, to preserve degrees of freedom, the number of lags is restricted uniformly to 1 (m = 0). In matrix form, the extended VARX model can then be written as

$$\begin{bmatrix} \mathbf{Y}_{1t} \\ \mathbf{Y}_{2t} \end{bmatrix} = \begin{bmatrix} \mathbf{d}_{11} & \mathbf{d}_{12} \\ \mathbf{d}_{21} & \mathbf{d}_{22} \end{bmatrix} \begin{bmatrix} \mathbf{Y}_{1t-1} \\ \mathbf{Y}_{2t-1} \end{bmatrix} + \begin{bmatrix} \mathbf{e}_1 \\ \mathbf{e}_2 \end{bmatrix} + \begin{bmatrix} \boldsymbol{\epsilon}_{1t} \\ \boldsymbol{\epsilon}_{1t} \end{bmatrix},$$

where now

$$\mathbf{Y}_{1t} = [y_{1t} \ldots y_{6t}]', \quad \mathbf{Y}_{2t} = [y_{7t} \ldots y_{11t}]', \quad \mathbf{e}_1 = [e_1 \ldots e_6]',$$

$$\mathbf{e}_2 = [e_7 \ldots e_{11}]', \quad \boldsymbol{\epsilon}_{1t} = [\varepsilon_{1t} \ldots \varepsilon_{6t}]', \quad \boldsymbol{\epsilon}_{2t} = [\varepsilon_{7t} \ldots \varepsilon_{11t}]'$$

and the submatrices d_{ij}, based on the restrictions defined earlier, are given by[21]

$$\underset{(6\times 6)}{\mathbf{d}_{11}} = [d_{ij}]_{i,j=1,\ldots 6},$$

$$\underset{(6\times 5)}{\mathbf{d}_{12}} = \begin{bmatrix} d_{17} & 0 & d_{19} & d_{110} & d_{111} \\ 0 & d_{28} & d_{29} & d_{210} & d_{211} \\ 0 & 0 & d_{39} & d_{310} & d_{311} \\ 0 & 0 & d_{49} & d_{410} & d_{411} \\ 0 & 0 & d_{59} & d_{510} & d_{511} \\ 0 & 0 & d_{69} & d_{610} & d_{611} \end{bmatrix}$$

$$\underset{(5\times 6)}{\mathbf{d}_{21}} = \begin{bmatrix} d_{71} & 0 & 0 & 0 & 0 & 0 \\ 0 & d_{82} & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \end{bmatrix},$$

[21]The dependence of the credit-to-GDP ratio on the (lagged) output gap in the respective country, as noted earlier, explains why the submatrix $\mathbf{d}_{21}$ does not contain only zeroes but instead is specified as having $d_{71} \neq$

and

$$\underset{(5\times5)}{\mathbf{d}_{22}} = \begin{bmatrix} d_{77} & 0 & 0 & 0 & 0 \\ 0 & d_{88} & 0 & 0 & 0 \\ 0 & 0 & d_{99} & 0 & 0 \\ 0 & 0 & 0 & d_{1010} & d_{1011} \\ 0 & 0 & d_{119} & d_{1110} & d_{1111} \end{bmatrix}$$

Based on these matrices, we can calculate as before the gain in terms of degrees of freedom that the extended VARX model provides, relative to a standard VAR model with no restrictions of any sort. From the above matrices, this gain is now given by 11*(11+1) – (6*6 + 20 + 2 + 8) = 121 – 66 = 55.[22]

The variance decompositions are shown in Table 2, using the following Cholesky ordering: the world price of oil, the US real interest rate, the US output gap, the credit variables in the Dominican Republic and Haiti, the output gap in the Dominican Republic and Haiti, inflation deviation for the Dominican Republic and Haiti, and the real exchange rates in the two countries. We therefore take the world price of oil as the most "exogenous" variable, followed by the US variables; the rest of the ordering is as for the basic VARX model.[23]

For the purpose at hand, the important issue is the extent to which variability in the "core" macro variables (real output, inflation, and the real exchange rate) in each of the two countries is influenced by shocks to common external factors—captured now by shocks to two US variables and world oil prices.

The results indicate that at a horizon of 10 periods, own innovations play a much less significant role for output gaps and inflation rates—in contrast to the results obtained with the

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0 and $d_{82} \neq 0$.

[22] In an unpublished Appendix (Appendix C, available upon request), we also estimated an alternative extended VARX model, in which the real exchange rate variables were treated only as partially interactive. Although the gain in terms of degrees of freedom implied by the additional restrictions proved substantial (equal to 121 – 46 = 75, with only 46 parameters to estimate, instead of 66), the results obtained were very similar to those reported here.

[23] Again, the order in which the variables for the Dominican Republic and Haiti was inverted to check for robustness, but this did not have a significant impact on the results.

basic VARX model. For the output gap, the share of all three variables is about 7 percent for the Dominican Republic and 10 percent for Haiti. For inflation, the shares are 12 percent and 10 percent, respectively, and for the real exchange rate 7 percent and 8 percent, respectively. Innovations in credit ratios play a significant role (compared to the real exchange rate) in explaining fluctuations in the output gap in both countries; at the same time, innovations in output gaps and inflation rates have a sizable effect on fluctuations in the real exchange rate in both countries. Country effects are a bit more significant as well. Nevertheless, fluctuations in the external factors account for a relatively small share of the fluctuations in the domestic variables. Thus, the extended VARX model show some significant differences in differences in the cause of variability in the countries could be indicative of underlying differences in the transmission mechanism and the policy strategies in both countries, which could be an obstacle to monetary integration.

Table 2
Extended VARX Model: Variance Decompositions

Variance Decomposition of GAP_DR_BK:

Period	S.E.	OIL	RATE_US	GAP_US_I	CRED_DR	CRED_HT	GAP_DR_I	GAP_HT_I	DLINFL_D	DLINFL_F	RER_DR	RER_HT
1	0.490207	2.911458	0.167632	0.238579	10.60113	12.16244	73.91876	1.97E-32	1.67E-31	6.61E-31	0	0
2	0.531892	2.48656	0.805917	1.847915	12.37915	10.1151	63.97836	5.993559	1.349464	0.42766	0.576829	0.039478
3	0.561766	2.441494	1.046419	2.815543	11.34676	9.814089	57.80101	6.346508	3.753742	1.502699	0.581988	2.54975
4	0.573333	2.379367	1.016905	2.7094	10.91463	9.80191	55.89782	6.247548	4.747881	1.827877	0.562731	3.893925
5	0.577166	2.350443	1.014247	2.716998	10.85068	9.777016	55.24923	6.397418	5.065115	1.835215	0.638823	4.104816
6	0.579668	2.404873	1.033826	2.694777	10.91212	9.778258	54.76684	6.423367	5.299408	1.820749	0.745273	4.120508
7	0.581458	2.485556	1.059709	2.67908	10.94586	9.783529	54.39671	6.399088	5.520844	1.809451	0.788557	4.131509
8	0.583222	2.524076	1.082678	2.680815	10.93797	9.778721	54.19805	6.389059	5.667838	1.803846	0.801601	4.141367
9	0.585674	2.534729	1.097218	2.698025	10.92378	9.767992	54.12746	6.380706	5.72441	1.801443	0.802445	4.139788
10	0.58922	2.534466	1.103454	2.721533	10.91957	9.764584	54.1007	6.38265	5.729871	1.800434	0.804238	4.138495

Variance Decomposition of GAP_HT_BK:

Period	S.E.	OIL	RATE_US	GAP_US_I	CRED_DR	CRED_HT	GAP_DR_I	GAP_HT_I	DLINFL_D	DLINFL_F	RER_DR	RER_HT
1	1.025414	2.531544	3.989565	0.336139	4.662177	2.907731	0.008131	85.56471	1.60E-33	2.20E-31	0	0
2	1.558491	2.349202	3.711958	1.403855	5.997176	3.927433	0.08307	74.9252	0.04916	2.616944	1.899881	3.039124
3	2.027911	3.150755	3.600793	1.97089	5.767771	3.923559	0.217358	71.32713	1.898087	2.764744	2.244977	3.133939
4	2.323827	3.069193	3.714169	2.002865	6.164983	3.863817	0.657121	69.52772	2.486369	2.795282	2.265816	3.452265
5	2.491868	3.255572	3.784973	2.165968	7.493706	3.805714	1.529442	67.02617	2.434237	2.858762	2.316785	3.328669
6	2.59986	3.474646	3.81213	2.245431	8.907791	3.949306	2.006982	63.58462	3.167921	2.927982	2.419284	3.503909
7	2.675784	3.712121	3.79937	2.224655	9.789104	4.250102	2.065184	59.92191	4.689124	2.957974	2.567711	4.022742
8	2.731859	3.923011	3.776409	2.131394	10.16883	4.552284	1.979866	56.93896	6.332862	2.9358	2.699671	4.560907
9	2.777277	4.076278	3.773551	2.057212	10.2595	4.746491	1.911154	54.98111	7.61075	2.88914	2.794829	4.899986
10	2.818383	4.173084	3.793047	2.045158	10.22532	4.819053	1.892131	53.93167	8.391329	2.847908	2.849416	5.031889

Variance Decomposition of DLINFL_DUS_DR:

Period	S.E.	OIL	RATE_US	GAP_US_I	CRED_DR	CRED_HT	GAP_DR_I	GAP_HT_I	DLINFL_D	DLINFL_F	RER_DR	RER_HT
1	0.014059	11.91047	0.187517	0.02463	23.63136	5.66987	0.026492	2.763422	55.78623	1.54E-30	0	0
2	0.01642	7.753365	1.848001	0.171545	14.1869	6.260108	0.573216	2.620396	55.19308	0.397762	3.912698	7.083527
3	0.016897	7.019173	1.676855	0.941155	12.14634	6.095478	3.884295	2.601619	53.18966	0.482704	3.269608	8.693112
4	0.017004	6.904676	1.535843	3.443291	12.90164	5.695467	6.439564	3.100174	48.92541	0.512598	3.004179	7.937162
5	0.017089	6.285628	1.408293	4.615171	13.88261	6.442057	6.902638	3.098845	45.32117	0.783277	2.816269	8.444009
6	0.017214	6.131537	1.311327	4.837433	14.38927	7.820562	6.433477	2.81406	42.77881	1.026528	2.746301	9.710694
7	0.017373	6.175052	1.284866	4.625589	14.50075	9.256066	5.836665	2.55227	41.13026	1.146915	2.758947	10.73262
8	0.017506	6.355111	1.338995	4.309273	14.42949	10.40641	5.376192	2.392475	40.13526	1.185164	2.776644	11.29499
9	0.017582	6.573378	1.458613	4.058642	14.30236	11.17009	5.084643	2.314692	39.55789	1.191134	2.778911	11.49964
10	0.017614	6.767998	1.612627	3.948923	14.18466	11.58566	4.92503	2.290129	39.22372	1.189678	2.76989	11.50169

Variance Decomposition of DLINFL_DUS_HT:

Period	S.E.	OIL	RATE_US	GAP_US_I	CRED_DR	CRED_HT	GAP_DR_I	GAP_HT_I	DLINFL_D	DLINFL_F	RER_DR	RER_HT
1	0.039247	1.756485	2.461371	3.072477	2.869983	8.879094	0.712573	0.012284	23.92241	56.31333	0	0
2	0.079821	8.123614	2.376093	1.884758	1.933532	5.667883	4.805308	0.376947	20.9312	49.6113	0.040491	4.244879
3	0.109743	7.823196	2.22404	1.685342	1.727498	4.783744	5.184043	1.642516	20.81229	46.20998	1.475787	6.431563
4	0.131137	6.926455	2.032436	1.556464	3.460914	4.241611	4.585446	3.287849	21.92567	41.85195	3.059636	7.071572
5	0.144616	6.445902	1.887412	1.470418	6.041851	3.949751	4.130605	3.490413	24.00191	36.71352	4.420842	7.447377
6	0.15189	6.376484	1.79967	1.362675	7.238942	3.995763	3.68209	3.291381	26.6363	32.53145	5.055313	8.02993
7	0.155267	6.350386	1.751892	1.261602	7.286916	4.082639	3.44093	3.182453	28.76921	30.08919	5.221076	8.563707
8	0.156638	6.283971	1.729149	1.326571	7.063014	4.04771	3.536255	3.204915	29.83867	29.0054	5.234797	8.729554
9	0.15724	6.210688	1.71336	1.554552	7.026333	3.990796	3.796148	3.268495	29.98611	28.60767	5.198276	8.647576
10	0.157722	6.149273	1.693032	1.828702	7.252178	4.085047	4.007749	3.286741	29.64139	28.32314	5.136532	8.596218

Variance Decomposition of RER_DR:

Period	S.E.	OIL	RATE_US	GAP_US_I	CRED_DR	CRED_HT	GAP_DR_I	GAP_HT_I	DLINFL_D	DLINFL_F	RER_DR	RER_HT
1	0.031733	0	0	0	0	0	0	0	0	0	100	0
2	0.051379	0.078923	1.511467	3.25976	0.580077	0.744099	0.265902	7.143967	0.704692	0.101974	85.60772	0.001416
3	0.065506	0.579564	1.508122	3.118324	3.105982	0.713795	0.631428	7.058289	2.070085	0.123529	81.00525	0.085534
4	0.076043	1.135332	1.479979	3.029358	3.420575	1.472312	0.588214	6.523436	5.096312	0.396964	74.78602	1.271498
5	0.085729	1.278387	1.417751	3.644717	3.359079	1.996579	0.728236	6.262577	7.031416	0.50123	71.24404	2.535965
6	0.095048	1.279798	1.400131	3.63863	3.359462	2.164567	0.924426	6.241253	7.741337	0.500226	69.90472	2.895453
7	0.103482	1.300644	1.401676	3.671998	3.287278	2.206307	1.037894	6.265232	7.941335	0.498404	69.46515	2.924083
8	0.110511	1.307173	1.405012	3.736199	3.296075	2.203093	1.09531	6.275539	7.955162	0.505577	69.30297	2.917886
9	0.115868	1.304492	1.404457	3.794714	3.336671	2.213819	1.121651	6.267536	7.942748	0.515302	69.15234	2.94627
10	0.119571	1.309809	1.399577	3.82501	3.39581	2.266398	1.128747	6.24573	7.974723	0.523397	68.91609	3.01471

Variance Decomposition of RER_HT:

Period	S.E.	OIL	RATE_US	GAP_US_I	CRED_DR	CRED_HT	GAP_DR_I	GAP_HT_I	DLINFL_D	DLINFL_F	RER_DR	RER_HT
1	0.026984	0	0	0	0	0	0	0	0	0	0	100
2	0.029779	1.48598	1.560399	0.302552	2.075817	0.017505	8.00E-01	14.90705	1.539109	4.392729	0.196592	72.72258
3	0.03133	3.107407	1.502228	0.533651	8.197564	0.122366	4.688296	12.36236	1.317994	6.536184	1.556354	60.2756
4	0.031949	5.045081	1.209534	1.130857	9.436074	1.246332	5.486868	11.44995	3.323109	6.140626	1.745437	53.78613
5	0.032165	5.404721	1.180348	1.084713	9.073203	2.034399	5.259533	11.13801	4.99882	5.882004	1.669556	52.27469
6	0.032307	5.328205	1.16266	1.248118	9.209059	2.151838	5.650457	10.95771	5.191041	5.794864	1.686246	51.6238
7	0.032416	5.275782	1.14579	1.511103	9.655933	2.126056	5.981095	10.79821	5.186319	5.745453	1.741777	50.83248
8	0.032476	5.245233	1.127111	1.67227	9.975062	2.235094	5.978358	10.56098	5.655043	5.684247	1.813861	50.05274
9	0.0325	5.232165	1.110866	1.704927	10.08588	2.451799	5.846858	10.31563	6.384091	5.601125	1.883712	49.38294
10	0.03251	5.238183	1.102874	1.682653	10.07783	2.666243	5.744086	10.14128	7.028953	5.519441	1.935273	48.86318

Source: Author's calculations.

Notes: OIL is the rate of change of the world price of oil, RATE_US is the real US Treasury rate, CRED_DR (CRED_HT) is the ratio of private sector credit to GDP in the Dominican Republic (Haiti), and RER_DR (RER_HT) is the real exchange rate for the Dominican Republic (Haiti). For the other variables, see the note to Table 1. The Choleski ordering of the variables is as described in the text.

We examine next the impulse response functions associated with both domestic and external shocks. These functions, which are constructed as described earlier, are shown in Figures 10 to 16. For clarity, we report only those related to the output gap, inflation, and the real exchange rate in both countries.

Without getting into all the details of these results, some broad features can be identified. In general, and contrary to what one would have expected for some of them (e.g., a shock to the US output gap, given the importance of the United States as a trade partner and a source of remittances for both countries), external shocks do not have large effects on domestic variables—as can be inferred from an examination of Figures 10 to 12. For instance, in Figure 10, which illustrates the impact of an oil price shock, the only significant responses are a slight increase in the inflation differential (on impact in the Dominican Republic, in the second period in Haiti), and an initial real appreciation in the Dominican Republic; the response of the other variables are not statistically significant, and therefore not much can be inferred from their pattern.

By contrast, for domestic shocks, responses vary depending on the shock. A positive shock to the output gap in the Dominican Republic has no statistically significant effects on other domestic variables or variables in Haiti (see Figure 13), whereas a positive shock to the output gap in Haiti generates a small increase in the rate of real depreciation (brought about by a nominal exchange rate depreciation, given that the inflation differential for the country does not drop by much) and no effect on variables in the Dominican Republic (see Figure 14). More interestingly, although a positive shock to the inflation differential for Haiti affects only the country's real exchange rate (it leads to a significant and sustained real appreciation, as could be expected, see Figure 16) and no foreign variables, a positive shock to the inflation differential for the Dominican Republic leads not only to a higher rate of inflation domestically but also to higher inflation in Haiti (see Figure 15). Although the impact on inflation in Haiti is less persistent (two years instead of three for the Dominican Republic) it is highly significant statistically.

Figure 10
Impulse Response functions: Oil Price Shock

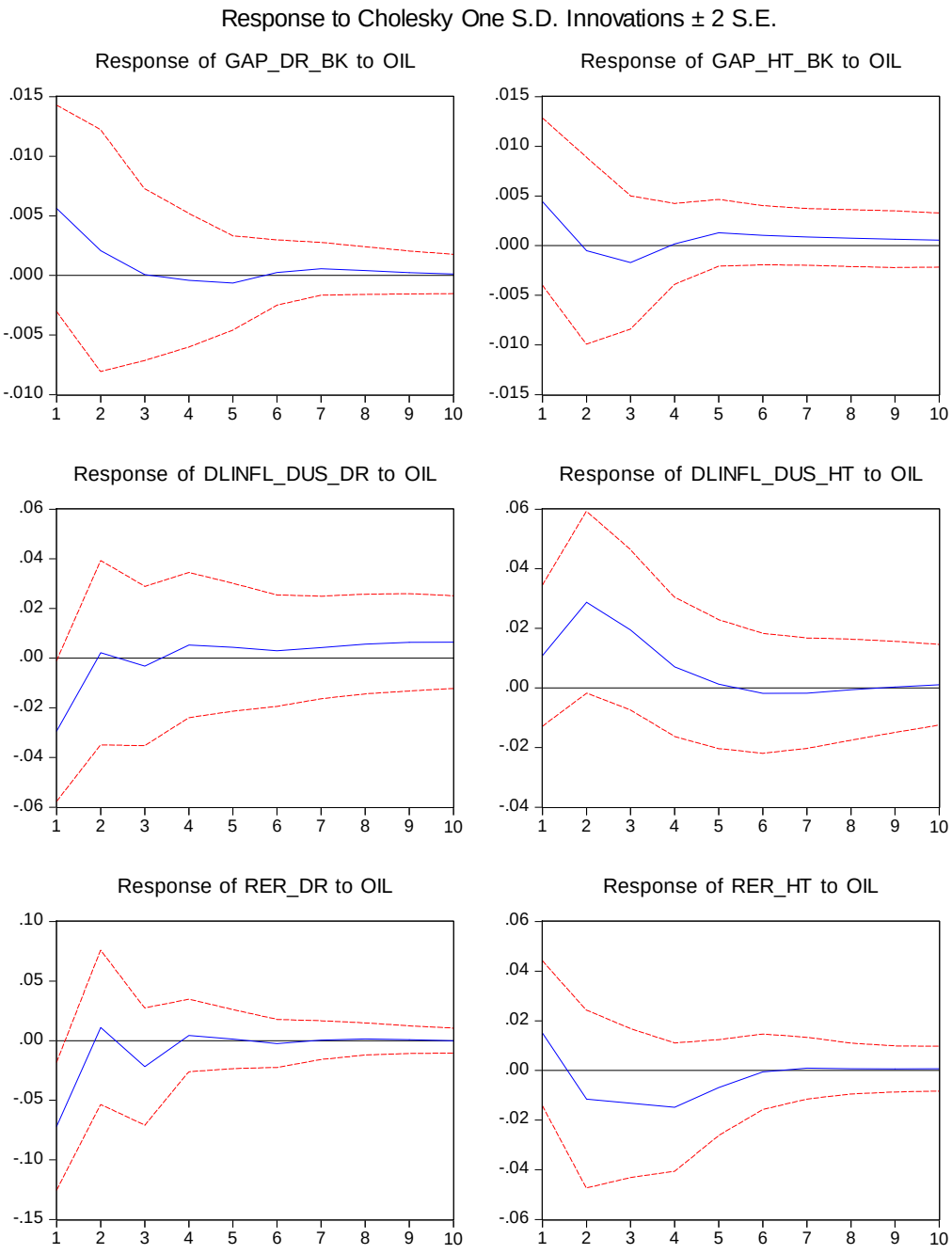


Figure 11
Impulse Response functions: US Real Interest Rate Shock

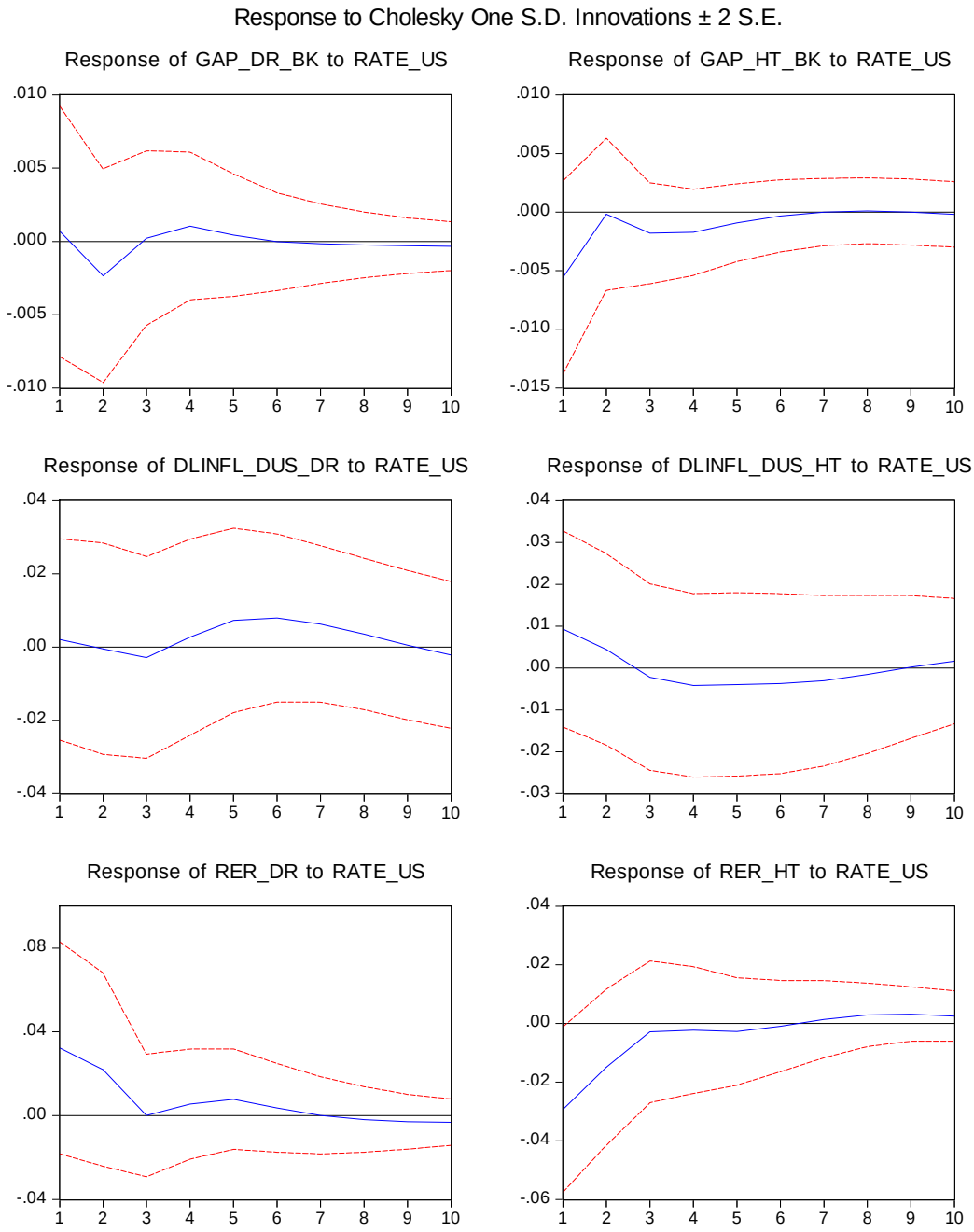


Figure 12
Impulse Response functions: US Output Gap Shock

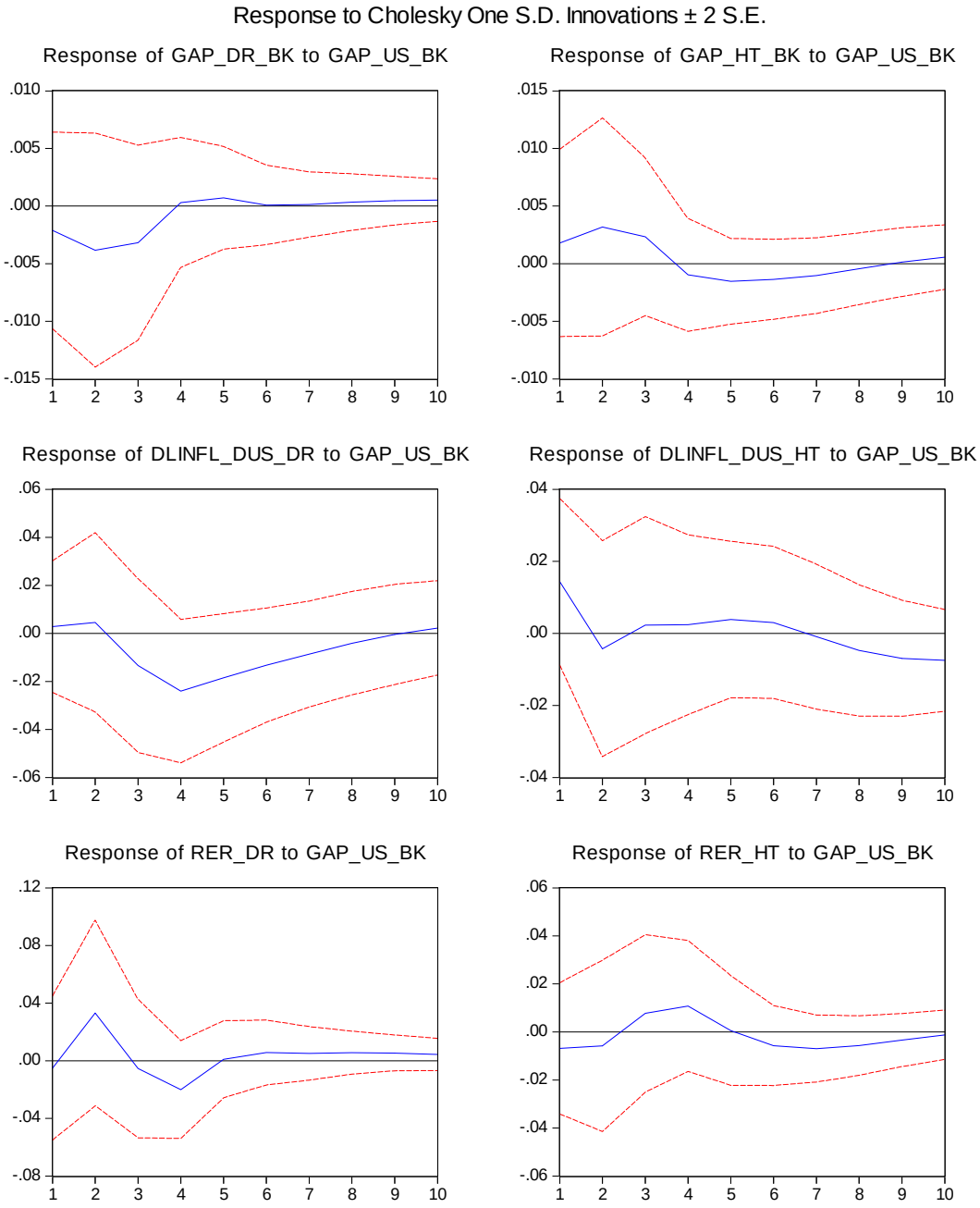


Figure 13
Impulse Response functions: DR Output Gap Shock

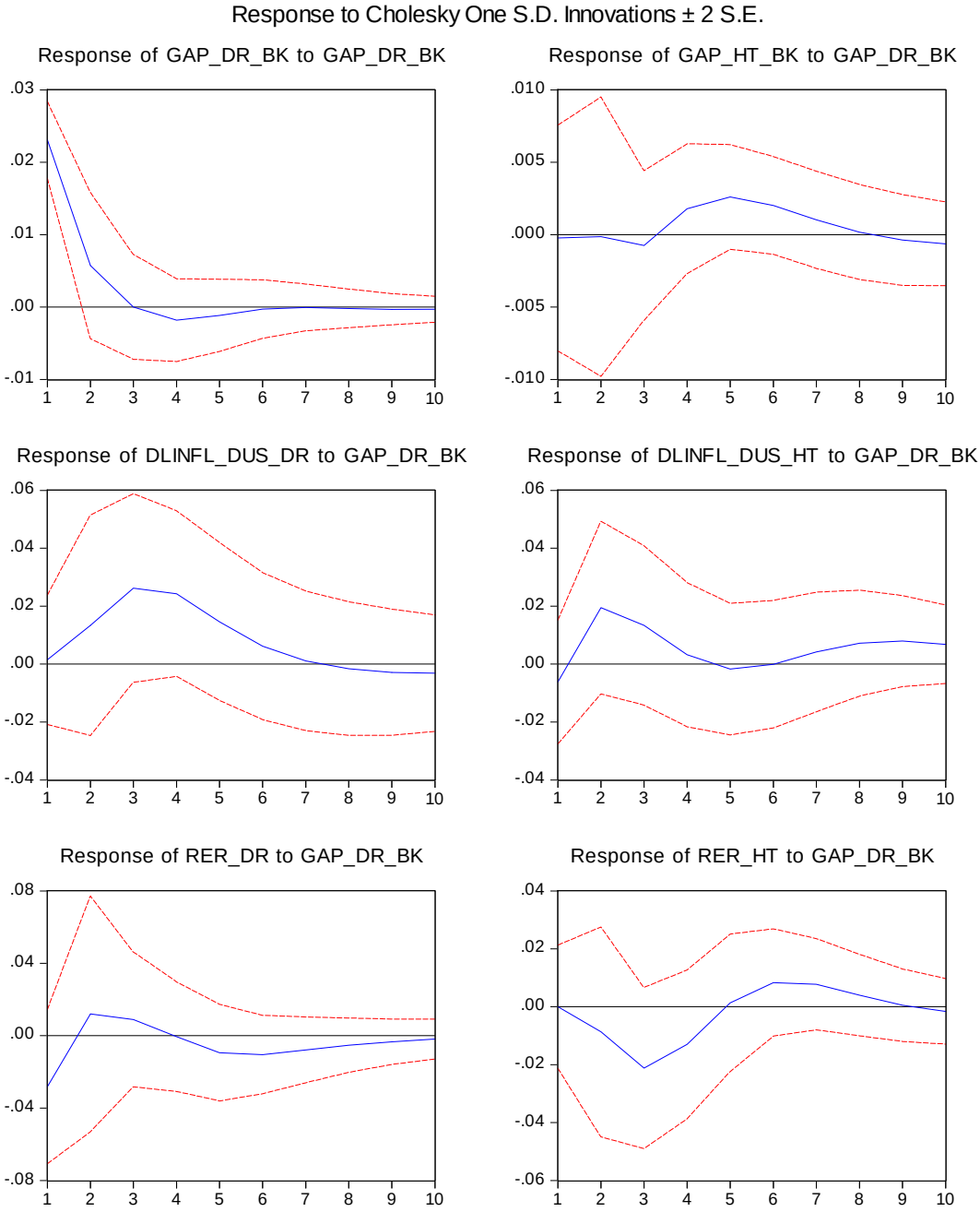


Figure 14
Impulse Response functions: Haiti Output Gap Shock

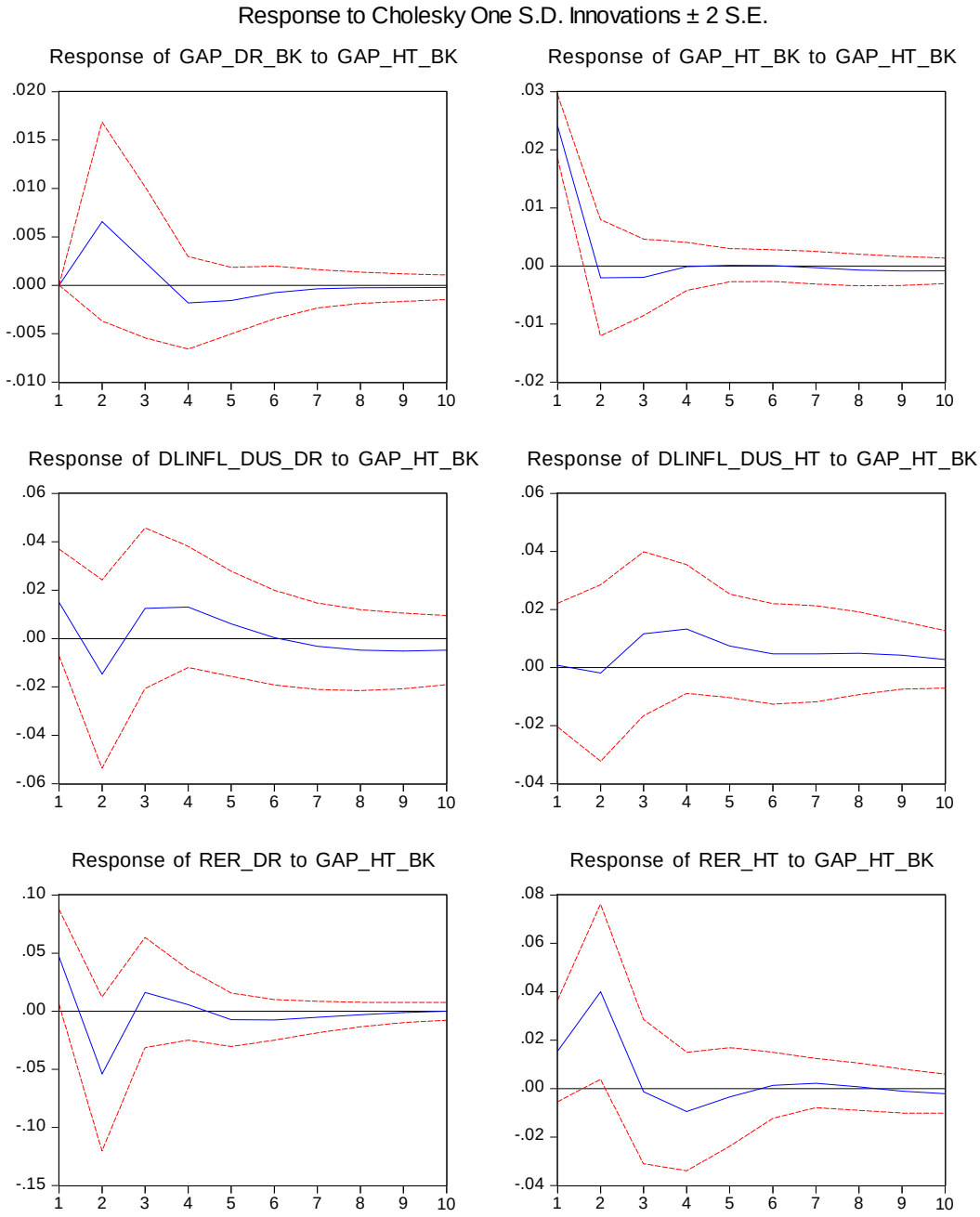


Figure 15
Impulse Response functions: DR-US Inflation Differential Shock

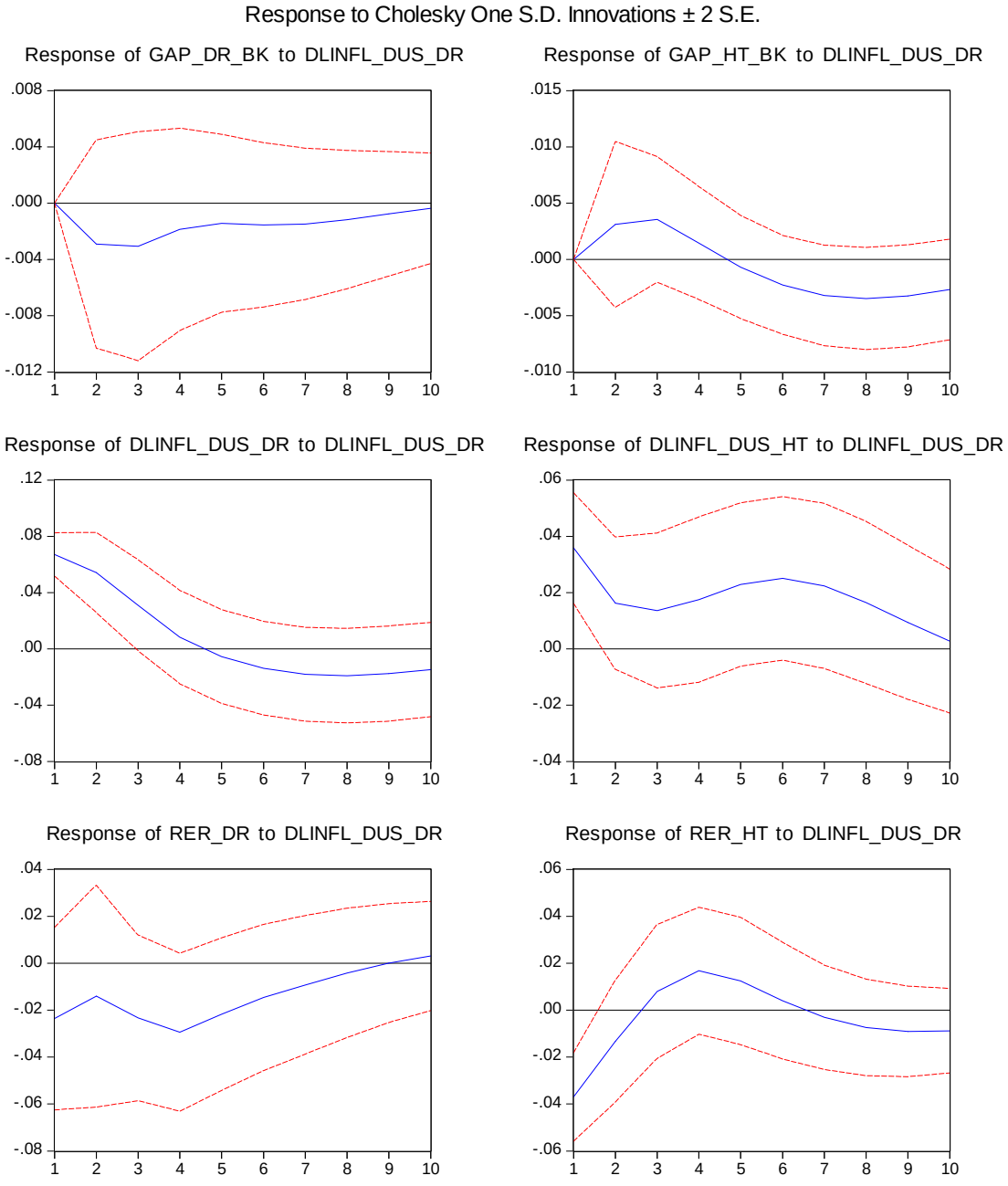
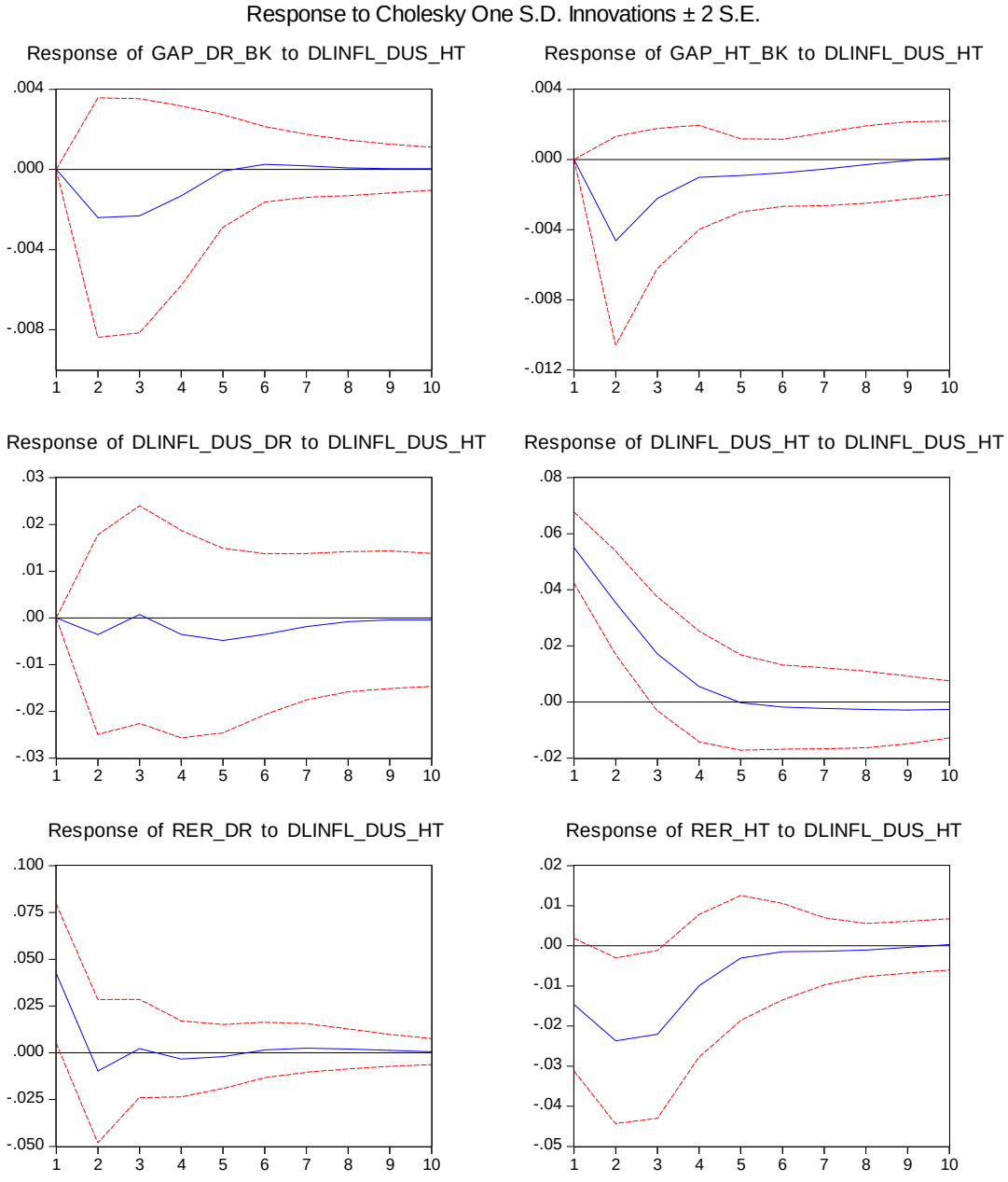


Figure 16
Impulse Response functions: Haiti-US Inflation Differential Shock



VI. SUMMARY AND POLICY IMPLICATIONS

The purpose of this paper was to offer a preliminary assessment of the potential benefits and costs of an economic and monetary union (EMU) between the Dominican Republic and Haiti—two countries sharing the same island but whose history is one of conflict and divergent economic prospects in recent decades. After a brief review of the historical context, it examined the nature of these potential benefits and costs. It then conducted a preliminary analysis (using basic statistical techniques) of some key criteria for the formation of an EMU between the two countries.

The third part conducted a more formal analysis of business cycle synchronization, based on integrated (two-country) VARX models as opposed to standard VARs, to economize on degrees of freedom and permit estimation using annual time series. The goal of the analysis was to examine if and how each country's domestic macroeconomic variables respond to the same external shock, and if and how they respond to shocks in the other country. To the extent that both countries respond in a similar way to external shocks (that is, by displaying a high degree of symmetry), they are better potential candidates for a CCA. Moreover, the speed of response matters also; in general, the slower is the adjustment after disturbances, the larger will be the cost of maintaining a single currency. A basic VARX model (involving only inflation rate differentials in the two countries relative to US inflation, and output gaps, with the US output as the common external shock) and an extended model (involving, in addition to the previous variables, the world oil price, the US real interest rate, bilateral real exchange rates, and private sector credit-to-GDP ratios) were formulated, with explicit and plausible restrictions on the degree of interactions between these variables, and estimated using standard techniques. In general, impulse response functions indicated that innovations in external variables do not seem to generate clear and common patterns in domestic variables, thereby suggesting limited business cycle synchronization between the two countries in response to the occurrence of common external shocks. This is also the case for domestic shocks—there appear to be limited "spillovers effects" from one country to another—except for positive shocks to inflation in the Dominican Republic, which appear to translate quickly into inflation in Haiti.

Overall, both the preliminary analysis and the more formal VARX models suggest that at this stage several economic criteria are not satisfied for the two countries to fully benefit from an EMU. For instance, the lack of similarity in the response and adjustment process to shocks, both external and domestic, may reflect very different policy responses between the two countries; indeed, if shocks are not immediately offset by a policy response, then their effect will vary substantially between the two countries, with no obvious common policy response appropriate to both of them. In turn, this suggests potentially severe coordination problems.

At the same time, however, it is important to keep in mind that most of the criteria for forming an EMU (including the degree of business cycle synchronization) are endogenous and may change in response to an explicit and credible commitment to move toward greater integration. This militates in favor of an aggressive medium-term agenda for integration and partnership between the two countries—provided that the political will to do so goes beyond the recent rhetoric. Indeed, although the focus of this paper has been on the economic criteria for the formation of an EMU, the lesson of history is that the political commitment toward forming and ensuring the viability of a union by all members may be just as important.

Appendix A
Benefits and Costs Associated with a Currency Union

Currency unions entail various benefits and costs. The traditional literature has focused on the reduction in transactions costs and reduced exchange rate uncertainty as the main benefits of monetary union, whereas more recent work has emphasized potential gains in terms of financial integration and credibility. One of the key disadvantages is the loss of monetary independence—because it deprives members of the ability to alter the nominal exchange rate of their currency in response to a shock. This Appendix provides a more detailed overview of these benefits and costs.

A.1 Benefits Associated with Currency Unions

A.1.1 Reduced Transactions Costs

A common and immediate benefit from currency union is the elimination of transactions costs; there is no longer a need to convert currencies when trading with other countries within the union. These benefits can be particularly large for members for which weaker financial markets and technology makes transacting in foreign currencies more costly, and trade is denominated mostly in foreign currencies (as is the case for most developing countries). If, in addition to currency conversion, trade with the rest of the world involves additional financial costs (in the form, for instance, of letters of credit), a currency union may generate cost savings in those areas as well.

A.1.2 Reduced Exchange Rate Uncertainty

An immediate benefit of a common currency is a reduction in exchange rate risk (that is, the uncertainty associated with exchange rate movements) involved in trade and financial transactions between countries. For instance, a contract in the seller's currency can leave buyers uncertain as to the amount (in their own currency) that they will actually have to pay upon delivery. While there are ways to hedge against this risk (by using forward contracts and options, for instance), doing so may be costly or impossible, especially when a developing country currency is involved.[24] Moreover, if a currency union reduces exchange rate variability relative to union partners, and leads to a decrease in the risk premium built into domestic interest rates, it may stimulate investment, by making attractive "marginal" projects that are not currently undertaken due to the relatively high cost of capital; there is therefore an "investment creation" effect, as discussed by Agénor and Aizenman (2008). Thus, the larger the trade and financial flows between member countries, the greater the gain from a reduction in exchange rate volatility.[25]

[24]For instance, contracts that would allow domestic borrowers to hedge foreign currency-denominated obligations into domestic currency obligations may not be readily available for a sufficiently long horizon, corresponding to the term of the transaction.

[25]An adverse effect of exchange rate volatility on trade in developing countries may be due to the fact that, in these countries, hedging markets do not exist, or may be very illiquid. Parsley and Popper (2006) for

However, the evidence about the effects of exchange rate variability on exports, capital flows, and investment is largely inconclusive, suggesting that the magnitude of saving may not be very high. For instance, using a broad sample of eighty seven countries (both industrial and developing) from 1970 to 1997, and after accounting for various sources of bias, Tenreyro (2007) found that exchange-rate variability had no significant impact on trade. This finding suggests that the availability of forward contracts, currency options, and other alternatives for risk diversification and management may provide sufficient hedging to reduce the potential drawbacks of exchange-rate variability on trade. From that perspective alone, then, the benefit of a currency union may be mitigated. At the same time, however, there is other evidence suggesting that confirms that exchange rate volatility may still be an important discouraging factor when it comes to trade flows involving developing countries among themselves, or between themselves and developed countries (see for instance Inter-American Development Bank (2006)). In such conditions, the gains highlighted above would remain quite substantial.

A.1.3 Increased Financial Integration

A currency union may (all else equal) improve welfare of all members by increasing financial diversification in two ways. First, by reducing currency risk, as noted earlier, it allows national financial intermediaries to seek greater exposure on their liability side. Second, it offers greater scope to these intermediaries to diversify their lending portfolios across member countries. From the perspective of individuals, a single currency area may also offer risk-sharing benefits when domestic capital markets are limited in their ability to facilitate consumption insurance (Ching and Devereux (2003)). As discussed later, however, to the extent that credit market imperfections continue to persist after the formation of the union (because of difficulties of harmonizing bankruptcy legislation among members with very different legal systems to begin with, for instance), these gains may be slow to materialize.

A.1.4 Improved Credibility

Joining a currency union provides a credible constraint for a country wishing to "tie its hands" and prevent discretionary changes in short-run monetary policy that are inconsistent with the long-run objective of low and stable inflation (Guillaume and David Stasavage (1999)). The decision to surrender the power to alter the exchange rate and manipulate interest rates is indeed a possible way to signal a country's commitment to low inflation and influence inflation expectations.[26] In a sense, membership in a monetary union plays a role

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instance found that Asia-Pacific firms remain significantly exposed to fluctuations in major currencies and that their the degree of foreign exchange exposure has not diminished over time—suggesting that hedging options remain limited.

[26]See Agénor (1991) for a more detailed discussion. As discussed in that paper, for a policymaker concerned with both inflation and competitiveness, the desirability of "tying one's hands" as a solution to the time inconsistency problem depends on what one's hands are tied to. When union members have stable, low inflation rates, precommitment to a fixed exchange rate may help demonstrate domestic resolve to maintaining

equivalent to appointing a "conservative" central banker, highly averse to inflation (see Rogoff (1985)). The weaker the political institutions are, the more desirable it is for the authorities to adopt an institutional arrangement that imposes large (political or otherwise) costs on reneging on it. Put differently, because joining a monetary union imposes irrevocably fixed exchange rates (or at least rates that are very difficult to change), it may provide a "quick gain" in credibility.

A.2 Costs Associated with Currency Unions

Costs associated with joining a currency union relate essentially to the use of the exchange rate as a policy instrument, particularly in the presence of large external shocks. Depending on the nature of these costs, a country's commitment to the "rules of the game" of a monetary union may lack credibility—thereby hampering the extent to which membership in a union can overcome time inconsistency problems.

A.2.1 Loss of Monetary Independence

From the standpoint of an individual country, the most important cost of a currency union is the loss of monetary independence. When effective, an independent monetary policy can be used as a stabilization tool, in order to dampen cyclical fluctuations. As discussed later, the greater the degree of asymmetry of shocks across countries, and the more limited alternative adjustment mechanisms are to these shocks, the greater the cost associated with the loss of monetary independence.

However, as argued by Grubel (2005), the loss of monetary sovereignty that joining a currency union entails may be highly beneficial in some countries, to the extent that it also ensures greater independence of monetary policy from political influence. And the more open an economy, the more devaluation becomes a source of imported inflation; this may reduce significantly the benefits associated with an adjustment via currency changes because domestic inflation will mitigate the initial effect of a nominal depreciation on the real exchange rate.

Moreover, if the economy of the potential union member is highly dollarized, the cost of losing monetary independence may not be as high as it commonly thought. Indeed, if debts are denominated largely in foreign currency, and the pass-through from exchange rates to prices and foreign-currency liabilities occurs promptly, a nominal depreciation could lead to bankruptcies and depression, through large balance sheet effects. Thus, in a dollarized economy, adjustment through currency devaluation loses an important advantage over a deflationary adjustment, namely, the capacity to dilute the real value of the debt. By implication, this suggests that the higher the initial degree of liability dollarization, the less the cost of foregoing monetary independence.

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financial discipline. But when the economy is subject to large nominal shocks, the credibility gain may be outweighed by the cost of lost autonomy.

A.2.1 Flexibility provided by an Alternative Nominal Anchor

Irrevocably fixing a country's nominal exchange in the context of a currency union is not the only way to provide a strong nominal anchor to the economy and constrain monetary policy. Countries can impose such constraints by adopting an alternative credible nominal anchor, namely the inflation rate itself, as several developing countries have done in recent years with relative success (see Gonçalves and Salles (2008)). At the same time, an inflation targeting regime allows some degree of monetary independence, thereby providing some discretion to respond to (temporary) shocks. However, it is also true that institutional requirements for the adoption of inflation targeting are quite demanding, and that the credibility that it confers is not automatic—it requires sustained success in achieving the target.

Appendix B
Data Sources and Unit Root Tests

The data underlying the analysis presented in this paper are taken essentially from the IMF's *International Financial Statistics* and the World Bank.

The *output gap* is measured as the log deviation of real GDP from its trend, with the trend value calculated using the modified Baxter-King filter (see Christiano and Fitzgerald (2003)). The output gap for the United States is calculated in a similar fashion.

The *inflation rate differential* is measured by the difference between domestic inflation and inflation in the US; each inflation rate (at an annual rate) is measured in terms of the consumer price index.

The *US real interest rate* is measured as the nominal three-month T-bill rate minus the US inflation rate (in terms of consumer prices).

The *world price of oil* is the price of Brent crude in US dollars.

The *bilateral real exchange rate* is constructed for each country by taking the nominal exchange between the national currency and the US dollar (average over the period, converted into an index), multiplied by the US consumer price index, and divided by the domestic consumer price index.

The *ratio of credit to the private sector* is measured as claims of commercial banks on the private sector, divided by nominal GDP.

The unit root tests (based on standard ADF tests) for all the variables used in the basic and extended VARX models are reported in Table B1. As can be inferred from the results, the null hypothesis of nonstationarity is rejected at 1 percent (critical value) for most of the variables, at 5 percent for all but one (the realinterest rate in the US), and at 10 percent for all of them.

Table B1

ADF Tests in Level

(With a non zero intercept and no trend)

OIL	-6.164***
RATE_US	-2.837*
GAP_US_BK	-6.146***
CRED_DR	-6.958***
CRED_HT	-4.984***
GAP_DR_BK	-5.124***
GAP_HT_BK	-5.502***
DLINFL_DUS_DR	-3.514**
DLINFL_DUS_HT	-3.043**
RER_DR	-7.747***
RER_HT	-4.734***

ADF is the Augmented Dickey Fuller t-statistic.

*** denotes significance at 1 percent;

** 5 percent; and * at 10 percent.

The critical values are respectively

(-3.589, -2.930, and -2.603)

Lag selection was via SIC with a maximum of 9 lags

Appendix C
Alternative Extended VARX Model
With partially Endogenous Bilateral Real Exchange Rates

We extend the basic VARX model of the paper to consider, in addition to the five variables above (the output gaps and inflation deviations in the two countries, and the US output gap), the following variables:

a) the ratio of credit to GDP in the two countries (which is a measure of the availability of loanable funds);

b) the rate of change of the real bilateral exchange rate vis-à-vis the US dollar in both countries;

c) the rate of change of a world index of commodity prices (including oil, given that both countries are oil importers);

d) the real US 3-month Treasury bill rate (given by the nominal rate deflated by the US inflation rate in consumer prices).

For convenience, we rename the US output gap variable as y_{11t}. The degree of endogeneity of the new variables, numbered now 5 to 10, is as follows. Variables y_{5t} and y_{6t}, the real exchange rates in Haiti and the Dominican Republic, respectively, are taken to be partially interactive; they affect directly only the output gap in the respective county. It depends only on its lagged value and the output gap. Similarly, variables y_{7t} and y_{8t},, the credit variables in Haiti and the Dominican Republic, respectively, only affect the output gap in the respective country, with no direct effect on inflation or the real exchange rate. In addition, it also depends only on its lagged value and the output gap, to capture bidirectional causality between credit and economic activity. Variable y_{9t}, the rate of change in world commodity prices, depends only on its past value(s); it can affect all domestic variables. Variable y_{10t}, The US real interest rate, is assumed to depend not only on its past value(s) but also on lagged value(s) of the US output gap, which is now y_{11t}. Conversely, the US output gap is also assumed to depend now not only on its lagged value but also on the lagged value(s) of the real US interest rate and world commodity prices. Thus, the model now accounts for interactions between the US variables themselves, and between world commodity prices (including oil) and US activity—while maintaining the unidirectional causality between US variables and domestic variables in Haiti and the Dominican Republic (y_{10t} and y_{11t} can affect all domestic variables). In the same vein as before, all of the partially endogenous variables can affect the fully interactive variables.

Given the increase in the number of variables, to preserve degrees of freedom, the number of lags is restricted uniformly to 1 (m = 0). In matrix form, the extended VARX model can then be written as

$$\begin{bmatrix} \mathbf{Y}_{1t} \\ \mathbf{Y}_{2t} \end{bmatrix} = \begin{bmatrix} \mathbf{d}_{11} & \mathbf{d}_{12} \\ \mathbf{d}_{21} & \mathbf{d}_{22} \end{bmatrix} \begin{bmatrix} \mathbf{Y}_{1t-1} \\ \mathbf{Y}_{2t-1} \end{bmatrix} + \begin{bmatrix} \mathbf{e}_1 \\ \mathbf{e}_2 \end{bmatrix} + \begin{bmatrix} \boldsymbol{\epsilon}_{1t} \\ \boldsymbol{\epsilon}_{1t} \end{bmatrix},$$

where now

$$\mathbf{Y}_{1t} = [y_{1t} \ldots y_{4t}]' \quad \mathbf{Y}_{2t} = [y_{5t} \ldots y_{11t}]'$$

$$\mathbf{e}_1 = [e_1 \ldots e_4]' \quad \mathbf{e}_2 = [e_5 \ldots e_{11}]' \quad \boldsymbol{\epsilon}_{1t} = [\varepsilon_{1t} \ldots \varepsilon_{4t}]'$$

$$\boldsymbol{\epsilon}_{2t} = [\varepsilon_{7t} \ldots \varepsilon_{11t}]'$$

and the submatrices d_{ij}, based on the restrictions defined earlier, are given by[27]

$$\underset{(4\times4)}{\mathbf{d}_{11}} = [d_{ij}]_{i,j=1,\ldots4}$$

[27]The dependence of the credit-to-GDP ratio on the (lagged) output gap in the respective country, as noted earlier, explains why the submatrix $\mathbf{d}_{21}$ does not contain only zeroes but instead is specified as having $d_{71} \neq 0$ and $d_{82} \neq 0$.

$$\mathbf{d}_{12}= \underset{(4\times7)}{\begin{bmatrix} d_{15} & 0 & d_{17} & 0 & d_{19} & d_{110} & d_{111} \\ 0 & d_{26} & 0 & d_{28} & d_{29} & d_{210} & d_{211} \\ 0 & 0 & 0 & 0 & d_{39} & d_{310} & d_{310} \\ 0 & 0 & 0 & 0 & d_{49} & d_{410} & d_{311} \end{bmatrix}}$$

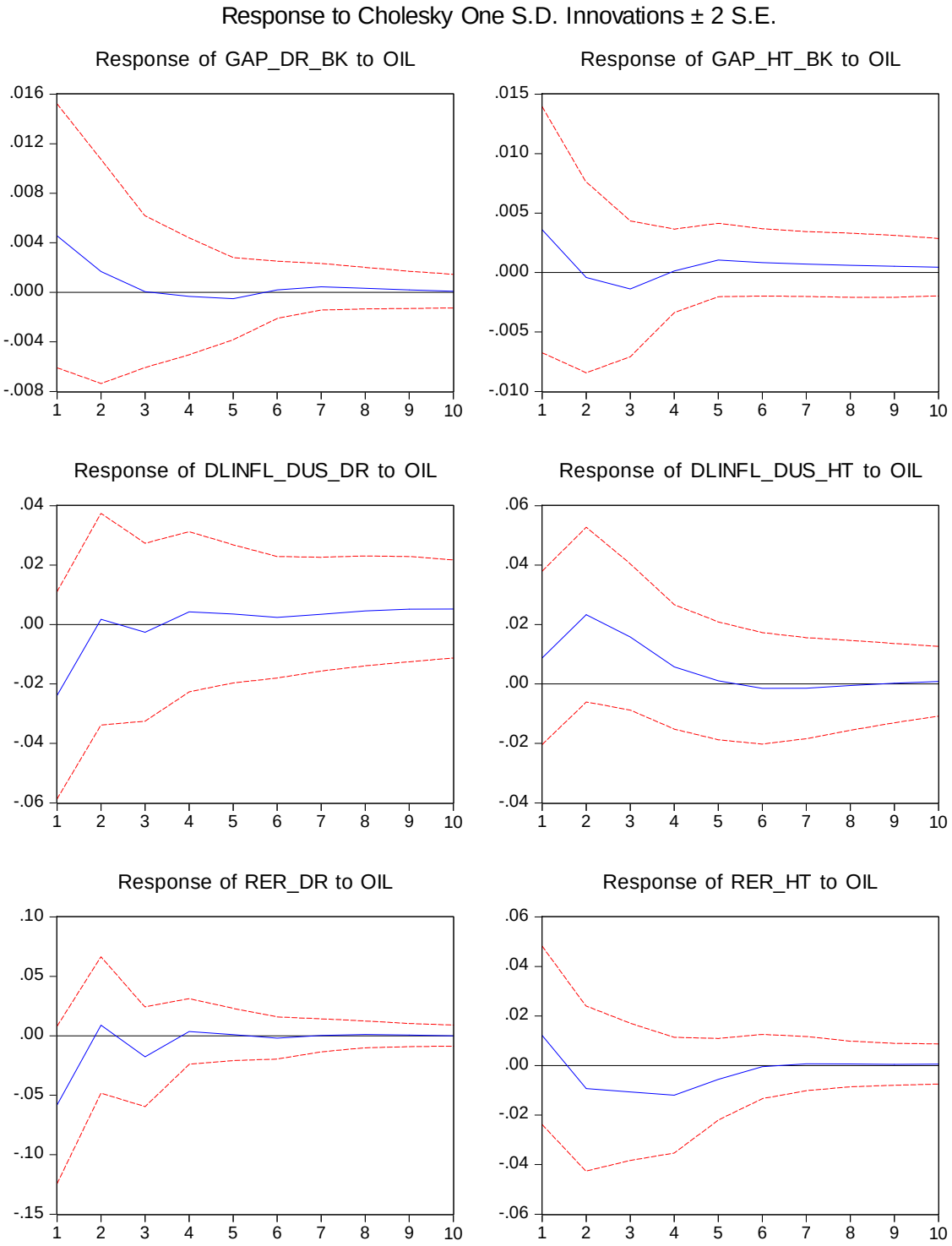
$$\mathbf{d}_{21}= \underset{(7\times4)}{\begin{bmatrix} d_{51} & 0 & 0 & 0 \\ 0 & d_{62} & 0 & 0 \\ d_{71} & 0 & 0 & 0 \\ 0 & d_{82} & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \end{bmatrix}}$$

and

$$\mathbf{d}_{22} = \underset{(7\times7)}{\begin{bmatrix} d_{55} & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & d_{66} & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & d_{77} & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & d_{88} & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & d_{99} & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & d_{1010} & d_{1011} \\ 0 & 0 & 0 & 0 & d_{119} & d_{1110} & d_{1111} \end{bmatrix}}$$

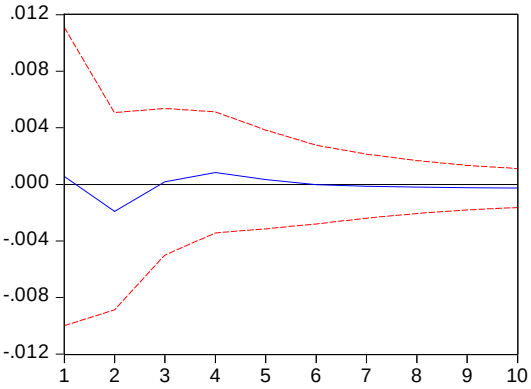
Based on these matrices, we can calculate as before the gain in terms of degrees of freedom that the extended VARX model provides relative to a standard VAR model with no restrictions of any sort. This gain is now given by 11*(11+1) – (4*4 + 16 + 4 + 10) = 121 – 46 = 75.

The following figures show the impulse response functions, which are broadly similar to those reported in the text.


Response to Cholesky One S.D. Innovations ± 2 S.E.
Response of GAP_DR_BK to OIL
Response of GAP_HT_BK to OIL
Response of DLINFL_DUS_DR to OIL
Response of DLINFL_DUS_HT to OIL
Response of RER_DR to OIL
Response of RER_HT to OIL

Response to Cholesky One S.D. Innovations ± 2 S.E.

Response of GAP_DR_BK to RATE_US



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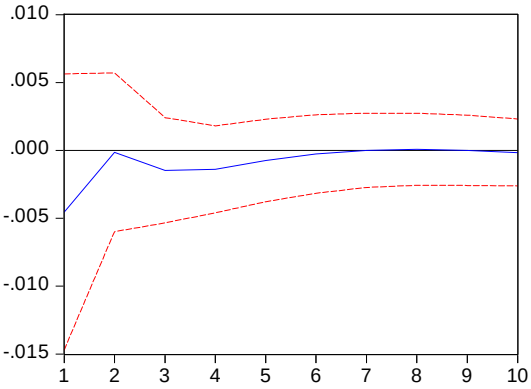

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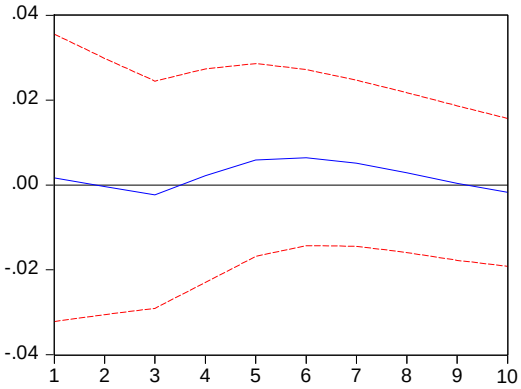

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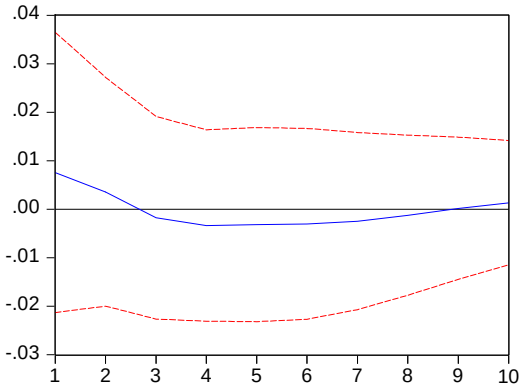

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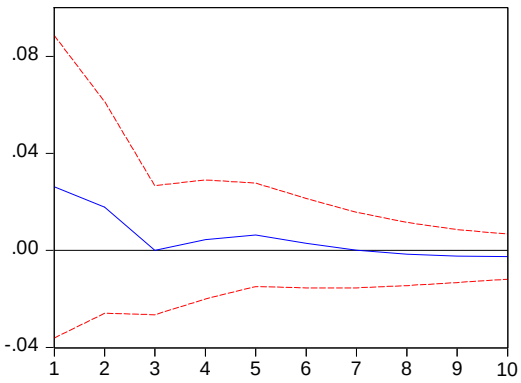

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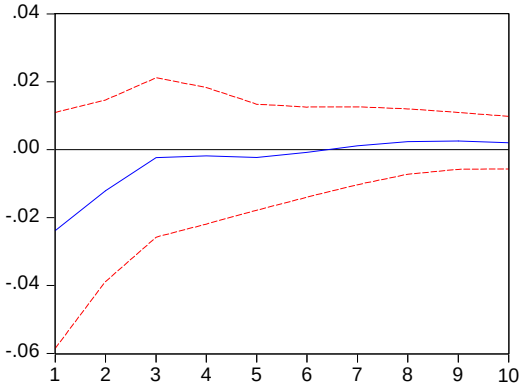
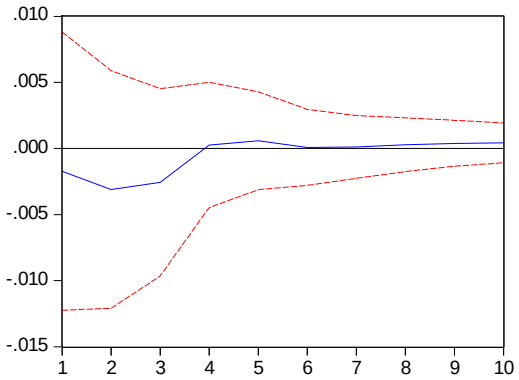
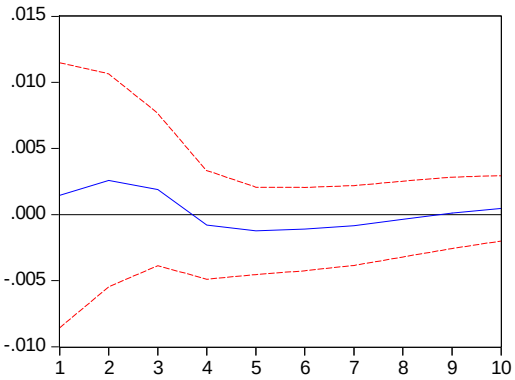


Response to Cholesky One S.D. Innovations ± 2 S.E.

Response of GAP_DR_BK to GAP_US_BK



Response of GAP_HT_BK to GAP_US_BK



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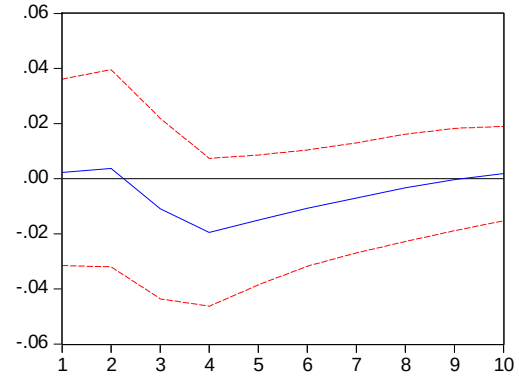

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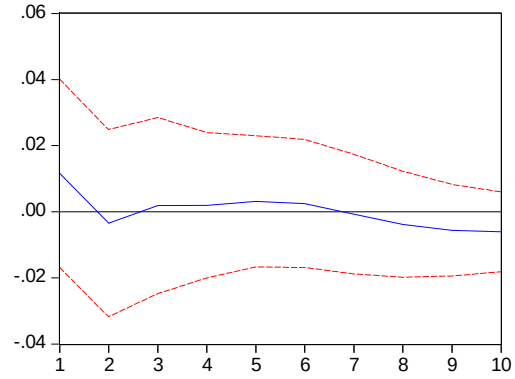

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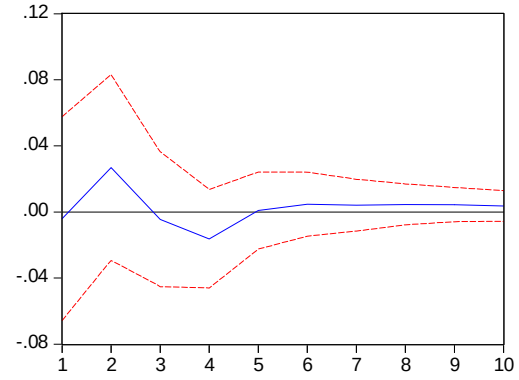
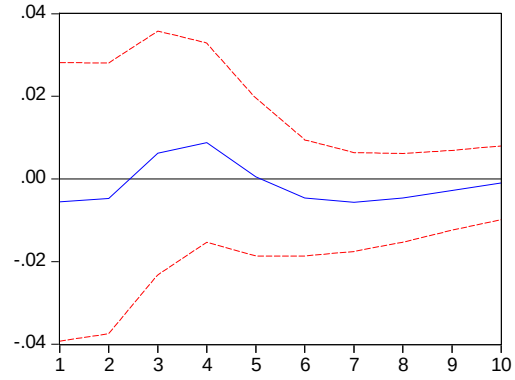
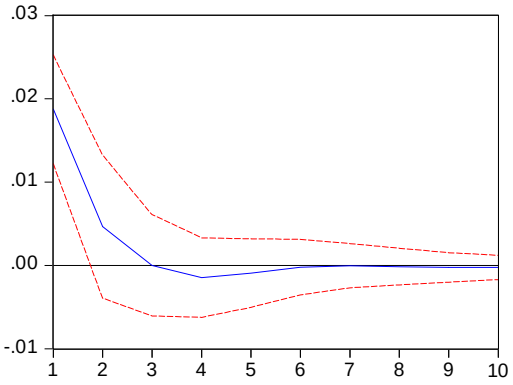


Response of RER_HT to GAP_US_BK

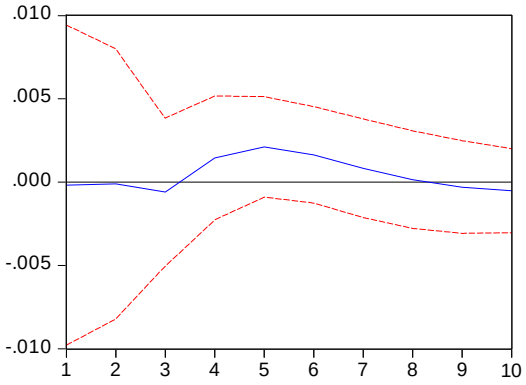


Response to Cholesky One S.D. Innovations ± 2 S.E.

Response of GAP_DR_BK to GAP_DR_BK



Response of GAP_HT_BK to GAP_DR_BK



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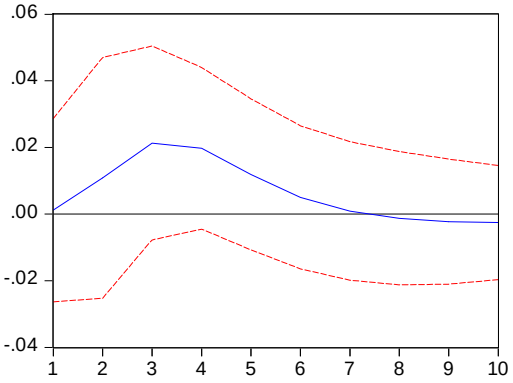

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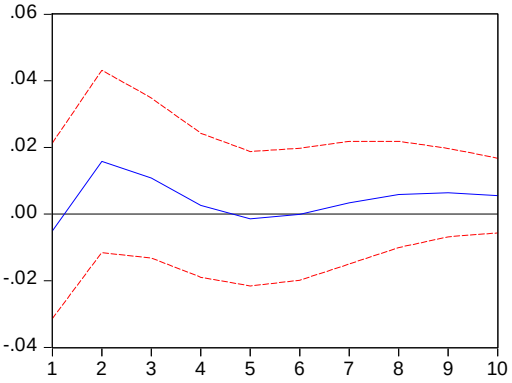

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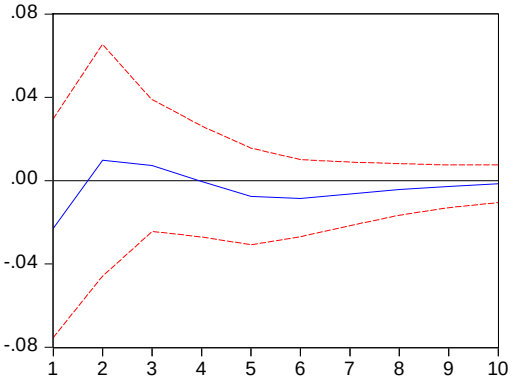
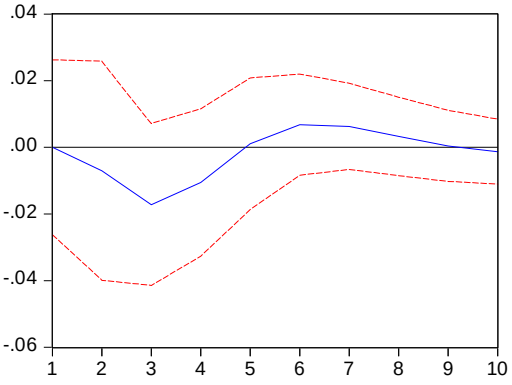
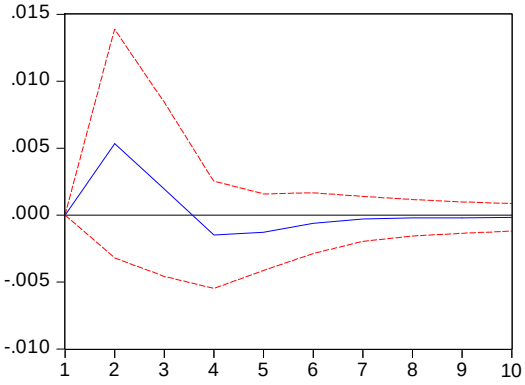


Response of RER_HT to GAP_DR_BK



Response to Cholesky One S.D. Innovations ± 2 S.E.

Response of GAP_DR_BK to GAP_HT_BK



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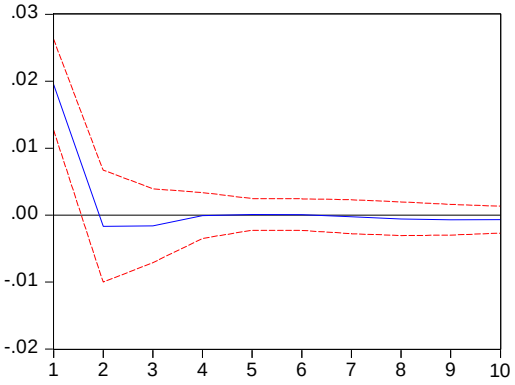

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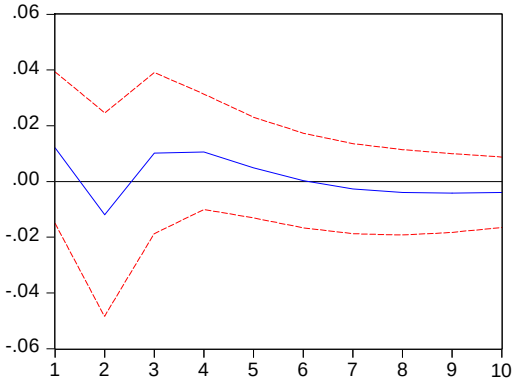
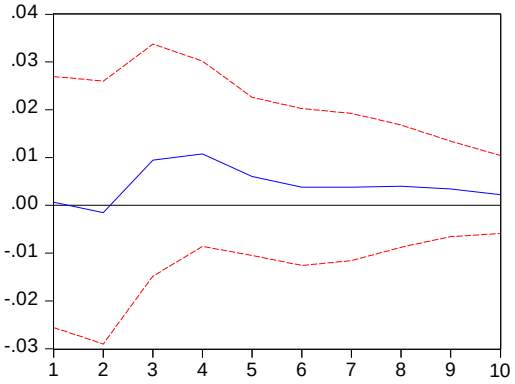


Response of DLINFL_DUS_HT to GAP_HT_BK



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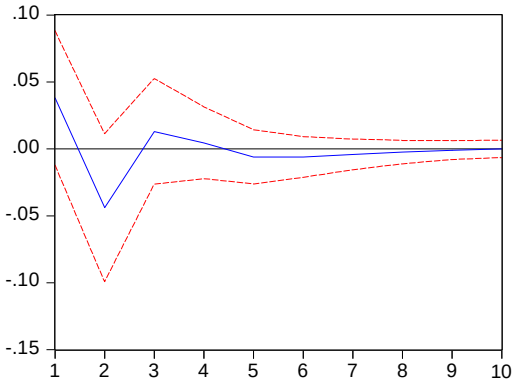

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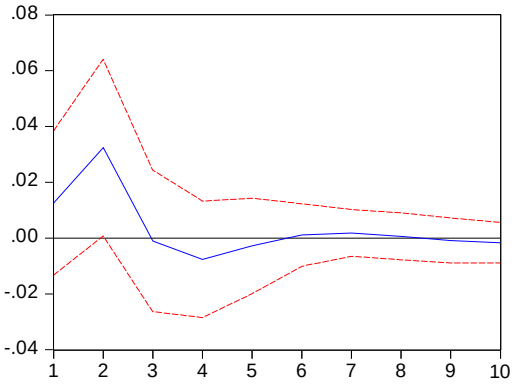
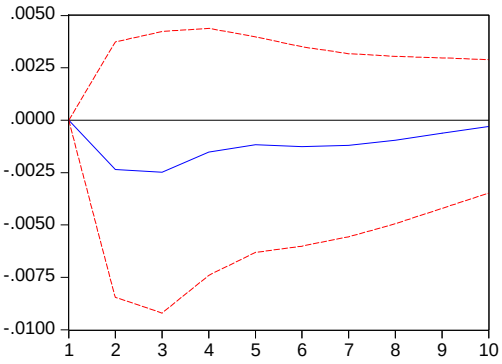


Response to Cholesky One S.D. Innovations ± 2 S.E.

Response of GAP_DR_BK to DLINFL_DUS_DR



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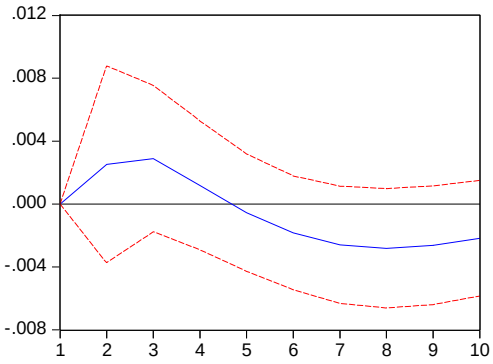

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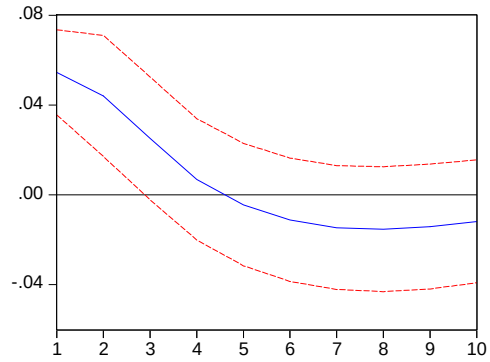

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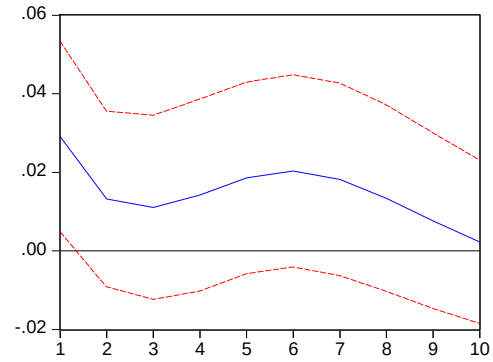

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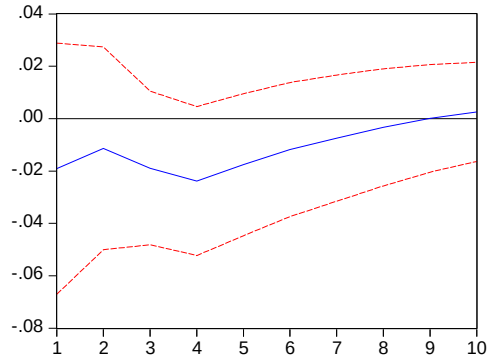

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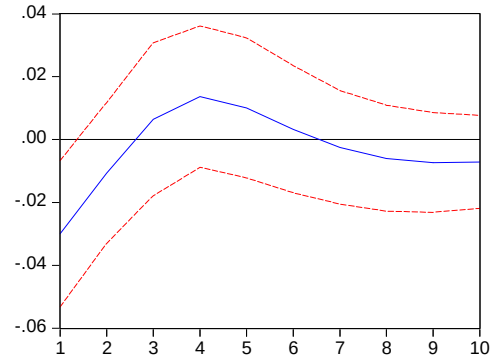
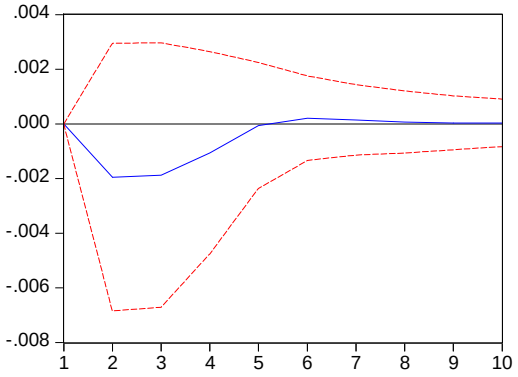


Response to Cholesky One S.D. Innovations ± 2 S.E.

Response of GAP_DR_BK to DLINFL_DUS_HT



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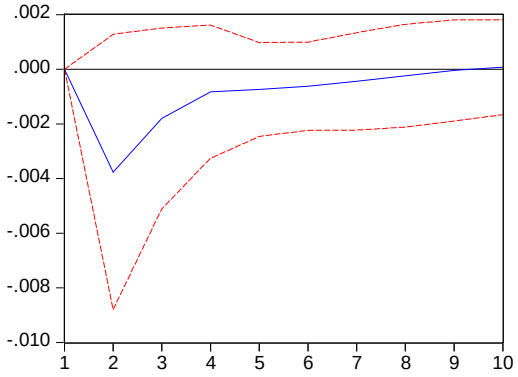

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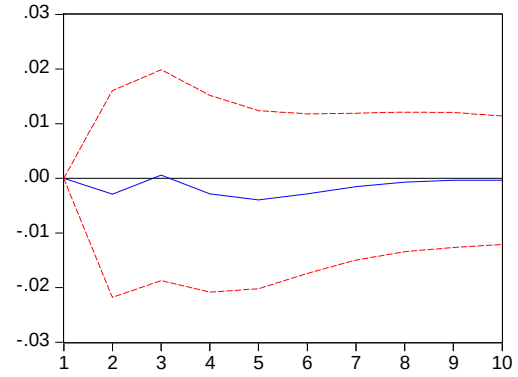

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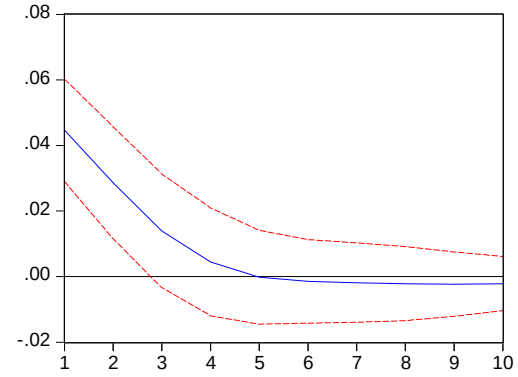

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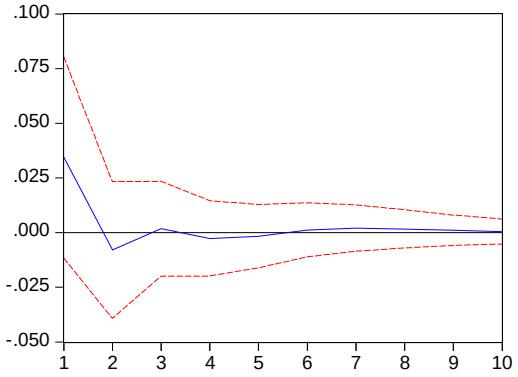

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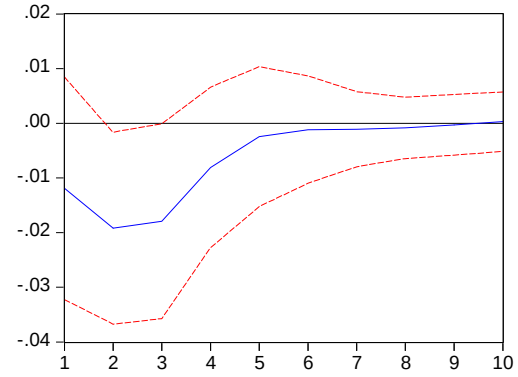

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