A DYNAMIC FACTOR MODEL OF QUARTERLY REAL GROSS DOMESTIC PRODUCT GROWTH IN THE CARIBBEAN: THE CASE OF CUBA AND THE BAHAMAS

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Real output growth is a central economic indicator for all policy makers. It defines the business cycle, establishes the timing of recessions, and largely drives discretionary fiscal and monetary policy decisions. The lack of timely reporting of quarterly GDP in some countries presents difficulties in the assessment of current economic conditions, and has fomented a growing literature that "nowcasts" GDP at higher (monthly) frequencies and anticipates quarterly data releases.[2] While increasingly rare among emerging market economies, many countries do not report quarterly GDP growth at all—a number of these cases are found in the Caribbean, and the availability of timely indicators of economic activity is even more important for policy makers in these economies. This study proposes a framework that combines nowcasting econometric techniques with data that takes advantage of the geographic characteristics of Caribbean economies to estimate quarterly GDP growth rates.

Caribbean economies exhibit a number of characteristics that aid the statistical inference of their quarterly output growth. First, as islands, commercial shipping dominates the transport of their external trade in goods, hence providing more accurate and timely measures of trade than overland routes for other countries. Second, external trade tends to reflect a large proportion of internal consumption and investment, as these economies are relatively small and specialized, and hence they import a large part of their consumption basket and investment goods. Thus trade generally mirrors economic activity in the wider economy. Third, their geographic proximity to the U.S. and various trade treaties implies that most of their trade is with the United States, and to a lesser extent the EU and China, all of which publish accurate and timely bilateral trade data. Fourth, one of their dominant industries is tourism, for which at least summary statistics are accurately measured and published on a timely basis.[3] Moreover, this sector closely links an important part of Caribbean economic activity to labor conditions in advanced economies, for which there is broad data availability. Finally, idiosyncratic regional exposure to factors such as hurricanes and extreme weather events, advanced economy financial sectors, or remittances, among others, also lends itself to timely measurement and reporting.

Among the larger Caribbean economies, many already produce and publish quarterly Gross Domestic

1. International Monetary Fund, Western Hemisphere and Fiscal Affairs Departments, respectively. The views expressed are those of the authors and do not necessarily represent those of the IMF or IMF policy.

2. See, for example, Liu, Matheson and Romeu (2010) on nowcasting monthly GDP in Latin America and the Caribbean.

3. See Romeu (2008) on the influence of trade treaties, natural disasters, and tourism for Caribbean economies.

Output, such as Jamaica or the Dominican Republic. Others, such as Guadeloupe, Turks and Caicos Islands, or Puerto Rico are not separate political entities, and hence, their economic activity is largely reported by other (OECD) economies to varying degrees. As a result, this study focuses on Cuba and The Bahamas, two larger Caribbean economies that do not publish quarterly GDP and for which the aforementioned conditions, such as geographic proximity to the U.S. or dependence on tourism, are likely to aid in quarterly GDP estimation.

Annual GDP data published by national authorities in both countries can be delayed as much as six months. Hence, in the early part of any given year, the latest official information on national economic activity can be as much as eighteen months old. Nonetheless, a large number of aforementioned indicators are released more frequently and are available with a shorter lag. Arguably, policy makers likely already use these indicators in their assessment of the economy. No systematic analysis of the impact on policy of changes in short-term has been made public, only ad-hoc references and, in some cases, official announcements being available.

To address these problems, this study creates a quarterly model of GDP growth for Cuba and The Bahamas using higher frequency indicators. The framework adopts the parametric dynamic factor model (DFM) to summarize a large number of indicators to produce a quarterly GDP series. This model can be used to assess recent economic developments and provide short-term quarterly forecasts of GDP. The proposed analytical framework provides a more timely assessment of GDP, and can be updated on an ongoing basis as new data are released and indicators are updated.

The model results help shed light on the impact of the crisis that began in 2007 on these economies. Official data released by Cuban authorities reported aggregate 2009 GDP growth of 1.3 percent, compared to 5 percent in 2008.[4] The nowcast shows, however, that the annual figure masks a very strong output decline in the last quarter of 2008 and the first quarter of 2009, followed by moderate recovery. The quarterly path for The Bahamas similarly displays a very sharp decline in output in the first quarter of 2009 (a contraction exceeding 5 percent on an annualized basis), with a moderate recovery appearing only in the last quarter of 2009. For 2010, the model predicts a moderate improvement in short-term GDP growth for both countries. Cuba is projected to increase growth from 1.3 percent in 2009 to approximately 2.5 percent in 2010, and The Bahamas is projected to rise from -4.7 percent in 2009 to under 1 percent in 2010. Sustained high U.S. unemployment and low U.S. growth appears to be weighing down on the forecasts for both countries through 2010, and a prolonged period of very low growth is forecasted for the next two years on the basis of existing data.

The next section outlines the modeling methodology. This is followed by an overview of the data, which is detailed in the Appendixes, and testing of the model, including forecast comparisons of the proposed dynamic factor model with comparator forecasting models, and summary of results. The last section concludes.

METHODOLOGY

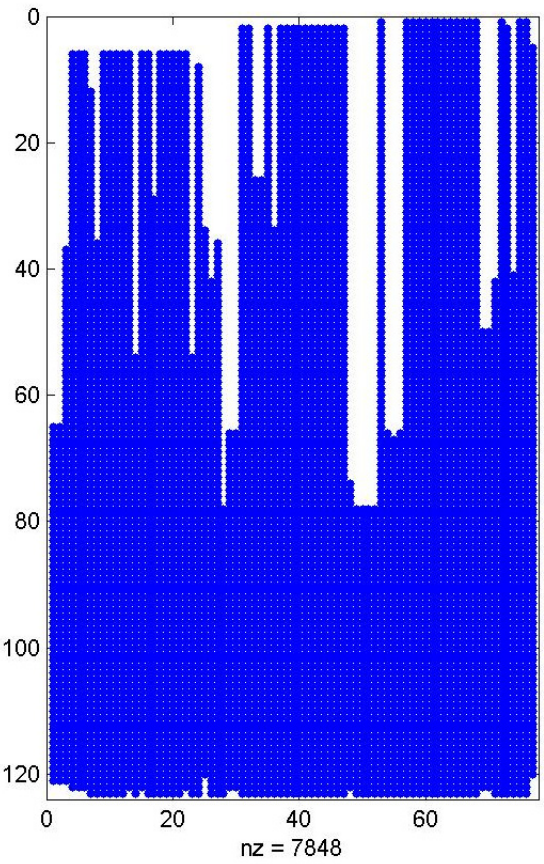
This section presents the dynamic factor model employed for nowcasting and forecasting quarterly GDP growth. Generally, the estimation procedure can be separated into the following four steps. First, the Dynamic Factor Model (DFM) is estimated based on the unbalanced dataset. Second, the Kalman filter recursion is used to help predict the missing observations to produce a balanced panel. Third, the factors are re-estimated based on the new balanced panel.[5] Finally, the quarterly GDP series are computed based on Chow and Lin's (1971) interpolation procedure.

4. Official GDP in Cuba is heavily weighted towards services (over 80 percent), which is higher than in the rest of Latin American and the Caribbean. To address the potential overweighting, Romeu (2010) compares nowcasts of official GDP and an unofficial (reweighted) Cuban GDP based on the services weight for the Dominican Republic.

5. In practice, steps two and three are repeated until there is little change to the estimated factor.

The second and third steps are critical for filling in missing observations for both past and current (as yet unreported) series. This is illustrated in Figure 1, which shows missing data for Cuba in a quarterly sample of 77 series from 1980 to 2010. A naturally occurring "rugged edge" appears in the dataset as a result of the asynchronous timing of new data releases and differences in historical data availability. The Dynamic Factor Model addresses these by "filling" in the missing observations recursively using the estimated factors, which are shown in the figure as white area. The Kalman smoother is then used to fill backwards and forwards missing values based on information in the entire dataset, and thereby produce a balanced panel.

Figure 1. Cuba: Data Availability of Quarterly Indicators of Economic Activity



Source: Authors' estimates.
Note: The figure shows missing data for Cuba in a quarterly sample of 77 (across the horizontal axis) series from 1980.1 to 2010.3 (along the undated vertical axis). The shadowed area shows observed data. The Dynamic Factor Model addresses the naturally occurring "jagged" edge of the dataset resulting from the asynchronous timing of new data releases by filling in the missing observations recursively.

THE DYNAMIC FACTOR MODEL

Assume that the n x 1 vector of weakly stationary time series X_t has the following factor representation:

$$X_t = \Lambda F_t + e_t \quad \text{and} \quad e_t \sim N(0, \Sigma), \qquad (1)$$

where F_t is a k X 1 vector of common factors that drive the joint evolution of all variables and e_t is the idiosyncratic component associated with each observed time series,which is assumed to be normally distributed with zero mean and variance covariance Σ. Forni *et al* (2000) and Stock and Watson (2002) show that the common factors in equation (1) can be consistently estimated by principal components. To complete the specification of the DFM, the common factors are assumed to follow a VAR(p) process such that:

$$F_t = A(L)F_{t-1} + Bu_t \quad \text{and} \quad u_t \sim N(0, I_q) \qquad (2)$$

where $A(L)$ is an p^{th} order matrix polynomial, B is a k X q matrix of full rank q, and u_t is a vector of uncorrelated white noise shocks.[6] In the model, we assume three common factors (k), two pervasive common shocks (q), and two lags for the VAR.

The DFM described in equations (1) and (2) is estimated using the two-step procedure described in Giannone *et al* (2008). First, based on the balanced data panel, estimate the common factors using the principal component method and the VAR coefficients using ordinary least square (OLS). Next, given the initial parameter estimates, apply the Kalman filter to the entire data set (including missing observations), and re-estimate the factors. For missing observations, the implicit signal extraction process of the filter will place no weight on that variable in the computation of the factors in time t. Finally, we fill in the missing observations using the estimated factors (via equation

6. The uncorrelated white noise restriction is shown to help improve the forecasting performance of the DFM.

(1)). These steps are repeated until there is no further change to the estimated factors.

To map the annual GDP into quarterly series, we use the interpolation method developed by Chow and Lin (1971). The method assumes that it is possible to write the unobserved quarterly GDP series (y_t as a linear stochastic function of some observed quarterly indicators. In this case, we used the estimated common factors (F_t)) from the DFM such that:

$$y_t = \beta F_t + v_t \quad (3)$$

Where β' is a k X 1 vector of parameters and v_t is a vector of stochastic disturbances with covariance matrix Π.Let y^*_t be the observed T annual values of GDP,and C be an $T \times 4T$ aggregation matrix that converts quarterly series into its annual values.The annual and quarterly series can be expressed as y^*_t =Cy_1 . The annual a Cy_t, or

$$y_t^* = C\beta F_t + Cv_t \quad (4)$$

Although equation (3) cannot be directly estimated, estimates of its parameters can be obtained from equation (4) using generalized least square (GLS). Define F_t*= CF_t, the GLS estimator is given by $\hat{\beta} = [y_t^{*'}(C\Pi C')^{-1}y_t^*]^{-1}y_t^{*'}(C\Pi C')^{-1}F_t$. Using β from the GLS regression, one can obtain the estimates of quarterly GDP series such that:

$$\hat{y}_t = \hat{\beta}F_t + \Pi C'(C\Pi C')^{-1}(y_t^* - \hat{\beta}F_t^*) \quad (5)$$

y_t can be decomposed into two components: (i) the conditional expectation of quarterly GDP (y_t) give the common factors (F_t); and (ii) the redistribution of the annual prediction error into quarterly prediction errors. The second component ensures the aggregated quarterly series coincide with the observed annual series. Lastly, we substitute the forecast of the common factors into equation (5) to obtain the forecast of quarterly GDP.

DATA

The quarterly dataset used to project quarterly GDP consists of trade and financial variables for Cuba and The Bahamas, which are detailed in the Appendix. For The Bahamas, the Dynamic Factor Model summarizes approximately 130 monthly and quarterly indicators, of which roughly one-half are direct indicators of domestic activity in The Bahamas, such as electricity generation or manufacturing. The rest of the variables included for The Bahamas are indicators of the U.S. economy, which carry a particularly important weight for The Bahamas given its close proximity and its heavy dependence on tourism from U.S. residents. The influence of the U.S. on the Cuban economy is less direct, particularly because of limited direct trade. Nonetheless, the impact of shocks to the U.S. is felt in the Cuban economy indirectly through world financial variables, commodity prices, tourism indicators, and hence, these are included for Cuba. In addition, weather and natural disasters are included, as are income measures for residents abroad which are intended to reflect remittances in both countries.

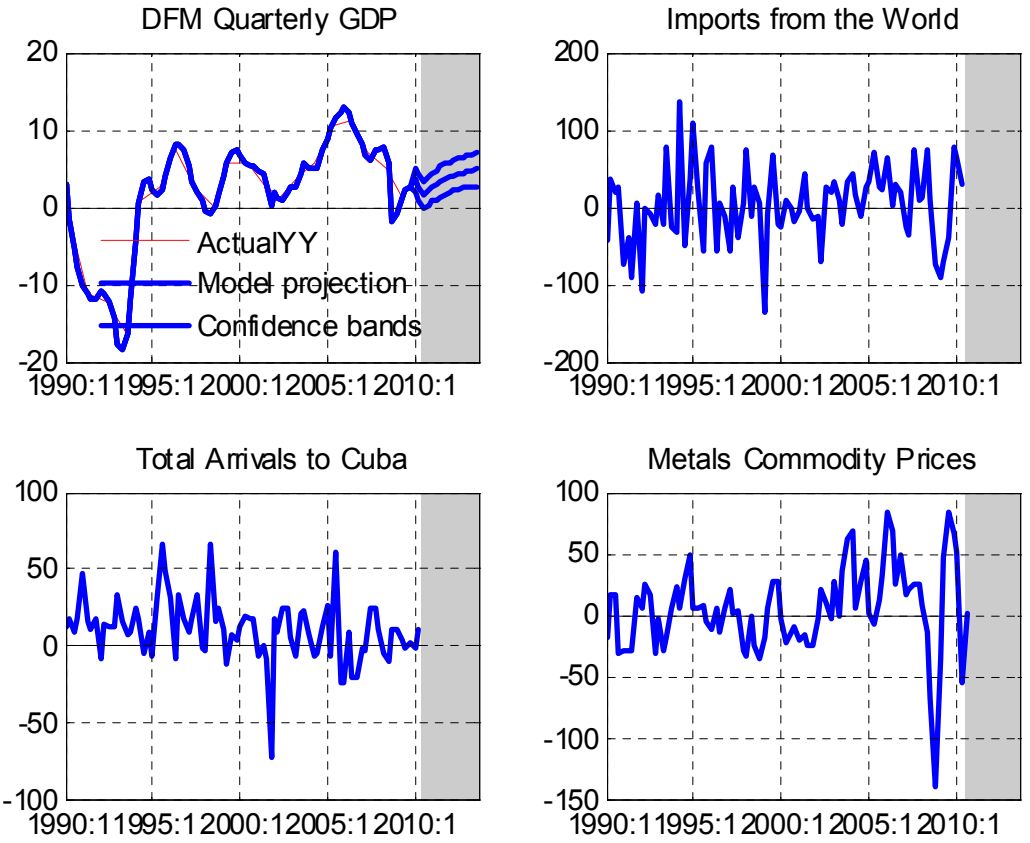
The median of the change in the underlying indicator variables (shown in the Appendix for Cuba), summarizes the overall change that the dynamic factor model captures. The median indicator changes suggest a slowing down of activity in 2008–09, with a recovery in late 2009, but a return to slow growth in 2010. The strong variation within some of the available series is eliminated by the factor modeling, which produces the common component of the available series.

MODEL TESTING AND RESULTS

To get a feel for the modeling results presented below, Figure 2 shows the derivation of quarterly GDP growth for Cuba.[7] The upper left panel compares actual GDP growth to the quarterly estimate. This estimate, based on the Dynamic Factor Model (DFM), results from extracting the common component of the series presented in Appendix 1 for Cuba (and Appendix 2 for The Bahamas). Three key series are shown, which drive the quarterly estimates. The upper right shows total imports by Cuba from the

7. Without loss of generality, the section presents general results pertaining to the DFM quarterly GDP nowcasting model alternatively for Cuba or The Bahamas, but not both.

Figure 2. Cuba: An Example of DFM Estimates



Source: GTA, Haver, Country authorities, Authors' estimates.

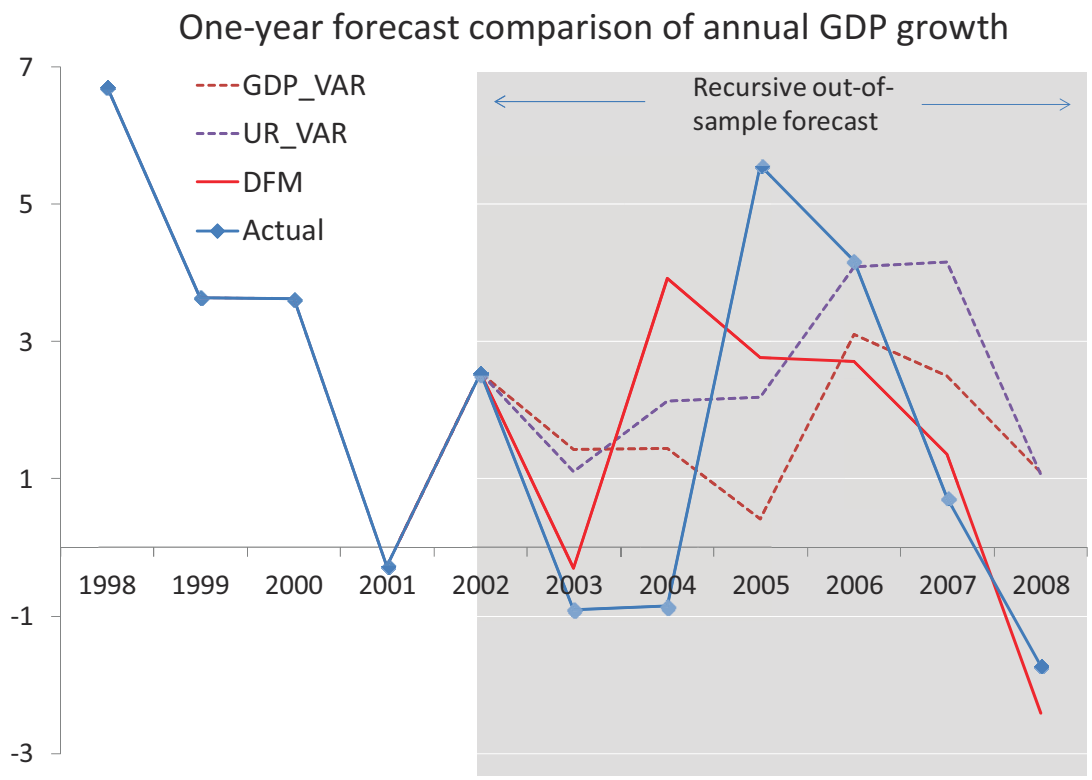
Note: The figure shows the derivation of quarterly GDP growth for Cuba. The upper left panel compares actual GDP growth to the quarterly estimate. This estimate, based on the Dynamic Factor Model (DFM), results from extracting the common component of the series presented in Appendix 1 for Cuba (and analogously for The Bahamas). Three key series are shown, which drive the quarterly estimates. The upper right shows total imports by Cuba from the world. The lower left shows total overnight tourist arrivals. The lower right shows the evolution of the nickel commodity price index, a key commodity export for Cuba. All figures expressed in annualized, seasonally adjusted, one-quarter growth rates.

world. The lower left shows total overnight tourist arrivals. The lower right shows the evolution of the nickel commodity price index, a key commodity export for Cuba. The DFM brings all the underlying series to the present (fills in the missing variables) and estimates quarterly GDP based on the common components of all the underlying series, of which three are shown.

The initial empirical test of the model is presented in Figure 3, which compares out-of-sample forecast for the DFM with two Bivariate Vector Auto-regression models (BiVAR). The first BiVAR model consists of annual GDP growth for The Bahamas and the U.S unemployment rate, while the second consists of annual GDP growth for The Bahamas and the U.S.[8] The figure shows the one-year-ahead forecast of GDP growth for The Bahamas from 2003 to 2008 for all three models, with the DFM forecast based on information at the end of each year over the corresponding period. The results show that the DFM outperforms the two BiVAR models in every year except for 2004. The root mean squared forecast errors

8. See Romeu and Wolfe (2010) for the links of tourism to OECD employment conditions driving this choice for the BiVAR for The Bahamas.

Figure 3. The Bahamas: Comparing Nowcasting Models 1998–08



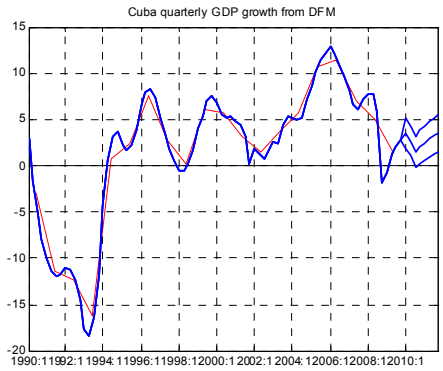
Source: Country authorities, Authors' estimates.
Note: The the figure compares actual GDP growth with out of sample forecast for the Dynamic Factor Model (DFM, solid red) with two Bivariate VAR (BiVAR) models of GDP growth based on U.S. unemployment rate and GDP growth. The shaded area shows the one-year-ahead recursive GDP growth rate forecast for The Bahamas from 2003 to 2008. The one-year-ahead DFM forecast is based on information at the end of each year over the corresponding period. The DFM outperforms the two BiVAR models in every year except for 2004, with a root mean squared forecast errors of 23 and 32 percent smaller than the two BiVAR model, respectively.

of the DFM is 23 and 32 percent smaller than the Bi-VAR model based on U.S. unemployment rate and GDP growth.

Figure 4 compares the long-term estimates of quarterly GDP for The Bahamas and Cuba with the official annual data. Both countries show large and persistent recession in the early to mid 1990s, however, Cuba's post-Soviet decline was more than double that of The Bahamas. This deep recession in the early 1990s illustrates the large quarterly declines that occurred within the year but are masked by the averaging that occurs in the official annual growth. For both countries, the trough of the recession in the early 1990s was significantly deeper than the reported annual decline (-8 percent for The Bahamas and -18 percent for Cuba). In addition, the figure shows the similarity in the sharp and rapid downturn experienced by both countries in the wake of the 2007/08 global financial crisis.

Figure 5 shows the Dynamic Factor model forecast for The Bahamas, including 95 percent bands against the annual data. The shaded area represents forecasting of quarterly GDP in 2009–11. The bottom panel shows tourist arrivals to The Bahamas (by air) which dropped off considerably in 2009, and is an important driver of the quarterly nowcast of GDP. The model suggests that at the trough, quarterly GDP declines exceeded 5 percent in early 2009, and at present, output has recovered mildly, to approximately one percent annualized growth. Similarly, Figure 6 shows the Dynamic Factor model forecast for Cuba, with 95 percent bands also shown and graphed

Figure 4. DFM forecasts for The Bahamas and Cuba



Source: Country authorities, Authors' estimates.
Note: Quarterly (DFM estimates, SAAR) and annual (official) GDP growth is presented for The Bahamas on the left, and Cuba on the right. The red line shows the annual growth rate, the blue shows the quarterly DFM forecast. Both countries show large and persistent recession in the early to mid 1990's, however, Cuba's post-Soviet decline was more than double that of The Bahamas. The recession of 2008 was of similar magnitude across both economies

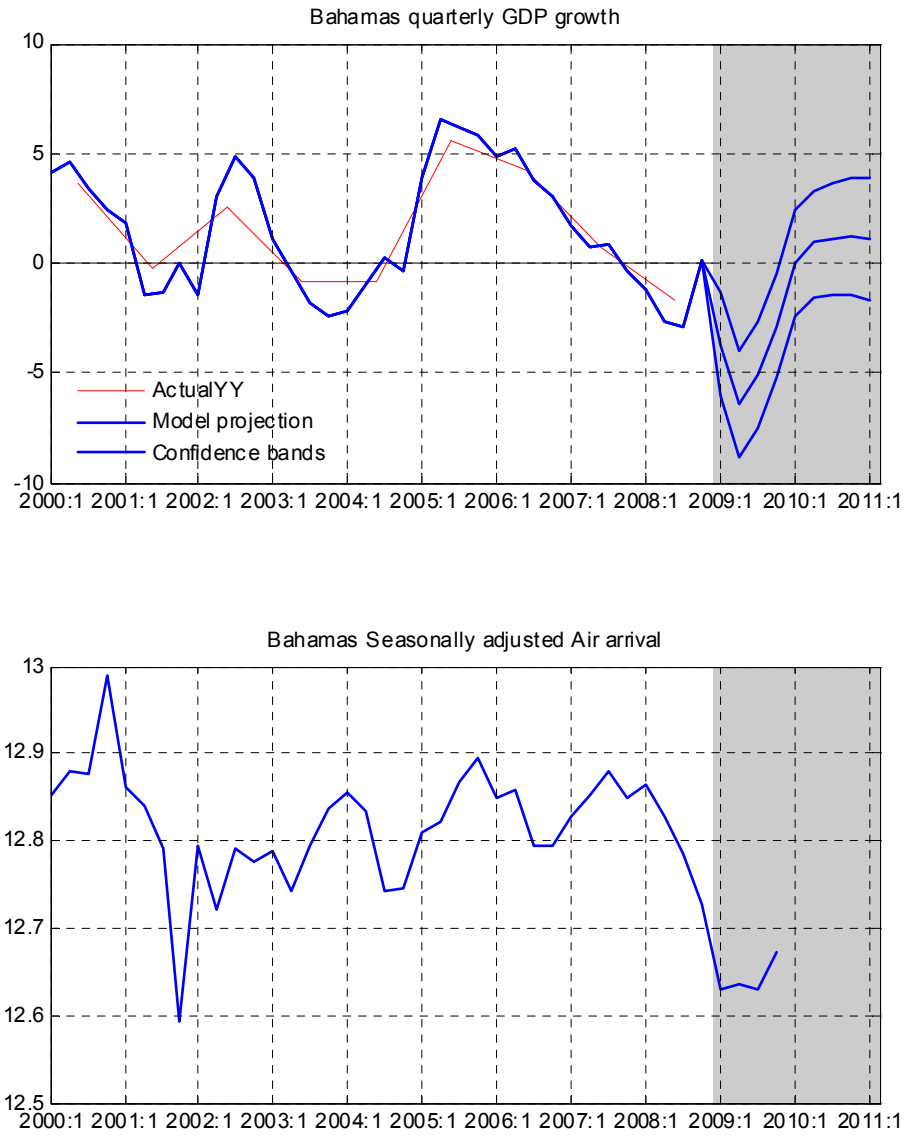
against the annual data. For Cuba, the bottom panel shows imports from the world, which is traditionally a key indicator of activity due in part to hard currency financing constraints, and which dropped off considerably in 2009. The model suggests that at the trough, quarterly GDP declined by approximately 2 percent at the end of 2008 and into 2009 in Cuba. In addition, estimates of output in 2010 suggest a mild recovered and a risk of a return to recessionary conditions, with seasonally adjusted annualized GDP growth estimated at approximately one percent.

CONCLUSION

This paper proposes a framework for nowcasting and forecasting quarterly real GDP growth using a Dynamic Factor Model for Cuba and The Bahamas, countries which at present do not report quarterly output growth. The study employs several characteristics idiosyncratic to Caribbean countries that are particularly useful in estimating quarterly growth using the Dynamic Factor Model, including proximity to the U.S., the fact that they are islands, and trade treaties, among others. Estimates of the proposed model are evaluated against two simple Bivariate Vector Autoregressions, and the latter are found to underperform relative to the DFM.

The model estimations also shed light on both the depth and breadth of past recessions in both countries and the more recent impact of the global financial crisis. Both countries suffered historically large and prolonged recessions in the early part of the 1990s. During these, the reported annual declines in output did not exceeded 6 percent for The Bahamas, fluctuated between 10 and 15 percent for Cuba. The DFM estimates, however, show growth odeclines approaching 8 percent during this period for The Bahamas and nearly 20 percent in some quarters for Cuba. Hence, unsurprisingly, the annual growth tends to understate the depth of the contractions during some quarters of this period. For the global financial crisis that began in 2007/08, the DFM model estimates show a very rapid decline in GDP in both countries, with a particularly pronounced drop coinciding with the turmoil in the last quarter of 2008 and the first quarter of 2009. Moreover, both countries are currently facing very slow recoveries with projected growth rates under 3 percent for 2010.

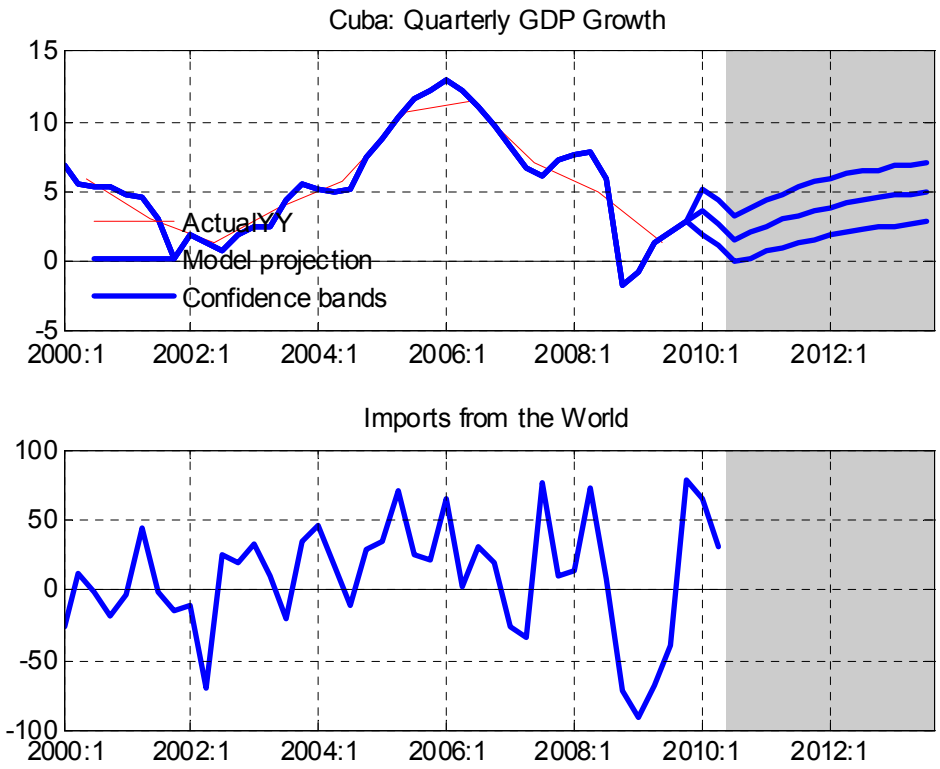
Figure 5. The Bahamas: The Crisis Impact and Current GDP



Source: Country authorities, authors' estimates.

Note: The upper panel shows the Dynamic Factor model forecasts for The Bahamas (thick line) including 95 percent bands against the annual data (thin). The shaded area represents forecasting of quarterly GDP in 2009–11. The bottom panel shows tourist arrivals to The Bahamas (by air) which dropped off considerably in 2009, and is an important driver of the quarterly nowcast of GDP. The model suggests that at the trough, quarterly GDP declines exceed 5 percent in early 2009, and at present, output has recovered mildly, to approximately one percent annualized growth.

Figure 6. Cuba: The Crisis Impact and Current GDP



Source: Country authorities, authors' estimates.

Note: The upper panel shows the Dynamic Factor model forecasts for the Cuba (thick line) including 95 percent bands against the annual data (thin). The shaded area represents forecasting of quarterly GDP in 2009–11. The bottom panel shows Cuba's imports from the world, arrivals to The Bahamas (by air) which dropped off considerably in 2009, and is an important driver of the quarterly nowcast of GDP. The model suggests that at the trough, quarterly GDP declines exceed 5 percent in early 2009, and at present, output has recovered mildly, to approximately one percent annualized growth.

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Appendix 1. Cuba: Data Description and Seasonally Adjusted Changes

	2000–07	2008	2009	2009Q4	2010Q1
Seas. Adj., Venezuela, imports from Cuba	-0.8	17.9	-0.4	-18.9	32.7
Seas. Adj., Venezuela, exports to Cuba	-4.2	3.4	0.9	7.8	9.5
Seas. Adj., WORLD, imports from Cuba	4.5	-8.7	6.8	12.2	11.6
Seas. Adj., ARG, imports from Cuba	-0.3	-7.5	14.6	206.1	75.3
Seas. Adj., BRA, imports from Cuba	-3.5	27.3	-14.5	-21.8	89.9
Seas. Adj., CAN, imports from Cuba	3.4	-22.0	8.1	31.9	5.4
Seas. Adj., CHN, imports from Cuba	9.7	-3.1	13.2	29.1	14.9
Seas. Adj., EU, imports from Cuba	-0.7	-4.3	7.1	-22.0	-3.3
Seas. Adj., JPN, imports from Cuba	-7.9	-18.8	24.6	88.7	-42.2
Seas. Adj., MEX, imports from Cuba	3.6	57.7	-51.2	-105.7	-2873.8
Seas. Adj., RUS, imports from Cuba	-17.1	-6.6	-6.7	-9.5	-4.8
Seas. Adj., WORLD, exports to Cuba	1.4	1.0	-10.3	18.2	15.4
Seas. Adj., ARG, exports to Cuba	5.6	3.0	-18.9	-40.6	259.8
Seas. Adj., BRA, exports to Cuba	5.9	5.8	-28.2	-40.4	31.0
Seas. Adj., CAN, exports to Cuba	3.9	-2.1	-25.0	-16.3	99.3
Seas. Adj., CHN, exports to Cuba	4.7	5.5	-16.4	-11.1	137.8
Seas. Adj., EU, exports to Cuba	2.0	5.2	-12.6	11.5	0.6
Seas. Adj., JPN, exports to Cuba	5.3	-22.2	-14.0	-25.4	6.2
Seas. Adj., MEX, exports to Cuba	1.3	13.8	5.4	16.6	3.3
Seas. Adj., RUS, exports to Cuba	4.4	-20.3	61.5	590.5	-70.2
Seas. Adj., USA, exports to Cuba	11.3	6.9	-7.6	4.5	-11.6
Seas. Adj., Arrivals, total	2.4	1.2	2.3	4.7	-1.2
Seas. Adj., Price Coffee Colombian	-1.0	0.2	5.4	5.9	4.6
Seas. Adj., Price Sugar Raw Cane World fob (Cents/Lb)	1.6	3.2	20.8	18.8	2.1
Seas. Adj., Dominican Republic Tourist Arrivals Rest Of The World	-2.9	2.4	-12.9	56.6	16.1
Seas. Adj., US Tourism: US Citizen Air Traffic to Mexico (NSA, Units)	1.8	-0.1	0.6	0.8	2.6
Seas. Adj., US Tourism: US Citizen Air Traffic to the Caribbean (NSA, Units)	0.1	-3.7	1.7	0.8	-1.3
Seas. Adj., CPI-U: Miami-Fort Lauderdale, FL (NSA, 1982–84=100)	0.8	1.1	0.0	1.1	-0.0
Seas. Adj., CPI-W: Miami-Fort Lauderdale, FL (NSA, 1982–84=100)	0.9	1.2	0.0	1.3	0.3
Seas. Adj., Cushing OK West Texas Intermediate Spot Price FOB ($/Barrel)	4.8	-0.3	13.1	31.8	9.8
Seas. Adj., Copper, High Grade: COMEX Spot Price ($/Lb)	3.9	-8.8	19.7	33.2	10.3
Seas. Adj., Cash Price: Soybeans, Number 1 Yellow, Central Illinois ($/bushel)	1.8	0.9	1.1	2.1	-11.5
Seas. Adj., Gold, Handy & Harman Base Price ($/Troy Oz)	2.5	-0.3	9.9	11.3	-2.5
Seas. Adj., KR-CRB Spot Commodity Price Index: Metals (1967=100)	2.5	-8.4	16.2	18.0	10.0
Seas. Adj., KR-CRB Spot Commodity Price Index: Raw Industrials (1967=100)	1.3	-4.0	9.3	11.0	7.2
Seas. Adj., KR-CRB Spot Commodity Price Index: Foodstuffs (1967=100)	1.5	1.9	-0.3	16.1	4.5
Seas. Adj., KR-CRB Spot Commodity Price Index: Fats and Oils (1967=100)	3.1	0.3	4.1	13.7	7.6
Seas. Adj., KR-CRB Spot Commodity Price Index: Livestock and Products (1967=100)	2.2	1.9	3.3	12.2	14.0
Seas. Adj., Prices Received by Farmers: All Crops (1990–92=100)	1.3	3.5	-3.0	8.3	-2.1
Seas. Adj., Spain: Foreign Trade Prices: Exports (NSA, 2000=100)	0.7	0.1	-2.4	0.8	1.9
Seas. Adj., Spain: Foreign Trade Prices: Imports (NSA, 2000=100)	0.7	1.0	-2.8	0.4	4.3
Seas. Adj., PPI: Finished Consumer Goods excluding Foods (NSA, 1982=100)	1.0	2.4	0.4	3.7	2.8
Seas. Adj., PPI: Finished Consumer Foods (NSA, 1982=100)	0.7	2.0	-0.4	2.1	2.5
Seas. Adj., Synthetic Euro calculated using 1997 GDP weights (US$/Euro)	1.3	-0.6	3.1	3.9	-5.0
Seas. Adj., Dominican Republic: Workers' Remittances (NSA, Mil.US$)	1.4	-0.1	-1.0	-5.0	0.0
Seas. Adj., Dominican Republic: Tourist Arrivals: Non-Residents (NSA, Persons)	0.8	-2.6	2.8	4.1	-0.8
Seas. Adj., Dominican Republic: Tourist Arrivals: Canada (NSA, Persons)	4.1	0.3	0.1	0.1	1.5
Seas. Adj., Dominican Republic: Tourist Arrivals: South America (NSA, Persons)	0.8	-0.5	10.8	32.5	-6.8
Seas. Adj., Dominican Republic: Tourist Arrivals: Europe (NSA, Persons)	-0.1	-2.7	0.3	3.5	-0.6
Seas. Adj., Max Wind SpeedMPH	0.8	2.0	-2.0	-3.9	2.5
Seas. Adj., Max Gust SpeedMPH	-4.0	-2.0	-2.4	-4.2	5.5
Seas. Adj., Fog=1 Fog-Rain=2 Rain=3 Rain-Thunderstorm=4 Thunderstorm=5	3.9	-2.0	5.4	17.5	28.3
Seas. Adj., PrecipitationIn	0.2	0.3	0.3	0.3	0.4
Median of all indicators	1.4	0.3	0.4	4.1	2.8

Source: GTA, Haver, ONE, Country authorities, NOAA, BIS, DX Data.

Note: The table shows the data employed in estimating the Dynamic Factor Model for Cuba, including the median one-quarter seasonally adjusted change in the variable is shown for the period in the header.

Appendix 2. Bahamas: Data Description and Sample Period

	Series name	Sample
Balance of payment	Goos exports	89Q1–09Q2
	Goods imports	89Q1–09Q2
	Trade balance	89Q1–09Q2
	Services receipts	89Q1–09Q2
	Services payments	89Q1–09Q2
	Income receipts	89Q1–09Q2
	Income payment	89Q1–09Q2
	Current account	89Q1–09Q2
	Direct foreign investment	89Q1–09Q2
	Overall balance	89Q1–09Q2
Government	Total revenue and grants	89Q1–09Q4
	Tax Revenue	89Q1–09Q4
	Nontax revenue	89Q1–09Q4
	Total expenditure	89Q1–09Q4
	current expenditure	89Q1–09Q4
	Capital expenditure	89Q1–09Q4
Electricity gneration	Generated	89Q1–08Q4
	Domestic	89Q1–08Q4
	Commercial	89Q1–08Q4
	Street	89Q1–08Q4
	Total	89Q1–08Q4
Construc-tion	permit issued value	94Q1–08Q4
	starts value	94Q1–08Q4
	completion values	94Q1–08Q4
Monetary stastistics	Net foreign assets	90Q1–09Q4
	Credit govt	90Q1–09Q4
	credit private	90Q1–09Q4
	total credit	90Q1–09Q4
	commercial deposit	90Q1–09Q4
	CB deposit	90Q1–09Q4
	total M1	90Q1–09Q4
	savings deposit	90Q1–09Q4
	fixed deposits	90Q1–09Q4
	foreign deposits	90Q1–09Q4
	total quasi money	90Q1–09Q4
	Notes and coins	90Q1–09Q4
	Weighted deposit rate	90Q1–09Q4
	Central bank rate	90Q1–09Q4
	Prime rate	90Q1–09Q4
	Total reserves	90Q1–09Q4
Commercial banks	Interest Income	93Q1–09Q3
	Interest Expense	93Q1–09Q3
	Interest Margin	93Q1–09Q3
	Commission & Forex Income	93Q1–09Q3
	Gross Earnings Margin	93Q1–09Q3
	Staff Costs	93Q1–09Q3
	Operating Costs	93Q1–09Q3
	Provisions for Bad Debt	93Q1–09Q3
	Net Income	93Q1–09Q3
	Effective Interest Rate Spread	93Q1–09Q3
	Average Monthly Assets	93Q1–09Q3

	Series name	Sample
Prices and exchange rate	Real efffective ER	89Q1–09Q4
	REER based on CP	89Q1–08Q4
	Nominal CPI	89Q1–08Q4
	CPI, seasonally adjusted	89Q1–08Q4
Tourism activities	Expenditure day Nassau	89Q1–07Q4
	Expenditure day Grand B	89Q1–07Q4
	Expenditure day Islands	89Q1–07Q4
	Expenditure day all	89Q1–07Q4
	Expenditure cruise Nassau	89Q1–07Q4
	Expenditure cruise Grand B	89Q1–07Q4
	Expenditure cruise Islands	89Q1–07Q4
	Expenditure cruise all	89Q1–07Q4
	Expenditure stop Nassau	89Q1–07Q4
	Expenditure stop Grand B	89Q1–07Q4
	Expenditure stop Islands	89Q1–07Q4
	Expenditure stop all	89Q1–07Q4
	Expenditure all Nassau	89Q1–07Q4
	Expenditure all Grand B	89Q1–07Q4
	Expenditure all Islands	89Q1–07Q4
	Total expenditure	89Q1–07Q4
	Stop over arrivals	89Q1–09Q4
	Cruise arrivals	96Q1–09Q4
US economy indicators	Stock Price Averages	89Q1–09Q4
	Standard & Poor's 500	89Q1–09Q4
	Wilshire 5000 Price	89Q1–09Q4
	West Texas Intermediate Cushing	89Q1–09Q4
	Brent Crude Oil	89Q1–09Q4
	Federal Funds Rate	89Q1–09Q4
	1–Year Treasury Bill Yield	89Q1–09Q4
	5–Year Treasury Note Yield	89Q1–09Q4
	10–Year Treasury Note Yield	89Q1–09Q4
	Treasury Bond Long-Term Composite	89Q1–09Q4
	Phila FRB Bus Outlook	89Q1–09Q4
	FRB Sr Officers Survey: Large Firms	89Q1–09Q4
	FRB Sr Officers Survey: Small Firms	89Q1–09Q4
	FRB Loan Survey: Commercial Real Estate	89Q1–09Q4
	FRB Sr Loan Survey: Res Mortgages	89Q1–09Q4
	Industrial Production Index	89Q1–09Q4
	Industrial Production: Manufacturing	89Q1–09Q4
	All Employees: Total Nonfarm	89Q1–09Q4
	All Employees: Total Private Industries	89Q1–09Q4
	All Employees: Construction	89Q1–09Q4
	All Employees: Manufacturing	89Q1–09Q4
	Average Weekly Hours: Total Private	89Q1–09Q4
	Average Weekly Hours: Manufacturing	89Q1–09Q4
	Civilian Employment	89Q1–09Q4
	Civilians Employed: Men 20 Years	89Q1–09Q4
	Civilian Unemployment Rate	89Q1–09Q4
	Civilian Unemployment Rate: Men	89Q1–09Q4
	Unemployed for 15 Weeks and Over	89Q1–09Q4
	Not in the Labor Force	89Q1–09Q4

	Series name	Sample
US economy indicators	Index of Help-Wanted Advertising	89Q1–09Q4
	Initial Claims for Unemployment	89Q1–09Q4
	Insured Unemployment	89Q1–09Q4
	Unemployment Insurance	89Q1–09Q4
	Unemployment Insurance: Duration	89Q1–09Q4
	Unemployment Covered Employment	89Q1–09Q4
	Retail Sales & Food Services	89Q1–09Q4
	Retail Sales: Total	89Q1–09Q4
	Retail Sales: Total Excl Motor Vehicle	89Q1–09Q4
	Personal Income	89Q1–09Q4
	Real Disposable Personal Income	89Q1–09Q4
	Real Personal Consumption Expenditures	89Q1–09Q4
	ISM Mfg: PMI Composite Index	89Q1–09Q4
	ISM Mfg: New Orders Index	89Q1–09Q4
	ISM Mfg: Production Index	89Q1–09Q4
	ISM-Chicago: Business Barometer Index	89Q1–09Q4
	ISM-Chicago: Production Index	89Q1–09Q4
	Conference Board: Consumer Confidence	89Q1–09Q4
	Conference Board: Consumer Expectations	89Q1–09Q4
	University of Michigan: Sentiment	89Q1–09Q4
	University of Michigan: Expectations	89Q1–09Q4
	KR-CRB Spot Commodity Price Index:	89Q1–09Q4
	Light Sweet Crude Oil Futures 1st Expiring	89Q1–09Q4
	Light Sweet Crude Oil Futures 6–Month	89Q1–09Q4
	Average Hourly Earnings	89Q1–09Q4
	ISM: Mfg: Prices Index	89Q1–09Q4
	Imports c.i.f.: Goods	89Q1–09Q4
	Nominal Trade-Weighted US$	89Q1–09Q4
	Nominal US$ vs Major Currencies	89Q1–09Q4
	Real Broad Trade-Weighted US$	89Q1–09Q4
	Real US$ vs Major Currencies	89Q1–09Q4
	Real Gross Domestic Product	89Q1–09Q4

Source: Country Authorities, Haver, Authors' estimates.

Note: The table shows the data employed in estimating the Dynamic Factor Model for The Bahamas.