Cuba's macroeconomic vulnerabilities to Venezuelan Shocks[1]

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December 2019

Abstract

Venezuelan resources going to Cuban are declining and becoming less sustainable given its economic collapse, which significantly affects Cuba's economic growth. This paper decomposes changes in Cuba's GDP for the period 1970 to 2017 to illustrate the effects of external factors. We rely on a battery of time series econometrics techniques, namely: structural change tests, linear regression models, and linear regression in state-space-form with time varying coefficients, to get an estimate of the fraction of the Cuban GDP annual growth rate explained by external factors. In particular, we explore the role of macroeconomics shocks coming from Cuba's main trading partners (Venezuela, Russia, China and Europe). Results show that the two economies with the largest influence on Cuba are Russia, and more recently Venezuela. This paper performs two counterfactuals to analyse how the Venezuelan economy has contributed to the growth of the Cuban economy over the last decades. Our first counterfactual exercise shows that Cuba's GDP in 2017 would be 0.3 percent higher in the counterfactual scenario in which Cuba did not increase its exposition to Venezuela. Higher exposition to Venezuela since 1999 allowed Cuba to experience a higher average rate of growth from 1999 to 2013 (4.65 percent vs. 4.49 percent). However, that higher exposition to Venezuela also led Cuba to experience a significantly lower average annual GDP growth since 2014 (1.76 percent vs. 2.40 percent). Our second counterfactual focuses on the implications of the Venezuelan economic collapse after 2013 for the Cuban economy. Results show that due to Venezuela's significant output decline Cuba experienced a lower average rate of growth from 2014 to 2017 (1.49 percent vs. 2.68 percent), with a total accumulated impact for 2017 of a lower GDP by 4.5 percent.

[1] The paper benefited from excellent research assistance provided by Gerardo Milano. All errors remain our responsibility.

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1. Motivation

1.1. Context and critical events of Cuba's relationship with Venezuela and Russia

First years of the "Castro Revolution" (1959-1975)

After the triumph of the Revolution in 1959, the new regime led by Fidel Castro accelerated the process of collectivization in Cuba, nationalizing foreign capital industries (Mesa-Lago and Pérez-López, 2010) and in parallel, carrying out an industrialization plan on the Island with the objective of reducing dependence on sugar exports. By 1960, Cuba and the Soviet Union signed a trade agreement where the Soviet government promised to buy one million tons of sugar from Cuba each year, in exchange for sending supplies such as oil and chemicals to the country (Mesa-Lago, 2009).

By 1963 the attempt to reduce dependence on sugar by promoting industrialization failed, and the Cuban regime re-emphasized the importance of sugar exports with the justification that it was an "instrument of economic diversification", and also committing to the Soviet Union in supplying sugar above market prices. Labour and agrarian reforms were also implemented, where medium-sized farms were expropriated. By 1968, all small and large businesses in Cuba were nationalized, bringing with them a slowdown in economic growth as a result of low productivity and state inefficiency (Mesa-Lago, 2009).

By the 1970s, with the increase in international sugar prices, Cuba's GDP grew on average 5.2% between 1971 and 1973. Even after the decline in sugar prices in 1975, the Cuban economy grew by 9.5%. The high growth during this period can be explained by the increase in public investment, especially in the modernization of the sugar industry, as well as by the contributions provided by the Soviet Union for the export of sugar at high prices, the transfers and the imports of oil and chemical products (Jales et. al.2018).

Decade of the eighties: a "roller coaster" (1980-1989)

During the 1980s, Cuba received large economic contributions in the form of transfers and subsidies from the Soviet Union, which allowed it to enjoy some growth in its GDP with an average of 7.42% between 1981 and 1984. However, for 1985 and 1988, although Soviet contributions to the Island's economy averaged approximately 23% of GDP (Hernandez-Catá, 2013), the bloc entered into crisis, and the Castro regime carried out a series of economic measures based on greater controls on the economy. This brought stagnation in Cuban economic growth, reaching an average of only 0.7% economic growth between 1985 and 1989.

On the other hand, Cuba began to have commercial relations with the European Union. By 1984, Cuba received humanitarian and development assistance from the European bloc, reaching 35.7% of its imports in 1988. Apart from the Soviet Union, the countries with the greatest participation in exports to Cuba were the Former German Federal Republic with 17.8%, Spain with 16.9% and Portugal with 4.1%[2].

[2] After diplomatic relations were established in 1984, the European Union sent 32.9% of its total exports to Cuba between 1988 and 1989 (source: UN Comtrade International Trade Statistics, own calculations).

"Special period": partial reforms in Cuba (1990-2000)

The 1990s did not begin in the best way for both the Soviet Union and its allied countries. Since its dissolution in 1991, Cuba went through a deep economic crisis due to the sharp drop in imports from the countries of the bloc, which represented approximately 85% of total imports (Rodríguez García, 2011), causing a significant collapse of the Cuban economic activity in approximately 25% from 1991 to 1993. By 1992, the United States added new measures to the embargo on the Island with the approval of the Torricelli Amendment[3], where commercial vessels were prohibited from entering Cuba to trade goods and services; freight and passenger transport; and the imposition of strict limits on remittances to Cuba by US citizens to finance the trip of Cubans to the US, in order to prevent the Castro regime from accessing foreign currency.[4]

In that same period, the Cuban regime implemented an economic emergency program, whose objectives were to overcome the effects of the crisis, and to re-integrate the Cuban economy into the world market (Rodríguez García, 2011). Among the measures adopted, there were a series of amendments to the Cuban Constitution where the concepts of ownership and the role of the State in the economy were modified; ending the state monopoly on foreign trade, and recognizing private enterprises (Commission of the European Communities, 1995).

Between 1994 and 1999, the Cuban economy grew by approximately 21%, driven by the growth of the business sector after the exchange rate controls easing, the increase in foreign direct investment, and the restructuring of the banking and financial system in the country. With this, the imbalance in fiscal accounts was also reduced; leading to a strong appreciation in the Cuban peso against the dollar of 85.93%. However, the evidence suggests that social services were negatively affected. Schooling in the poorest sectors of Cuba was drastically reduced, as well as the quality of public health services, an increase in unemployment, and a more regressive income distribution (Rodríguez García, 2011).

The rise of Chavez in Venezuela and the new links with Russia (2000-2009)

The first years of the 2000s coincided with the rise to power in Venezuela of the late socialist leader Hugo Chávez Frías, whose ideological and political project was in line to that of Fidel Castro in Cuba. A Comprehensive Cooperation Agreement between the two countries was signed in 2000, whose objective was to promote the exchange of goods and services under more favourable conditions (Romero, 2013). In that agreement, Venezuela would sell highly subsidized oil to Cuba, and only 60% would be paid in the first 90 days, while the other 40% would be financed at an interest rate of one percent for 25 years (Piccone and Trikunas, 2014).

By 2003, Venezuelan crude oil shipments to Cuba reached 38,000 bpd and 97,000 bpd in 2008 under Petrocaribe[5] terms. By 2012, Venezuelan exports of combined oil and refined oil products increased to 104,000 bpd. For Venezuela, shipments to Cuba accounted for just 5.1% of total crude oil exports in 2011,

[3] Cuban Democracy Act. United States Code. Title 22. Foreign Relations and Intercourse, Chapter 69.

[4] In this decade, further restrictions were imposed the by the Helms–Burton Act of 1996, which among other things, restricted United States citizens from doing business in or with Cuba.

[5] Petrocaribe is a regional energy cooperation initiative founded by fourteen (which later was joined by four more) Caribbean countries in 2005. The purpose of this initiative is to guarantee energy supply in the region, with the provision of crude oil by Venezuela in more flexible terms of payment (in fact, the payment is deferred between 17 and 25 years, at an interest rate of one percent; and the terms will be longer once the price of oil increases).

although this proportion has increased over time due to the progressive decline in the production capacity of Venezuela as a result of the lack of investment and maintenance of its oil industry. Cuba, as part of the agreement, sent more than 13,000 Cuban workers from the health (doctors, nurses and paramedics) and sports sectors to Venezuela. These were deployed as part of a network of social assistance programs in the country known as "missions", focused on basic services, community health, sports and literacy programs carried out by the Chavista regime (Koivumaeki and Rodríguez Sosa, 2014).

On the other hand, since 2005 Cuba and Russia decided to re-establish the old links of bilateral collaboration that would cover almost all spheres (including economic and political aspects). The main export item from Russia to Cuba was vehicles, machinery and spare parts for the agricultural, automotive, tires, construction, metals, fertilizers and asbestos fibre sectors. Also, during those years, Russian commercial banks granted long-term loans for the purchase of high-tech products. As in the years with the Soviet Union, sugar remains the main article of Cuban export to Russia, representing on average up to 75% of the total; but with the particularity that the new bilateral relations allowed the development of other export areas for the economy, such as the medicines, tobacco and rum (SELA, 2009).

Recent years: Effects from Venezuelan economic collapse

After a period of continuous economic growth between 2000 and 2009, the Cuban economy began to show signs of stagnation during the following decade. Since 2010, oil production growth in Cuba stagnated to 2.2% in 2016, its lowest record since 2008 when the Cuban oil industry reached its highest growth with 3% (ONEI, 2017). Despite the recovery in some areas (including the agricultural sector, which experienced growth of 8.4% for 2016), industrial production remained at levels below 1989. This was due to the lagging Cuban productive capacity, as well as to the decrease in oil exports by Venezuela due to their production collapse (Feinberg, 2018).

Since 2014, Venezuela has experienced a deep and prolonged economic recession, with the recent years also experiencing hyperinflation. Venezuela has an accumulated contraction of 49.3%[6] in its economy from 2014 to 2018, accumulating an average inflation of 8,426.3%[7]. Economic mismanagement, collapsing oil production[8], significant contraction in the construction, services and manufacturing sectors; and a drastic reduction in investment have contributed to the Venezuelan economy having a slightly lower real GDP level as it had in 1999.

[6] Using BCV data and own calculations.

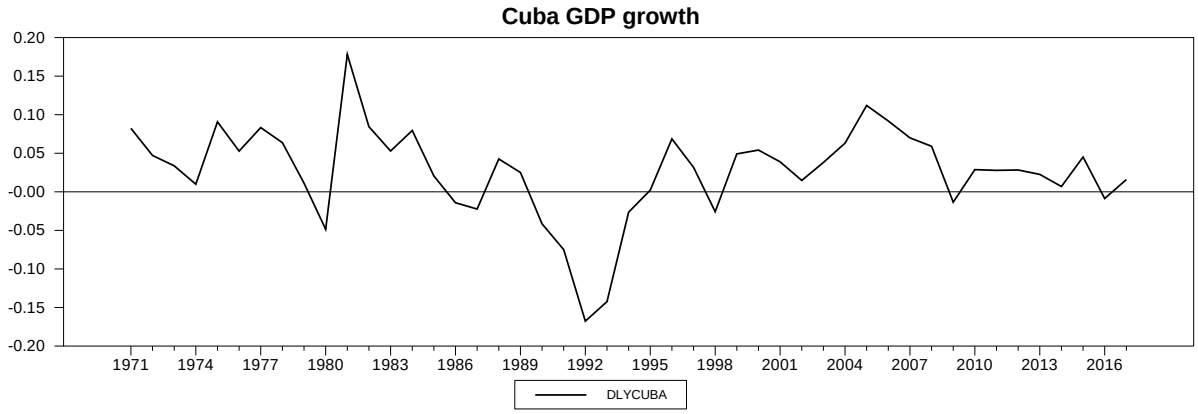
[7] Using BCV, Venezuelan National Assembly data and own calculations.

[8] It is worth mentioning that for the month of April 2019, the United States decreed a series of sanctions against companies and vessels that send oil to Cuba, with the aim of reducing the interference of the Castro regime on Venezuela. For September 2019, the Cuban regime decided to apply rationing measures in the consumption of gasoline and diesel in the face of the exacerbation of fuel shortages due to the decrease in the supply of Venezuelan crude oil. See: https://www.abc.es/internacional/abci-eeuu-decreta-sanciones-para-cortar-envio-petroleo-venezolano-cuba-201904060139_noticia.html; https://www.elnuevoherald.com/noticias/mundo/america-latina/cuba-es/article234979537.html.

1.2. Evidence from linear regressions: structural breaks and changing external drivers

The Cuban Economy experienced an average annual growth of 2.67% from 1970 to 2017, with significant volatility (see Figure 1). In fact, the standard deviation of Cuba's GDP growth during this period is 5.99%, which gives a relatively high coefficient of variation of 2.24.[9]

Figure 1. Cuba GDP growth (1971-2017)



Source: Own calculations.

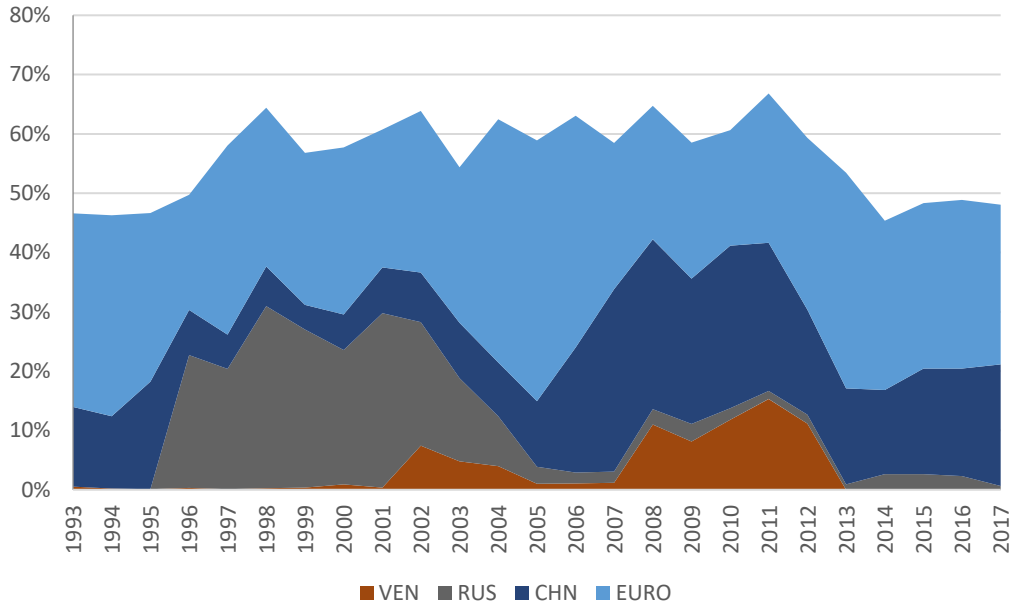
This high volatility of the Cuban economy has been the combination of external factors (the price of sugar, its main exporting item, and the economic performance of its allied countries) as well as domestic policy shocks. In terms of external factors, we can see the significant influence of Russia[10], China, Europe and Venezuela. In fact, using data from UNCOMTRADE, we can see not only that these countries/regions have a significant share of Cuban exports but also that these shares have not been stable over time. They have represented an average higher than 50% of Cuban exports, but the relative weight of countries like Russia has significantly decreased over the years, where the share of countries like China and Venezuela[11] has increased.

[9] During the same period the coefficient of variation for other relatively small (in terms of GDP) Latin American economies were much lower. For Dominican Republic was 0.72, for Ecuador was 0.86, while for Bolivia was 0.85.

[10] Which in this study will also be a proxy, although imperfect, of the impact on Cuba of the former Soviet Union.

[11] In the case of China, its exports to Cuba went from 6.3% in 2000 to 20.51% of total exports in 2017. On the other hand, Venezuelan exports to the Island for the year 2000 were of only 0.93% of the total, reaching 11.15% of the total in 2012 (source: own calculations based on UNCOMTRADE statistical information).

Figure 2. Countries' share of Cuban exports (1993-2017)



Source: UN COMTRADE and own calculations.

To have a better understanding of the role of external factors in explaining Cuba's economic performance, we run linear regression analysis, in which we explain changes of Cuba's GDP[12] as a function of a constant (its growth trend), and the changes of GDP for Venezuela, Russia, China and France[13]. For the entire sample, the only country with a statistically significant influence is Russia (see Table 1). Given the high volatility of Cuba's GDP as well as the changing relative importance of countries on Cuba's total exports we decide not only not to impose any cointegration relation between the changes of GDP of these countries (so, the analysis will just run simple linear regression on the changes variables), but also to explore for the presence of structural breaks. In fact, results from the Bai and Perron (2003) test for structural break, presented on Table 2 shows that there are two structural breaks in the regression, which has been identified for the years 1984 and 1993.[14]

[12] We use the change of the GDP value for each country normalized (1970=100). We also tried regressions with changes of log GDP values, but the R2 was lower, so we keep the changes of GDP as the main variable of interest. See Annex 1 for a comparison of results for the entire sample.

[13] We use France as a representative country for the European Union, because of data availability over the period of analysis and its very high correlation with the GDP growth for the EU.

[14] See Annex 2 to see the statistical significance of the results of the different sub samples.

Table 1. Linear regression. Explaining changes in Cuba's real GDP by external factors (full sample)

Linear Regression - Estimation by Least Squares					
Dependent Variable DYCUBA					
Annual Data From 1971:01 To 2017:01					
Usable Observations	47				
Degrees of Freedom	42				
Centered R^2	0.4846183				
R-Bar^2	0.4355344				
Uncentered R^2	0.5744626				
Regression F(4,42)	9.8733				
Significance Level of F	0.0000101				
Log Likelihood	-165.4186				
Durbin-Watson Statistic	1.7142				
	Variable	Coeff	Std Error	T-Stat	Signif
1	Constant	4.666334	2.810721	1.66019	0.104325
2	DYVZLA	0.009164	0.112642	0.08135	0.935549
3	DYRUSS	1.381714	0.247404	5.58484	1.57E-06
4	DYCHIN	0.002559	0.011948	0.21413	0.831481
5	DYEURO	-0.39943	0.517724	-0.77152	0.444719

Table 2. Bai and Perron test for structural break

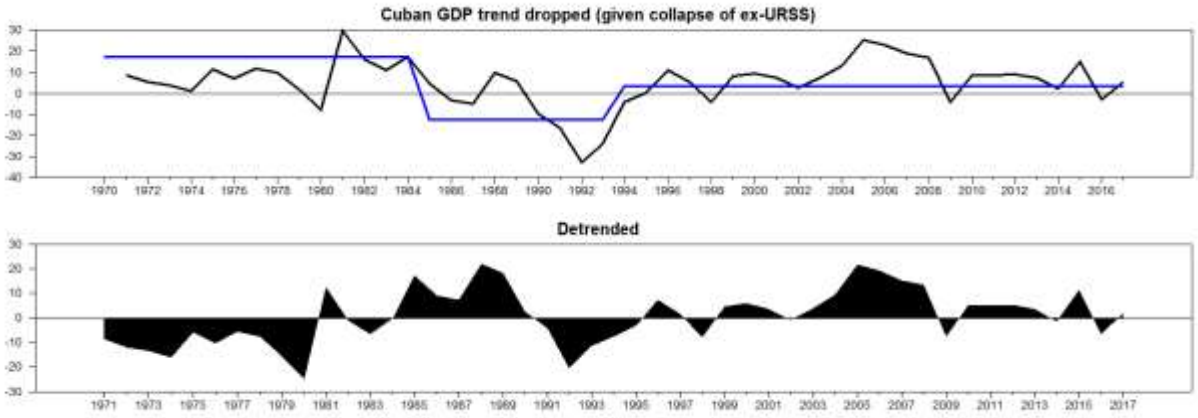
Bai-Perron Break Point Analysis Dependent Variable DYCUBA			
Shifting Regressors	>1984:01	<=1984:01<=1993:01	1993:01>
Constant	17.299255	-12.476070	3.501635
DYVZLA	0.912698	-0.165712	0.205518
DYRUSS	-2.108695	1.822687	0.627270
DYCHIN	0.096023	0.128606	0.014372
DYEURO	-1.562214	1.886047	-0.032298
Breakpoint:		Lower 95%	Upper 95%
1984:01		1984:01	1989:01
1993:01		1992:01	1994:01

As we can see from Tables 1 and 2, there is a significant variability of the role of different countries/regions in explaining changes of Cuba's GDP. Prior to 1984, no country has a statistically significant explanatory power, although Russia is the closets with a significance of 13.3%. For the period, 1984 to 1993, both Russia and Europe have a statistically significant influence in Cuba's GDP, with coefficients of similar magnitudes. Finally, for the period after 1993 Russia and Venezuela are the two countries with a statistically significant influence in Cuba's GDP, although Venezuela's coefficient is about a third of Russia's.[15] The overall long term trend of Cuba's GDP dropped in the second sample period as the results of the collapse of the ex-Soviet Union, and never fully recovered from that (see Figure 3). This indicates

[15] Note that China's coefficient is not statistically significant for any of the sub-samples, but given the size of the Chinese economy the effect is economically relevant for the explanation of changes in Cuba's GDP.

that the role of domestic drivers in the Cuban economy significantly dropped relative to the role played by external factors.

Figure 3. Cuba's GDP trend (1970-2017)



2. Time varying coefficients linear regression in state-space-form

Linear Regression with constant coefficients

The classical regression model is given by, $y_t = \alpha + \beta X_t + \varepsilon_t$

where ε_t is a white noise. It assumes that the relationship between the explanatory and explained variables remains constant through the estimation period.

Linear Regression with Time-Varying Coefficients [16]

In this model, we assume that the parameters alpha and beta evolve according to a random walk. This means that the current exposure to the market is a normally distributed random variable taking as mean the exposure of the last period. The corresponding noises are normally distributed and not correlated.

Therefore, the system can be written as: $y_t = \alpha_t + \beta_t X_t + \varepsilon_t$

$$\alpha_t = \alpha_{t-1} + \epsilon_t$$
$$\beta_t = \beta_{t-1} + \xi t$$

where: ϵ_t = Alpha disturbances at time t, ξt = Beta disturbances at time t. and,

[16] See Durbin & Koopman (2001), pages 54-55.

$\varepsilon t \sim \aleph(0, \sigma^2_{\varepsilon t}), \epsilon_t \sim \aleph(0, \sigma^2_{\epsilon t}), \xi t \sim \aleph(0, \sigma^2_{\xi t})$

3. Data

Data for Cuba's GDP is taken from the National Accounts Estimates of Main Aggregates of the United Nations Statistics Division. Data for real GDP for Russia, China, Europe and Venezuela is taken from the World Bank's World Development Indicators (WDI), using GDP (constant LCU). Since we are interested in decomposing changes on Cuba's GDP over time across a selected group of countries, we normalize all GDP values to be 100 for the year 1970. For Russia, we use WDI data since 1989, applying growth rates from Maddison's per capita GDP growth from 1970-1999 (given the almost zero population growth experienced by Russia in this period). For Venezuela, we use WDI data until 2014, and apply the real GDP growth data from the Venezuelan Central Bank for 2014-1017.

4. Results[17]

The parameters estimation from the time varying coefficients linear regression in state-space-form are obtained by maximum likelihood (combining simplex &BFGS numerical estimation[18]), with coefficients (states) estimation done by using the Kalman-filter and smoothing using the Durbin & Koopman-smoother for annual data for the period 1970-2017. The equation to estimate is the following:

DYCUBA[t] = BETA(1)[t] + BETA(2)[t]*DYVZLA+ BETA(3)[t]*DYRUSS+ BETA(4)[t]*DYCHIN+
BETA(5)[t]*DYEURO + epsilon[t]

Where epsilon[t] ~ N(0,v)

BETA(k)[t] = BETA(k)[t-1] + mu(k)[t], with mu(k)[t] ~ N(0, exp(wk)) for k = 1,2,3,4,5
and DYCOUNTRY = inter-annual variation of the real GDP of each country.

Results are consistent with the previous analysis of linear regression with constant coefficients and structural breaks, where we show variability in the countries' effects on Cuba's GDP. As we can see from Table 3, Russia and Venezuela have statistically significant coefficients. Figure 4 shows the value of the coefficients for the entire sample, presenting an interesting role of external factors in explaining the evolution of Cuba's GDP over time. The first thing to notice is the significant drop in Cuba's trend at the end of the 80s. Second, the significant increase in the coefficient since 1992 for Venezuela. Third, the drop, although non monotonically, in the coefficient for Russia (particularly after the collapse of the Soviet Union). Finally, close to zero coefficient and almost constant coefficients for China and Europe, which is in line with the results from the linear regressions.

[17] All computations have been performed in WINRATS Pro 10.0.

[18] The Broyden–Fletcher–Goldfarb–Shanno (BFGS) algorithm is an iterative method for solving unconstrained nonlinear optimization problems.

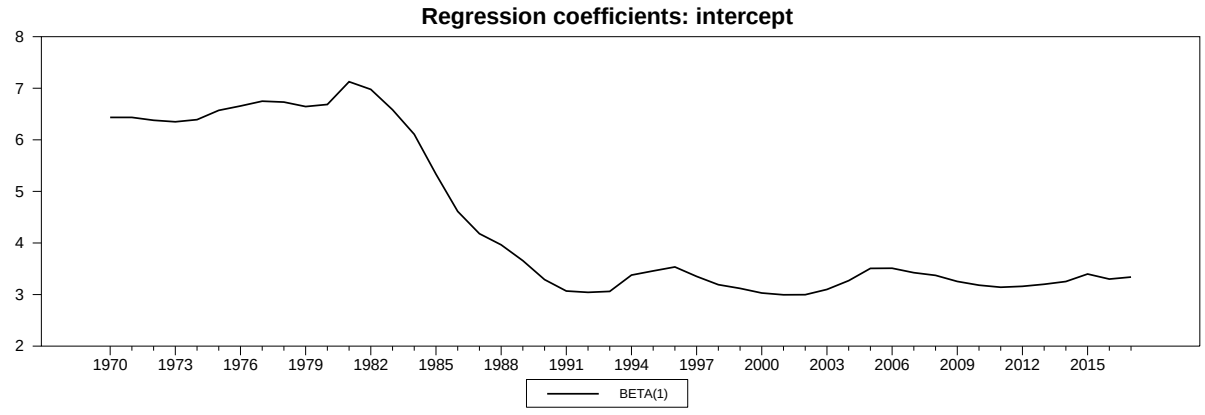
Table 3. Results from time varying coefficients linear regression in state-space-form

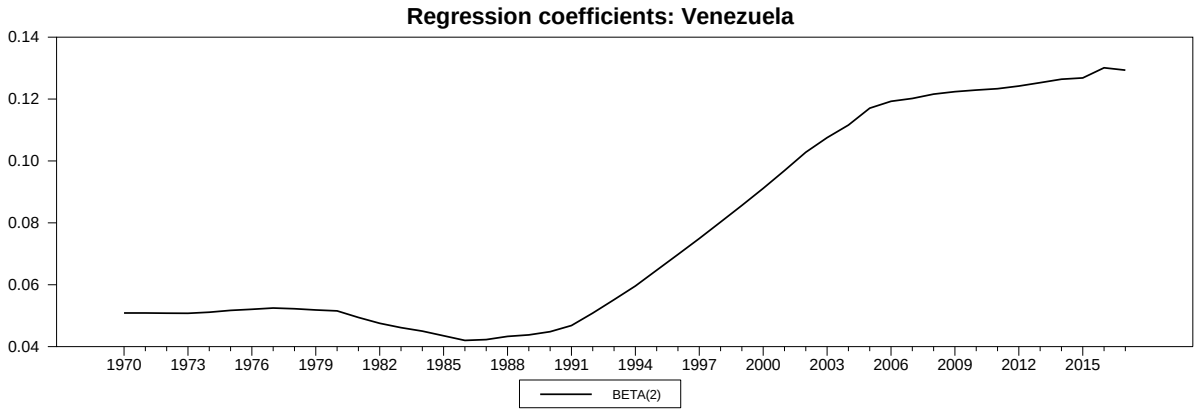
DLM - Estimation by BFGS
Convergence in 94 Iterations. Final criterion was 0.0000000 <= 0.0000100

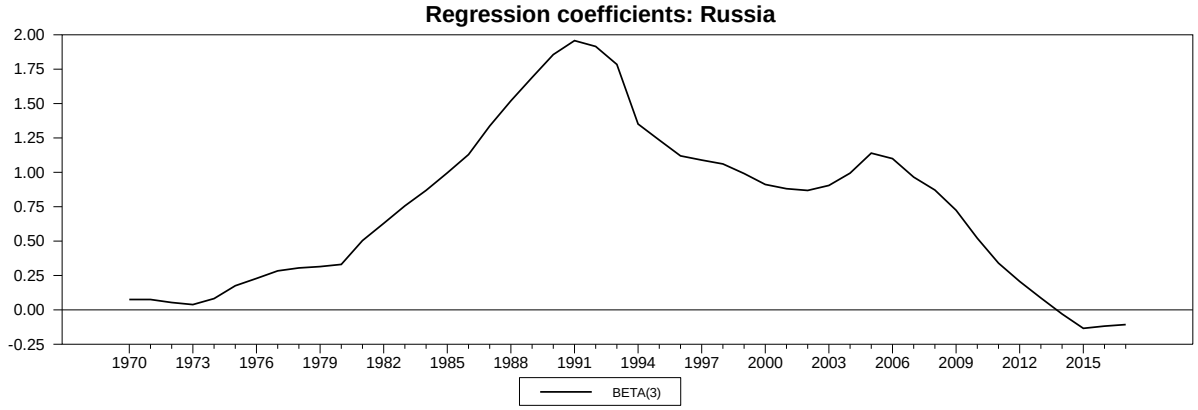
Annual Data From 1970:01 To 2017:01	
Usable Observations	48
Rank of Observables	42
Log Likelihood	-168.4103

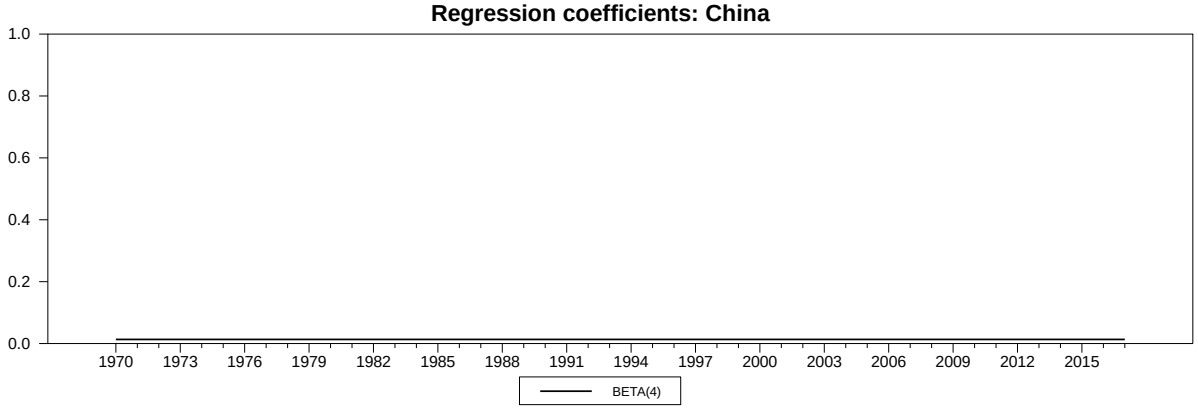
Variable	Coeff	Std Error	T-Stat	Signif
1. intercept(t)	0.374656	0.752396	0.49795	0.61851889
2. dyvzla(t)	-6.821790	5.117733	-1.33297	0.18254132
3. dyruss(t)	-1.849805	0.113228	-16.33700	0.00000000
4. dychin(t)	-25.766386	2239.525052	-0.01151	0.99082031
5. dyeuro(t)	-20.284462	4337.584807	-0.00468	0.99626875
6. V	55.208678	9.893885	5.58008	0.00000002

Figure 4. Regression Coefficients. State-Space Approach




Regression coefficients: Venezuela
0.14
0.12
0.10
0.08
0.06
0.04
1970 1973 1976 1979 1982 1985 1988 1991 1994 1997 2000 2003 2006 2009 2012 2015
BETA(2)


Regression coefficients: Russia
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.00
-0.25
1970 1973 1976 1979 1982 1985 1988 1991 1994 1997 2000 2003 2006 2009 2012 2015
BETA(3)


Regression coefficients: China
1.0
0.8
0.6
0.4
0.2
0.0
1970 1973 1976 1979 1982 1985 1988 1991 1994 1997 2000 2003 2006 2009 2012 2015
BETA(4)

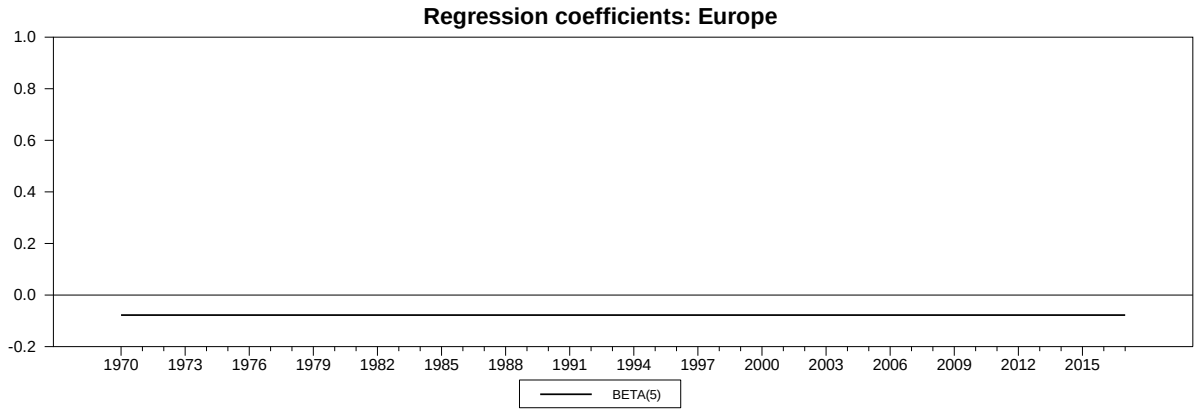
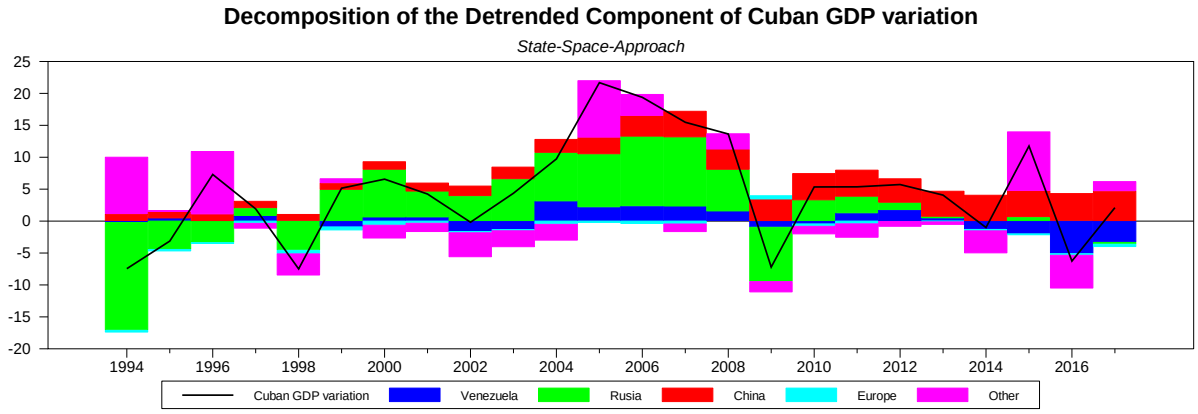


Figure 5 shows the contribution of each factor in explaining the observed changes on Cuba's real GDP. We present results since 1994, which is the latest period of the sample, after the structural breaks identified on section 2. As we can see in this figure, Russia has a significant contribution to changes on Cuba's GDP for most of the period (significantly dropping after the Financial crisis and almost inexistent after 2012). On the other hand, Venezuela's contribution starts to be more important after 2002, and it plays a big role in the poor macroeconomic performance experienced by Cuba after 2013. In the case of Venezuela, it seems that the increasing positive effect after 2004 built vulnerabilities in the Cuban economy that are now more visible after the recent collapse of the Venezuelan economy. [19]

Figure 5. Decomposition of Cuba's cyclical GDP variation. State-Space Approach (1994-2017)



[19] See Annex 3 for the figure with the decomposition of contributions for the entire period. Notice that similarly to the case of the constant coefficient linear regression, the external factors have a very small explanatory power, so the residual of the regression has a very large role to play. In this Annex, we also present we present a similar decomposition for the linear regression case with different sub-samples, as determined by the structural break points presented on Table 2.

5. Counterfactual exercises.

Given the results presented in the previous section, we would like to present a series of counterfactual exercises to understand the implications for the Cuban economy on its relationship to the Venezuelan economy. The first counterfactual exercise presents the estimated decomposition of Cuba's GDP changes if we maintain the observed changes on Venezuela's GDP, but imposing the average coefficients for Venezuela observed prior to 1999, since this is the year in which late president Hugo Chávez Frías took office in Venezuela. This exercise will give an idea of the macroeconomic cost for Cuba, in terms of accumulated GDP changes, of increasing its exposition to the Venezuelan economic collapse. Counterfactual 2. High exposure and Venezuelan economic collapse. The second counterfactual, presents the estimated decomposition of Cuba's GDP changes if we maintain the observed coefficients for Venezuela since 1999, but conserving the average Venezuelan GDP changes observed in the sample between 1999-2013 (before Venezuela's economic collapse). This counterfactual exercise will give an idea of the expected macroeconomic benefits for Cuba, in terms of accumulated GDP changes, of increasing its exposition to the Venezuelan economy in a scenario of relatively high oil prices.

Counterfactual 1. Increasing "exposure" to Venezuelan risks

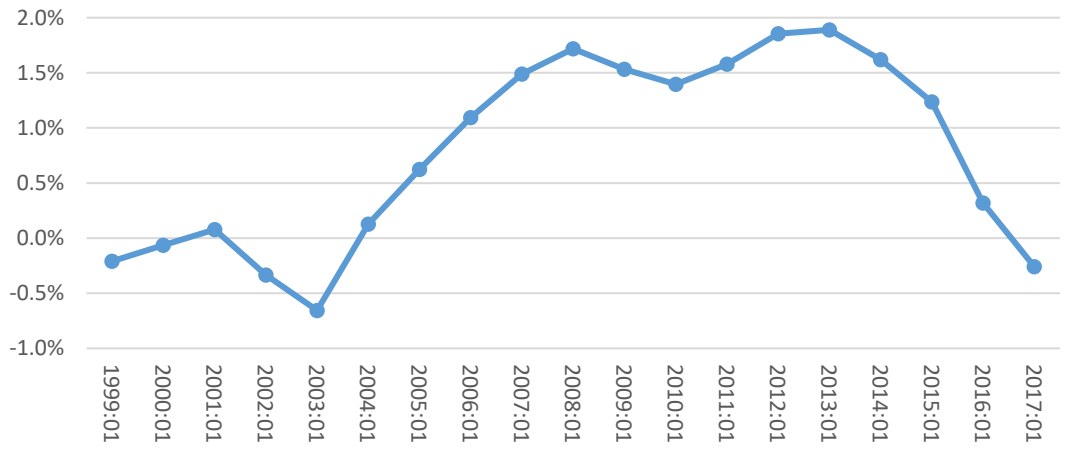
Table 4 shows the results from our first counterfactual exercise illustrating that given the increased exposition to Venezuela after 1999, Cuba experienced a higher average rate of growth from 1999 to 2013 (4.65 percent vs. 4.49 percent). However, that also made Cuba to experience a lower average annual GDP growth (1.76 percent vs. 2.40 percent). Figure 6 illustrates the increase in Cuba's GDP until 2013 due to its higher exposition to Venezuela, which allowed it to have a GDP 1.9 percent higher. However, the Figure also shows the significant drop in GDP that Cuba experienced since 2013, because of the collapse of the Venezuelan economy. The final net result is that Cuba's GDP in 2017 is 0.3 percent lower because of its higher exposition to Venezuela compare with the counterfactual scenario in which Cuba maintained its low exposition to Venezuela, before its economic collapse. This implies that the unsustainable macroeconomic performance of Venezuela together with the increase on Cuba's exposition to this country have lowered economic growth in Cuba by around 0.64 percent, something that is expected to get worse as the Venezuelan economy continue its severe contractionary trend.[20]

Table 4. **Counterfactual 1. Cuba's average annual GDP growth (percentage)**

Period	Actual	Counterfactual 1	Difference
1999-2017	3.62	3.64	-0.01
1999-2013	4.65	4.49	0.16
2013-2017	1.76	2.40	-0.64

Note: Imposing low exposition to Venezuela (average 1970-1998), and actual Venezuela's GDP Growth.

Figure 6. Counterfactual 1. Percentual difference Cuba's GDP fitted vs. fitted counterfactual



[20] According to the Venezuelan Central Bank, the Venezuelan economy decreased by 19.62 percent in 2018 (representing an accumulated 49 percent drop in the economy compare to its value in 2013). In addition, oil production continues declining. Venezuela's oil production was 3.5 million barrels per day (mbpd) in 1998, prior Chavez taking office. In 2015 production was 2.5 mbpd, but after 2016 production has collapsed. In 2018 production was 1.3 mbpd, while in November 2019 production was below 0.7 mbpd, according to the OPEC Monthly Oil Market Report of December 2019.

Note: Imposing low exposition to Venezuela (average 1970-1998), and actual Venezuela's GDP Growth.

Counterfactual 2. Venezuela's economic collapse under high "exposure"

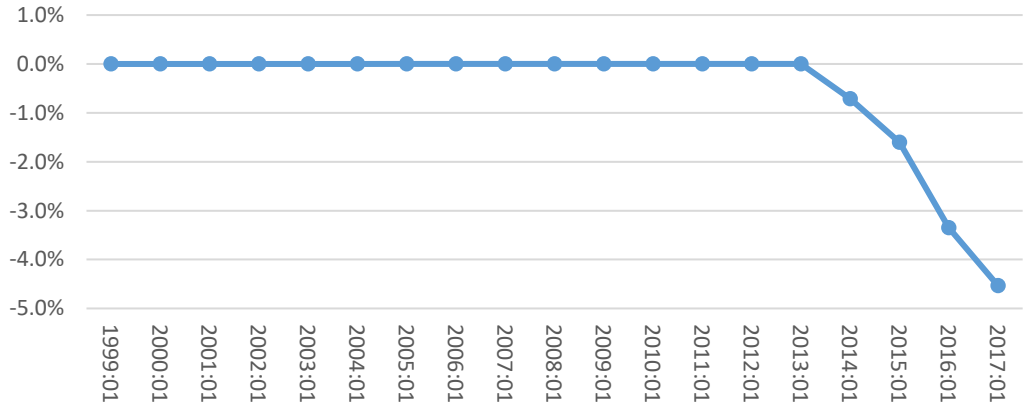
Our second counterfactual focuses on the implications of the Venezuelan economic collapse for the Cuban economy. Table 5 illustrates the effects of the collapse of Venezuela's economic growth after 2013, [21]which led Cuba to experience a significantly lower average rate of growth from 2014 to 2017 (1.49 percent vs. 2.68 percent). Figure 7 illustrates the decrease in Cuba's GDP after 2013 due to Venezuela's growth collapse, lowering its GDP by 4.5 percent. These results complement well with the previous counterfactual, since the first counterfactual illustrated the importance for Cuba's GDP growth of increasing its exposition to Venezuela, while the second exercise illustrates the effects of the unfortunate combination for Cuba of a higher exposition to Venezuela together with its economic collapse.

Table 5. Counterfactual 2. Cuba's average annual GDP growth (percentage)

Period	Actual	Counterfactual 2	Difference
1999-2017	3.62	3.89	-0.27
1999-2013	4.65	4.65	0.00
2013-2017	1.49	2.68	-1.18

Note: Imposing Cuba's actual exposition to Venezuela, and 1999-2013 Venezuela's GDP Growth for period 2014-2017.

Figure 7. Counterfactual 2. Percentual difference Cuba's GDP fitted vs. fitted counterfactual



Note: Imposing Cuba's actual exposition to Venezuela, and 1999-2013 Venezuela's GDP Growth for period 2014-2017.

[21] According to the Venezuelan Central Bank, the Venezuelan economy decreased on average by 12 percent between 2013 to 2017.

6. Conclusions

This paper decomposes changes in Cuba's GDP for the period 1970 to 2017 illustrating the effects of external factors. We rely on a battery of time series econometrics techniques, namely: structural change tests, linear regression models, and linear regression in state-space-form with time varying coefficients, to get an estimate of the fraction of the Cuban GDP annual growth rate explained by external factors. In particular, we analyse the effects on Cuba's GDP of changes on its own trend, as well as changes on the GDP of Venezuela, Russia, China and Europe. Results show that the two economies with the largest influence on Cuba are Russian and more recently Venezuela. This paper performs two counterfactual analyses of how the contribution of the Venezuelan economy and oil export income has contributed to the growth of the Cuban economy in the last decades. Our first counterfactual exercise show that Cuba's GDP is in 2017 will be 0.3 percent higher in the counterfactual exercise in which Cuba did not increase its exposition to Venezuela. Given the increased exposition to Venezuela after 1999, Cuba experienced a higher average rate of growth from 1999 to 2013 (4.65 percent vs. 4.49 percent). However, that also made Cuba to experience a lower average annual GDP growth (1.76 percent vs. 2.40 percent). Our second counterfactual focuses on the implications of the Venezuelan economic collapse after 2013 for the Cuban economy. Results show that Cuba experienced a significantly lower average rate of growth from 2014 to 2017 (1.49 percent vs. 2.68 percent), with a final accumulated impact for 2017 of a lower GDP by 4.5 percent. This illustrates the negative effects for Cuba of the unfortunate combination of a higher exposition to Venezuela that is recently experiencing an economic collapse, creating an important source of macroeconomic vulnerability for the Cuban economy.

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Annex 1. Linear regression using alternative measures of changes of Cuba's real GDP.

Linear Regression - Estimation by Least Squares	
Dependent Variable DYCUBA	
Annual Data From 1971:01 To 2017:01	
Usable Observations	47
Degrees of Freedom	42
Centered R^2	0.4846183
R-Bar^2	0.4355344
Uncentered R^2	0.5744626
Regression F(4,42)	9.8733
Significance Level of F	0.0000101
Log Likelihood	-165.4186
Durbin-Watson Statistic	1.7142

	Variable	Coeff	Std Error	T-Stat	Signif
1	Constant	0.030697841	0.027461061	1.11787	0.26997698
2	DLYVZLA	0.018668424	0.114394165	0.16319	0.87114854
3	DLYRUSS	0.728174297	0.139945490	5.20327	0.00000549
4	DLYCHIN	-0.111701961	0.255455101	-0.43727	0.66415831
5	DLYEURO	-0.104593923	0.469977588	-0.22255	0.82496382

Linear Regression - Estimation by Least Squares	
Dependent Variable DLYCUBA	
Annual Data From 1971:01 To 2017:01	
Usable Observations	47
Degrees of Freedom	42
Centered R^2	0.4240281
R-Bar^2	0.3691736
Uncentered R^2	0.5200365
Regression F(4,42)	7.7301
Significance Level of F	0.0000921
Log Likelihood	79.2767
Durbin-Watson Statistic	1.6270

	Variable	Coeff	Std Error	T-Stat	Signif
1.	Constant	0.030697841	0.027461061	1.11787	0.26997698
2.	DLYVZLA	0.018668424	0.114394165	0.16319	0.87114854
3.	DLYRUSS	0.728174297	0.139945490	5.20327	0.00000549
4.	DLYCHIN	-0.111701961	0.255455101	-0.43727	0.66415831
5.	DLYEURO	-0.104593923	0.469977588	-0.22255	0.82496382

Annex 2. Linear regression for split samples

Linear Regression - Estimation by Least Squares	
Dependent Variable DYCUBA	
Annual Data From 1971:01 To 1984:01	
Usable Observations	14
Degrees of Freedom	9
Centered R^2	0.4263410
R-Bar^2	0.1713815
Uncentered R^2	0.7330772
Regression F(4,9)	1.6722
Significance Level of F	0.2393905
Log Likelihood	-45.9085
Durbin-Watson Statistic	1.8596

	Variable	Coeff	Std Error	T-Stat	Signif
1	Constant	17.29925450	7.69464158	2.24822	0.05115172
2	DYVZLA	0.91269773	0.60676655	1.50420	0.16678578
3	DYRUSS	-2.10869504	1.27764150	-1.65046	0.13324596
4	DYCHIN	0.09602287	0.30026106	0.31980	0.75642050
5	DYEURO	-1.56221367	1.21244772	-1.28848	0.22971481

Linear Regression - Estimation by Least Squares	
Dependent Variable DYCUBA	
Annual Data From 1985:01 To 1993:01	
Usable Observations	9
Degrees of Freedom	4
Centered R^2	0.9583637
R-Bar^2	0.9167273
Uncentered R^2	0.9689236
Regression F(4,4)	23.0175
Significance Level of F	0.0050564
Log Likelihood	-21.9202
Durbin-Watson Statistic	1.9725

	Variable	Coeff	Std Error	T-Stat	Signif
1	Constant	-12.47607011	6.66060592	-1.87311	0.13434649
2	DYVZLA	-0.16571240	0.20191400	-0.82071	0.45790637
3	DYRUSS	1.82268742	0.32340105	5.63600	0.00487758
4	DYCHIN	0.12860558	0.12240797	1.05063	0.35271030
5	DYEURO	1.88604674	0.73145079	2.57850	0.06142455

Linear Regression - Estimation by Least Squares	
Dependent Variable DYCUBA	
Annual Data From 1994:01 To 2017:01	
Usable Observations	24
Degrees of Freedom	19
Centered R^2	0.6069592
R-Bar^2	0.5242138
Uncentered R^2	0.8033183
Regression F(4,19)	7.3353
Significance Level of F	0.0009495
Log Likelihood	-72.4668
Durbin-Watson Statistic	2.1269

	Variable	Coeff	Std Error	T-Stat	Signif
1	Constant	3.501634526	3.575982240	0.97921	0.33978126
2	DYVZLA	0.205518423	0.086208903	2.38396	0.02771345
3	DYRUSS	0.627270008	0.247940916	2.52992	0.02040920
4	DYCHIN	0.014372482	0.013435911	1.06971	0.29815339
5	DYEURO	-0.032297593	0.446276909	-0.07237	0.94306292

Annex 3. Alternative Decompositions of Cuba's cyclical GDP variation

Figure A3.1. Decomposition of Cuba's cyclical GDP variation. State-Space Approach (full sample)

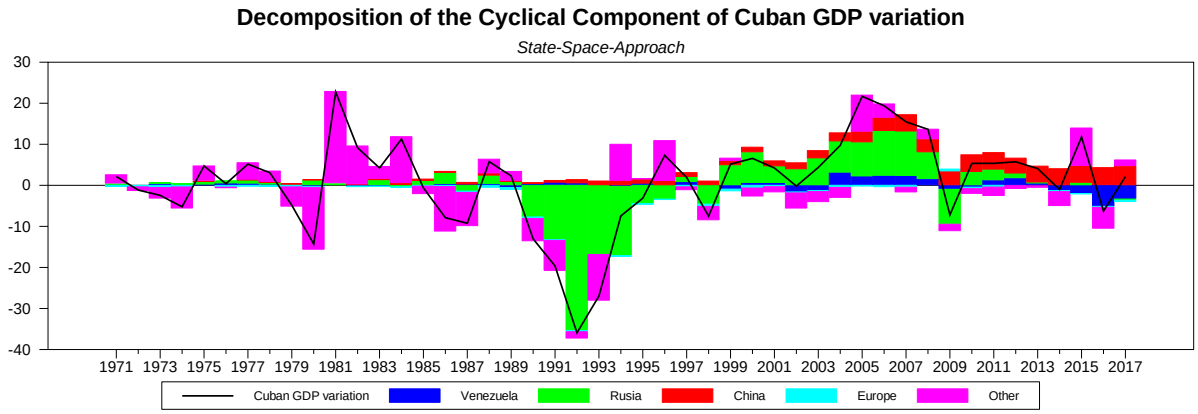

Figure A3.2. Decomposition of Cuba's cyclical GDP variation. Linear Regression (1994-2017)