
The business cycle in Ecuador: an analysis of stylised facts before and after dollarisation

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Abstract: This study examines stylised facts related to the business cycle in Ecuador for the period of 1990–2019. To reflect on the dollarisation process that the country went through by the end of 1999, the analysis is conducted for two sub-periods: 1990–1999 and 2000–2019. The paper investigates a wide range of macroeconomic variables for Ecuador, including variables regarding demand, the labour market, nominal variables, and variables related to an open economy. The sensitivity of correlations is studied through two detrending techniques: 1) the modified Hodrick-Prescott (MHP) filter; 2) a Hodrick-Prescott filter with a smoothing parameter of 1,600. The results reveal substantial changes in the cyclical behaviour of the Ecuadorian economy under dollarisation. In particular, the country shows greater dependence on the international market and high vulnerability to demand shocks.

Keywords: economic cycle; Ecuador; dollarisation.

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1 Introduction

Recurrent fluctuations in economic activity are common in both developed and developing economies. These have been addressed through various approaches that have been nurtured by multiple stylised facts and explain this phenomenon with relative success (Agenor et al., 1999). In this sense, modern theory establishes two basic objectives in business cycle research: on the one hand, the complete and systematic characterisation of cyclical phenomena in the form of 'stylised facts', and on the other, the construction of complete general equilibrium (CGE) models that can be evaluated qualitatively and quantitatively in terms of their ability to reproduce these facts.

This paper departs from an atheoretical perspective and aims to identify most of the stylised facts related to the economic cycle in Ecuador. These relationships between macroeconomic variables are crucial since they have policy implications and could guide the design of stabilisation and structural adjustment programs (Agénor and Montiel, 2015). Furthermore, the compilation of stylised facts about the economic cycle is important because it summarises the co-movement between aggregates in the economy. This allows for an approximation of the magnitude of fluctuations in the variables analysed and, thus, enables selecting leading indicators for economic activity, in addition

to examining the validity of the theoretical models. Cyclical volatility can arise from a variety of sources and can be exacerbated by different economic policy regimes (Aiolfi et al., 2011), possibly reflecting slowly evolving institutional factors (Acemoglu et al., 2003) as well as different degrees of financial and trade openness (Kose et al., 2006).

Considering this, this paper attempts to cover a wide range of macroeconomic variables for the Ecuadorian case, including variables relating to the demand side, the labour market, nominal variables, as well as variables related to an open economy. This study provides an assessment of the co-movements, persistence and volatility of each of these macroeconomic variables. In light of the monetary change that Ecuador underwent by the end of 1999 and to provide an overview of the statistical behaviour of Ecuador's macroeconomic aggregates before and after the dollarisation process, the analysis is divided into two sub-periods, 1990–1999 and 2000–2019. The sensitivity of the correlations is studied through two detrending techniques:

- 1 the modified Hodrick-Prescott (MHP) filter by Hanif et al. (2017)
- 2 a Hodrick-Prescott (HP) filter with a smoothing parameter of 1,600.

The remainder of the article is structured as follows. Section 2 provides a review of the relevant literature. Section 3 presents the methodology and data. Section 4 reports the results of the empirical analysis, and Section 5 offers some conclusions.

2 Stylised facts and the business cycle

The notion of stylised business-cycle facts has its roots in the work of Mitchell and Burns (1938), whose basic idea was to present features of the data in a theoretical way. This idea was challenged by Koopmans (1947), who argued that economic theory should be taken into consideration in two ways: first, it serves as a mechanism for distinguishing important facts from unimportant ones, and second, descriptions of economic phenomena cannot be made without specifying structural econometric models based on supply and demand schemes.

Kydland and Prescott (1990) accept the first consideration but reject the second. Since their work, reporting the characteristics of business cycles has become a routine activity in macroeconomics. These authors emphasise the importance of having a minimum set of stylised facts about business cycles to validate the models used for macroeconomic analysis.

Following Lucas (1977), Kydland and Prescott (1990) define business cycles as repetitive deviations of output from their trends and behaviour relative to other monetary aggregates. Among their main results, they point out the procyclical behaviour of prices in the USA. However, they do not find evidence favourable to the monetarist hypothesis that any monetary aggregate, such as issuance or M1, lead or drive the business cycle. Instead, they find that the difference between M2 and M1, i.e., the credit channel, is a good leading indicator of the cycle – even better than M2. To obtain the trend and cycle components of the series and subsequently establish the relationships of movement between the main macroeconomic variables and output over the business cycle, they use the methodology developed by Hodrick and Prescott (1981).

Subsequent studies have applied this atheoretical methodology to document evidence of the business cycle in different countries. Backus et al. (1992) apply the same methodology for ten OECD countries, dividing the data into pre- and post-war. Among their main results, they find a decrease in the volatility of output in the post-war data and that the cyclical components of consumption and investment are procyclical to output. They report two significant changes in the cyclical behaviour of prices. In the pre-war period, output and price levels were positively correlated. In contrast, in the post-war data prices show countercyclical behaviour. In addition, they report a significant increase in the persistence of price movements in most of the countries considered.

Recent literature has also focused on providing aggregate overviews of business cycle correlations in Europe. Focusing only on the unemployment rate in the 2000–2016 period, Oliskevych and Lukianenko (2020) conclude that European countries behave asymmetrically over the business cycle. For instance, De Haan et al. (2008) find that business cycles in the euro area have experienced periods of both convergence and divergence and that countries who enter the union and adopt the euro present a non-perfect business cycle correlation (Fidrmuc and Korhonen, 2006). To identify how business cycles change after adopting the euro, Campos et al. (2019) conduct a meta-analysis in which they include the HP filter, among other methodologies. They conclude that correlation coefficients have significantly increased.

In the case of Latin American countries, either due to the absence of data or economic instability, this line of research has tended to be neglected. Therefore, most of the literature has been developed based on data availability, where Mexico has gained an important role (Ikeda, 2020). Among the first works carried out for these economies is that of Kydland and Zarazaga (1997), who apply the same methodology as Kydland and Prescott (1990) and document the properties of the business cycle in Argentina. Since the main problem they face is data availability, they use two unconsolidated versions of the national accounts. As a result, however, the stylised facts of the business cycle are not robust across databases.

Among the main conclusions they report is the high volatility of output compared to the US, and they also find that the results obtained are not favourable to the hypothesis that nominal factors play the most important role in economic fluctuations. In particular, the price level is countercyclical, as are monetary aggregates. Finally, the authors conclude that nominal factors do not seem to account for any significant fraction of business cycles in Latin American countries, and in particular in Argentina.

Agenor et al. (1999) investigate the existence of a set of stylised business-cycle facts in seven middle-income countries as well as Chile, Colombia, Mexico and Uruguay. The paper concentrates on the cycles of an industrial production index, using two procedures to obtain the cyclical component: the HP and Baxter-King (BK) filters. Among the main results, they find that the volatility of output measured by the standard deviation varies substantially among developing countries and that, on average, the volatility is much higher than in industrialised countries. They find evidence in favour of the hypothesis that real wages are procyclical, i.e., there is no consistent relationship between output and either price levels or inflation. They also report that the correlation between money and output is positively contemporaneous but not extraordinarily strong. Their results highlight the importance of supply shocks in driving the business cycle in developing countries.

Belaisch and Soto (1998) find that the *Monetary Myth* found by Kydland and Prescott (1990) in the US economy is also present in Chile. Among their main results, they report the excessive sensitivity of consumption to output fluctuations. In turn, the volatility of investment is approximately four times higher than that of output. They also find a contemporaneous correlation between exports and output, indicating that exports could play an important role in determining short-term fluctuations in the Chilean economy. Furthermore, they report a countercyclical movement of prices and a procyclical movement of real wages. However, fluctuations in M1 are strongly procyclical and lead the cycle for up to two quarters.

For the Colombian economy, Restrepo and Reyes (2000) repeat the exercise performed by Kydland and Prescott (1990) and find an excessive volatility of investment and an acyclical behaviour of exports. They report that productive inputs present procyclical behaviour, with less volatility than GDP. Their conclusions differ from Agenor et al. (1999): prices and different measures of money are procyclical and their correlations are contemporaneous. They conclude that the cyclical fluctuations of the Colombian economy are mainly explained by demand shocks.

Among the main literature that relates the economic cycle with the exchange rate is the paper by Baxter and Stockman (1989), who investigate whether the statistical properties of the economic cycles of 43 countries depend on the choice of the exchange rate. Their study focuses on comparing the behaviour of the main macroeconomic series under the Bretton Woods fixed exchange-rate system with the floating exchange-rate system that prevailed from 1973. The authors use three alternative methods to decompose the series into cycles and trends. They conclude that some series, such as foreign trade and industrial production, have become more volatile under flexible exchange rates, although the increase is small in magnitude. Furthermore, there is little evidence that these changes are due to the choice of exchange rate.

Parra (2008), in his work on the Colombian economy for the 1994:I–2007:I period, performs an analysis of the main short- and long-term stylised facts. Based on this, he describes the main characteristics of economic cycles, thus obtaining the intensity, persistence and position with respect to the GDP. The author highlights that there is no clear evidence regarding whether the dynamics of the Colombian economy are predominantly affected by supply shocks. In contrast, demand shocks are more influential when talking about inflation and terms of trade as determining variables. Among the variables found to be procyclical are domestic consumption, government spending, capital stock and the effective labour force. In contrast, the trade balance and labour supply show countercyclical behaviour.

From a global cycle perspective, there is no consensus on business cycle dynamics in the Latin American region. On the one hand, evidence suggests that during international booms or crises the countries' cycles are more synchronised, which would support policy coordination at a regional level (Campos and Andujar, 2019). Other works deny any synchronised movement of countries (Ikeda, 2020). The conclusions are largely driven by the particular methodologies used and the countries and macroeconomic variables included.

In the case of Ecuador, the work of Gachet et al. (2011) stands out. It covers the 1965–2008 period and identifies the interrelationships between the country's main macroeconomic variables in order to lay the empirical foundations for the development of consistent dynamic models for the Ecuadorian economic system. The authors conclude that aggregate consumption is the demand component that contributes the most to

growth. On the other hand, investment represents 17.38% of the outcome during 1965:I–2008:IV and is highly coincident with it. On the other hand, the growth rate of consumption is explained primarily by domestic consumption and household consumption is more volatile than output, being highly procyclical. Exports are found to be more volatile than output but less so than imports, and they are highly acyclical.

Finally, a recent contribution by Castillo-Ponce et al. (2021) analyses the effects of the dollarisation process in Ecuador by studying the dynamics of its business cycles in relation to anchor economy, the US. By means of cointegration and common cycle tests for data at the aggregate and industry levels, the authors find that dollarisation led to an overall closer economic interdependence between Ecuador and the US. Despite there being some relationship between the countries' cycles before the monetary adoption, this was significantly strengthened afterwards. Our study adds to this line of research; however, it only provides an analysis of the business cycles of the adopting country before and after this important monetary process.

3 Methodology and data

The stylised facts that characterise the business cycle in Ecuador were obtained from quarterly information from the Central Bank of Ecuador (BCE) for the 1990–2019 period, and the lending and passive rates of International Monetary Fund loans were obtained through their digital databases. All data is expressed in 2007 dollars. A summary of the variables employed and some descriptive statistics can be found in Appendix 1.

In recent years, an important debate has been sparked regarding the ability of different statistical methods to decompose time series in terms of trends and cycles (Baxter and King, 1999; Canova, 1994). The relative advantages of different techniques such as those of Beveridge and Nelson (1981), Hodrick and Prescott (1990) and Baxter and King (1999) have not been established, and it is possible to question the robustness of the results obtained through these.

Mechanical filters have been criticised by several authors. Harvey and Jaeger (1993), for instance, point out that the HP filter can produce spurious cycles when applied to a dataset. Guay and St-Amant (1996) find that the HP and BK filters are not good at identifying the cyclical components of a time series that has a spectrum with the characteristic shape of most macroeconomic series. Baxter and King (1995) point out that both the HP and BK filters are poorly defined at the beginning and end of the sample.

To specify the regularities of the economic cycle, in this paper we adopt the methodology used by Kydland and Prescott (1990), which involves obtaining the cyclical component of the series by means of the HP filter. Furthermore, following Hanif et al. (2017), a variant of the HP filter is used when choosing the optimal smoothing parameter for each series. That is, a lambda parameter is computed endogenously. Selecting these alternatives facilitates a comparison of our results with previous work, by 'looking through the same window' (Canova, 1994). A description of this standard methodology can be found in Appendix 2.

4 Results

Since the 1990s, Ecuador has not been successful in achieving sustainable growth and has been characterised by the instability of its national product. In this regard, the studies by Salamanca (2012), Toro et al. (2013) and Wanderley et al. (2018) stand out, showing that the major problems that have limited Ecuador's growth and that of other emerging countries are the persistence of the fiscal gap and the unfavourable evolution of terms of trade. This situation has further deteriorated in recent years due to the instability of international financial markets and the lack of dynamism in world trade.

Table 1 Stylised facts in Ecuador: multiple periods

<i>Period</i>	<i>Some stylised facts</i>
1986–1990	Negative oil price shock; reduced inflation; strengthened fiscal position.
1998–1999	Impact of natural phenomena; low oil prices; political, financial and exchange-rate crisis; freezing of financial deposits.
2000–2009	Dollarisation of the economy; price adjustment; drop in exports due to deterioration of the terms of trade; improvement in the purchasing capacity of economic agents and the results of the national financial system.
2010–2014	Second oil boom due to high prices on the international market; expansion of public spending and public investment; the 2016 earthquake reactivates private credit; growth rates are registered in the housing credit and productive credit segments.
2015–2018	The economy slows down as a result of <ol style="list-style-type: none"> 1 a sharp contraction in public spending, especially capital spending 2 a sustained reduction in the price of oil. Nevertheless, remittances continue to be an important source of dollar income for the country. Lastly, the level of unemployment remains steady with a slight upward trend, but underemployment is on the rise and prices alternate between inflationary and deflationary periods.

Source: Author's elaboration of BCE (2010) and Comisión Económica para América Latina y el Caribe (CEPAL, 2011, 2012a, 2012b, 2013, 2014, 2015, 2016, 2017, 2018) data

The following is a description of some stylised facts relevant to Ecuador, showing the unstable evolution of its economy.

We report detailed computations of stylised facts in Appendix 3 for the sake of space. These include statistics for the following four aspects of the cyclical behaviour of the series that will be analysed in this section:

- 1 The amplitude of fluctuations (volatility) measured by the standard deviation of each series. This is expressed in logarithms and corresponds to the standard deviation of the percentage by which the cyclical component of the variable deviates from the growth component.
- 2 The relative volatility measured by the ratio between the standard deviation of each series and the outcome.
- 3 The degree of co-movement, measured by the magnitude of the correlation coefficient $p(j) \in (0, \pm 1, \pm 2, \dots)$, between the cyclical component of y_t and x_t . A

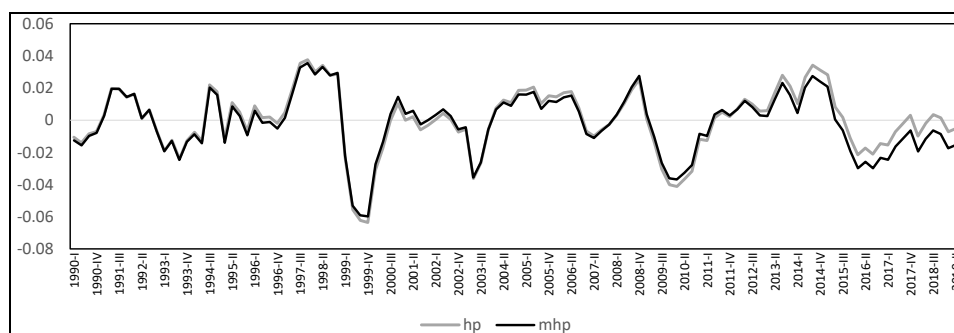
series y_t is considered to be procyclical, acyclical or countercyclical depending on whether the contemporaneous correlation, $p(0)$ is positive, zero or negative.

- 4 The cross-correlation coefficients, $p(j)$, which indicate the phase of change of the variable in relation to the cyclical component of GDP. Thus, y_t leads the cycle by j periods if $|p(j)|$ is the maximum for a positive value of j ; is synchronous if $|p(j)|$ is the maximum for $j = 0$; and lags the cycle if $|p(j)|$ is the maximum for a negative value of j .

Figure 1 shows the evolution of the cyclical component of Ecuador’s GDP in the period under analysis. In the series filtered using the Bry-Boschan algorithm to determine the chasms and valleys, seven different cycles (measured from peak to peak) are identified; however, they differ in terms of magnitude and size.

The average duration of a cycle during the period under analysis is approximately four years. The duration of the recession phase has been decreasing, especially since dollarisation, and in recent periods it is shorter than the duration of the expansion phase. However, the recovery in the expansion phase is highly volatile. As described in the following sections, all series present high volatility, a fundamental characteristic of business cycle fluctuations in developing countries (Agenor et al., 1999).

Figure 1 Ecuador’s GDP cycle: evolution



Source: Author’s computations based on BCE (2010) data

Table 2 Ecuador’s GDP cycle: multiple periods

Cycle		Average annual growth rate	Duration (quarters)	Contraction (quarters)	Expansion (quarters)
Start	End				
1991-II	1994-III	0.82%	14	9	5
1994-III	1997-IV	0.63%	14	5	9
1997-IV	2000-IV	0.29%	12	8	4
2000-IV	2005-II	1.15%	18	10	8
2005-II	2008-IV	1.11%	14	8	6
2008-IV	2014-III	1.06%	24	5	19
2014-III	2017-IV	0.10%	13	6	7
2017-IV		0.09%			

Source: Author’s computations based on BCE (2010) data

Table 3 Ecuador: phases of acceleration and deceleration of the economic cycle, 1990–2019

<i>Deceleration periods</i>	<i>Average duration (quarters)</i>	<i>Acceleration periods</i>	<i>Average duration (quarters)</i>
1991-II–1993-III	9	1993-III–1994-III	5
1994-III–1995-IV	5	1995-IV–1997-IV	9
1997-IV–1999-IV	8	1999-IV–2000-IV	4
2000-IV–2003-II	10	2003-II–2005-II	8
2005-II–2007-II	8	2007-II–2008-IV	6
2008-IV–2010-IV	5	2010-I–2014-III	19
2014-III–2016-I	6	2016-I–2017-IV	7

Source: Author's computations based on BCE (2010) data

The cyclical fluctuations of GDP are shown in Table 2, and a summary of the phases of acceleration and deceleration is provided in Table 3. The former were initially identified on the basis of the acceleration and deceleration phases of the Ecuadorian economy in the 1990–2019 period, using quarterly GDP series. In addition to the phases themselves, the analysis also includes the duration and number of episodes that occurred (see Table 4). An important point to highlight is that the acceleration phases were longer than the deceleration phases.

Table 4 Ecuador: demand components and average duration of business cycle acceleration and deceleration phases, 1991–2019

<i>Variable</i>	<i>Acceleration phase</i>	<i>Deceleration phase</i>
GDP	8.3 quarters	7.3 quarters
Consumption	16.25 quarters	12.67 quarters
Investment	12.6 quarters	6 quarters
Exports	5 quarters	7.67 quarters
Imports	12.8 quarters	11.5 quarters

Source: Author's computations based on BCE (2010) data

In Ecuador, on average, output grew more in the acceleration phases than in the deceleration phases. It should be noted that in general, the more sustained phases of acceleration have also been associated with moderate periods of deceleration. Unlike other South American countries, in which there was a clear divergence between economic cycles during the 1990s, Ecuador shows a rather slow process of convergence, especially from 2008 onwards when the cycle tends to be more uniform between accelerations and decelerations. It should also be noted that the evolution of the GDP cycle is due, among other factors, to the fact that a considerable portion of the country's foreign trade is intra-subregional.

For the Ecuadorian economy, a systematic pattern can be observed in the behaviour of output gaps over time. For example, there was a drop between 1991 and 1993, followed by another between 1994 and 1995, and at the end of the decade there was a significant slowdown in the economy between 1997 and 1999.

The strongest contraction of the Ecuadorian economy occurred from the fourth quarter of 2000 to the second quarter of 2003, as a result of the slow adjustment of the economy within the framework of the new exchange-rate regime due to dollarisation.

Furthermore, in the 2010–2014 period Ecuador registered an important dynamic in its economic activity as a result of the Second Oil Boom and the high price of this commodity on the international market.

4.1 GDP and the components of aggregate demand

The first notable characteristic reported is the difference in GDP volatility between the two periods of analysis. There was greater volatility in the pre-dollarisation period, with 2.33% relative to 1.65% post-dollarisation, and volatility close to that of the US. In other Latin American countries, for instance, Colombia, Restrepo and Reyes (2000) report a volatility of 1.61%. In Argentina, Kydland and Zarazaga (1997) find a volatility of output fluctuations twice that of Ecuador. These volatilities are higher than those reported for industrialised economies.¹

This high volatility is in part a reflection of the structural characteristics of the Ecuadorian economy (relative absence of automatic stabilisers, underdeveloped financial markets, little diversification of the productive structure). Another notable characteristic is the high persistence (autocorrelation) of GDP, showing a coefficient of 0.82. That is, when output falls (rises), this fall (rise) tends to persist and become more pronounced.

Table 5 Ecuador: growth of GDP components, 1990–2017 (average annual rates of variation)

Indicator	1990–1997	1998	1999	2000	2000–2008	2009	2009–2017	1990–2017
GDP	3.08	3.27	−4.74	1.09	4.26	0.57	3.06	3.18
Gross domestic investment	1.71	4.48	−25.22	12.45	10.21	−3.60	3.82	4.26
Final consumption	3.21	5.39	−10.79	1.33	4.61	0.90	3.17	3.22
General government	0.75	−2.32	−2.86	4.00	3.64	11.61	6.44	3.27
Private consumption	3.76	6.88	−12.20	0.80	4.80	−0.99	2.51	3.23
Exports of goods and services	7.14	−4.74	7.63	2.54	4.97	−4.79	1.82	4.33
Imports of goods and services	6.16	6.53	−31.60	12.82	12.23	−9.92	1.73	5.35

Source: Author's computations based on BCE (2010) data

Duncan (2003) states that output volatility is a decreasing function of the exchange-rate regime. Moreover, this volatility will depend on the monetary authority's ability to accommodate real shocks, as well as its degree of credibility and its capacity to distinguish relatively quickly between permanent and transitory shocks. In the absence of one of these, the monetary authority's action would become destabilising, resulting in higher costs in terms of inflation. The lack of credibility of the monetary authority was partly due to the lack of independence of the central bank and a history of mismanagement of monetary policy. Dollarisation gave greater stability to the product, which is reflected in lower volatility at this stage.

Table 6 shows the rate of expansion of the different components of aggregate supply and demand for Ecuador. For the approximately three decades considered, gross domestic investment and exports stand out as the main drivers of GDP growth. In fact, their greater relative dynamism persists in each subperiod, with a particular emphasis in 1990–1997. Consumption expenditure, with a large weight as a proportion of aggregate demand, grew at rates similar to those of GDP, with the public component showing greater dynamism than the private component in the dollarised period.

Table 6 Cyclical behaviour of the main macroeconomic variables with respect to GDP

<i>Variable</i>	<i>Co-movement*</i>		<i>Phase change**</i>	
	<i>1990–1999</i>	<i>2000–2019</i>	<i>1990–1999</i>	<i>2000–2019</i>
<i>Components of aggregate demand</i>				
Private consumption	Procyclical	Procyclical	Coincidental	Coincidental
Government consumption	Procyclical	Acyclical	Coincidental	Leads by 4 quarters
Investment	Procyclical	Procyclical	Coincidental	Coincidental
Imports	Procyclical	Procyclical	Coincidental	Coincidental
Exports	Acyclical	Procyclical	Leads by 1 quarter	Leads by 4 quarters
<i>Labour market</i>				
Real wage	Acyclical	Procyclical	Leads by 5 cycles	Coincidental
Employment	Procyclical	Acyclical	Coincidental	Leads by 5 quarters
<i>Monetary aggregates, interest rates and prices</i>				
M1	Procyclical	Procyclical	Leads by 1 quarter	Leads by 3 quarters
M2	Acyclical	Acyclical	Lags by 4 quarters	Lags by 1 quarter
Nominal interest rate	Countercyclical	Acyclical	Lags by 4 quarters	Lags by 5 quarters
Consumer price index (CPI)	Acyclical	Countercyclical	Lags by 4 quarters	Leads by 5 quarters
Inflation	Countercyclical	Acyclical	Leads by 4 quarters	Lags by 4 quarters
Nominal exchange rate	Countercyclical	Acyclical	Lags by 1 quarter	Lags by 1 quarter

Notes: *Acyclical, procyclical, countercyclical: evaluates correlation with time $t = 0$.

**Indicates the phase change of the variable with respect to the GDP cycle:

- 1 leading
- 2 coincidental
- 3 lagging.

Source: Author's elaboration of BCE (2010) data

Table 6 Cyclical behaviour of the main macroeconomic variables with respect to GDP (continued)

Variable	Co-movement*		Phase change**	
	1990–1999	2000–2019	1990–1999	2000–2019
<i>International aspects</i>				
Terms of exchange	Acyclical	Acyclical	Leads by 3 quarters	Leads by 2 quarters
Balance of trade	Countercyclical	Countercyclical	Coincidental	Leads by 3 quarters
Real exchange rate	Countercyclical	Acyclical	Coincidental	Leads by 3 quarters
<i>Public sector variables</i>				
Non-oil revenues	Acyclical	Procyclical	Leads by 3 quarters	Leads by 4 quarters
Current expenditure	Acyclical	Procyclical	Leads by 3 quarters	Leads by 1 quarter
Capital expenditure	Procyclical	Procyclical	Leads by 4 quarters	Leads by 4 quarters
Oil revenues	Acyclical	Procyclical	Lags by 1 quarter	Leads by 2 quarters

Notes: *Acyclical, procyclical, countercyclical: evaluates correlation with time $t = 0$.

**Indicates the phase change of the variable with respect to the GDP cycle:

- 1 leading
- 2 coincidental
- 3 lagging.

Source: Author's elaboration of BCE (2010) data

Hence, private consumption has been highly procyclical – as seen in most countries and it moves contemporaneously with output. In both periods, consumption is more volatile than output. Following CGE models that are essentially neoclassical, consumption is usually modelled under the permanent income hypothesis. In this sense, the volatility of consumption should be smaller than that of output since agents optimising intertemporally tend to smooth out consumption (De Gregorio, 2007). This high volatility suggests that constraints on access to credit in Ecuador are important.

Government consumption is procyclical and synchronous with the GDP cycle only for the pre-dollarisation period, since for the post-dollarisation period government spending shows acyclical behaviour and its dynamic (cross-) correlations are not significant for any lag or advance. This last result is in line with the available evidence for industrialised countries. In addition, a high relative volatility close to 1.6 times that of GDP is reported for this variable for the two periods of analysis, suggesting that government consumption could play an important role in economic fluctuations. Savastano and Edwards (1999) argue that one of the benefits of formal dollarisation is that it generates fiscal discipline since it eliminates the possibility of monetary issuance to finance the fiscal deficit, which has not been proven in Ecuador.

Another interesting feature of the business cycle in Ecuador is the presence of large fluctuations in investment, which are even more volatile in the pre-dollarisation stage (12% vs. 9%), i.e., 5.5 times greater than the volatility of GDP. These results are

consistent with international evidence offered by Kydland and Prescott (1990) for the USA, Fisher et al. (1996) for Australia and Kydland and Zarazaga (1997) for Argentina. A procyclical relationship coinciding with the GDP cycle is also evident for the entire study period.

On the other hand, over the course of almost three decades the rate of expansion of imports exceeded that of exports. Starting from a situation of foreign trade deficit, this pattern showed a tendency to require ever greater external resources to finance the growing trade deficit as a proportion of GDP. However, in 1999 and 2009 imports showed a decrease in their rate of activity, given that these were years of overall crisis in the subregion.

Therefore, exports and imports are, respectively, 2.6 and 4.8 times more volatile than GDP in the pre-dollarisation stage and 2 and 4.4 times more volatile than the post-dollarisation output. Exports are procyclical and significant only for the dollarisation stage, and they precede the cycle by four quarters. This highlights the important role that exports play in short-term fluctuations in a small and open economy such as that of Ecuador, given that the composition of exports is mainly commodities (oil and bananas).

Imports are procyclical and move together with the GDP cycle for both periods; however, the correlation is lower for the post-dollarisation stage as the correlation coefficient goes from 0.80 to 0.47. The procyclical pattern of imports may be associated with the strong procyclicality of investment. An interesting result arises from the lower volatility of the cyclical component of imports after dollarisation. This may be a direct consequence of the lower volatility of the exchange rate, since dollarisation reduces the transaction costs related to trade.

In terms of the specific contribution of the components of aggregate demand and supply to Ecuador's economic growth in these years, the reactions of each of them to the 1999 and 2009 crises should be highlighted. In this regard, the sharp contraction of investment in real terms in 1999 and 2009 (25% and 3%) stands out. This fall had never been seen before, and in fact, the ratio of investment to GDP has not yet recovered, even though investment regained momentum in 2010–2012 (CEPAL, 2016).

The reduction in the country's growth potential represents a key challenge for economic policy as it is a major obstacle to the much-needed progress towards development with equality. It is particularly relevant because, as pointed out in the Structural Change for Equality document (CEPAL, 2012b), Latin America has been one of the least dynamic emerging regions in recent decades and continues to be among the most unequal in the world.

4.2 *Labour market*

In the real cycle literature, stimulated by Kydland and Prescott (1982), the labour market is fundamental to the transmission of productive shocks in the economy. This market also concentrates some of the most relevant challenges faced by this literature. The labour market, through government policies, contains rigidities that move policies away from the equilibrium obtained in undistorted models. The rigidities of factor markets are clear in Ecuador.

The *real wage* is highly volatile: 4.7 times more than GDP in the two periods. Furthermore, the real wage showed acyclical behaviour but preceded GDP by five quarters in the pre-dollarisation phase and showed procyclical behaviour that coincides with GDP in the post-dollarisation phase, although this correlation is low. This evidence

suggests that the Phillips curve based on nominal wage rigidities is not realistic, since this type of model predicts a countercyclical real wage (De Gregorio, 2007). The results reported for Ecuador are in line with general equilibrium models, which point out that real wages are procyclical. For Abraham and Haltiwanger (1995), technology shocks tend to produce procyclical behaviour in real wages, results consistent with CGE models, which indicate a dominant role for technology shocks as they change the pattern of labour demand in the short run.

In the real economic cycle models, the incorporation of intertemporal labour substitution allows generating a positive correlation between employment and product. This fact is also observed in the cyclical *employment* series, which presents procyclical behaviour – but only in the pre-dollarisation stage – and is less volatile than GDP, as reported for developed and emerging economies. In the post-dollarisation stage, it is acyclical and precedes the GDP cycle by five quarters. These results show strong labour constraints in the country.

4.3 Monetary aggregates, interest rates and prices

The behaviour of nominal variables has traditionally been the subject of much attention in business cycle research. To analyse the cyclical behaviour of monetary aggregates, including M1 and M2, in the dollarisation stage money issuance and the authority's capacity to use monetary policy is restricted. Therefore, the money supply will be the result of the balance of payments (Rojas-Suarez, 1999).

In the 1994–1999 period, M1 is five times more volatile than output and reflects the interest of the monetary policy followed by the Central Bank of Ecuador. M1 leads the cycle by up to one quarter of the output cycle. The contemporaneous correlation between GDP and M2 is zero (acyclical). However, there is a positive correlation that leads output by four quarters.

Therefore, the monetary myth found by Kydland and Prescott (1990) in the USA, whereby M1 coincides with the GDP cycle, seems to have been a reality in Ecuador before 2000. Quasi-money (M2–M1) shows acyclical behaviour but, nevertheless, leads the GDP cycle by four quarters. After dollarisation, M1 and M2 show the same behaviour. However, the former lags the cycle by four quarters and the latter lags the cycle by only one quarter. Therefore, as Kydland and Prescott (1990) point out, the analysis of the credit market can occupy an important place in the study of the Ecuadorian business cycle before and after dollarisation.

A common situation in the two subsamples is the high volatility of M1, M2 and quasi-money. The results are consistent with those in the international literature (Backus et al., 1992). On the other hand, when analysing the behaviour of the interest-rate cycle, notable differences are found in the two subsamples. In the first subsample, short-term nominal interest rates show a countercyclical pattern and lead the output cycle in three quarters, which would indicate a more active monetary policy. Therefore, increases in the short-term interest rate would be followed by declines in GDP. In contrast, in the dollarisation implementation period the short-term interest rate shows a highly acyclical pattern, reflecting the way interest rates are set in the country: as the average of those set in the commercial banking system (Carrasco Vintimilla, 2015).

The international interest rate, represented by the IMF lending rate, shows a procyclical relationship. It coincides with the GDP cycle in the pre-dollarisation and countercyclical stage and leads the output cycle in two quarters for the dollarisation stage.

In the business cycle literature, the aggregate supply and real business cycle theories state that if output movements occur due to demand shocks, prices are expected to be procyclical to output. However, if shocks originate on the supply side, then prices are expected to be countercyclical. The results are inconclusive given that in the pre-dollarisation stage inflation was countercyclical and the price index was acyclical, inflation preceded the cycle by two quarters and the price lagged the GDP cycle by four quarters. In contrast, in the post-dollarisation stage inflation presents acyclical behaviour and the consumer price index (CPI) is countercyclical. The latter leads the cycle in five quarters, and inflation lags the cycle in four quarters.

Another important fact that should be highlighted for the 1990–1999 period is the cyclical behaviour of the nominal exchange rate. This is, in turn, countercyclical and lags the GDP cycle by one quarter, reaffirming previous evidence: in times of recession the monetary authority devalued the currency as a mechanism to attenuate the GDP cycle. However, exchange rate depreciation can directly affect the price of domestically produced goods if monetary policy lacks credibility (De Gregorio, 2009). Therefore, agents are likely to react to nominal depreciation by raising the price of domestic goods.

4.4 International features of the cycle

Finally, in a small and open economy such as Ecuador's, a significant effect of the international economic cycle on the domestic economy is expected, especially when foreign trade is strongly dependent on commodity prices. In this case, the dependence arises from the large share of oil in total exports.

Given that commodity prices are highly volatile, it is not surprising to find that the *volatility of the terms of trade* is five times that of GDP in the pre-dollarisation stage and ten times more volatile after dollarisation. This volatility is much higher than that reported for developed economies, which have an average volatility of 3.5%. However, according to Mendoza (1995), Latin American and African economies show an average volatility of around 12%.

The co-movement pattern is similar throughout the sample period. It is acyclic with the GDP cycle but leads GDP for three quarters. This shows that shocks in the terms of trade are one of the main drivers of the Ecuadorian business cycle. Rodriguez-Mata (1997) points out that half of the fluctuations in Costa Rican GDP are due to these types of shocks. In a set of emerging economies, Mendoza (1995) provides evidence that terms-of-trade shocks are long, persistent and weakly procyclical. Mendoza's study finds that terms-of-trade shocks explain between 40 and 50 percent of output variability. This result suggests that volatile and persistent terms-of-trade deviations could lead to cycles in output, given the anticipated movement with output.

The trade balance for the two study periods is weakly countercyclical, leading the GDP cycle in five quarters of the pre-dollarisation stage and in three quarters of the post-dollarisation stage. This behaviour is consistent with the relatively high burden of imports in the procyclical factor. This relationship is higher in the pre-dollarisation stage. In the post-dollarisation stage, strong tariff barriers were imposed to adjust the trade balance.

The analysis of the behaviour of the real exchange rate (RER) is of great relevance since this variable plays a determining role in describing the degree of competitiveness of

the economy with respect to the rest of the world (Larraín and Sachs, 2002). Regarding the behaviour of the exchange rate in the 1990–1999 period, it shows countercyclical behaviour and coincides with GDP in the pre-dollarisation stage. In the post-dollarisation period, the relationship between this variable and GDP is acyclical; however, the RER precedes the GDP cycle by three quarters. In consequence, after dollarisation, when a real shock hits the Ecuadorian economy the RER adjusts more slowly towards its fundamental value. This longer period of RER misalignment could lead to economic imbalances. While it is true that these results are not conclusive evidence, they can be taken as a reference for future research analysing the importance of RER misalignment in the Ecuadorian economy and its potential policy implications.

4.5 Public sector variables

Examining the relationship between economic activity and expenditures (current and capital) and revenues (oil and non-oil) is crucial from a policy perspective, including for the design of macroeconomic stabilisation programs in a dollarised economy such as Ecuador's. In the pre-dollarisation stage, revenues and expenditures are highly volatile – 13 times more volatile than GDP, on average. However, all public sector variables are acyclical, oil revenues lag the cycle, and non-oil revenues precede the cycle. On the other hand, both current and capital expenditures precede the cycle by four quarters. These results clearly differ in the post-dollarisation stage, where both revenues and expenditures are procyclical. Oil revenues lead the GDP cycle in three quarters, showing the strong dependence of the Ecuadorian economy on oil prices. Non-oil revenues also lead the output cycle in four quarters. The current expenditure cycle precedes the GDP cycle by one quarter and the capital expenditure cycle by four quarters. This shows that the fiscal impulse does not play a stabilising role in the short-term, which should be sought in a dollarised economy. The procyclical behaviour of current spending indicates that it is necessary to re-examine the sources of spending to ensure that these allow for the attenuation of domestic fluctuations.

5 Conclusions

This paper identifies stylised facts related to Ecuador's economic cycle in two periods: 1990–1999 and 2000–2019. This temporal division provides evidence regarding whether the statistical behaviour of Ecuador's macroeconomic aggregates changed substantially before and after dollarisation. For this purpose, a wide range of macroeconomic variables were analysed, including variables in relation to the demand side and the labour market, as well nominal variables and those related to an open economy. The sensitivity of the correlations was examined according to two detrending techniques: the MHP method developed by Hanif et al. (2017) and a HP filter with smoothing parameter of 1,600.

Table 6 systematises the main results. Relevant changes in the cyclical behaviour of the Ecuadorian economy in the dollarised period are observed. In fact, government consumption becomes acyclical, in line with an aggressive fiscal policy disconnected from the cycle since 2007. The latter is based on a growing dependence on oil revenues, which become procyclical with a leadership of up to two quarters in the 2000–2019 period. Likewise, exports show procyclical behaviour after dollarisation – besides leading

the product for four quarters – denoting a high dependence of the Ecuadorian economy on the international market.

As for nominal variables, M2, the nominal interest rate, inflation and the nominal exchange rate become acyclical in the dollarised period. This was expected given that the new monetary scheme implied minimising room for the manoeuvring of monetary policy.

Finally, fundamental variables on the competitiveness of the Ecuadorian economy show unsettling behaviour in the dollarised period. On the one hand, employment, despite procyclical behaviour before 2000, shows acyclical variations in the 2000–2019 period, in line with a labour market with increasing structural problems. Likewise, the RER and the terms of trade become acyclical from 2000, reflecting an economy that is vulnerable to demand shocks.

Appendices/Supplementary materials are available on request by emailing the corresponding author.

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Notes

- 1 Volatility in Europe was 1.01% in the 1970–1990 period.