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# Instability Constraints and Development Traps: An Empirical Analysis of Growth Cycles and Economic Volatility in Latin America

**Danilo Sartorello Spinola***

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**Abstract**

Latin America is a region marked by an endogenous pattern of volatility that halts its development process. This article consists of empirically testing its volatility characteristics in terms of cycles. This paper (1) uses a filter decomposition to isolate economic cycles of distinct natures on the GDP growth time series for 136 countries covering the period 1950-2016. (2) It calculates each country's cycle GDP volatility (standard deviation), and finally (3) applies clustering methods to classify the results into groups. The main conclusions point that the majority of Latin American countries the relative dominance of the long-run economic cycles explaining the overall volatility. Exceptions to that are Mexico, Colombia and Chile, in which the short-run cycle shows a higher relative importance. Data shows that LAC is not the most volatile region of the world, but it has some characteristics as a region in terms of the origin of their volatility.

**Keywords:** Macroeconomic Volatility, Economic Cycles, Time Series, Filter Decomposition

**JEL:** C21, C32, 047.

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## Introduction

Historically, sustaining growth has been a central problem for a virtuous development strategy in many developing countries (Foster-McGregor, Kaba, & Szirmai, 2015). Short-term growth and high volatility of macroeconomic prices are constantly observed in developing countries, reducing their average period of stable growth. It results in an endogenous pattern of instability, reproduction of inequality, net outflows of financial capital, and halt in investments. Macroeconomic volatility creates major constraints to the process of economic development, affecting long-term decisions and imposing periodic crises (Stiglitz, 2000). This volatility has impacts on the economic structure, affecting long-run economic growth (Ocampo, 2008).

Macroeconomic Instability is not a new issue and it is a central problem currently affecting developing countries. Despite its importance, little effort has been made to understand the consequences of the type of instability that emerges from the productive structure, affecting the growth potential. It is mostly treated in the literature as related to fluctuations in stock markets and government debt (Eichengreen & Hausmann, 2010) and not linked to structural fragility and to the productive structure, which opens a gap in the literature.

Based on the Structuralist theory (Taylor, 1991; Ocampo, 2002), we plan to address the periodical phenomenon of volatility that emerges from the structural fragilities (defined as the weakness of an economy to absorb external economic shocks). In this article, we focus on understanding the aspects concerning GDP growth volatility. We empirically show distinct patterns of volatility that emerges from different countries and regions.

Many Structuralist authors have claimed that the structural causes of volatility in Latin America are related to its peripheral position in the international division of labour (Prebisch, 1951; Ffrench-Davis, 2005; Ocampo & Taylor, 2009). This position is caused by external fragilities related to these countries' productive structure. The fragilities result in a low resilience to external shocks, which is a main source of volatility. In this sense, authors from the Structuralist theory argue that the historical development of Latin American economies gave them an idiosyncratic aspect that makes these countries more fragile (Furtado, 1970). Nonetheless there is a lack of empirical research to prove these claims. This research tries to contribute to fill this gap in order to answer the following research question: **Are Latin American economies different in terms of their volatility patterns than developed countries and other developing regions?**

To answer the above question, the paper does the following procedure: (I) Show some stylised facts of GDP growth volatility for the available countries in our dataset. Apply filtering techniques to decompose economic growth time series for many countries in distinct types of cycle and analyse the patterns that emerge from the data. (II) Build a typology using cluster analysis that groups patterns of volatility. This methodology gives an approach about the type of expansion-cycle processes followed by distinct countries.

In Section 1 there is a brief literature review relating (1) The main theories behind the idea of economic cycles, (2) The Structuralist perspective, and (3) Empirical evidences about the existence of cycles. In Section 2 there is the data used in this research. Section 3 focusses on the methodologies employed – the Christiano-Fitzgerald's Band Pass Filter, and the K-Means method of cluster analysis. In Section 4 there are evidences from the original data before applying the filtering analysis. Section 5 shows the results after applying the filters in the data, discussing them for the different types of cycle. Finally, Section 6 consists of a summary of the main results and the conclusion of the paper.

## I. Literature Review

This section consists of a brief literature review about the classical and the current state of the discussion in economic cycles and volatility in three aspects: (1) The relevance of cycles to economic theory. (2) The way volatility is observed in the Structuralist theory. (3) Some methodological and empirical evidence of the presence of cycles in the growth theory.

### a) Cycle Theory

The study and development of economic cycle theories has enabled many analysts to understand the behaviour of economic dynamics. Distinct theories approached the observance of economic cycles with its own explanations of the phenomenon. The relevance on the study of these cycles lays in the fact that their occurrence for some key economic variables affects countries' short- and long-run economic behaviour and their development strategies. Understanding the existence and causes of a cyclical behaviour is a topic largely addressed by a whole tradition in cliometrics and cliodynamics.

Economists claimed the discovery of cyclical patterns for economic prices and growth. Since before that, Clement Juglar (1889) had identified that cycles were related to business activities. The cycles ranged from 8 to 11 years and

were caused by the maturity of investments. This behaviour was later developed in the Business Cycle Theory. In terms of long run cycles, Kondratiev (1935) discussed the existence of periods of volatility every 45 to 60 years in the world economy. These long cycles are still the subject of debates in terms of their identification and causes (Korotayev et al, 2010). Another type of cyclical behaviour in the medium-run period was discovered by Kuznets (1940), who related them to the behaviour of infrastructure investments. This cycle was discussed by Abramovitz (1961, 1968), who empirically analysed the recurrence of growth-crises periods for a broad range of countries at similar intervals.

Joseph Schumpeter wrote in 1933 his classical book on business cycles. Schumpeter described how technological aspects related to the cyclical behaviour of an economy and proposed a typology for them according to their periodicity. An update of his typology (Jadevicius & Huston, 2014) leads us to identify four types of cycles: the Kitchin cycle (3 to 5 years); the Juglar cycle (8 to 11 years); the Kuznets cycle (15 to 25 years) and the Kondratiev wave (45 to 60 years). In this research we base ourselves on this typology. However, we expand the range of each cycle in order to have a perfect coverage of all the cycles that range between 2 and 60 years. The most important aspect of these economic cycles is that the fluctuations are not only related to a certain aspect of the economy, but affect all economies and are diffused through the whole economic system, having pervasive effects in the economic system.

The reasons behind the existence of cycles are topics of great debate in the economic theory. Different authors try to understand the causes of these cycles. These arguments range from the accumulation of inventories (Kitchin, 1923; Metzler, 1941). (2) credit behaviour. (3) the maturity of investments (Besomi, 2005; Fukuda, 2009). (4) investments in infrastructure (Kuznets, 1930; Abramovitz, 1968). (5) Technology development (Schumpeter, 1939; Perez, 2009). It is also worth noting the Debt Deflation theory (Fischer, 1933) and the Financial Instability Hypothesis (Minsky, 1974).

The Structuralist tradition has theories that seek to explain the behaviour of cycles, looking for either supply and demand-side aspects. The specificity of these theories is that they observe cycles as endogenous to the behaviour of the economic system. They are distinct from the traditional Real Business Cycle (RBC) framework that observes the main sources of cycles as exogenous (Kydland & Prescott, 1990). In this RBC's perspective, well-functioning markets results in a stable equilibrium. Therefore, fluctuations are a result of bad policies or market failures.

### b) Structuralism – Why developing countries are so volatile? What is the insertion of Latin America?

The concept of centre-periphery is at the centre of the research made by the Economic Commission of Latin America and the Caribbean (Eclac), historically linked to the Latin American Structuralist studies. Latin America has always been seen as a region with a specific economic dynamic compared to other regions. Since the works of Prebisch (1951), Furtado (1983), Sunkel (1972) and Fajnzylber (1990), and more recently with Ocampo (2002), Cimoli, Porcile (2013) and Perez-Caldentey & Vernengo (2010), Latin America is seen as a region with a peculiar economic dynamic. Taylor (1991) models and summarises the effects of the centre-periphery dynamic to the constitution of a cyclical dynamic. This is caused by the idiosyncratic economic and institutional historical shaping of the region. This specificity has impacts on the growth dynamic in the short- and long-run.

Prebisch (1951) developed a theory explaining the emergence of a centre-peripheral (or core-peripheral) dynamic. This dynamic is related to which types of products a country produces (depending on the product's technology intensity) and the country's insertion in the international division of labour. The centre (Central countries or Core of the system) is the locus of technological change, producing new advanced products. On the other hand, the periphery inserts itself in the international dynamic by producing and exporting raw goods and low technologic intensive products. This theory marks the beginning of the Latin American Structuralism. Bielchowsky (2009) shows all the improvements in the Structuralist theory during the 60 years of the economic thought at Eclac.

This international arrangement gives the periphery a distinct dynamic in the long run when compared to the centre. In this framework, the lack of development of the productive structure is seen as the main factor generating an increasing fragility into the developing countries (periphery). Following the long-run perspective, the theory argues for a decline of the Terms of Trade (Prebisch-Singer Hypothesis).

In the Post-Keynesian tradition, Thirlwall (1979, 2011) developed the Balance of Payments Constrained model. In it, countries are constrained in the long run by the income elasticity of demand from imports and exports of products they trade. An increase in growth rate should be compatible with the stability of the external sector, which depends on your productive structure and defines the fragility pattern. More recently, Cimoli & Porcile (2013) linked external constraints to the technological capabilities of peripheral countries, merging the Post-Keynesian, the Structuralist and the Evolutionary perspectives.

The lack of dynamism in the productive structure of developing countries and the aforementioned fragility result in a specific pattern of specialisation in international trade. Developing countries concentrate their activities in low technological intensive products and highly standardised goods (commodities). This creates an additional issue to the Terms of Trade decline: the specialisation in commodities results in higher volatility. Commodity prices in international markets are more volatile than high-technology manufactured goods. This volatility affects the Balance of Payments conditions of developing countries not only in the long-run, as discussed by Thirlwall (2011) but also in the short-run. This results in constraints to the process of economic development. **High volatility in developing countries comes from the increased fragility created by a specialised and low dynamic productive structure. This is the result of a specific peripheral insertion in the international division of labour.**

The claim above can be explained through some channels. Higher volatility in international prices generates a mismatch in the Balance of Payments (exports, imports and capital flows). It affects economic growth through the following mechanisms:

(1) It increases uncertainty, affecting the decisions of economic agents in the short- and long-run. In this sense, investment projects with high capital immobilisation would be perceived as less profitable. It results in reduced marginal capital efficiency, as described by Keynes (1936), constraining long-run projects, investment and aggregate demand (reducing growth).

(2) Instability in the external account reduces the possibilities to import capital goods. This is particularly relevant for developing countries in which a catch-up strategy demands access to capital goods (machinery) situated in the technologic frontier. (Stiglitz, 2000)

(3) Volatility in external prices may affect the exchange rate of a country. Increasing oscillation in the exchange rate increases the uncertainty, which may generate arbitration and speculation possibilities, but do not positively improve development possibilities. (Andrade & Prates, 2013)

(4) Uncertainty affects not only investment but also consumption. Real wages are very sensitive to changes in the exchange rate. The price channel in an uncertain environment reduces consumption and aggregate demand. (Gabriel et al., 2016).

(5) Increased uncertainty in investments and in the exchange rate affects agents' behaviour through higher price volatility. Agents protect themselves by protecting their Mark-up (Steindl, 1979) by increasing prices. In this sense, volatility is also seen an inflationary mechanism.

(6) Reduction in investments, especially in the manufacturing sector, is also linked to a reduction in productivity. Following the old Kaldor-Verdoorn (Kaldor, 1967; Verdoorn, 1949) discussion, still debated by McCombie & Sperafico (2015), investment and growth boost not only the capital stock but as well as its quality, generating economies of scale and higher learning opportunities. In this sense, this is another mechanism that reinforces the specialisation in low technological intensive activities.

In the mainstream, economists argue that fragility is related to a higher resilience to shocks. This especially for external shocks that comes from abrupt price changes (Blanchard & Gali, 2007) and also from institutional issues (Acemoglu et al, 2003). Countries with less diversified exports suffer most from external price volatility. Volatility of low technology intensive goods is historically much higher than for high technology intensive manufacturing goods. This results in higher fragility in developing countries (Combes & Guillaumon, 2002).

The import-export pattern is seen as a central to this discussion, either related to the short-run fluctuations and to long-run waves. As discussed above, there is a whole tradition of literature that searched for the sources of volatility in the short- and long-run, but very few that have tried to measure them. In this sense, this study aims to measure distinct aspect of volatility using cycle theories.

### c) Methodologies used for cycle analysis and some empirical evidence of economic cycles

Distinct methodologies in the field of Time Series have been developed to extract cycles from the original GDP growth time series data. There is a whole tradition in fields such as physics (oscillatory dynamics) in which frequencies as are essential to understand the behaviour of certain volatile phenomena. This is similar in economics, in which we can observe empirically the existence of a cyclical behaviour in many economic variables.

In terms of the main methodologies used to observe empirically the existence of cycles, we can cite the **Spectral Analysis** (Kuczynsky, 1978; Bossier & Huge, 1981; Van Ewijk, 1981; Korotayev et al, 2010), the **Filter design approach** (Metz & Stier, 1992; Kriegel et al, 2009) and the **Wavelet analysis** (Gallegati et al, 2017). These methodologies focus on analysing the distinct frequencies that emerge from time series.

**Spectral analysis** applies Fourier transformations to time series and observes its spectrum in different frequencies. Using power accumulated frequencies it is then possible to identify the existence of periodic oscillations in the time series. This method initially removes the trend from the series as a requirement of stationarity. Fourier transformations uses combinations of sines and cosines to represent a non-local function – so changes affect the whole function. This restriction allows for using windowed transformation (use of bands). The wavelet analysis is analogous to the Spectral analysis but it uses a finite domain.

This paper uses a **Filter Design approach**, which is a development of the Spectral Analysis by defining a specific band filter. There are distinct filters, described and enumerated by Pollock (2014). One commonly used filter is the low pass filter, the Hodrick-Prescott's filter (Hodrick and Prescott, 1980). This methodology was heavily criticised by Hamilton (2016). Another important methodology is the Band-Pass filter, in which we observe the symmetric (Baxter-King) and asymmetric (Christiano-Fitzgerald) versions. This latter method is used to observe long waves and growth cycles. The procedure filters coefficients to isolate specific frequencies looking for the ideal filter band.

Baxter and King (1999) developed the symmetric band-pass filter by inverting the Fourier series and truncating the data constructing a moving average. This methodology had an issue related to reaching the ends of the sample. The issue is solved by the asymmetric Band-Pass filter of Christiano and Fitzgerald (2003).

We observe some empirical evidences of the existence of regular patterns of volatility (cycles) in GDP growth. There are many studies which test the existence of cycles at the global level. Korotayev et al (2010) using spectral analysis, claim that it is highly likely that Kitchin, Juglar and Kondratiev cycles exist at a global level. Kuznets' cycles are the third harmonic of the Kondratiev cycle, detected for the world level for each 17 years. In another relevant work, Diebol & Doliger (2006, 2008) identified Kuznets swing for GDP growth.

Despite the fact that these works pointed to the existence of cyclical behaviour in the economic systems, it is important to point out that the results found in the literature are still contrasting and contradictory, depending on the methodology applied. There are still disagreements about the empirical existence of short and long waves (Bosserelle, 2013). The disagreement does not invalidate the results of this research. The cyclical decomposition used to observe patterns of volatility is an important mathematical tool to investigate and classify groups according to specific elements, such as growth volatility.

## II. Data

This paper uses the Maddison Project Database (MPD), updated with data from the World Bank Database (WBD). The MPD continues the works of Maddison (2001) and Maddison (2003). The database was most recently updated by Bolt and Van Zanden (2013). These authors calculated the long-run historical data of per capita GDP for a large number of countries and regions. The MPD has data since ancient times until 2010. We select from the MPD the period from 1950 to 2010 and update for 2010 to 2016 using the growth rates of per capita GDP from the World Bank Database (WBD). The updating procedure involved removing the population growth in order to find GDP growth data. Former soviet republics and former Yugoslavia were excluded.

The treated database consists of GDP growth data from 1951 to 2016 for 136 countries. For each country's time series, the Christiano and Fitzgerald (2003)'s Band Pass Filter was applied and the original data was decomposed in distinct cycles. These cycles cover very-short-run 2-8 years (Kitchin Cycle), short-run 8-15 years (Juglar cycle), medium-run 15-30 years (Kuznets cycle), and long-run 30-60 years (Kondratiev cycle). The results were grouped in clusters using the K-means methodology, dividing the instability patterns in different groups.

GDP growth data is used in this research for two main reasons: (1) There is a requirement of stationarity in order to apply the filtering methodology. (2) GDP growth focuses only on the dynamic aspect of volatility. The focus is not to observe how the stock of richness (GDP level) affects volatility, but how the flow (growth) is related to an oscillatory pattern.

## III. Methodology

### a) Band-Pass filter

Erten and Ocampo (2013) uses the Asymmetric Band-Pass (ABP) to identify cycles for commodity prices. The same method is used to filter the GDP growth time series. The ABP filter allows a time-series to be decomposed into different frequency components, which are then used to identify the cycles in the different time series. This approach is combined with the identification of medium-run cycles, following Comin and Gertler (2006) and Drehmann et al (2012). The approach adopted splits the per capita GDP growth ($y$) into five components: (i) a long-run cycle ($y^{\mathrm{LR}}$) – with periodicities of 30 to 60 years, corresponding to the Kondratiev cycle; (ii) a medium-run component ($y^{\mathrm{MR}}$) – with periodicities between 15 and 30 years corresponding to the Kuznets cycle; (iii) a short-run cycle ($y^{\mathrm{SR}}$) – with

periodicities between 8 and 15 years corresponding to the Juglar cycle; (iv) a very short-term cyclical component ($y^{\mathrm{SSR}}$) – with periodicities less than 8 years corresponding to the Kitchin cycle; and a residual component ($e$), that will be later discussed as the structural component.

$$y_t \equiv {y^{LR}}_t + {y^{MR}}_t + {y^{SR}}_t + y^{\mathrm{SSR}} + e \quad (1)$$

The average length of a super-cycle reported by Erten and Ocampo (2013) in their analysis is 35.7 years, with a minimum of 24 years and just three (out of 18) super-cycles being more than 40 years in length. The Kuznets cycles is considered as having a periodicity between 15 and 30 years. The long-run trend therefore has a periodicity greater than 30 years, until 60 years, following the Kondratiev waves. A medium-run cycle Juglar wave is then defined as having a periodicity between 8 and 20 years, with the short term cyclical Kitchin cycle trend having a periodicity of less than 8 years.

**Table 1. Cycles in economic theory and its periods**

| Cycle Name | Main origin | Period | Possible cause as discussed in the theory |
|---|---|---|---|
| Kitchin | Market Cycle | 0y-8y | Inventories (Consumption) |
| Juglar | Business Investment Cycle | 8y-15y | Medium-run Investments |
| Kuznets | Structural Investment Cycle | 15y-30y | Long-run Investments (Infra-Structure) |
| Kondratiev | Technological Cycle | 30y-60y | Technological paradigm change |
| Residual | Trend | - | Structural element |

### b) Cluster Analysis

Cluster Analysis consists of organising elements in similar groups or clusters according to some selected attributes. There is no standard way of clustering, but many distinct methodologies are used to group elements with similar aspects. In this paper, selected countries are divided into distinct groups based on their cycle standard deviations. The methodology used is the K-Means, a method of vector quantisation that partitions observations in cluster partitioning the data space into regions.

The K-Means is a randomised method that divides the data into $k$ distinct clusters. The $n$ objects are grouped according to the nearest mean to the clusters. The optimal number of clusters is not known and must be exogenously

defined. The objective of this methodology is to minimise intra-cluster variance (the squared error function). This is done through defining an objective function $j$ that calculates a distance function that must be then minimised. The objective function can be written as:

$$j = \sum_{j=1}^{k} \sum_{i=1}^{n} \left\| x_i^{(j)} - c_j \right\|^2 \tag{3}$$

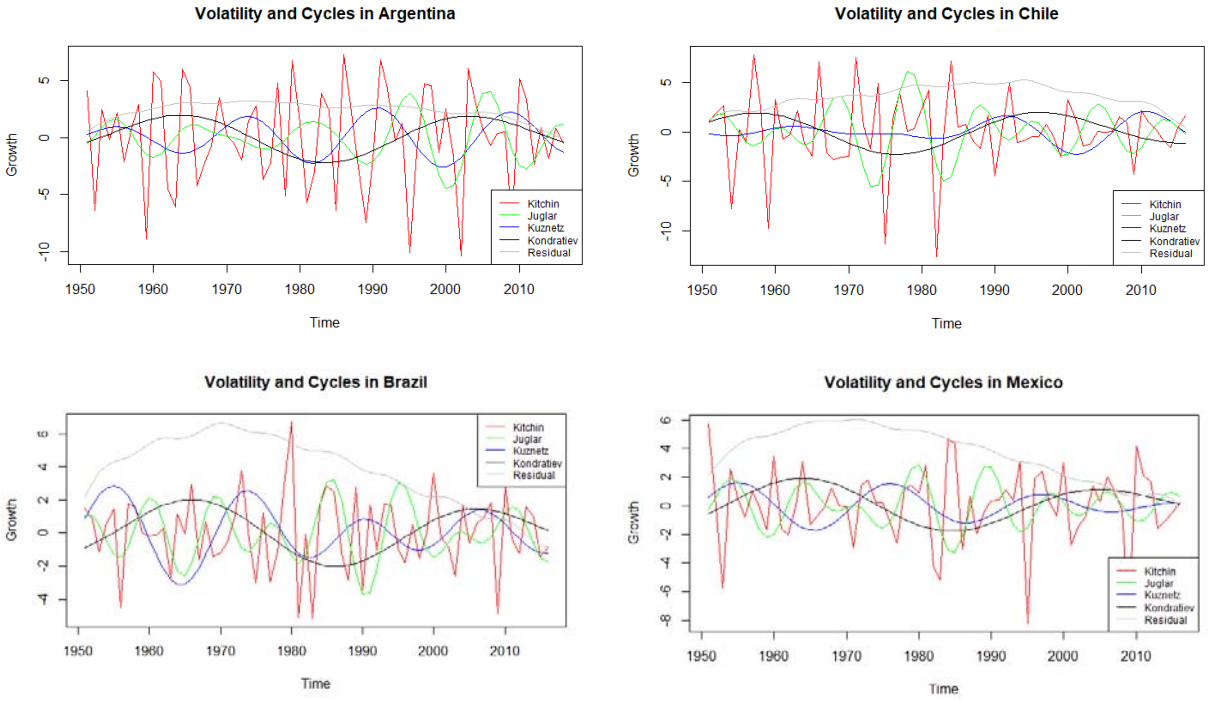
Where $x_i$ represents the case $i$ and $c_j$ represents the centroid for cluster $j$. The method firstly computes the clusters into the exogenously given $k$ groups. Then it randomly selects cluster centers and assigns observations to clusters, following the distance function, and calculates the mean of each object. This method repeats itself until minimising the distances. This method results in groups of clusters in which similar countries among themselves are divided from the others.

## IV. Analysis by type of cycle

The band-pass filter removes the high frequency Kitchin cycle from the original time series. The band is readjusted to extract the Juglar cycle from the residuals of the Kitchin cycle. From the residuals of the Juglar cycle the Kuznets cycle are extracted. The same procedure is used to extract the Kondratiev cycle from the residuals of the Kuznets cycle. The resulting data consists in a residual related to the Long-Run economic growth. The sum of the five components gives again the original time series. The different patterns of cyclicality observed in different countries can be grouped using cluster analysis. These patterns are compared in terms of the average duration of the cycles and their standard deviation.

In order to illustrate the methodology and the results obtained there is below the filtering methodology applied to selected LAC's country data. In Figure 1 we see the four types of cycle filtered from the original GDP growth time series for selected countries. Each cycle has a detailed aspect and can be used to help identifying some historical turns in countries' economies. This extraction shows the different degrees of stable volatility. An interesting aspect is the residual non-cyclical component. It shows the long-run aspects, possibly related to the countries' economic structures.

**Figure 1. Volatility, cycles and residual in selected LAC countries**




Source: Author's own and Maddison Project Database

Figure 1 shows the decomposition of growth time series into cycles and trend for Argentina, Brazil, Chile and Mexico. The scales are different in each graph, which represents the difference in terms of volatility patterns in each country. The short-run Kitchin cycles, in colour red, have a higher frequency and variance. This cycle is marked by high amplitude and small duration. The presence of major economic crisis can be easily seen in the market Kitchin cycle. This is the case of the 1980's in many Latin Americas countries, as the example of the Mexican peso crisis of 1982.

Each cycle can be linked to a major element, following the literature. The short-run Juglar cycles follows the investment cycles for each economy while the Kuznets cycle is related to longer investment cycles related to infrastructure. The Kondratiev cycle is related in the theory to technological changes (Perez, 2010). We can also observe the presence of the residual component. This latter does not follow a cyclical behaviour but a trend. This residual can be used to explain changes in the productive structure – such as the reduction on the weight of the industrial sector in a specialisation pattern that happened since the end of the 1970's in LAC.

### a) Results of the cluster analysis applied on Cycles

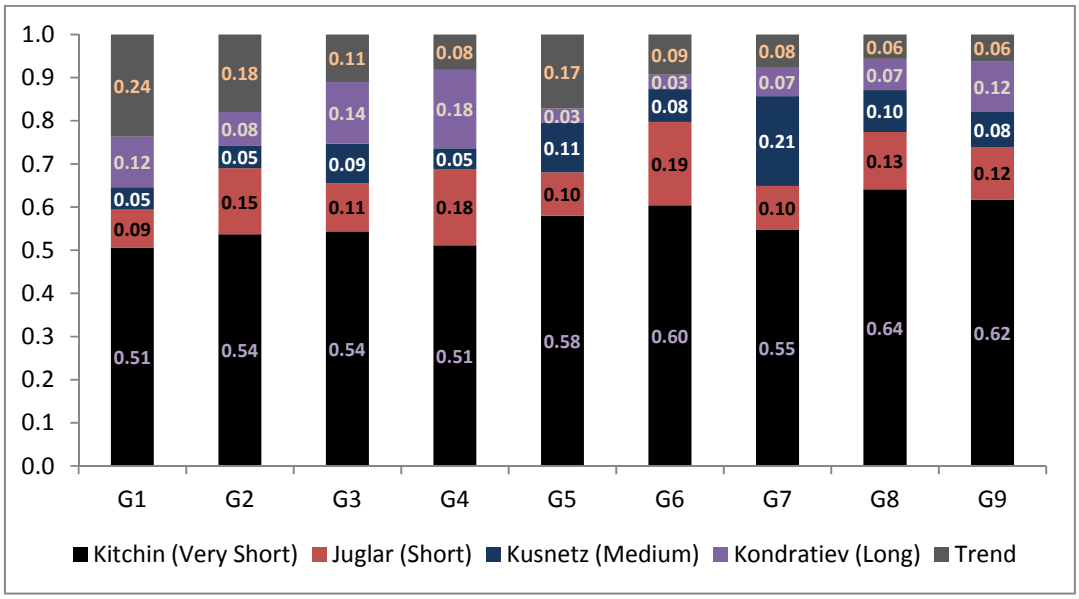
The cluster analysis is applied on the different cycle components time series. Countries are grouped by their volatility patterns. The algorithm was run 1000 times, caused by the randomised aspect of the K-mean. The cluster analysis considered the Short-, Medium- and Long- run cycles as attributes. Isolating the very-short-run cycles was a decision based on the fact that this type of cycles capture all the noise related to non-economic aspects. The number of cluster was selected using cluster optimisation criteria, this defined 9 groups.

**Table 2. Average variance per group**

| | | | | | |
|---|---|---|---|---|---|
| G1 | 7.90 | G4 | 28.76 | G7 | 33.09 |
| G2 | 15.93 | G5 | 22.17 | G8 | 69.97 |
| G3 | 21.84 | G6 | 26.65 | G9 | 181.13 |

Source: Author's own and Maddison Project Database

**Figure 2. Share of the cycle variances on the overall variance (average per group)**




Source: Author's own and Maddison Project Database

Group 1 (G1) represents the less volatile countries, in which most Developed countries are included. This group is marked by low variance, high relative importance of the trend component and long run cycles explaining overall volatility. G1 has smaller relative importance of the very-short- and short-run volatility. Group 2 (G2) has similar characteristics to G1, but a larger variance and higher relative relevance of the very short- and short-run volatilities. It is still composed by some developed countries and some emerging economies in Africa that show a similar volatility pattern.

Between Groups 3 and 6 (G3-G6) the overall variance is almost equal, as seem in Table 2. The differences are related to the relative importance of each cycle to explain volatility. In G3 the Kondratiev cycles are more important relatively and the trend, the short- and very-short cycles are below the average. In G4 both the Juglar and the Kondratiev cycles are relatively more relevant, while G5 shows a pattern with higher relative importance of the trend, the medium-run and the very-short-run cycles. Finally, for G6 we see a very big relevance of the Kitchin and Juglar cycles (group that presents higher share of short-run volatility explaining the overall).

G7 shows an average variance a little higher than the first six groups and it is marked by the higher presence of the medium-run cycles. Finally, Groups 8 and 9 (G8-G9) show a much higher variation in their overall volatility, both with a big relative relevance of the very-short run cycles and small importance of the long-run cycle and the long-run trend.

**Table 3. Summary of the relative characteristics per group (relative to the average of all groups)**

| | **Kitchin (Very Short)** | **Juglar (Short)** | **Kusnetz (Medium)** | **Kondratiev (Long)** | **Trend** |
|---|---|---|---|---|---|
| **G1** | -- | -- | - | + | ++ |
| **G2** | - | + | - | - | + |
| **G3** | - | - | **0** | ++ | - |
| **G4** | -- | ++ | - | ++ | - |
| **G5** | + | - | + | -- | + |
| **G6** | + | ++ | - | -- | - |
| **G7** | - | - | ++ | - | - |
| **G8** | ++ | **0** | + | - | - |
| **G9** | ++ | - | - | + | - |
| | **-- < -1 SD** | **-1SD < '-' < 0** | **0** | **0 < '+' < 1 SD** | **'++' > 1 SD** |

(++) More relatively important by more than 1 Standard Deviation; (+) more relatively important by until 1 SD;

(--) Less relatively important by more than 1 Standard Deviation; (-) less relatively important by until 1 SD;

Table 3 shows the relative comparison between different groups by its cycle characteristics. Each group is compared with the average share, showing which cycle is relatively the most relevant to explain differences between groups.

Each group shows a different behaviour which poses some questions: Why is a country more affected by long-run cycles? What determines that? Is it related to the structural conditions of the economies? Is it a matter of fragility? These questions open the floor to a whole research agenda.

Table **4** shows which countries are grouped in each of the clusters defined by the K-means methodology. In this table there are some regional features. Developed countries are entirely situated in Groups 1 and 2. In these two first groups there are also the presence of many low and middle-income countries in African and Asian such as Benin, Bangladesh, Bahrein, Burkina Faso India, Laos, etc. Most central Asian countries are in G8 and G9. Latin America finds itself between G2-G7 concentrated mostly in G3.

The measure is related to growth volatility, so a catch-up process right after WWII followed by long period of stagnation, as is the case of Japan, is measured in a certain specific way (Heteroscedasticity). On the other hand, countries with a profound stagnation are not volatile, which is the case of many of the developing countries observed in G1 and G2.

**Table 4. Cluster Analysis on the Standard Deviation of the Juglar, Kuznets and Kondratiev cycles.**

| GROUP 1 (G1) | | GROUP 2 (G2) | GROUP 3 (G3) | | GROUP 4 (G4) | GROUP 5 (G5) | GROUP 6 (G6) | GROUP 7 (G7) | GROUP 8 (G8) | GROUP 9 (G9) |
|---|---|---|---|---|---|---|---|---|---|---|
| AUS | LAO | BFA | ARG | MNG | ALB | BDI | CAF | CMR | GAB | AGO |
| AUT | LKA | CHE | BGR | MRT | POL | ECU | CHL | COG | IRN | GNQ |
| BEL | MAR | COL | BOL | NAM | ROU | EGY | CHN | COM | KHM | IRQ |
| BEN | NLD | ESP | BRA | PAN | PER | HKG | COD | CPV | LBN | KWT |
| BGD | NOR | FIN | BWA | PHL | CUB | IDN | LSO | JOR | NGA | LBY |
| BHR | NPL | GNB | CIV | PRY | NIC | KOR | MUS | SDN | PRK | OMN |
| CAN | PAK | HND | CRI | SLV | AFG | LBR | NER | TTO | RWA | QAT |
| DEU | PRI | IRL | DOM | STP | SAU | MWI | SYC | VEN | SLE | |
| DNK | SEN | JPN | DZA | TZA | DJI | MYS | THA | YEM | SOM | |
| FRA | SWE | KEN | GHA | UGA | ETH | SGP | URY | | SYR | |
| GIN | UK | MDG | GMB | ZMB | MOZ | TUR | ZWE | | TCD | |
| IND | USA | MEX | GRC | | SWZ | | | | UAE | |
| ITA | ZAF | MLI | GTM | | TGO | | | | | |
| | | NZL | HTI | | | | | | | |
| | | PRT | HUN | | | | | | | |
| | | TUN | ISR | | | | | | | |
| | | TWN | JAM | | | | | | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | VNM | MMR | | | | | | |

Source: Author's own and Maddison Project Database

In Table 4, the Latin American countries are in the grey colour. It is possible to observe that half of them concentrate in G3 (11 countries out of 23). The continent is represented in every group with the exception of the two most volatile (G8 and G9). Puerto Rico follows a similar pattern of that of the Developed countries. Colombia, Mexico and Honduras have a volatility pattern also more closely similar to that of developed countries. Chile and Uruguay differ from the majority of Latin American countries. This is not caused by differences of their overall volatility, but because in these countries we can observe that the very-short- and the short-run cycles are very relevant to explain the volatility. Peru, Cuba and Nicaragua are in G4. Ecuador is in G5. Venezuela and Trinidad & Tobago are in a more volatile group (G7). There are two main groups for LAC countries, the ones in which Short-Run (Juglar) cycles relatively dominate (G2, G4 and G6) and the majority in which Long-Run Cycles relatively dominate (G3 and G4). These two groups will be called Juglar-dominated and Kondratiev-dominated respectively.

**Table 5. Latin American countries by its cycle dominance**

| Juglar-dominated | Kondratiev-dominated | | Both dominances | None |
|---|---|---|---|---|
| CHL | ARG | HTI | CUB | ECU |
| COL | BOL | JAM | NIC | PRI |
| HND | BRA | PAN | PER | TTO |
| MEX | CRI | PRY | | VEN |
| URY | DOM | SLV | | |
| | GTM | | | |

Source: Author's own and Maddison Project Database

Some results for the behaviour of economic cycles in Latin America:

(1) Half of LAC countries are in Group 3, which is characterised by average standard deviation. In G3 (and G4) there is a high relative importance of the long-run cycles (Kondratiev) despite a smaller relevance of the long-run trend.

(2) Latin American countries are not totally homogeneous as a group in terms of their volatility patterns. This poses a challenge when generalising results to the whole continent. In this sense, finding a general theory to explain the causes of overall volatility in Latin American countries must take into account these

specificities and discuss the causes of these differences. It is relevant to highlight that we see one group (G3) that characterises most of the Latin American countries.

(3) LAC countries, in terms of volatility, differ clearly from the pattern observed in Developed countries. On the other hand, it shows a similar pattern to many other developing regions, especially with central Asia and parts of sub-Saharan Africa.

(4) Considering only the big countries in the region, Mexico and Colombia have a different pattern than Brazil and Argentina, which is also different than Chile.

(5) It is relevant to discuss the meaning of the Kondratiev-dominance. What does it mean to have a long-run cycle so relatively important in explaining growth volatility compared to the others?

**Figure 3. Map of volatility patterns in Latin America by cluster group.**


Source: Author's own and Maddison Project Database

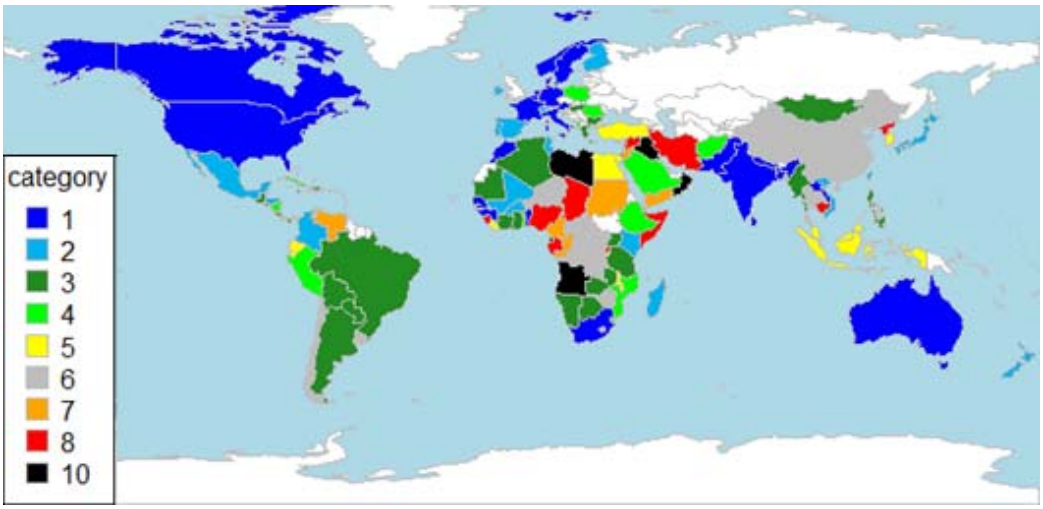
Before building a relationship between volatility and development, as it is the future intent of this research agenda, it is relevant to observe the aspects that lead to similar patterns in the world level. This occurs in groups of countries with many distinct volatility patterns. From the observance of the cluster analysis we may find the following results:

(1) Developed countries are the less volatile. They find themselves in G1 and G2. Oil rich countries are the more volatile in the world, being in G8 and G9.

(2) Despite the developed countries, there are many low- and medium-income countries in the G1 and G2. This aspect has to be further investigated, as the sources of their low volatility may not be related to their structural conditions.

(3) Developing countries with a similar overall volatility have a very distinct pattern when observing the sources of this volatility. For some countries the volatility comes from shorter-run cycles while for others, it comes from longer-run cycles and the trend.

**Figure 4. Map of volatility patterns by cluster group, World Level.**




Source: Author's own and Maddison Project Database

**b) Kondratiev-dominance: the importance of the long-run cycles**

The evidences in this research show that most of the Latin American countries are in a situation in which the Kondratiev long-run cycle is relatively dominant compared to the other groups defined in the previous session. The Kondratiev long run growth is associated to technological changes in international pattern (Perez, 2010).

Latin America has a high dependency in commodities. Changes in technological paradigm result in long run volatility in commodity prices. This is caused by a reduction in the dependency of the inputs of the previous industrial paradigm, with effects on the exchange rate (Guzman, Ocampo, & Stiglitz, 2017). The emergency of a new paradigm requires new inputs. Because of that LA economies adjust to the cycle and change the products in which they will specialise if they have the possibility to do so. In Brazil for instance there was the Rubber cycle, the Sugar Kane cycle, the Gold cycle, the Oil cycle. All related to the industrial paradigm of the period.

Most developing countries have a high dependency of commodities, Latin America included. This region, though, seems to be integrated to the world economy in a different way. If we observe cycle synchronisation, Latin America runs actually very coherently with the international pattern. This coherence is not that strong in Africa and Asia. The economic space of Latin America seems strongly linked with the developed countries, especially for long-run changes. The short-run volatility is not as big as expected, but there is an element of dependency that generates high volatility in the long-run. A high integration in a peripheral way may be the key to answer the specificity of Latin America. There is a low capacity of absorbing and generating technology, and a structure that favours specialisation in low technology intensive sectors. This is reinforced by the dependency situation (Cardoso, 1982) in which the political and economic elites control the natural resources and concentrate the income, allowing them to keep a modern high living standard with very high inequality.

### c) Juglar-dominance: the importance of the short-run cycles

Juglar cycles are related in the literature to investment cycles (Korotayev & Tsirel, 2010).

A high volatility in this type of cycle is related to the fact that investments are done in blocks. The uncertainty intrinsic of certain economic systems is higher in developing countries. This uncertainty results in investments being made in periods in which there is a positive environmental condition, commonly related to periods that coincide with commodity cycles. These cycles start maturing meanwhile environmental conditions of the economic situation change. There is a period in which no new investments coincide with a reduction in the environmental conditions, increasing uncertainty and raising the costs to make new investments. There is a period with no new investments that results in a reduction of the cycle.

This cyclical component is associated as well with commodity cycles in developing countries. The dependence of the productive structure on the imports and exports of a few low-technology intensive commodity goods is a main component of the uncertainty. The Balance of Payments Constrained model (Thirlwall, 2012) states that investment in these economies tend to be endogenous to the external conditions. The unstable effect of export and import prices as well as the price and income elasticity of imports and exports of traded goods result in the oscillation captured by the Juglar Cycles.

This is the case of countries such as Chile, Mexico and Colombia, in which the dependence of mining activities have been the main economic activity in terms of exports. Investments are responsive to price changes in the mining products these countries export, happening only when prices sustain themselves in high level for a certain period of time.

## V. Conclusion

Macroeconomic volatility is a thermometer that measures the resilience that countries suffer from economic, political and institutional shocks. This paper proposed itself to empirically study volatility at country level. The specificity of this paper is the effort to identify different types of regularities on GDP growth time series. The filter analysis extracted the regularities from the original series into different components (cycles). A cluster analysis applied on the cycle components allowed the identification of countries with similar volatility patterns.

The above procedure allowed the constitution of country groups that helped answering the research question initially defined in this research: **Are Latin American economies different in terms of their volatility patterns than developed countries and other developing regions?** The answer to this question is not simple and should take into account the following consideration:

LAC is in its most characterised by an average GDP growth standard deviation. Half of its countries are marked by a high relative importance of the long-run cycles, despite a smaller relevance of the long-run trend (and of the short-run cycle). The part of LAC of the countries are not homogeneous in terms of their volatility patterns but follow a similar characteristic of a high relative relevance of the short-run Juglar cycle. This creates a problem when generalising results to the whole continent. In this sense, finding a general theory to explain the causes of overall volatility in LAC countries must take into account these specificities and discuss the causes of these differences.

On one hand, LAC in terms of volatility differs clearly from the pattern observed in Developed countries. On the other hand, it shows a similar pattern to many other developing regions, especially with central Asia and parts of sub-Saharan Africa. We see some evidences to suppose that LAC has a distinct behaviour compared to Developing countries, but there are no evidences to extend this conclusion to other developing countries.

In summary, the evidence from the Maddison's data shows that LAC is less volatile than developed countries. This is not necessarily true to other developing countries. The Structuralist perspective frequently compares LAC with developed countries and not to other developing regions, which leads to these strong statements. On the other hand, we see that LAC as a continent follows a similar behaviour after applying the filtering methodology, which characterises an idiosyncratic element – at least for the majority of LAC countries.

The results found in this empirical analysis should be further investigated. The causes and consequences of this instability need more study. The results are used as inputs to the development of the Chronic Macroeconomic Instability model. This model links volatility, productive structure and the fragility pattern of countries. Theoretically built on the Structuralist theory (Taylor, 1991), the model aims to explain how some countries are trapped in development issues that do not let them catch-up in their economic development strategies.

## VI. References


Abramovitz, M. (1961). The nature and significance of Kuznets cycles. Economic Development and Cultural Change, 9(3), 225-248.

Abramovitz, M., 1968. The passing of the Kuznets cycle. *Economica*, *35*(140), pp.349-367.

Acemoglu, D., Johnson, S., Robinson, J. and Thaicharoen, Y., 2003. Institutional causes, macroeconomic symptoms: volatility, crises and growth. Journal of monetary economics, 50(1), pp.49-123.

Aiolfi, M., Catão, L.A. and Timmermann, A., 2011. Common factors in Latin America's business cycles. Journal of Development Economics, 95(2), pp.212-228.Akamatsu, K., 1961. A theory of unbalanced growth in the world economy. Weltwirtschaftliches Archiv, pp.196-217.Artis & Zhang, 1997

Andrade, R. P., & Prates, D. M. (2013). Exchange rate dynamics in a peripheral monetary economy. *Journal of Post Keynesian Economics*, *35*(3), 399-416.

Barbosa□Filho, N.H. and Taylor, L., 2006. Distributive and demand cycles in the US economy—a structuralist Goodwin model. Metroeconomica, 57(3), pp.389-411.

Baxter, M. and King, R.G., 1999. Measuring business cycles: approximate band-pass filters for economic time series. the Review of Economics and Statistics, 81(4), pp.575-593.

Benkemoune, R., 2009. Charles Dunoyer and the Emergence of the Idea of an Economic Cycle. *History of Political Economy*, *41*(2), pp.271-295.

Besomi, D., 2005, December. Clément Juglar and the transition from crises theory to business cycle theories. In *a Conference on the Occasion of the Centenary of the Death of Clement Juglar. Paris* (Vol. 2).

Bielschowsky, R., 2009. Sixty years of ECLAC: structuralism and neo-structuralism. Cepal Review.

Blanchard, O.J. and Gali, J., 2007. The Macroeconomic Effects of Oil Shocks: Why are the 2000s so different from the 1970s? (No. w13368). National Bureau of Economic Research.

Bolt, J. and Van Zanden, J.L., 2013. The first update of the Maddison project; re-estimating growth before 1820. Maddison-Project Working Paper WP-4, University of Groningen, January, 5

Bosserelle, É., 2015. Mouvements longs Kondratieff, transformations institutionnelles et performances du capitalisme. Revue française de socio-Economie, (1), pp.283-298.

Bossier, F. and Huge, P., 1981. Une vérification empirique de l'existence de cycles longs à partir de données belges. *Brussels Economic Review*, *90*, pp.253-267.

Calderon, C., Chong, A. and Stein, E., 2007. Trade intensity and business cycle synchronization: Are developing countries any different?. Journal of international Economics, 71(1), pp.2-21.

Cardoso, F.H. and Faletto, E., 1979. Dependency and development in Latin America (Dependencia y desarrollo en América Latina, engl.). Univ of California Press.

Casanova, L., 2005. Latin America: Economic and business context. The International Journal of Human Resource Management, 16(12), pp.2173-2188.

Cappelen, A., Castellacci, F., Fagerberg, J. and Verspagen, B., 2003. The impact of EU regional support on growth and convergence in the European Union. JCMS: Journal of Common Market Studies, 41(4), pp.621-644.

Christiano, L.J. and Fitzgerald, T.J., 2003. The band pass filter. *international economic review*, *44*(2), pp.435-465.

Cimoli, M., Porcile, G. and Rovira, S., 2010. Structural change and the BOP-constraint: why did Latin America fail to converge?. Cambridge Journal of Economics, 34(2), pp.389-411.

Cimoli, M. and Porcile, G., 2011. Global growth and international cooperation: a structuralist perspective. Cambridge Journal of Economics, 35(2), pp.383-400.

Cimoli, M. and Porcile, G., 2013. Technology, structural change and BOP-constrained growth: a structuralist toolbox. Cambridge Journal of Economics, 38(1), pp.215-237.

Juglar, C., 1889. Des crises commerciales et de leur retour périodique en France, en Angleterre et aux États-Unis. Guillaumin.

Combes & Guillaumon, 2002

Comin, D. and Gertler, M., 2006. Medium-term business cycles. *The American Economic Review*, *96*(3), pp.523-551.

Diebolt, C. and Doliger, C., 2006. Economic cycles under test: A spectral analysis. *NATO security through science series e human and societal dynami*cs, 5, p.39.

Diebolt, C. and Doliger, C., 2008. New international evidence on the cyclical behaviour of output: Kuznets swings reconsidered. *Quality & Quantity*, 42(6), pp.719-737.

Drehmann, M., Borio, C.E. and Tsatsaronis, K., 2012. Characterising the financial cycle: don't lose sight of the medium term!.

Eichengreen, B. and Hausmann, R. eds., 2010. *Other people's money: debt denomination and financial instability in emerging market economies*. University of Chicago Press.Michal Snyder (2010)

Erten, B. and Ocampo, J.A., 2013. Super cycles of commodity prices since the mid-nineteenth century. *World Development*, *44*, pp.14-30.

Fagerberg, J. and Verspagen, B., 1996. Heading for divergence? Regional growth in Europe reconsidered. JCMS: Journal of Common Market Studies, 34(3), pp.431-448.

Fajnzylber, F., 1990. Industrialización en América Latina: de la caja negra" al" casillero vacío": comparación de patrones contemporáneos de industrialización". Cepal.

Ffrench-Davis, R. and CEPAL, N., 2005. Macroeconomía, comercio y finanzas para reformar las reformas en América Latina. CEPAL.

Fisher, I., 1933. The debt-deflation theory of great depressions. *Econometrica: Journal of the Econometric Society*, pp.337-357.

Foster-McGregor, N., Kaba, I. and Szirmai, A., 2015. *Structural change and the ability to sustain growth* (No. 048). United Nations University-Maastricht Economic and Social Research Institute on Innovation and Technology (MERIT).

Fukuda, K., 2009. Measuring major and minor cycles in univariate economic time series. Economic Modelling, 26(5), pp.1093-1100.

Furtado, C.M., 1983. Breve introducción al desarrollo un enfoque interdisciplinario (No. 338.9 F8).

Furtado, C., 1970. Obstacles to development in Latin America (Vol. 747). Garden City, NY: Anchor Books.

Gabriel, L.F., Jayme, F.G. and Oreiro, J.L., 2016. A North-South model of economic growth, technological gap, structural change and real exchange rate. Structural Change and Economic Dynamics, 38, pp.83-94.

Gallegati, M., Gallegati, M., Ramsey, J.B. and Semmler, W., 2017. Long waves in prices: new evidence from wavelet analysis. *Cliometrica*, *11*(1), pp.127-151.

Goodwin, R.M., 1982. A growth cycle. In *Essays in Economic Dynamics* (pp. 165-170). Palgrave Macmillan UK.

Granger, C. W. J., & Hatanaka, M. (2015). Spectral Analysis of Economic Time Series.(PSME-1). Princeton university press.

Harding, D. and Pagan, A., 2006. Synchronization of cycles. Journal of Econometrics, 132(1), pp.59-79.

Hamilton, J.D., 2016. Why You Should Never Use the Hodrick-Prescott Filter. University of California, Working Paper.

Hodrick, R.J. and Prescott, E.C., 1997. Postwar US business cycles: an empirical investigation. *Journal of Money, credit, and Banking*, pp.1-16. (1980)

Jadevicius, A. and Huston, S., 2014. A "family of cycles"–major and auxiliary business cycles. *Journal of Property Investment & Finance*, 32(3), pp.306-323.

Juglar, C., 1862. IDes crises commerciales et de leur retour périodique en France. Angleterre et aux ÉtatsYUnis, PaperbacN, Adamant Media Corporation.

Kaldor, N., 1967. Strategic factors in economic development.

Kay, C., 2010. Latin American theories of development and underdevelopment (Vol. 102). Routledge.

Kitchin, J., 1923. Cycles and trends in economic factors. *The Review of economic statistics*, pp.10-16.

Kojima, K., 2000. The "flying geese" model of Asian economic development: origin, theoretical extensions, and regional policy implications. Journal of Asian Economics, 11(4), pp.375-401.

Kondratiev, N. D. 1935. The long waves in economic life, Review of Economic Statistics, no. 17, 105-15. Juglar(1862)

Korotayev, A.V. and Tsirel, S.V., 2010. A spectral analysis of world GDP dynamics: Kondratieff waves, Kuznets swings, Juglar and Kitchin cycles in global economic development, and the 2008–2009 economic crisis. *Structure and Dynamics*, *4*(1).

Kriegel, H.P., Kröger, P. and Zimek, A., 2009. Clustering high-dimensional data: A survey on subspace clustering, pattern-based clustering, and correlation clustering. ACM Transactions on Knowledge Discovery from Data (TKDD), 3(1), p.1.

Kuczynski, T., 1978, August. Kondratieff cycles—appearance or reality. In *Proceedings of the Seventh International Economic History Congress, Edinburgh*.

Kuznets S. 1930. Secular Movements in Production and Prices. Their Nature and their Bearing upon Cyclical Fluctuations. Boston: Houghton Mifflin.

Kuznets, S., 1940. Schumpeter's business cycles. *The American Economic Review*, pp.257-271.

Kydland, F.E. and Prescott, E.C., 1990. Business cycles: Real facts and a monetary myth. *Real business cycles: a reader*, *383*.

Larrain, F. and Sachs, J.D., 1986. Contractionary devaluation, and dynamic adjustment of exports and wages.

Lavopa, A. and Szirmai, A., 2014. Structural modernization and development traps: an empirical approach.

Lewis, W. Arthur (1978). Growth and Fluctuations 1870–1913. London: Allen & Unwin. pp. 33–68.

Maddison, Angus (2001). The World Economy. A millennial perspective. Paris, OECD.

Maddison, Angus (2003). The World Economy. Historical Statistics. Paris, OECD.

McCombie, J.S. and Spreafico, M.R., 2015. Kaldor's 'technical progress function'and Verdoorn's law revisited. Cambridge Journal of Economics, 40(4), pp.1117-1136.

Metz, R. and Stier, W., 1992. Filter design in the frequency domain. In *New Findings in Long-Wave Research* (pp. 45-79). Palgrave Macmillan UK.

Metzler, L.A., 1941. The nature and stability of inventory cycles. *The Review of Economics and Statistics*, *23*(3), pp.113-129.

Minsky, H.P., 1974. The modeling of financial instability: An introduction. *Modelling and Simulation*, *5*(1), pp.267-272.

Montoya, L.A. and de Haan, J., 2008. Regional business cycle synchronization in Europe?. International economics and economic Policy, 5(1-2), pp.123-137.

Ocampo, J.A., 2002. Rethinking the development agenda. Cambridge Journal of Economics, 26(3), pp.393-407.

Ocampo, J.A., 2008. A broad view of macroeconomic stability. The Washington consensus reconsidered, pp.63-94.

Ocampo, J.A., Rada, C. and Taylor, L., 2009. Growth and policy in developing countries: a structuralist approach. Columbia University Press.

Perez, C., 2009. Technological revolutions and techno-economic paradigms. *Cambridge journal of economics*, p.bep051.

Caldentey, E.P. and Vernengo, M., 2010. Back to the future: Latin America's current development strategy. Journal of Post Keynesian Economics, 32(4), pp.623-644.

Pollock, D.S.G., 2014. Cycles, syllogisms and semantics: Examining the idea of spurious cycles. Journal of Time Series Econometrics, 6(1), pp.81-102.

Prebisch, R., 1951. The economic development of Latin America and its principal problems. Economic Bulletin for Latin America. Economic Commission for Latin America – United Nations.

Rostow, W. W. (1975). Kondratieff, Schumpeter, and Kuznets: trend periods revisited. *The Journal of Economic History*, *35*(04), 719-753.

Schumpeter, J.A., 1939. *Business cycles* (Vol. 1, pp. 161-74). New York: McGraw-Hill.

Shin, K. and Wang, Y., 2003. Trade Integration and Business Cycle Synchronization in East Asia. Institute of Social and Economic Research, Osaka University.

Silverberg, G.; Verspagen, B. (2000). Breaking the Waves: A Poisson Regression Approach to Schumpeterian Clustering of Basic Innovations. Maastricht: MERIT.

Sismondi, J.C.L. Simonde de. 1966 (1815). Political Economy. New York: Augusts M. Kelley

Sismondi, J.C.L. 1991 [1819]. New Principles of Political Economy. Richard Hyse, Translator and Annotator. Foreword by Robert Heilbroner. New Brunswick, NJ: Transaction Publishers

Soares, M.J., 2011. Business cycle synchronization and the Euro: A wavelet analysis. Journal of Macroeconomics, 33(3), pp.477-489.

Stiglitz, J.E., 2000. Capital market liberalization, economic growth, and instability. *World development*, *28*(6), pp.1075-1086.

Sunkel, O., 1972. Big Business and" Dependencia": a latin american view. Foreign Affairs, 50(3), pp.517-531.

Szirmai, A., 2012. Industrialisation as an engine of growth in developing countries, 1950–2005. Structural Change and Economic Dynamics, 23(4), pp.406-420.

Szirmai, A. and Verspagen, B., 2015. Manufacturing and economic growth in developing countries, 1950–2005. Structural Change and Economic Dynamics, 34, pp.46-59.

Taylor, L., 1991. Income distribution, inflation, and growth: lectures on structuralist macroeconomic theory. MIT Press.

Tobin, J., 1975. Keynesian models of recession and depression. *The American Economic Review*, *65*(2), pp.195-202.

Thirlwall, A.P., 1979. The balance of payments constraint as an explanation of the international growth rate differences. PSL Quarterly Review, 32(128).

Van Ewijk, C., 1981. The long wave—a real phenomenon?. *De Economist*, *129*(3), pp.324-372.

Verdoorn, P.J., 1949. Fattori che regolano lo sviluppo della produttivita del lavoro. Ed. L'industria.

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