Towards the Latin-American Union and the Latin-American Peso (LAT)

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Abstract— **Objective.** To propose the creation of a Latin-American Union and support it with solid arguments such as the creation of the Latin-American peso (LAT) as the common currency. **Methodology.** Analysis and synthesis proposing theory and reviewing its validity. **Results.** The LAT seems to be a robust enough currency. **Limitations.** Several questions remain: Should the LAT be exchanged for USD? How to finance the Latin-American Central Bank? Would the LAT create inflation?, among others. **Originality.** The idea for the LAT is completely original, although the Latin-American Union idea has considerably history. **Conclusions.** The LAT promises to be a good option for stabilizing Latin-American and promote its regional development.

***Index Terms*— Latin-American Union; LAT; money**

I. Introduction

Latin America includes all sovereign Spanish, Portuguese and French speaking countries in North America, Central America and South America. These countries share a common ancestry language: Latin. Hence, the term Latin America. Table 1 shows all 20 sovereign Latin American countries and some relevant information about them. Figure 1a shows all Latin American countries and the four common subregions in which they are located. Figure 1b shows the proposed shield for the Latin-American Union. Figure 1c shows the proposed Latin-American Union Flag.

What do these countries need to have in common in order to be considered a part of Latin America? First, they all need to share the same geographical location, which is being in the American continent south of the United States. Second, they should share the same cultural heritage from the late Roman empire and the Latin root of their respective languages (hence the term Latin America). Third, they all need to be independent, sovereign nations, whose sovereignty was either granted by decree from their colonizing countries or gained through an Independence war.

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Table 1. Relevant information of all 20 sovereign Latin American countries.

No.	Flag	Name	Area (km^2)	Population (2016)	Population Density	Capital
1		Argentina	2,780,400	43,847,430	14.40	Buenos Aires
2		Bolivia	1,098,581	10,887,882	9.00	Sucre and La Paz
3		Brazil	8,515,767	207,652,865	23.60	Brasília
4		Chile	756,096	17,909,754	23.00	Santiago
5		Colombia	1,141,748	48,653,419	41.50	Bogotá
6		Costa Rica	51,100	4,857,274	91.30	San José
7		Cuba	109,884	11,475,982	100.60	Havana
8		Dominican Republic	48,442	10,648,791	210.90	Santo Domingo
9		Ecuador	283,560	16,385,068	54.40	Quito
10		El Salvador	21,040	6,344,722	290.30	San Salvador
11		Guatemala	108,889	16,582,469	129.00	Guatemala City
12		Haiti	27,750	10,847,334	350.00	Port-au-Prince
13		Honduras	112,492	9,112,867	76.00	Tegucigalpa
14		Mexico	1,964,375	127,540,423	57.00	Mexico City
15		Nicaragua	130,375	6,149,928	44.30	Managua
16		Panama	75,517	4,034,119	54.20	Panama City
17		Paraguay	406,752	6,725,308	14.20	Asunción
18		Peru	1,285,216	31,773,839	23.00	Lima
19		Uruguay	176,215	3,444,006	18.87	Montevideo
20		Venezuela	916,445	31,568,179	31.59	Caracas
		Total	20,010,644	626,441,659		

The purpose of this paper is to set the rationale, historical and socio-economic basis for the creation of a Latin-American union. The first basis for the creation of a Latin-American union are the three characteristics discussed in the previous paragraph that the countries being considered to be members of the Latin-American union all share. There are seven other countries that do share the same geographical location, which is to be in the American continent south of the United States, but are not independent or sovereign national states: Belize, French Guiana, Guadeloupe, Martinique, Puerto Rico, Saint Barthélemy, and Saint Martin.

The second issue of relevance in order to be able to create a Latin-American union is the economical basis for such union, that is, to be able to have one common currency, which it is proposed to be called the Latin-American peso (or LAT in short). A robust, consistent and reasonable way to value such currency versus the local currencies of all of the twenty

Latin-American countries being considered is proposed and fully discussed in this paper.

Figure 1. Subregions in Latin America and Latin-American Union Shield and Flag

a. Subregions in Latin America

b. Latin-American Union Shield

c. Latin-American Union Flag

Due to data availability reasons, the valuation of the LAT is analyzed and discussed only for the case of nine out of the twenty potential Latin-American union members: Argentina (having the Argentinian peso or ARS as their local currency), Brazil (Brazilian real or BRL), Chile (Chilean peso or CLP), Colombia (Colombian peso or COP), Costa Rica (Costa-Rican colon or CRC), Mexico (Mexican peso or MXN), Peru (Peruvian nuevo sol or PEN), Uruguay (Uruguayan peso or UYU) and Venezuela (Venezuelan bolivar soberano or VEF).

Concepts such as the Big Mac index (The Economist, 2019), inflation (Fischer, Dornbusch, & Schmalensee, 1990; Friedman, 2008) and the value of money through time (Newnan, 1988; Copertari Isaacson, 2014), Purchasing Power Parity or PPP (Krugman, Obstfeld, & Melitz, 2018) and complementary currencies (Hallsmith & Lietaer, 2011; Lietaer, 2001; Greco, Jr., 2009; Lietaer & Dunne, 2013) are considered in this paper. The reason why only nine out of the twenty Latin-American union candidates are analyzed is because of the data availability for this study of the Big Mac index, which plays a central role in the valuation of the LAT. The dream of a Latin-American union is not new. Independence heroes such as Simón Bolívar, José de San Martín, José Martí and Miguel Hidalgo y Costilla have historically championed these ideas, being Simón Bolívar the most outspoken one about it (Arana, 2013; Bushnell, 1970; Harvey, 2000; Crow, 1980; Holden & Zolov, 2000).

The two basic data sources are the Big Mac index spreadsheet (The Economist, 2019; The Big Mac Index Spreadsheet, 2019) for the historical price of a Big Mac in the respective local currencies from April 2000 to October 2019 (the actual dates for the data collected are April 2000, April 2001, April 2002, April 2003, May 2004, June 2005, January 2006, May 2006, January 2007, June 2007, June 2008, July 2009, January 2010, July 2010, July 2011, January 2012, July 2012, January 2013, July 2013, January 2014, July 2014, January 2015, July 2015, January 2016, July 2016, January 2017, July 2017, January 2018 and October 2019), and the Banco de Mexico public data source for the value of the United States dollar (USD) with respect to the local currencies for the same period for all nine countries being analyzed (Banco de México, 2019).

II. Theory

2.1. Price indices

There are innumerable ways of compiling price indices. Price indices essentially measure how price levels evolve through time. Typically, a representative basket of goods and/or services for a given economy is selected. Any given such index can then be used in order to calculate inflation, which is the annual percentage by which the level of prices in a price index rises.

The Big Mac index measures the value of a Big Mac through time given in the local currency of the country being considered. A Big Mac can be considered a price index representative enough, since a Big Mac has vegetables, cheese, meat, bread, spices (at least mayonnaise) and human labor. No price index is perfect, and for the purposes of this paper, the Big Mac index is considered to be representative enough. Of course, it is possible to use other indices, such as the price of an iPhone in case the price index should lean towards a more technological basis.

2.2. Inflation measurement

Inflation is typically defined as the generalized increase in prices in a given year. In order to measure inflation, we need a set of two prices in time and the amount of time elapsed between these moments in which these two prices were obtained. The prices under consideration should somehow reflect the prices of all goods and services in any given economy.

To illustrate, consider there are two consumer prices: C_t and C_{t-1}, which correspond to times t and the previous time t-1. In order to simplify, suppose we are considering the price of a Big Mac between January 1, 2018 and January 1, 2019. There is one year between these two prices. Also, suppose that the price of a Big Mac in January 1, 2018 was USD $4.00 and the price of the same Big Mac in January 1, 2019 was USD $5.00. For this, the (yearly or annualized) rate of inflation was (($5.00 - $4.00)/$4.00)×100% = ($1.00/$4.00)×100% = 0.25×100% = 25%. That is, between 2018 and 2019 the inflation rate as being measured by the price of a Big Mac rose 25%. If such price (the price of a Big Mac) more or less reflects the general trend of all the prices of such imaginary economy, then it can be said the inflation in 2019 was 25%. In typical economic situations, the Consumer Price Index is

used. For the case of this paper, we use the price of a Big Mac as assumed to properly reflect the Consumer Price Index.

Thus, the equation required to calculate the yearly rate of inflation for year t (R_t), where C_{t-1} is the Consumer Price Index (or for the case of this paper the consumer price of a Big Mac) at year t-1 and C_t is the Consumer Price Index (consumer price of a Big Mac) at year t (Fischer, Dornbusch, & Schmalensee, 1990) is given according to equation (1).

$$R_t = \frac{C_t - C_{t-1}}{C_{t-1}} \times 100\% \quad (1)$$

However, this requires having the price of a Big Mac in January 1, 2018 and January 1, 2019. The data available for the Big Mac index is not always yearly, but rather monthly and for months other than January. To simplify, suppose we have the price of a Big Mac in January 1, 2018 and April 1, 2018. The number of days between these two dates is 3 months × 30 days per month = 90 days, or roughly ¼ of a year. So, if the price of a Big Mac in January 1, 2018 was USD $4.00 and the price of a Big Mac in April 1, 2018 was USD $4.25, then the inflation rate at April 1, 2018 was ($4.25-$4.00)/$4.00×100% = 6.25% for one trimester. Since there are four trimesters in a year, the approximated rate of inflation for the year was 6.25%×4 = 25%.

Nevertheless, the previous analysis assumes a nominal increase in the inflation between quarters. This is not the typical case. If the price in April 1, 2018 was $4.25, a 6.25% increase per quarter will mean a price of $4.25×1.0625 = $4.515625 for July 1, 2018, which is slightly larger than $4.25+$0.25 = $4.50, because prices rise not only upon the initial price but also upon the increment of $0.25 occurred between January 1, 2018 and April 1, 2018.

Consequently, let d_t be the date at time t, d_{t-1} be the date at time t-1, C_t be the consumer price at time t, C_{t-1} be the consumer price at time t-1 and the number of days in a year assumed to be 365.25 days (because 1 out of 4 years is a leap year with 366 days instead of 365 days), then equation (2) gives the yearly (annualized) rate of inflation at time t (R_t). The inflation rate from equation (2) is known as a compound inflation rate. Refer to compound interest rate (or rather compound rate of return) in order to understand equation (2) if necessary (Copertari Isaacson, 2014; Newnan, 1988).

$$R_t = \left(\left(\frac{C_t - C_{t-1}}{C_{t-1}} + 1\right)^{\frac{365.25}{d_t - d_{t-1}}} - 1\right) \times 100\% = \left(\left(\frac{C_t}{C_{t-1}}\right)^{\frac{365.25}{d_t - d_{t-1}}} - 1\right) \times 100\% \quad (2)$$

Applying equation (2) to our example, gives R_2 = (((4.25-4)/4+1)$^{(365.25/91)}$-1)×100% ≈ 27.54910517% per year, which is the annualized inflation rate at the second quarter of 2018 (between April 1, 2018 and July 1, 2018).

2.3. Implied versus official value of a local currency with respect to the United States dollar (over or under USD valuation)

Let $P_{k,t}$ be the price of a Big Mac for Latin-American country k at time t, given in the local currency, where t is any date between April 2000 and October 2019 and k = 1, …, 20 is anyone of the twenty Latin-American countries as listed in Table 1 (k = 0 is the price of a Big Mac in United States dollars or USD). Table 2 shows nine candidate twenty Latin-American countries having Big Mac data and their corresponding currencies.

Table 2. Currencies for nine candidate Latin American countries.

Number (k)	Country	Currency	Currency Symbol
1	Argentina	Peso	ARS
3	Brazil	Real	BRL
4	Chile	Peso	CLP
5	Colombia	Peso	COP
6	Costa Rica	Colon	CRC
14	Mexico	Peso	MXN
18	Peru	Nuevo Sol	PEN
19	Uruguay	Peso	UYU
20	Venezuela	Bolivar Soberano	VEF

Then, the implied price of any given local currency in USD for country k at time t ($I_{k,t}$) is given according to equation (3), where $P_{k,t}$ is the price of a Big Mac for country k at time t given in the local currency of country k, and $P_{0,t}$ is the price of a Big Mac for the United States given in United States dollars (USD).

$$I_{k,t} = \frac{P_{k,t}}{P_{0,t}}, k = 1, \ldots, 20 \quad (3)$$

The rationale for equation (3) is as follows. Let us consider Mexico as an example for October 2019 (k = 14, t = October 2019). The local currency in Mexico is the peso (MXN). For time t = October 2019, a Big Mac in Mexico costs $P_{14,\text{Oct 2019}}$ = $48.94 MXN/Big Mac. At the same time, a Big Mac in the United States costs $P_{0,\text{Oct 2019}}$ = $5.58 USD/Big Mac. If we divide these two numbers, we get:

$I_{14,\text{Oct 2019}}$ = ($48.94 MXN/Big Mac)/($5.58 USD/Big Mac) = $8.77 MXN/USD.

That is the implied price of the Mexican peso with respect to the United States dollar. It is the actual value the USD should be worth in MXN.

Also, let $O_{k,t}$ be the official price of the local currency of Latin-American country k at time t given in local currency per USD. For our example, $O_{14,\text{Oct 2019}}$ = $19.16 MXN/USD. That means the USD is overvalued in Mexico for October 2019, because the official price is much higher than the price suggested by a Big Mac, the latter indicating the underlying relationships between the two countries. Thus, let $V_{k,t}$ be the over or under valuation of currency for country k at time t. Then, equation (4) applies.

$$V_{kt} = \left(\frac{O_{k,t} - I_{k,t}}{I_{k,t}}\right) \times 100\%, k = 1, \ldots, 20 \quad (4)$$

In our example, we have:
$V_{14,Oct\ 2019}$=($19.16 MXN/USD - $8.77 MXN/USD)/($8.77 MXN/USD)×100% = 118.47%

That means the USD is overvalued with respect to the MXN in 118.47%, that is, the USD is officially worth 2.1847 times more than it should in MXN per USD (MXN/USD), which is considerable. The same analysis can be carried out for other countries and other times.

It is also useful to calculate the price of a Big Mac in USD. Let $B_{k,t}$ be the price of a Big Mac in USD (USD/Big Mac). That calculation is carried out using equation (5).

$$B_{k,t} = \frac{p_{k,t}}{o_{k,t}}, k = 1, \dots, 20 \quad (5)$$

In our example, that is:
$B_{14,Oct\ 2019}$ = ($48.94 MXN/Big Mac)/($19.16 MXN/USD) = $2.55 USD/Big Mac

2.4. LAT valuation, complementary currencies and LAT monetary supply

What should the value of one Latin-American peso (LAT) be? Let $L_{k,t}$ be the value of one LAT in the local currency of Latin-American country k at time t. Then, in order not to incur in over or under valuation of the LAT, the value of the LAT is made equal to the implied price of a Big Mac in USD as indicated in equation (6).

$$L_{k,t} = I_{k,t} = \frac{p_{k,t}}{p_{0,t}}, k = 1, \dots, 20 \quad (6)$$

What kind of currency is the LAT? That requires tackling the definition of money. But, what is money? According to Harvey (2014) money is "a means whereby I can make a claim on the social labour of others: that is, a claim in that labour which is expended on the production of goods and services for others in the marketplace." (p. 25).

To really understand money requires us to immerse ourselves deeply into the issue. In order to start understanding what money is, it is useful to consider the historical evolution of money. Greco, Jr. (2009) identifies five types of money: a) barter trade, b) commodity money, c) symbolic money, d) credit money, and e) credit clearing.

Barter trade is the first and most basic way of exchanging goods and services. If A has something that B needs and B has something that A needs, they could agree on exchanging given quantities of such products or services. It could get more complicated if A has something that B needs, B has something that C needs and C has something that A needs, thus completing the exchange circle. Barter trade was the first step in human civilization towards goods and services exchange. Commodity money is based on a good or service that has intrinsic value (use value) in itself and can be used to perform the function of exchange value. Examples are cigarettes, coffee seeds, gold, and so on. Symbolic money are receipts received for a deposit of seeds, gold or some other valuable good that can be used as exchange money. Credit money is one of the actual form monies takes place today. For example, a mortgage on a house is given in exchange for credit on a bank account (although such credit is actual money to be used). The concept of fractional deposits or fractional reserve banking is very important here (McLeay, Radia, & Thomas, 2014). Banks only do have a fraction on a real deposit for the credit they issue. This fact is responsible for a large number of economic crises (Hallsmith & Lietaer, 2011; Lietaer & Dunne, 2013). Finally, there is potential for the use of a credit clearing system, in which A owes to B, B owes to C, C owes to D and D owes to A (or any other more complex arrangement) and all transactions are cleared tending to a zero balance (when things operate properly). The latter is the potential for a new form of money based on electronic clearing transactions. Most forms of complementary currencies operate based on this principle.

Table 3 shows different types of complementary currencies.

Table 3. Complementary currencies classification.

Type of complementary currency	Complementary currencies examples
Business to Business	Barter Industry "Trade Dollars"
Local/Regional	Bristol Pounds, Ithaca HOURs, Banco Palma
Time	Time Dollars, Credits AKA "Time Banking"
Social Purpose	Nu-Spaarpas, HERO Rewards "Merits"
Loyalty	Frequent Flyer Miles, Coffee Cards
Reputation	Ebay, Amazon Seller Ratings
Cryptographic	Bitcoin, Ripple, Ethereum

The LAT is a Local/Regional type of complementary currency. However, there is one very important characteristic: the LAT is meant to have legal tender in Latin America. That is, if I go to a bank in Mexico with one LAT, I should be able to get the corresponding number of MXN in return, or if I go to an Argentinian bank with a given quantity of ARS, I should be able to get the corresponding number of LATs. The LAT is meant to be used as a means of exchanging local currencies within all Latin-American countries participating in the Latin-American union.

Thus, the next natural question to ask is: how many LATs should the Latin-American Central Bank (thus created) place into circulation? Apparently, the value of the LAT is not dependent on the number of LATs circulating, but on the implicit value of a Big Mac in Latin America compared to the value of the same Big Mac in the United States. Nevertheless, it is clear that too few or too many LATs are not a good idea. Consequently, the number of LATs in circulation should be exactly the ones required to make a complete conversion of any given local currency in one Latin-American country into another one.

To illustrate with a simple example, suppose the only product or service in the economy is a Big Mac burger. Let $Q_{k,t}$ be the number of Big Macs produced in Latin-American country k at time t. Thus, the total amount of money in circulation in the economy of Latin-American country k at time t ($N_{k,t}$) is the price of a Big Mac multiplied by the quantity of Big Macs produced, as indicated in equation (7).

$$R_{k,t}Q_{k,t} = N_{k,t}, k = 1, \dots, 20 \quad (7)$$

Thus, $Q_{k,t}$ can be solved from equation (7), which is shown in equation (8).

$$Q_{k,t} = \frac{N_{k,t}}{P_{k,t}}, k = 1, \dots, 20 \quad (8)$$

Notice that the quantity of Big Macs, for being the Big Mac the only product or service in this imaginary economy, is equal to the monetary supply of LATs that should be place in circulation, for being the Big Mac the only source of wealth in this illustrative economy (Harvey, 2010), since by definition the value of one LAT is the value of one Big Mac burger.

In the real world a Big Mac is not the only burger sold by McDonald's, nor is the Big Mac, by far, the only product or service of the economy. Nevertheless, it should be relatively straightforward to determine the value in local currency of all McDonald's sales, which gives the value of $N_{k,t}$. The price of a Big Mac ($P_{k,t}$) is well known. Thus, the equivalent quantity of Big Macs ($Q_{k,t}$) can be calculated from equation (8). However, this value is not the monetary supply of LATs for Latin-American country k at time t, because there are plenty others goods and services to be considered. What can we do?

Let w_k be relative weight of all of McDonald's sales out of the economy of Latin-American country k. Then, the actual amount of local currency circulating in economy k at time t ($N'_{k,t}$) is given by equation (9).

$$N'_{k,t} = \frac{N_{k,t}}{w_k}, k = 1, \dots, 20 \quad (9)$$

Consequently, the number of LATs that need be placed in economy k at time t ($M_{k,t}$) is given by equation (10).

$$M_{kt} = \frac{N'_{k,t}}{P_{k,t}}, k = 1, \dots, 20 \quad (10)$$

The total number of LATs that need be available throughout all Latin-American countries participating in the Latin-American union at time t (M_t) is given by equation (11).

$$M_t = \sum_{k=1}^{20} M_{kt} \quad (11)$$

Clearly, because of their relative weight and importance, the three Latin-American countries that are considered to become the engine of the Latin-American union are Argentina, Brazil and Mexico. In the Appendix, an illustrative demonstration of the calculations required is given for these three countries.

Alternatively, we could use the Gross Domestic Product given at the corresponding Purchasing Power Parity or GDP (PPP). Let $G_{k,t}$ be the GDP (PPP) for country k at year t, which is given in USD. In order to convert that to the local currency, we need to multiply it by the implied value of the local currency per LAT ($I_{k,t}$) as indicated by equation (12), which gives us the money supply of country k at year t ($S_{k,t}$).

$$S_{k,t} = G_{kt} I_{kt}, k = 1, \dots, 20 \quad (12)$$

However, $S_{k,t}$ is not the amount of money in circulation in country k during year t, because such money circulates throughout the economy several times. Let $T_{k,t}$ be the number of times the money circulates in economy k at time t. Then, the actual amount of local currency circulating in country k during year t ($N'_{k,t}$) is given according to equation (13).

$$N'_{k,t} = \frac{S_{k,t}}{T_{k,t}}, k = 1, \dots, 20 \quad (13)$$

Having $N'_{k,t}$, it is possible to calculate $M_{k,t}$ and M_t according to equations (10) and (11), respectively.

2.5. Purchasing Power Parity (PPP)

A practical definition of Purchasing Power Parity (PPP) in the context of our discussion is simply how in excess or in lack the official value of the USD is with respect to the implied value of the USD. Thus, let $PPP_{k,t}$ be the PPP for Latin-American country k at time t, then equation (14) gives the corresponding PPP.

$$PPP_{k,t} = \frac{U_{k,t}}{I_{k,t}}, k = 1, \dots, 20 \quad (14)$$

Notice that the PPP gives the same information as the over or under valuation of the USD ($V_{k,t}$), with the exception that $V_{k,t}$ is in percentage points and it is less in one unit with respect to the $PPP_{k,t}$.

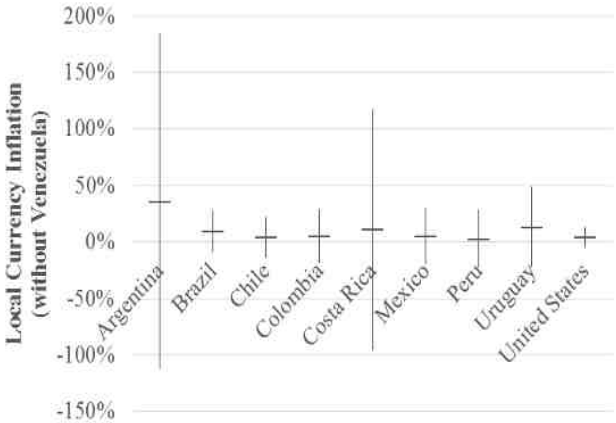
III. Results

A thorough analysis of the data obtained for this study was carried out by conveniently applying equations (1) to (14) as required. The first such analysis was to calculate the inflation rate of the price of a Big Mac in local currency, including the United States. Then, the average (mean) annualized inflation rate was calculated as well as the typical deviation (T.D. or standard deviation). According to the central limit theorem and assuming a normal distribution of the data (Kvanli, Guynes, & Pavur, 1989), 95% of the data will be between the mean ± 2×T.D. This is shown in Table 4. Table 4 is illustrated in Figure 2. Notice that Figure 2 does not include the data for Venezuela for being such values extreme outliers clouding the rest of the data.

Table 4. Mean ± 2×T.D. of annualized inflation rates for the price of a Big Mac.

Country	Mean	Mean+2×T.D.	Mean-2×T.D.
Argentina	36.10%	184.58%	-112.39%
Brazil	9.89%	28.11%	-8.34%
Chile	4.13%	22.20%	-13.95%
Colombia	5.29%	28.63%	-18.06%
Costa Rica	11.28%	117.87%	-95.32%
Mexico	5.27%	29.63%	-19.09%
Peru	2.83%	28.60%	-22.95%
Uruguay	13.49%	48.70%	-21.73%
Venezuela	1569.65%	14488.11%	-11348.81%
United States	4.44%	13.17%	-4.29%

Figure 2. Mean ± 2×T.D. of annualized inflation rates for the price of a Big Mac.

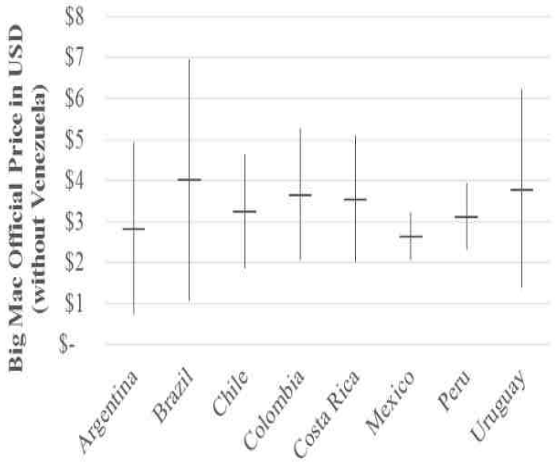


The price of a Big Mac in USD was calculated as indicated by equation (5). The mean ± 2×T.D. results are shown in Table 5 and illustrated in Figure 3. Once again, Figure 3 is without Venezuela to avoid outliers clouding display of results in the chart.

Table 5. Mean ± 2×T.D. of the price of a Big Mac in USD.

Country	Mean	Mean+2×T.D.	Mean-2×T.D.
Argentina	$ 2.84	$ 4.92	$ 0.76
Brazil	$ 4.02	$ 6.96	$ 1.09
Chile	$ 3.26	$ 4.64	$ 1.88
Colombia	$ 3.66	$ 5.28	$ 2.05
Costa Rica	$ 3.56	$ 5.09	$ 2.03
Mexico	$ 2.64	$ 3.22	$ 2.07
Peru	$ 3.13	$ 3.94	$ 2.31
Uruguay	$ 3.79	$ 6.20	$ 1.38
Venezuela	$ 880.78	$ 3,525.71	$ 0.00

Figure 3. Mean ± 2×T.D. of the price of a Big Mac in USD.

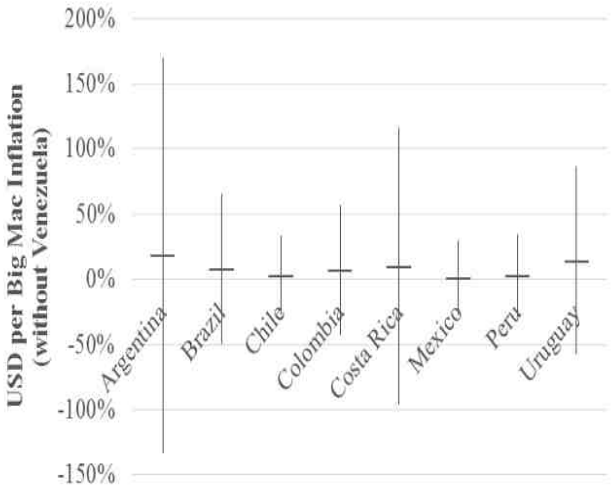


The annualized inflation of the price of a Big Mac in USD given according to equation (2) was calculated. Such results are shown in Table 6 and Figure 4. Figure 4 does not include Venezuela for being its results too extreme to chart.

Table 6. Mean ± 2×T.D. of the annualized inflation for the price of a Big Mac in USD.

Country	Mean	Mean+2×T.D.	Mean-2×T.D.
Argentina	18.54%	170.39%	-133.32%
Brazil	8.15%	65.43%	-49.13%
Chile	3.05%	33.18%	-27.08%
Colombia	6.81%	56.59%	-42.96%
Costa Rica	10.14%	115.90%	-95.63%
Mexico	1.25%	29.50%	-27.01%
Peru	2.65%	33.75%	-28.45%
Uruguay	14.48%	86.04%	-57.08%
Venezuela	3831.79%	31114.28%	-23450.71%

Figure 4. Mean ± 2×T.D. of the annualized inflation for the price of a Big Mac in USD.

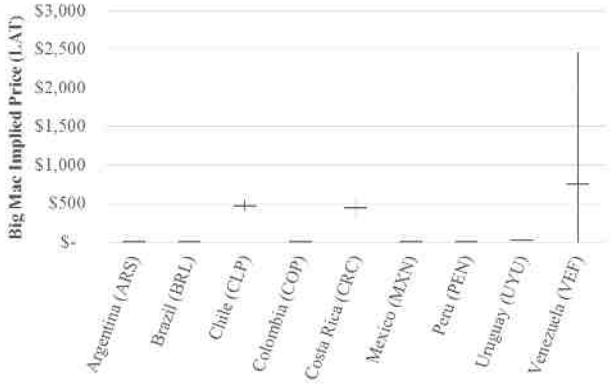


The average Big Mac implied price as calculated by equation (3) which equals the value of the LAT in local currency as indicated by equation (6) given by the mean ± 2×T.D. of the results are shown in Table 7 and Figure 5. Notice that in the cases in which the value for the mean - 2×T.D. was negative, a zero was used. Also, Venezuela is included because if it not were included, the values for Chile and Costa Rica would still make the chart useless.

Table 7. Mean ± 2×T.D. of the implied value of the Big Mac (value of the LAT) in local currencies.

Country	Mean	Mean+2×T.D.	Mean-2×T.D.
Argentina (ARS)	$ 4.84	$ 12.60	$ 0.00
Brazil (BRL)	$ 2.35	$ 3.45	$ 1.25
Chile (CLP)	$ 474.18	$ 537.23	$ 411.12
Colombia (COP)	$ 1.97	$ 2.34	$ 1.60
Costa Rica (CRC)	$ 443.32	$ 586.51	$ 300.13
Mexico (MXN)	$ 8.88	$ 10.07	$ 7.70
Peru (PEN)	$ 2.45	$ 3.33	$ 1.57
Uruguay (UYU)	$ 21.07	$ 29.38	$ 12.75
Venezuela (VEF)	$ 749.54	$ 2,467.99	$ 0.00

Figure 5. Mean ± 2×T.D. of the implied value of the Big Mac (value of the LAT) in local currencies.

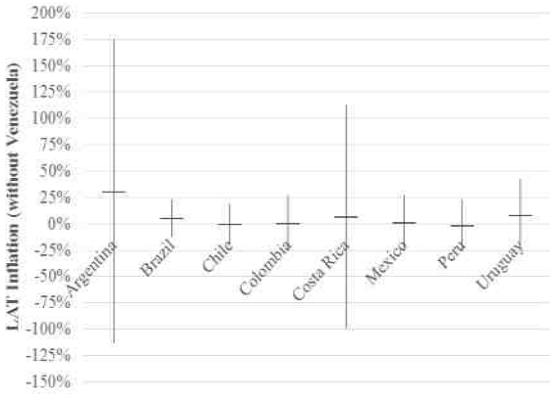


The annualized inflation of the previous data was also calculated. This is the LAT inflation in local currencies. Table 8 and Figure 6 show the mean ± 2×T.D. of the inflation for the value of a Big Mac in USD (inflation for the LAT).

Table 8. Mean ± 2×T.D. of the annualized inflation for the implied value of the Big Mac (inflation in the value of the LAT) in local currencies.

Country	Mean	Mean+2×T.D.	Mean-2×T.D.
Argentina	30.68%	174.65%	-113.30%
Brazil	5.43%	22.98%	-12.13%
Chile	-0.02%	18.94%	-18.98%
Colombia	0.69%	26.81%	-25.43%
Costa Rica	6.66%	112.47%	-99.15%
Mexico	1.11%	26.74%	-24.52%
Peru	-1.72%	22.66%	-26.09%
Uruguay	8.33%	42.28%	-25.61%
Venezuela	1497.42%	13856.25%	-10861.42%

Figure 6. Mean ± 2×T.D. of the annualized inflation for the implied value of the Big Mac (inflation in the value of the LAT) in local currencies.



The historical USD over or under valuation as indicated by equation (4) is shown in Figure 7. Notice that some countries have no data available for some dates. Also, Table 9 and Figure 8 show the mean ± 2×T.D. of such over or under valuation historical results.

Table 9. Mean ± 2×T.D. of the USD over or under valuation.

Country	Mean	Mean+2×T.D.	Mean-2×T.D.
Argentina	57.79%	201.39%	-85.81%
Brazil	8.42%	70.85%	-54.01%
Chile	22.50%	59.20%	-14.20%
Colombia	20.65%	88.68%	-47.39%
Costa Rica	21.76%	63.32%	-19.79%
Mexico	50.14%	116.81%	-16.52%
Peru	29.97%	77.45%	-17.51%
Uruguay	23.12%	110.97%	-64.73%
Venezuela	-66.63%	2.22%	-135.48%

Figure 7. Historical USD over or under valuation.

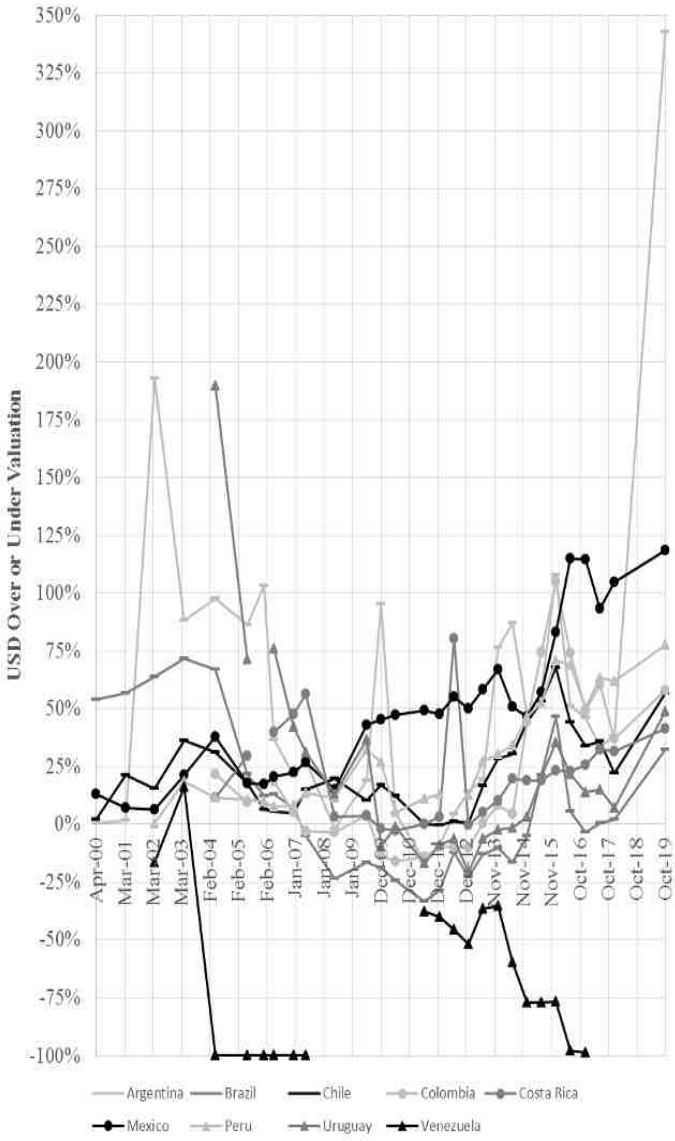


Figure 8. Mean ± 2×T.D. of the USD over or under valuation.

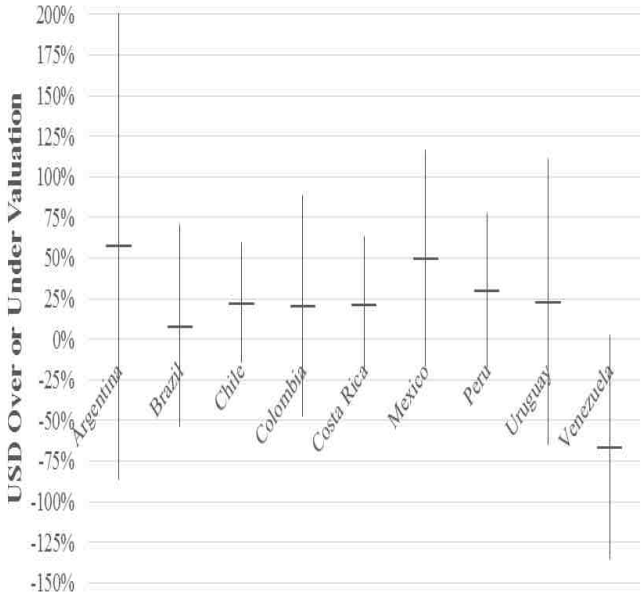


Figure 9 shows the historical Purchasing Power Parity (PPP) as calculated according to equation (14). Also, Table 10 and Figure 10 show the mean ± 2×T.D. of such Purchasing Power Parity (PPP) calculations.

Table 10. Mean ± 2×T.D. of the Purchasing Power Parity (PPP) calculations.

Country	Mean	Mean+2×T.D.	Mean-2×T.D.
Argentina (ARS)	1.5779	3.0139	0.1419
Brazil (BRL)	1.0842	1.7085	0.4599
Chile (CLP)	1.2250	1.5920	0.8580
Colombia (COP)	1.2065	1.8868	0.5261
Costa Rica (CRC)	1.2176	1.6332	0.8021
México (MXN)	1.5014	2.1681	0.8348
Peru (PEN)	1.2997	1.7745	0.8249
Uruguay (UYU)	1.2312	2.1097	0.3527
Venezuela (VEF)	0.3337	1.0222	0.0000

Figure 9. Historical Purchasing Power Parity (PPP).

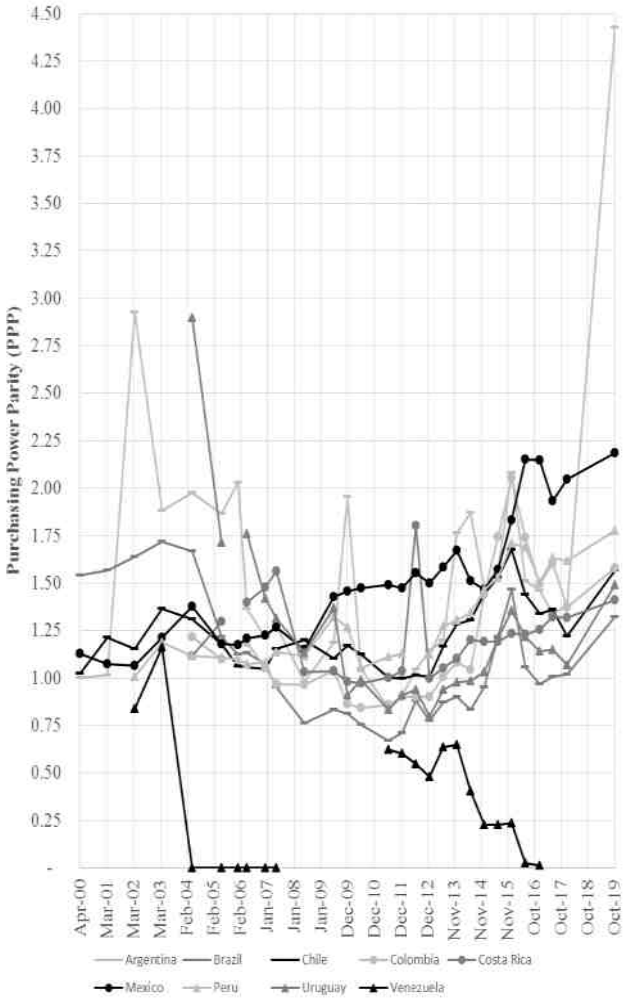
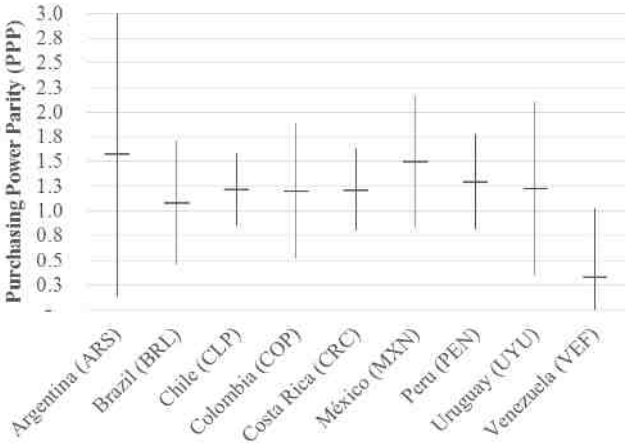


Figure 10. Mean ± 2×T.D. of the Purchasing Power Parity (PPP) calculations.



Finally, Table 11 and Figure 11 show an inflation comparison of the average for the local currency versus the LAT, whereas Table 12 and Figure 12 show a currency comparison between the average value of the USD and the LAT. Table 13 calculates the LAT supply according to equations (10) to (13).

Table 11. Average inflation comparison between the local currency and the LAT.

Country	Local currency	LAT
Argentina	36.10%	30.68%
Brazil	9.89%	5.43%
Chile	4.13%	-0.02%
Colombia	5.29%	0.69%
Costa Rica	11.28%	6.66%
Mexico	5.27%	1.11%
Peru	2.83%	-1.72%
Uruguay	13.49%	8.33%
Venezuela	1569.65%	1497.42%

Figure 11. Average inflation comparison between the local currency and the LAT.

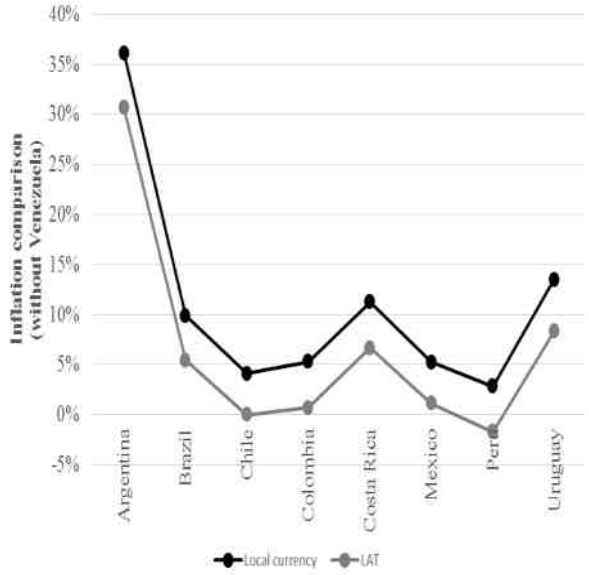


Table 12. Currency comparison between the average value of the USD and the average value of the LAT.

Country	USD		LAT	
Argentina (ARS)	$	8.27	$	4.84
Brazil (BRL)	$	2.47	$	2.35
Chile (CLP)	$	578.65	$	474.18
Colombia (COP)	$	2.34	$	1.97
Costa Rica (CRC)	$	500.57	$	443.32
Mexico (MXN)	$	13.38	$	8.88
Peru (PEN)	$	3.12	$	2.45
Uruguay (UYU)	$	23.68	$	21.07
Venezuela (VEF)	$	997.69	$	749.54

Figure 12. Currency comparison between the average value of the USD and the average value of the LAT.

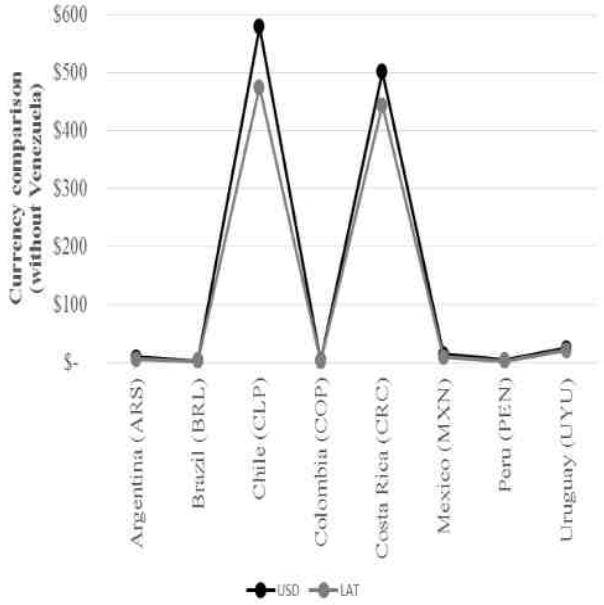


Table 13. LAT supply for 2015 ($T_{k,2015} = 4$).

k	Country	GDP (PPP) in 2015 (millions of USD)	$S_{k,2015}$ (Millions in Local Currency)	$N'_{k,2015}$ (Millions in Local Currency)	$M_{k,2015}$ (Millions of LATs)
1	Argentina	$972,300.00	$5,683,590.81	$1,420,897.70	$50,746.35
3	Brazil	$3,207,900.00	$9,041,054.28	$2,260,263.57	$167,426.93
4	Chile	$424,300.00	$186,018,789.14	$46,504,697.29	$22,145.09
5	Colombia	$724,160.00	$1,194,334,864.30	$298,583,716.08	$37,795.41
6	Costa Rica	$74,100.00	$33,259,916.49	$8,314,979.12	$3,867.43
14	Mexico	$2,220,100.00	$22,710,835.07	$5,677,708.77	$115,871.61
18	Peru	$385,400.00	$804,592.90	$201,148.23	$20,114.82
19	Uruguay	$74,200.00	$1,750,438.41	$437,609.60	$3,872.65
20	Venezuela	$491,600.00	$13,547,223.38	$3,386,805.85	$25,657.62
M_{2015} (Millions of LATs)					$447,497.91

IV. Discussion and Conclusion

Average inflation rates based on the price of a Big Mac (see Table 4) for Brazil, Chile, Colombia, Mexico and Peru are single digit. Costa Rica and Uruguay have slightly higher inflation rates. Venezuela is out of control with its inflation rate. Also, the historical variation in these inflation rates are reasonable for Brazil, Chile, Colombia, Mexico, Peru, Uruguay and the United States. Costa Rica and Argentina have a wide historical variety in their inflation. Venezuela has such a wild behavior that it is not even included in Figure 2. The average (mean) price of a Big Mac given in USD as shown in Table 5 provide reasonable values of prices between $2.84 USD/Big Mac and $4.02 USD/Big Mac, with the exception of Venezuela, having a wild average price of $880.78 USD/Big Mac. The deviation from this mean price as shown in Figure 3 is not so large (once again, with the exception of Venezuela). Inflation rates for the price of a Big Mac in USD are even lower than the inflation for the prices in the respective local currencies of each country as shown by Table 6. Only Argentina and Uruguay have larger than one-digit inflation, whereas Venezuela has an inflation of 381.79%. The variability around these mean prices are considerable for Argentina, Costa Rica and Uruguay as shown in Figure 4. Notice that Uruguay shows a larger inflation variation when such inflation is valued based on the price of a Big Mac in USD. Table 7 shows the average value of a LAT with respect to the local currency. These values are reasonable low with the exception of Costa Rica and Venezuela. The variabilities above and below such mean values are shown in Figure 5. Notice that with the exception of Chile, Costa Rica and Venezuela, these variations are considerably low. The LAT inflation rate is shown in Table 8. Notice that Chile and Peru indicate negative inflation rates, which means that when valuing the actual worth of money (in LATs) these countries seem to be in technical trouble for having a negative inflation rate for the LAT. The fluctuations are considerable for the case of Argentina and Costa Rica (and certainly Venezuela), the latter not included in Figure 6 for being an outlier. The remaining countries show reasonable variations. Figure 7 show the historical over or under valuation of the USD with respect to the local currencies. Notice that all countries with the exception of Venezuela tend to over-valuate the USD. Argentina is an extreme case of USD overvaluation, although such behavior is located near the beginning of the data (year 2000) and the end of such data (year 2019). Venezuela, when data is available, grossly under-valuate the USD, which means their local currency (Bolivar Soberano) is out of touch with reality and tends to be worthless. The mean in the over or under valuation of the USD and variation above and below such mean is shown in Table 9. Figure 8 illustrates this data. Figure 9 shows the historical PPP, which actually offers the same information as the USD over or under valuation from Figure 7. Table 10 and Figure 10 show historical fluctuation in the PPP. Finally, notice that the inflation, when measured based on the LAT instead of the local currencies is lower in all cases (even Venezuela) as shown in Table 11 and Figure 11. Thus, the LAT seems to better maintain value. The value of money when measured by the USD compared to the LAT tends to be more or less the same. The LAT tends to have a slightly lower value when compared to the local currencies than the USD, but generally speaking, is a good holder of monetary value, as shown in Table 12 and Figure 12. Table 13 shows LAT supply calculations according to equations (10) to (13). The total monetary offer of LATs should be LAT $447,497.91 million of LATs, and such monetary offer should become available to the assumed (given data availability in this case)

participating countries only: Argentina, Brazil, Chile, Colombia, Costa Rica, Mexico, Peru, Uruguay and Venezuela. Notice that Argentina, Brazil and Mexico combined have 74.65% of all the USD monetary offer (the same occurs with the proposed LAT monetary supply). It is assumed that in the case of all nine countries considered, the money fully circulates four times in the economy in the year 2015 ($T_{k,2015} = 4$).

It can be concluded that having one common currency for all Latin-American countries such as the LAT seems to be a good idea. Also, such currency should tend to average seasonal fluctuations of money value in Latin America, which are typical of the region. Further research is required concerning money supply as suggested according to equations (7) to (13).

Confirmatory research would also be useful, especially when considering other goods as indicators of the Consumer Price Index, such as the value of an iPhone or an iPad, coffee or a mixed basket of several goods. In conclusion, the LAT as presented and valued in this paper seem to make good sense for a Latin-American union initiative. There are several important questions to be answered: Should the LAT be interchangeable for USD? If so, should we charge a tax to avoid money laundering? What exchange spread should be charged? Should loans be made? If so, with what kind of priorities. Also, the Latin-American Central Bank would need to pay for its costs, exactly how so? And the list of questions goes on. Out of sheer curiosity, some research into cryptocurrencies was carried out (Mehta, Agashe, & Detroja, 2019; Narayanan, Bonneau, Felten, Miller, & Goldfeder, 2016; Vigna & Casey, 2016) in order to see if they offer any useful ideas for the LAT and the Latin-American union. To tell the truth, cryptocurrencies do not make any economic sense. They seem to be a novel attempt at going back in time to something similar to the gold monetary standard, which the 1930s Great Depression and the consequential Bretton Woods agreement (Markwell, 2006; Mikesell, 1994; Van Dormael, 1978; Steil, 2013) showed not to be a good idea. Cryptocurrencies seem to have more to do with technological development than good economic sense.

REFERENCES

[1] Arana, M. (2013). *Bolivar: American Liberator*. Simon & Schuster.

[2] Banco de Mexico. (2019). Tipos de Cambio para Revalorización de Balance del Banco de México. (Foreign Exchange Rates for the U.S. Dollar.) Retrieved from: https://www.banxico.org.mx/SieInternet/consultarDirectorioInternetAction.do?accion=consultarCuadro&idCuadro=CF336&sector=6&locale=es.

[3] Bushnell, D. (1970). *The Liberator, Simón Bolívar*. Alfred A. Knopf.

[4] Copertari Isaacson, L. F. (2014). *Evaluación Financiera de Proyectos*. Editorial Umbral.

[5] Crow, J. A. (1980). *The Epic of Latin America*. University of California Press.

[6] Fischer, S., Dornbusch, R., & Schmalensee, R. (1990). *Economía*. McGraw-Hill.

[7] Friedman, M. (2006). *The Optimum Quantity of Money*. Transaction Publishers.

[8] Greco, Jr., T. H. (2009). *The End of Money and the Future of Civilization*. Chelsea Green Publishing.

[9] Hallsmith, G. & Lietaer, B. (2011). *Creating Wealth: Growing Local Economies with Local Currencies*. New Society Publishers.

[10] Harvey, D. (2010). *A companion to Marx's Capital*. Verso.

[11] Harvey, D. (2014). *Seventeen Contradictions and the End of Capitalism*. Oxford University Press.

[12] Harvey, R. (2000). *Liberators: Latin America's Struggle for Independence 1810-1830*. The Overlook Press.

[13] Holden, R. H. & Zolov, E. (2000). *Latin America and the United States: A Documentary History*. Oxford University Press.

[14] Krugman, P. R., Obstfeld, M., & Melitz, M. J. (2018). *International Economics: Theory and Policy*. Pearson Education Limited.

[15] Kvanli, A. H., Guynes, C. S., & Pavur, R. J. (1989). *Introduction to Business Statistics*. West Publishing Company.

[16] Lietaer, B. & Dunne, J. (2013). *Rethinking Money: How New Currencies turn Scarcity into Prosperity*. Berrett-Koehler Publishers.

[17] Lietaer, B. (2001). *The Future of Money: A new way to create wealth, work, and a wiser world*. Random House Group Limited.

[18] Markwell, D. (2006). *John Maynard Keynes and International Relations: Paths to War and Peace*. Oxford University Press.

[19] McLeay, M., Radia, A., & Thomas, R. (2014). Money creation in the modern economy, *Bank of England Quarterly Bulletin, Q1*, 1-14.

[20] Mehta, N., Agashe, A., & Detroja, P. (2019). *Bubble or Revolution?: The Present and Future of Blockchain and Cryptocurrencies*. Paravane Ventures.

[21] Mikesell, R. F. (1994). *The Bretton Woods Debates: A Memoir*. Princeton University.

[22] Narayanan, A., Bonneau, J., Felten, E., Miller, A., & Goldfeder, S. (2016). *Bitcoin and Cryptocurrency Technologies*. Princeton University Press.

[23] Newnan, D. G. (1988). *Análisis Económico en Ingeniería*. McGraw-Hill.

[24] Steil, B. (2013). *The Battle of Bretton Woods: John Maynard Keynes, Harry Dexter White, and the Making of a New World Order*. Princeton University Press.

[25] The Big Mac Index Spreadsheet. (2019). Big Mac Index Spreadsheet. Retrieved from: http://bigmacindex.org/spreadsheet.

[26] The Economist. (2019). The Big Mac index. Retrieved from: https://www.economist.com/news/2019/07/10/the-big-mac-index.

[27] Van Dormael, A. (1978). *Bretton Woods: Birth of a Monetary System*. Homes & Meier.

[28] Vigna, P. & Casey, M. J. (2016). *The Age of Cryptocurrency: How Bitcoin and the Blockchain are Challenging the Global Economic Order*. Picador.

Appendix. Illustrative example calculations for Argentina, Brazil and Mexico and LAT supply equations

The date being considered is t = October 2019. The values given, with the exception of the quantity of Big Macs produced, the value of McDonald's sales and the percentage of McDonald's sales with respect to the sales of all of the economy for each country under consideration are almost real values. The difference is due to the approximation made in order to simplify calculations. The countries being considered, Argentina, Brazil and Mexico, are numbered k = 1, 3 and 14, respectively. A value of k = 0 indicates data for the United States. We assume $w_1 = w_3 = w_{14} = 1\%$.

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The approximated prices of a Big Mac are:
P_0 = \$5 USD/Big Mac
P_1 = \$75 ARS/Big Mac
P_3 = \$15 BRL/Big Mac
P_{14} = \$50 MXN/Big Mac

McDonald's assumed sales are:
N_1 = \$150,000 ARS
N_3 = \$45,000 BRL
N_{14} = \$50,000 MXN

The assumed quantities being produced are:
Q_1 = 2,000 Big Macs
Q_3 = 3,000 Big Macs
Q_{14} = 1,000 Big Macs

The assumed price of the local currency per USD are:
O_1 = \$60 ARS/USD
O_3 = \$4 BRL/USD
O_{14} = \$20 MXN/USD

Argentina (k = 1)	Brazil (k = 3)	Mexico (k = 14)
P_1 = 150,000/2,000 = = \$75 ARS/Big Mac	P_3 = 45,000/3,000 = = \$15 BRL/Big Mac	P_{14} = 50,000/1,000 = = \$50 MXN/Big Mac
B_1 = \$75/\$60 = = \$1.25 USD/Big Mac	B_3 = \$15/\$4 = = \$3.75 USD/Big Mac	B_{14} = \$50/\$20 = = \$2.50 USD/Big Mac
$I_1 = L_1$ = \$75/\$5 = = \$15 ARS/USD = = \$15 ARS/LAT	$I_3 = L_3$ = \$15/\$5 = = \$3 BRL/USD = = \$3 BRL/LAT	$I_{14} = L_{14}$ = \$50/\$5 = = \$10 MXN/USD = = \$10 MXN/LAT
V_1 = (\$60-\$15)/\$15×100 % = +300%	V_3 = (\$4-\$3)/\$3×100 % = +33.33%	V_{14} = (\$20-\$10)/\$10×100 % = +100%
PPP_1 = \$60/\$15 = 4.00	PPP_3 = \$4/\$3 = 1.33	PPP_{14} = \$20/\$10 = 2.00
N'_1 = 150,000/0.01 = = 15'000,000 ARS	N'_3 = 45,000/0.01 = = 4'500,000 BRL	N'_{14} = 50,000/0.01 = = 5'000,000 MXN
M_1 = 15'000,000/75 = = 200,000 LAT	M_3 = 4'500,000/15 = = 300,000 LAT	M_{14} = 5'000,000/50 = = 100,000 LAT
$M = M_1+M_3+M_{14}$ = 200,000 + 300,000 + 100,000 = 600,000 LAT		

Equations (10) to (13) and equation (6) for LAT supply deserve further analysis. We have:

$$M_{kt} = \frac{N'_{k,t}}{R_{k,t}} = \frac{\frac{S_{k,t}}{T_{k,t}}}{R_{k,t}} = \frac{S_{kt}}{T_{kt}R_{kt}} = \frac{G_{kt}I_{kt}}{T_{kt}R_{kt}} = \frac{G_{kt}\frac{R_{k,t}}{P_{0,t}}}{T_{kt}R_{kt}} = \frac{G_{k,t}\cancel{R_{kt}}}{T_{k,t}P_{0,t}\cancel{R_{kt}}} = \frac{G_{kt}}{T_{kt}P_{0,t}}$$

That is, the monetary supply of LATs for country k in year t depends only on the GDP (PPP) of country k at year t, the number of times money circulates in a year in country k ($T_{k,t}$) and the value of a Big Mac in the United States at year t ($P_{0,t}$). Notice that if there are two values for $P_{0,t}$ in year t, we use the average of them. The units relevant are [(USD/Year)/((Times/Year)(USD/Big Mac))] = [Big Mac], which makes sense since the value of a Big Mac (regardless of currency) is equivalent to the value of a LAT.