

Prospective Empirical Study on the Determinants of Bitcoin Price Formation (Case Study on Morocco)

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Despite being illegal in Morocco, bitcoin has gained great popularity in Morocco. However, in recent months, the Moroccan monetary authorities have set up two commissions to deal with crypto assets. The purpose of these commissions was to monitor international financial trends (in particular crypto assets). The current work will put forward a prospective study on the determinants that forms the price of bitcoin in Morocco, provided that the Moroccan monetary authorities would decide the legalization of the use of crypto assets. In an ARDL approach, an econometric model is applied to variables that reflect, not only all the factors related to the traditional currency, but also to variables that reflect specific factors to bitcoin over an eight-years period. This prospective study has highlighted that the frequency of bitcoin search on Google Trend, the number of bitcoins in circulation and the exchange rate between the Dollar and the Moroccan Dirham represent the main indicators that explain the formation of the price of bitcoin in the national territory.

Keywords: prospective study, price formation, frequency of bitcoin search, exchange rate, the number of bitcoins in circulation

INTRODUCTION

Bitcoin is a peer-to-peer payment system created in 2009 (In 2009, Bitcoin emerged as peer-to-peer payment system). Compared to a standard fiat currency, such as the dollar or the Euro, the main characteristic of bitcoin is that the number of units in circulation is not controlled by a person, a group, a company, a central authority or a government, but by a software algorithm. But given the complex nature of bitcoin, in the sense that, it does not rely on any underlying, the vulnerability of its price is illustrated by its volatility compared to other traditional currencies. In 2017, the prohibition by Bank Al Maghrib and the Ministry of Economy and Finance of transactions via crypto-assets by considering them as a violation of the regulations provided for by the texts, did not prevent a massive increase of peer-to-peer transactions in Morocco, resulting in a 215% surge in trading volume on the Local Bitcoins platform between November 2017 and February 2021. As a reaction to this finding of fact, and not to witness a difference between what is being done elsewhere and the domestic market, in recent months, Bank Al Maghrib “has set up not just one commission but three, one for the central bank’s electronic money and the other two for crypto- assets and monitoring of developments,” says the BAM governor. Similarly, the rise of crypto- assets and digital currency in this case the e-dirham would be an inevitable fact! These various movements from the side of the Moroccan monetary authorities, even in a “conservative” logic, aim to follow global trends in line with

the Fourth Industrial Revolution, even if the impact of such decisions will only be perceived in the medium to long run.

Hence the question: **If the Moroccan monetary authorities, in a prospective approach, would legitimize the use of crypto-assets -in our case bitcoin-, what would be the determinants of the formation of the price of bitcoin in the Moroccan economy?**

At this stage, the main hypothesis is as follows: s: «the determinants of the formation of the bitcoin price would be both the result of factors related to the traditional currency but also to factors specific to bitcoin».

This paper would be divided into two main points. A first point will highlight some empirical work that has identified three major sets of factors contributing to the formation of the bitcoin price. A first set of factors linked to the traditional currency but also a second set of factors specific to bitcoin. And finally, a final set of factors related both to the factors of the traditional currency, but also to the factors specific to bitcoin (1.). According to the empirical literature, but also the actions taken by the Moroccan monetary authorities on the subject of crypto assets, leading in a futuristic scenario – in the medium or long run – to the legalization of cryptos assets in the national territory. A final point in this paper would be dedicated to highlight, in a prospective approach, the determinants of the formation of the price of bitcoin in Morocco, from an econometric model in an ARDL approach from 2013 to 2020 (2.).

Review of the Empirical Literature on the Determinants of Bitcoin Price Formation

The genesis of bitcoin was made possible by the blockchain technology. Thus, several academicians were interested, more particularly, in this crypto-asset. And in this same vein, the work that has been conducted on the topic relating to the determinants of the formation of the bitcoin price has focused on three main factors: A first set of factors related to the traditional currency (1.1). A second set of factors specific to bitcoin (1.2). And finally, a final set of factors – which we can consider – hybrid, in the sense that, the formation of the price of bitcoin is mainly related to both the factors of the traditional currency, but also to the factors specific to bitcoin (1.3).

Determinants Related to Traditional Currency Factors

Some empirical literature considered that the determinants that would contribute to the formation of the price of bitcoin would be linked to the traditional currency. First, this work assumed that the interaction between supply and demand of bitcoin would be a determining factor in the formation of the bitcoin price (1.1.1.). However, other empirical research highlighted the role of global macro- economic and financial development in determining the price of bitcoin (1.1.2.).

Market Forces: Supply and Demand for Bitcoin

One of the key determinants in the formation of bitcoin prices according to (Buchholz, et al., 2012) would be the interaction between bitcoin supply and demand. They noted that, to a large extent, the price movements of bitcoin could be explained by interactions between its supply and demand (Bouoiyour & Selmi, 2015), had reached the same result. This suggests, that the demand for bitcoin would be driven primarily by its value as a means of exchanging goods and services, that is, by its value in future exchange.

Global Macroeconomic and Financial Development

An empirical study conducted by Van Wijk (2013), has focused on the impact of indices and the price of oil on the formation of the price of bitcoin. The results obtained have concluded that several financial indicators, including the value of the Dow Jones, the euro-dollar exchange rate, and the price of WTI oil, have a significant effect on the value of Bitcoin in the long term. But it should also be noted that the value of the Dow Jones index also significantly affects the value of Bitcoin in the short run. However, other empirical work by Krugman & Obstfeld (2003) has found that inflation and price indices are the other type of indicator that reflect important macroeconomic and financial developments. Therefore, they affect the formation of the bitcoin price.

The price of oil is one of the main sources of pressure on demand and costs, and it provides a preliminary indication of economic development in general. This finding of fact, connotes with the empirical work of Palombizio & Morris (2012). Similarly, Dimitrova (2005) and from a multi-variable regression has been able to clarify the link between foreign exchange markets and stock markets. The results suggest that lower stock prices may encourage foreign investors to sell the financial assets they hold. This, in turn, can lead to a depreciation of the respective currency, but can boost the price of bitcoin, if investors substitute investment in equities for investment in bitcoin. On the other hand, other work in the empirical literature opposing the first, states that the formation of the price of bitcoin is related to factors specific to bitcoin (1.2.).

Determinants Related to Bitcoin-Specific Factors

Some empirical work has verified and validated two major hypotheses, one of which is that the price of bitcoin is related to the contribution of speculation. While, other authors claimed that research trends, cyber security and media coverage are decisive elements in terms of investment attractiveness, and therefore in determining the price of bitcoin (1.2.1.). On the other hand, the empirical literature has highlighted the ecosystem of outsourcing in the formation of the bitcoin price (1.2.2.).

Investment Attractiveness

In this hypothesis, Bouoiyour & Selmi (2015) examined the short-run and long-run links between the price of Bitcoin and these potential factors. The results they have highlighted show that from the decomposition of the variance of the bitcoin price, that 69.17% of the Bitcoin price is explained by its own innovative shocks. While investor attractiveness (TTR) seemed to be the main driver of Bitcoin price formation (20.34%). However, work conducted by Kristoufek (2014), based on continuous analysis by wavelets and in particular the coherence of wavelets has revealed that, if bitcoin is likely to be a refuge, it could become, in another configuration, a speculative bubble, or even look like business income. Similarly, the attractiveness of investors would push the price of bitcoin up during the period of explosive prices, while it would go down under the period of rapid decline. However, the study showed wavelet coherence between bitcoin prices and search engine queries. On the other hand, Greco (2001) explained that controlling the exchange process in people's hands, giving them more choice on how they would apply their energies, and their resources, attracted investment through this means and it would provide, also, to the community a means of exchange which, by its nature, is abundant, democratic and locally controlled. In addition, other empirical work conducted by Barber et al. (2012) has shed light on the credibility of bitcoin. The results indicated that cyber-attacks could destabilize the entire bitcoin system and ultimately lead to its collapse to the point that, malwares would become associated with the exploitation of crypto currency mining (Andrew, 2019).

These data corroborated with the same results (Moore & Christin, 2013) through a study conducted on 40 bitcoin exchanges, the authors revealed that the average transaction volume of an exchange would be negatively correlated with the probability that it would close prematurely. Conversely, the volume of transactions would be positively correlated to a violation. For example, over 43,000 bitcoins were stolen from the Bit coinica trading platform in March 2012 (Leyden, 2012). Similarly, Lee (2014) assumed that media news could have an influence, positive or negative, and generate high price cycles. This would imply that the attention-oriented behavior of investors and users could have a positive or negative impact on the price of bitcoin, which would be the major attention of the media at some point in time.

The Outsourcing Ecosystem

The empirical literature will focus on the implementation of the fair payment framework based on the blockchain at the level of the offshoring ecosystem which could be one of the key determinants in the formation of the bitcoin price. One of the empirical works conducted by Zhang et al. (2018) is that a blockchain-based payment solution for outsourcing services, could respond effectively to the threat of fraud from malicious participants and provide assurances that the service would be properly established. Along the same lines as Armbrust et al. (2010) found that cloud computing could offer a variety of outsourcing

services, including storage and computing. Other work conducted by Huang et al. (2016) went further in the sense that they studied the implementation of an outsourcing calculation system based on Blockchain, in which a trusted third party would still be omnipresent. However, a number of authors attempted to empirically study the determinants of the price of bitcoin from factors related both to the traditional currency and also to factors specific to bitcoin (1.3).

Hybrid Determinants in Bitcoin Price Formation: Factors Related to Both Traditional Currency and Bitcoin-Specific Factors

The empirical literature is also thought to address both traditional currency and bitcoin-specific factors (1.3.1.).

Determinants That Are at the Same Time Traditional and Specific Forming the Price of Bitcoin

Empirical work by Ciaian et al. (2015) on hybrid” determinants – both traditional and specific- tried to identify the research gap by taking into account the three types of bitcoin price determinants identified in the previous literature and by considering the interactions between them. According to the authors, the results confirmed that bitcoin supply and demand market forces have a significant impact on bitcoin prices and their importance tends to increase over time. On the other hand, the hypothesis that speculative investor behavior that would be a proxy variable of investment attractiveness would influence the price of bitcoin in the short and long run and therefore this hypothesis could not be -really- rejected.

However, the study conducted by Bouoiyour & Selmi R. (2016) raised three main groups of determinants of bitcoin price. The first group contains the use of bitcoin in trade and the deterioration of the yuan and the uncertainty surrounding Brexit and the demonetization of India. The second group is formed by bitcoin fundamentals, when uncertainty surrounding the 2016 US presidential elections. The third group takes into account the bitcoin fundamentals when the speed of bitcoins, the price of gold, the heightened fears about Venezuelan demonetization and the hash rate. The second section would be dedicated to present - in a futuristic approach, either in the medium or long run, where the Moroccan monetary authorities would legalize the use of crypto-assets in the national territory-an econometric modeling concerning the determinants of the formation of the price of crypto-assets and in our case bitcoin (2.).

ECONOMETRIC MODELING OF DETERMINANTS OF BITCOIN PRICE FORMATION IN MOROCCO: ARDL BOUND TESTING APPROACH

This work is part of a prospective vision whose postulated scenario foresees that the Moroccan monetary authorities, so as not to be overtaken by the financial! evolution train,” with what is being done internationally, will legalize the use of crypto-assets, either medium or long-run, in the Moroccan territory. The present work will attempt to detect the determinants of bitcoin price formation in Morocco in the future predicted scenario. The objective is to develop an econometric model that would explain the factors that would contribute to the formation of the price of bitcoin in Morocco. At this level, and according to the empirical literature (*see 1.*), the central hypothesis of our research can be understood as follows: “the determinants of bitcoin price formation would be both the result of factors related to the traditional currency, but also to factors specific to bitcoin.”

To do so, this work will be divided into three main points. A first point, in the form of an overall overview of the work methodology and the data used (2.1). The second point will be to apply a statistical method, in the form of an econometric model in an ARDL approach. The aim is to detect the main determinants of the formation of the price of bitcoin in Morocco over the period from 2013 to 2020; then analyze the results obtained (2.2). Finally, the third and final point will conclude our work with an exhaustive conclusion (2.3).

Global Overview About Work Methodology and Data Used

The first step in our empirical study will be a presentation of the study methodology (2.1.1.), construction, and description and data sources of the variables (2.1.2.).

Study Methodology

The objective of this work is to identify the determinants of the formation of the price of bitcoin in Morocco, over the period from 2013 to 2020, in a futuristic scenario where the monetary authorities would legalize the use of bitcoin at the level of the Moroccan territory. To do this, a model would be developed in the form of linear regression, highlighting explanatory variables, and explained variable.

We used sub-annual, quarterly data, from the first quarter of 2013 to the fourth quarter of 2020. The choice of the period is not arbitrary. That is because, 2013 is the year the transactions in bitcoins made by Moroccans according to the LocalBitcoin platform. Similarly, and from the empirical literature that has highlighted factors related to the traditional currency, and other factors specific to bitcoin, but also hybrid factors highlighting both factors related to the traditional currency and also factors specific to bitcoin. Our research hypothesis would be formulated as follows: «The determinants of the formation of the price of bitcoin would be both the result of determinants related to the traditional currency but also specific to bitcoin».

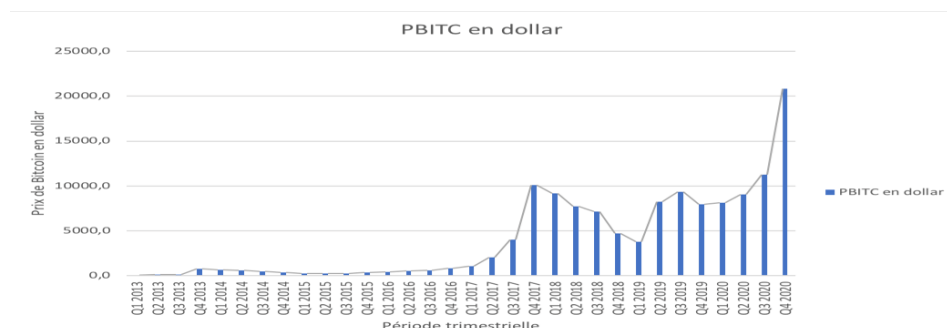
Construction, Description and Data Sources of Variables

Explained Variable

Referring to the empirical literature, but also to our research hypothesis cited above, our explained variable concerns the price of bitcoin in dollar (PBITC). Thus, the information was collected from the investing.com financial platform based on the work of Ciaian P. et al. (2015) over an 8-year period, from the first quarter of 2013 to the fourth quarter of 2020.

The following chart shows the evolution of the PBITC over the analysis period.

CHART 1
EVOLUTION OF THE PRICE OF BITCOIN IN DOLLAR



Source: chart prepared by the author based on data from investing.com

Explanatory Variables

The empirical literature identifies three major sets of factors explaining the determinants of bitcoin price formation: factors related to the traditional currency and factors specific to bitcoin. While the third set of factors is the result of the combination of the first two.

The choice of explanatory variables reflecting the determinants of the formation of the bitcoin price was based on variables related to the factors qualifying the traditional currency, but also specific to bitcoin. In other words, eight variables were highlighted. In order to highlight the impact of global macroeconomic and financial development on the price of bitcoin, we will start on the path of Van Wijk (2013) and Krugman & Obstfeld (2003) and we will use the price of Brent oil in dollar per barrel (BR) and the Moroccan stock market index (MADEX), which is a stock market index composed of the 62 most active securities on the

Casablanca stock exchange. We will also use the exchange rate between the US dollar and the Moroccan dirham (EXC), because in our data the price of bitcoin is denominated in US dollars. Thus, based on the work of (Buchholz, et al., 2012), the demand for bitcoin on the national territory will be presented by the volume of bitcoin transactions in Morocco on the Local Bitcoin Platform (LOCBITC). The supply of bitcoin will be presented by the number in millions of bitcoin in circulation (BITCIR). However, the variables concerning the implementation of the fair payment framework based on the blockchain at the level of the offshoring ecosystem according to Zhang et al. (2018); Armbrust et al. (2010), and also the implementation of an outsourcing calculation system based on the Blockchain, in which a trusted third party is always omnipresent according to Huang et al. (2016), will be approached, in the Moroccan case, by the revenues in millions of dhs of Business Process Outsourcing (BPO) and the revenues in millions of dhs of Information Technology Outsourcing (ITO) as determinants in the formation of the bitcoin price. Finally, in order to illustrate the attractiveness of investment, we will refer to the path adopted by Kristoufek (2013) which was based on the volume of bitcoin daily views on Wikipedia. On the other hand, our study will be based on the frequency of searches in Google trend (BITSER), as a good measure of the interest of potential investors for bitcoin, but also since we will use quarterly data.

The data sources for the explanatory variables are broken down as follows:

- MADEX, MAD/DOLLAR are collected from the financial platform “Investing”;
- BR is collected from the official website of the US Energy Information Administration;
- LOCBITC and BITSER are collected from the “coin dance” platform;
- BPO and ITO are collected from the official website of the “exchange office”;
- IIROC is collected from the online portal “statista”;

It should be noted that all our data is sub-annual, from the first quarter of 2013 to the fourth quarter of 2020. The construction, description but also the sources of our data, we will then have the opportunity to apply our econometric methodology and extract the results obtained (2.2).

Econometric Methodology and Analysis of Results

In the econometric level, we will begin by first highlighting the correlation between our variables before removing the effect of seasonality. Then we will have the opportunity to remove the seasonality effect from our data so that our results are not biased (2.2.1). The second step will be dedicated to the estimation methodology in an ARDL approach, which seems to us the most appropriate. The next step in this approach will allow us to choose the optimal model through the SIC (Schwartz information criterion) information criterion and then interpret the results of our estimate. The next step will be to validate our model through residual autocorrelation, stability and error normality tests (2.2.2). Finally, we will proceed with the cointegration bounds test to identify the dynamic behavior between our variables in the long-run but also in the short-run horizon (2.2.3).

State of Play

Correlation Between Variables Before Seasonal Adjustment. First of all, it should be noted that all-time series of data related either to factors of the traditional currency or to factors specific to bitcoin are quarterly and extend over a period of 8 years, from the first quarter of Q1 of 2013 to the fourth quarter of Q4 of 2020.

TABLE 1
CORRELATION BETWEEN OUR VARIABLES BEFORE SEASONAL ADJUSTMENT

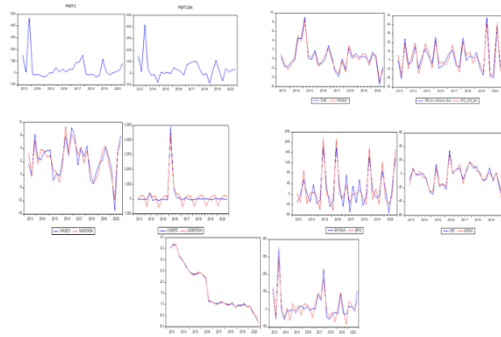
PBITC	MADEX	LOCBITC	ITO_EN_MILLIONS_DHS	EXC	BR	BPO	BITCSER	BITCIR
1,000	0,545	0,323	0,729	0,161	-0,341	0,565	0,516	0,741
0,545	1,000	0,631	0,618	0,444	-0,338	0,271	0,583	0,702
0,323	0,631	1,000	0,529	0,512	-0,499	0,207	0,216	0,644
0,729	0,618	0,529	1,000	0,484	-0,520	0,549	0,200	0,887
0,161	0,444	0,512	0,484	1,000	-0,886	0,103	0,003	0,685
-0,341	-0,338	-0,499	-0,520	-0,886	1,000	-0,150	-0,084	-0,734
0,565	0,271	0,207	0,549	0,103	-0,150	1,000	0,086	0,431
0,516	0,583	0,216	0,200	0,003	-0,084	0,086	1,000	0,305
0,741	0,702	0,644	0,887	0,685	-0,734	0,431	0,305	1,000

Source: Eviews Outputs

It can be seen from *Table 1* that the BITCIR and the ITOs - before the seasonal adjustment - explain the PBITC significantly respectively 0.741 and 0.729 compared to the other explanatory variables. Thus, it can also be noted that there is a significant correlation between ITO and BITCIR (0.887); between BR and BITCIR (-0.734) and between LOCBITC and BITCIR (0.644).

Variables and Seasonality: Retirement of the Effect of Seasonality.

CHART 2
RETIREMENT OF THE EFFECT OF THE SEASONALITY OF OUR VARIABLES



Source: Eviews Outputs

After seasonal adjustment, graphically we can see that there are no significant changes between seasonal and non-seasonal data for all our variables, as the difference between the data before seasonal adjustment and after seasonal adjustment tends towards zero.

Estimation Methodology: ARDL Approach

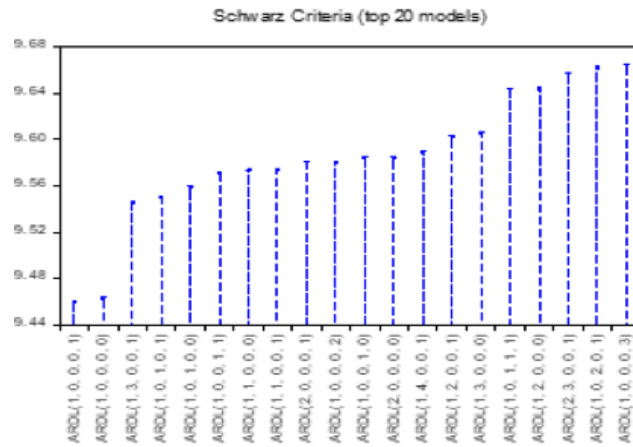
The Choice of the ARDL Approach. Within this part, we adopt a quantitative methodology based on an ARDL (AutoregressiveDistributedLag) model. The purpose of this model is to see if long-term relationships are present when we have a group of variables, some of which may be stationary while others are not. Thus, this approach is better suited for samples of smaller sizes, unlike Johansen’s co-integration approach, which requires a large sample to obtain a valid result. It should be noted that the study of series stationarity has been examined graphically (*see chart 2*), where all variables appear to be stationary, except for the last variable BITCIR relative to the number of bitcoin in circulation which is not stationary. On the

other hand, the advantage of the ARDL lies in the possibility of being applied if the variables used are all I (1), are all I (0), or are mixed.

Choosing the Optimal Model. The optimal estimation of our model is based on the SIC (Schwartz information criterion) information criterion.

Optimal Model Selection Criteria.

CHART 3
THE 20 APPROPRIATE MODELS BASED ON THE SIC INFORMATION CRITERION



Source: Eviews Outputs

The model chosen is the one that minimizes the SIC information criterion. Chart 3 illustrates changes in the value of the information criterion for the 20 most appropriate models.

Result of the Estimate

The model selected by the Schwartz criterion (SIC) is an ARDL model (1,0,0,1). It is the model that gives the most statistically significant results with fewer parameters; the results of the estimation are presented in the following table.

Regression in this case allows us to identify the following results:

- Only the stock exchange index variable (MADEX) is not significant in the model. It has a p-value of 15.2% which is above the 5% threshold.
- On the other hand, the variable on Bitcoin search trends on search engines (BITCSERSA), the number of bitcoin in circulation (BITCIRSA) and the exchange rate between the dollar and the Moroccan dirham (EXCSA) are significantly at the 5% threshold.
- At the same time, the coefficient of determination is significantly important, it takes the value 0.912.

**TABLE 2
RESULT OF THE ESTIMATE**

Variable	Coefficient	Std. Error	t-StaBsBc	Prob.*
PBITCSA (-1)	-0.071780	0.069823	-1.028035	0.3146
EXCSA	-6.317782	2.282492	-2.767932	0.0109
BITCSERSA	0.964504	0.140679	6.856072	0.0000
MADEXSA	1.541111	1.040176	1.481587	0.1520
BITCIRSA	36.95932	18.53464	1.994068	0.0581
BITCIRSA (-1)	-21.23012	20.21074	-1.050438	0.3044
C	-6.088531	13.10567	-0.464572	0.6466
R-squared	0.912279	Meandependent var		33.41038
Adjusted R-squared	0.889396	S.D. dependent var		87.73201
S.E. of regression	29.17725	Akaike info criterion		9.785619
Sumsquaredresid	19580.17	Schwarz criterion		10.11256
Log likelihood	-139.7843	Hannan-Quinn criter.		9.890212
F-staBsBc	39.86595	Durbin-Watson stat		1.846781
Prob(F-staBsBc)	0.000000			
*Note: p-values and any subsequent tests do not account for model selecBon.				

Source: Eviews Outputs

Finally, the bitcoin price model equation reads as follows:

$$PBITCSA = -(6.088531) - (6.317782) \times EXCSA + (0.964504) \times BITCSERSA + (1.541111) \times MADEXSA + (36.95932) \times BITCIRSA$$

The next step will be dedicated to model validation.

Model Validation. Model validation is a critical step in ensuring the statistical validity of the estimation results. This step requires the application of several statistical tests, allowing statistical judgments of the properties and conditions of the validity of the estimates. The sequence of tests is presented as follows:
Autocorrelation Test.

**TABLE 3
RESIDUAL CORRELOGRAM**

Date: 07/03/21 Time: 17:49
Sample: 2013Q1 2020Q4
Included observations: 30
Q-statistic probabilities adjusted for 1 dynamic regressor

Autocorrelation	Partial Correlation	AC	PAC	Q-Stat	Prob*
1	0.058	0.058	0.1118	0.738	
2	-0.146	-0.150	0.8446	0.656	
3	-0.120	-0.104	1.3576	0.716	
4	-0.065	-0.077	1.5147	0.824	
5	-0.009	-0.036	1.5176	0.911	
6	0.095	0.066	1.8773	0.931	
7	-0.061	-0.095	2.0331	0.958	
8	-0.150	-0.136	3.0180	0.933	
9	-0.023	-0.022	3.0432	0.963	
10	-0.168	-0.232	4.3913	0.928	
11	0.069	0.041	4.6296	0.948	
12	0.174	0.081	6.2533	0.903	
13	0.102	0.067	6.8370	0.910	
14	-0.101	-0.076	7.4491	0.916	
15	-0.101	-0.084	8.1057	0.919	
16	-0.347	-0.385	16.376	0.427	

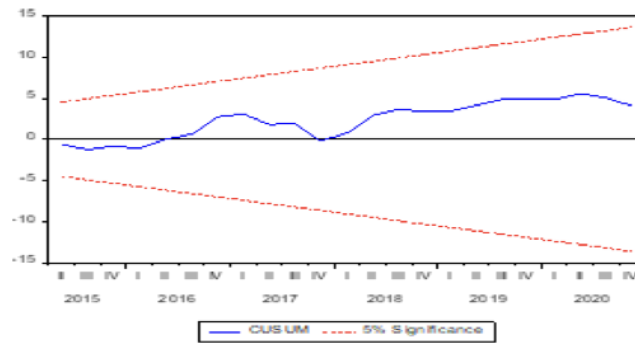
*Probabilities may not be valid for this equation specification.

Source: Eviews Outputs

The correlogram of the residue indicates that it is a random walk, the correlogram of the residue squared does not indicate any terms significantly different from 0; the residues are therefore homoscedastic. So, the residue is white noise. The Q statistic has a critical probability of 0.427 (for $k = 16$) well above 0.05; we accept the hypothesis of nullity of the coefficients of the correlogram.

Stability Test (Cusum Test). The “cusum” test examines the stability of the estimated model.

**CHART 4
CUSUM TEST**

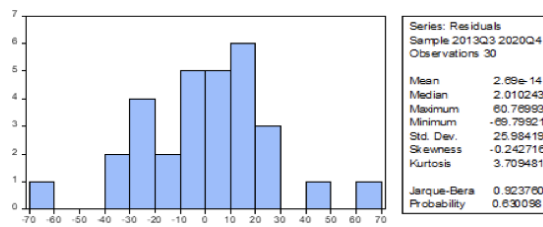


Source: Eviews Outputs

The values taken by the statistics remain inside the bounds of significance, which refers to the stability of the Model.

Tests for Error Normality.

**CHART 5
ERROR NORMALITY**



Source: Eviews Outputs

We can see that the normality of the errors is validated, since the probability is 0.630098. Therefore, based on the results of the residue autocorrelation, stability and ultimately tests for error normality, the estimated model is validated. At this stage, it will be appropriate to test -whether or not - there is one or more co-integration relationships between the variables.

The Bounds Co-Integration Test. The third step will be to test if there is one or more co-integration relationships between the variables: EXCSA, BITCSERSA, MADEXSA, BITCIRSA, by comparing the ARDL (Bounds test) method with other traditional co-integration methods, this method has three advantages:

- The first is that it does not require variables to be integrated of the same integration order, the variables can be integrated of the same order or of a different order; in other words, they can be $I(1)$ and $I(0)$ but never of an order greater than one;
- The second advantage is that this method is more effective than other methods in cases where the samples are small; thus, it is more suitable for this study where we work with a sample of 30 observations after adjustment;

- The third and final advantage is that the ARDL method provides unbiased estimates of long-term coefficients (Harris & Sollis, 2003).

TABLE 4
CO-INTEGRATION TEST RESULT

F-Bounds Test	Null Hypothesis: No levels relationship			
Test Statistics	Value	Signif.	I (0)	I (1)
			Asymptotic: n=1000	
F-statistic	76.97834	10%	2.2	3.09
k	4	5%	2.56	3.49
		2.5%	2.88	3.87
		1%	3.29	4.37
Actual Sample Size	30		Finite Sample: n=30	
		10%	2.525	3.56
		5%	3.058	4.223
		1%	4.28	5.84

Source: Eviews Outputs

The Fisher test indicates that there is, of course, a co-integration relationship since the fisher statistic (F=76.97834) is greater than the values of the bounds.

Model Result

The existence of the cointegration relationship in the estimation of the model requires us to split the results into long-run behavior and a short-run one.

The results of the short-run dynamics are presented in the following table:

- *Short-run result*

The following table summarizes the modeling results:

TABLE 5
THE RESULT OF THE MODEL IN THE SHORT RUN

CondiBon Error CorrecBon Regression				
Variable	Coefficient	Std. Error	t-StaQsQc	Prob.
C	-6.088531	11.19649	-0.543789	0.5918
PBITCSA (-1)*	-1.071780	0.071141	-15.06556	0.0000
EXCSA**	-6.317782	2.495824	-2.531341	0.0187
BITCSERSA**	0.964504	0.077267	12.48271	0.0000
MADEXSA**	1.541111	1.126235	1.368374	0.1844
BITCIRSA (-1)	15.72920	6.196625	2.538349	0.0184
D(BITCIRSA)	36.95932	25.00862	1.477863	0.1530

* p-value incompaBble with t-Bounds distribuBon.

** Variable interpreted as $Z = Z(-1) + D(Z)$.

Source: Eviews Outputs

The short-run results show that the price of bitcoin positively depends on the trend of bitcoin search frequency on Google trend, and the number of bitcoin in circulation. While it depends negatively on the exchange rate between the dollar and the Moroccan dirham.

• *Long-run result*

The following table summarizes the results of the modeling

TABLEAU 6
THE RESULT OF THE MODEL IN THE LONG RUN

Levels EquaBon				
Case 2: Restricted Constant and No Trend				
Variable	Coefficient	Std. Error	t-StaQsQc	Prob.
EXCSA	-5.894663	1.813503	-3.250429	0.0035
BITCSERSA	0.899908	0.146614	6.137932	0.0000
MADEXSA	1.437898	0.953198	1.508499	0.1450
BITCIRSA	14.67577	6.797688	2.158935	0.0415
C	-5.680766	11.90995	-0.476977	0.6379

EC = PBITCSA – (-5.8947*EXCSA + 0.8999*BITCSERSA + 1.4379*MADEXSA + 14.6758*BITCIRSA -5.6808)

Source: Eviews Outputs

The results of the long-run relationship also show that the price of bitcoin positively depends on the trend of bitcoin's search frequency on Google trend, and the number of bitcoin in circulation. However, it depends negatively on the exchange rate between the dollar and the Moroccan dirham.

The final stage of our study will be an exhaustive conclusion (2.3).

Exhaustive Conclusion

The purpose of this latter subsection is based on a general synthesis of our econometric study. It was carried out in a prospective approach, where the Moroccan monetary authorities -in the medium or even long run- would decide to legalize the use of crypto-assets (since two commissions have been set up in this

regard) (2.3.1.). The results obtained, over a period of 8 years, from our econometric study have highlighted three main indicators, allowing to explain the formation of the price of bitcoin in Morocco. Similarly, from the co-integration bound test we detected the existence of several cointegration relationships between our studied variables (2.3.2.). However, in view of the inability to fill all the parameters and events that may occur – in the future – and therefore biased our research hypothesis; we thought it appropriate to propose some recommendations, which we consider capable of coping with these unforeseen circumstances (2.3.3.).

Synthetic Summary

In this work, we examined the determinants of the formation of the bitcoin price - in a prospective approach where the Moroccan monetary authorities in the medium or even long run - would decide to legalize the use of crypto-assets, as two commissions for crypto-assets have already been established for this purpose. Similarly, our empirical study designs a simulation for such a scenario, which could become a reality in the future. Therefore, to draw one aspect among other fundamentally important aspects in such a situation, the determination of the price of crypto-assets would be one of the priorities of monetary authorities, but also academicians given the opaque nature of such innovations. In this work, we have taken bitcoin as a reference to crypto assets in our case study.

The choice of such a reference is based on its popularity and dominance, but also on the availability and credibility of the information that will be useful for our econometric study. This study will be spread over an 8-year period, from the first Q1 of 2013 to the fourth Q4 of 2020. Based on the empirical literature, three major sets of factors have been identified that explain the determinants of bitcoin price formation: factors related to both the traditional currency, and factors specific to bitcoin. While, the third set of factors is the result of the combination of the first two. As a result, eight variables were identified.

First, we removed the seasonality effect in the case of a series affected by a seasonal movement. Since in this case sub-annual data were used, the results of the seasonal adjustment showed that the gap between the data before seasonal adjustment and after seasonal adjustment is very minimal or even zero. We then established an econometric model in an ARDL approach, which seems to us the most appropriate, for the estimation of our model, because this approach is based on the possibility of being applied if the variables used are all I (1), I (0), or are mixed. Therefore, the study of the stationarity of the series and their order of integration seems optional. On the other hand, it is more suitable for smaller samples. Thus, the model selected by the Schwartz criterion (SIC) is an ARDL model (1,0,0,0,1) giving statistically more significant results, and with fewer parameters.

The estimation results excluded four explanatory variables ((LOCBITC), (ITO_EN_MILLIONS_DHS), (BR), (BPO)) leaving only four variables. That said, (MADEX) is a non-significant variable in our model. While, (BITCSERSA), (BITCIRSA) and (EXCSA) are significantly at the 5% threshold. Similarly, the coefficient of determination is significantly important, it takes the value 0.912. However, the model validation tests have been carried out. Based on the results of the residue autocorrelation, stability and ultimately error normality tests, the estimated model is validated.

At this stage, three scenarios emerge to discuss and analyze the results obtained (2.3.2).

Discussion and Analysis of Results in Prospective Approach

❖ **Phase 1: The Three Postulated Scenarios.** The estimation by an ARDL approach – after the validation of the model – allowed us to highlight three main indicators, allowing us to explain in a future scenario -where the use of crypto-assets would be legalized- the formation of the price of bitcoin in Morocco: The frequency of bitcoin search on Google Trend, the number of bitcoin in circulation and the exchange rate between the dollar and the Moroccan dirham. Various scenarios will be highlighted at this level.

A first scenario that would validate the third hypothesis, will rely on tracking the frequency of bitcoin search on Google Trend, and which, itself, would reflect the attractiveness of investment as factors specific to bitcoin, contributing to the formation of its price. This attractiveness of investment can be explained, generally, by the acceptance of new means of exchange of goods and services, given the advantages that such a means offers in this case bitcoin. Similarly, this follow-up in the formation of the bitcoin price

depends on the news and significant events presented by the media masses whether they are positive or negative. The good news would be -for example- the acceptance of several companies paying via bitcoin, such as the simple mention of the cryptocurrency's name and emoji on Tesla's boss's micro-biography causing a 14% jump in its price (Vergara, 2021). Another example of this would be the recent decision by El Salvador as the first country in the world to convert bitcoin into legal currency in order to increase investment, tourism and economic development of the Central American country according to President Nayib Bukele (Renteria & Wilson, 2021). As a result, these two events, whether it is a decision by a man who has a significant reputation, or a state decision to legally integrate bitcoin into its economy, will automatically attract domestic or foreign investors. And as the information takes an aspect of contagion that would positively impact the formation of the price of bitcoin in the Moroccan territory. By contrast, bad news will have negative or even disastrous repercussions on the formation of the price of bitcoin. For example, the Chinese authorities ban the crypto currency industry (Capital, 2021). Similarly, 7,000 cryptocurrency scams were reported to the FTC during the last quarter of 2020 and the first quarter of 2021 (International Mail, 2021). At the same time, the price of Bitcoin abruptly declined, temporarily losing up to 15% in the night from Wednesday to Thursday, falling to 46,045.10 dollars, a first since 1 March coinciding with the Tesla declaration that the huge energy consumption of mines has an irreversible impact on the environment (Ibrahimi, 2021). That said, bad news will be reported via the mass media in terms of the frequency of research, and thus the behavior of investors who will be, generally, discouraged by these factual findings will negatively affect and infect the formation of the bitcoin price on Moroccan territory.

The second scenario concerns the impact of the number of bitcoins in circulation on the price formation of the latter in Morocco. This second scenario validates the first hypothesis relating to market forces. The interaction between the supply expressed by the number of bitcoins in circulation, and the demand expressed by the volume of transactions exchanged on Moroccan territory will determine the formation of the bitcoin price. For our study, the gap in the transaction volume reflecting the demand for bitcoin, by the ARDL approach, can be explained by the use of crypto-assets, in this case bitcoin, in Morocco which is not yet acknowledged by the authorities. On the other hand, Moroccan investors circumventing the law, and recording a record on February 21, 2021 with around 900,000 dollars of Bitcoins exchanged on the local bitcoin platform for speculative purposes (Kadiri, 2021)! In a situation where - the use of this crypto asset would be legalized by the Moroccan monetary authorities - a large part of these transactions - for non-legal speculative purposes - in Moroccan territory, would be oriented towards purchase and sale transactions, considering bitcoin as a medium of exchange for goods and services. This futuristic scenario is taking into account the study made by the World Bank (BAM, 2019), which found that only 29% of Moroccan adults are banked. This situation can be an incentive for the use of crypto-assets in a fintech perspective leading to financial inclusion. It is in this same vein that the strong demand for bitcoin as a means of exchange for goods and services will be stimulated due to the high rate of unbanked people but also the low cost relating to the transactions carried out. As a result, the interaction of supply and demand - in a context of legalization of bitcoin - will determine its price.

The third and final scenario concerns the impact of the exchange rate between the dollar and the Moroccan dirham on the formation of the bitcoin price. This third scenario validates the second hypothesis on macroeconomic and financial development as factors linked to the traditional currency. As bitcoin is denominated in dollars, if the US dollar appreciated against the Moroccan dirham, it would probably also appreciate against bitcoin. Therefore, an increase in the exchange rate between the Moroccan dirham, and the US dollar, would lead to a decrease in the amount of US dollars that must be paid for a bitcoin, which would lower its price. The opposite situation would be the depreciation of the US dollar against the Moroccan dirham, and therefore it would probably also depreciate against bitcoin. Therefore, a decrease in the exchange rate between the Moroccan dirham and the US dollar would lead to an increase in the amount of US dollars that must be paid for a bitcoin, which increases its price. It is in this same logic that the formation of the price of bitcoin can be determined via the exchange rate relationship between the dollar and the Moroccan dirham.

The first phase of the results allowed us to highlight three main scenarios. While, the second phase of the results was aimed at studying the relationship of co-integration between variables through the bounds test (phase 2).

❖ **Phase 2: The Co-Integration Relationship.** The test bounds detected the existence of a co-integration relationship in the estimation of our model. Therefore, the analysis and discussion of the results can be split into two, always in a prospective logic, where the Moroccan monetary authorities would legalize the use of crypto-assets in Morocco:

- *Long-Run Result.* The results obtained in the long run - (see Table 6) where the price of bitcoin is the dependent variable- allow us to observe that the variables BITCSERSA and BITCIRSA have positive and significant coefficients. As opposed to the MADEXSA variable which has a positive but not significant coefficient. On the other hand, the EXCSA variable has a negative but significant coefficient. We noted that the two variables: the number of bitcoin in circulation (BITCIRSA) and the exchange rate between the dollar and the Moroccan dirham (EXCSA) recorded, respectively, the most important coefficients 14.6758 and 5.680766. The other variable is bitcoin's search frequency on google trend (BITCSERSA) is significant but with a low value of 0.899908. This finding corroborates with the empirical literature which states that, in the long run, tracking the frequency of bitcoin search on Google Trend has no impact on the formation of bitcoin price. Thus, we can say that the formation of the price of bitcoin in Morocco is not explained by the MADEX, but by the number of bitcoin in circulation (EXCSA) and the exchange rate between the dollar and the Moroccan dirham (EXCSA) and, to a lesser extent, by the frequency of bitcoin search on Google trend (BITCSERSA).
- *Short-Run Result.* The results obtained (Table 5) from the coefficients of the short-run dynamics show that the coefficient of the short-run dynamics of the variable (MADEX) is not significant, which connotes with the results obtained in the long run. Moreover, the coefficient of the short-term dynamics of the bitcoin search frequency on Google Trend (BITCSERSA) remains modest and also turns towards the results obtained in the long run. This can be explained by the fact that the integration of financial culture in Morocco requires a lot of time and therefore this has left the frequency of bitcoin search on Google Trend (BITCSERSA) unchangeable in both horizons. For the other variables, there are no major differences that should be noted.

The results obtained in both phases have tried to draw a global future scenario, in a prospective approach, illustrating the determinants of the formation of the price of bitcoin in Morocco. Thus, highlight, the cointegration relationship between our variables reflecting their long-run and short-run dynamic behaviors. However, our parameters may change and therefore the results may be biased. At this stage, the question concerning other, unpredictable parameters which might arise is worth asking (2.3.3.).

Recommendations for Unforeseen Parameters

We live in a “globalized” and interconnected world, where the understanding of each fact depends relatively and automatically on a set of elements (variables, conjuncture, etc.), internal and external, and in this context trying to find a verifiable reality, in human and social disciplines remains a fiction, if not an illusion; since reality is much more complex (Prof Mossadak, 2020). In this same logic, we can estimate that other unforeseen parameters may arise, and therefore all our analyses could be put in jeopardy, or even be biased. The use of crypto-assets in Morocco in a future scenario can be one of the transmission channels to achieve financial inclusion, since traditional finance -until the writing of this paper- did not meet the expected expectations. The failure of traditional finance led – as an example – to the legalization of the price of bitcoin in El Salvador, where – it is easily detectable – points of similarity in the degree of financial inclusion with Morocco. However, the result of such a decision – the legalization of bitcoin – cannot yield these fruits overnight, but it remains a choice that could put the country on a good footing as the old orientations have only maintained the status quo (Prof Machrafi, 2021).

Similarly, the purpose of this last point is to identify the parameters and unforeseen events, which may occur, and therefore biased the results obtained in our three scenarios above. To this end, we be giving

recommendations that we consider useful in such a situation. The frequency of bitcoin search on Google Trend, as one of the key determinants of bitcoin price formation, could give more disastrous results when it comes to fake news that could abruptly drop the price of bitcoin. At this stage, the Moroccan monetary authorities and their international counterparts must, in collaboration with the international monetary authorities in this case the BIS, try and establish a control system that ensures that the information is filtered, verified before the disclosure of any information relating to crypto assets and to stop the publication of such information but also penalize any individual with malicious intent. Such a system could only become a reality through the transition to the new financial paradigm of fintech (Sabah, 2021). Such an initiative could -in some way- minimize the damage that can be caused by fake news.

On the other hand, the interaction between the supply and demand of bitcoin is the second determining factor in the formation of its price in Morocco. The demand for bitcoin reflects the number of transactions, via bitcoin, being considered a means of exchanging goods and services. In a long-run horizon, such interaction would be unable to determine the price of bitcoin, and this for two fundamental reasons: The first is based on the fact that the maximum number of bitcoin that would be issued will be set at 21 million Bitcoins in 2140, because the bitcoin algorithm was programmed in this way, and therefore the bitcoin offer will be fixed, and therefore it can be taken for a digital gold. The second reason would be the gradual degradation of bitcoin demand as a means of exchanging goods and services - as was the case with gold in monetary history- because we will not have the opportunity to turn the money printing press in bitcoin in order to be able to operate an economy where finance is predominant. Therefore, in the long run, bitcoin could satisfy function as a store of value in a context where its value will no longer be too volatile.

Finally, the exchange rate between the dollar and the Moroccan dirham as one of the key determinants of bitcoin price formation in Morocco can necessarily be criticized. Currently, the hegemony of the dollar is evanescent, because there is the rise of other currencies since the old North/South dichotomy is no longer on the agenda, given the catching up of emerging countries, giving rise, according to the OECD report of 2011, a shift in global wealth (Shifting Wealth). Similarly, the political and monetary domination of the United States, which has been a hindrance to the construction of a system capable of dealing with the problems of adjustment of the balance of payments, and to endow the world with a fully international liquidity at Bretton Woods, was attenuated. These various observations represent the transition from an international monetary system based on the semi-standard dollar, to a multi-currency system implementing the infrastructure of a future monetary regionalization in a context of Sino-American rivalry. This situation could give rise to integrated units capable of monetary arrangements by assertion of key regional currencies. These different future scenarios may open up several possibilities where bitcoin will no longer be denominated in dollars. Consequently, it will be denominated in relation to the regional currency in which it has established itself. Finally, an extreme case that is far from realistic at the moment is that of collective polarization, which would lead to a situation where an ultimate liquidity will be used for international payments, both for public and private agents. At this level, the formation of the bitcoin price will depend on this ultimate liquidity, and therefore would be denominated in the latter.

CONCLUSION

To conclude, the empirical work has highlighted three major sets of factors that contribute to the formation of the price of bitcoin. A first set of factors related to the traditional currency. A second set of factors specific to bitcoin. Finally, a final set of hybrid factors. In the Moroccan case, and highlighting our research hypothesis, the results were divided into two phases. The first phase made it possible to highlight that the determinants of the formation of the price of bitcoin in Morocco, fall both factors related to the traditional currency, but also to factors specific to bitcoin. The second phase of the results relating to the bound test has identified co-integrative relationships between our variables, reflecting the dynamics of their behaviors in the short and medium term. Finally, recommendations were proposed in case of unforeseen events.

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