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RFC: ATI120618V12

Revista Dilemas Contemporáneos: Educación, Política y Valores.

<http://www.dilemascontemporaneoseduccionpoliticayvalores.com/>

Año: VI Número: Edición Especial. Artículo no.: 54 Período: Noviembre, 2018.

TÍTULO: El modelo econométrico para medir el impacto de la dolarización de la Economía Ecuatoriana. Reflexiones desde la perspectiva actual.

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RESUMEN: Para reducir la inflación existente, el gobierno decretó el congelamiento de los depósitos de los cuentahabientes durante un año a partir de marzo de 1999. Pese a esto, la hiperinflación tardó más de un año en estabilizarse, así el 9 de enero del 2000, se establece la conversión monetaria con el dólar como única alternativa desesperada para restaurar la confianza de la economía; por lo que para comprobar el impacto de la dolarización, se evaluó un modelo econométrico, que recoge todos los factores de productividad emparejados a una variable dependiente. Los resultados relatados en este artículo sugieren que el dólar tiene un impacto significativo y positivo sobre el crecimiento de la economía doméstica.

PALABRAS CLAVES: Crecimiento económico, dolarización, modelo econométrico, variables económicas.

TITLE: Econometric model to measure the impact of the dollarization of Ecuadorian economy.
Reflections from the current perspective.

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ABSTRACT: To reduce existing inflation, the government decreed the freezing of account holders' deposits for one year as of March 1999. Despite this, hyperinflation took more than a year to stabilize, so on January 9, 2000, it establishes the monetary conversion with the dollar as the only desperate alternative to restore the confidence of the economy; so to check the impact of dollarization, an econometric model was evaluated, which collects all the factors of productivity paired to a dependent variable. The results reported in this article suggest that the dollar has a significant and positive impact on the growth of the domestic economy.

KEY WORDS: Economic growth, dollarization, econometric model, economic variables.

INTRODUCTION.

The topic of the conversion was popular at the end of the 1990s and the early 2000s, when several economists advocated that emerging countries should adopt a foreign currency to stabilize their economies. The main argument in favor was the immediate price stability and trust in the economy that the adoption of the US dollar as legal tender would bring, particularly if the value of the domestic currency is in jeopardy.

Edwards & Igal Magendzo (2003) note that the probability of being a dollarized country depends on regional, geographical, political and structural variables, further argues that conversion, without being imposed by external actors, and is likely to occur under three circumstances: first, dollars to the domestic economy must be available in large quantities; second, domestic instability must affect the functioning of the financial system and the confidence of domestic actors, and third, there must be an important dollarized sector of the economy (Jameson, 2004).

Gale (2002) also list a set of benefits and costs associated with this money. They claim that an economy benefits because it reduces the transaction costs of trade, and if the country adopts a stable currency it commits to a stable monetary policy. The authors point out that conversion has the potential cost of abandoning monetary policy and the exchange rate as policy instruments and compromising the capacity to bail out the domestic banking system.

Castillo (2006) claims that the increased change of currency (financial) is positively associated with monetary growth. She also states that the process has a stronger impact on inflation than on any other variables. Furthermore, Castillo argues that dollarizing the economy helps attract foreign direct investment, lowers interest rates, and makes trade easier, especially for smaller countries in Latin America that trade predominantly with the United States. The analysis by listing the negative effects are the loss of monetary policy and the decline of the national identity represented by the national currency.

Perhaps one of the most disputed topics within the debate of this currency is the effect of the loss of a Lender of Last Resort (LOLR). Gale (2002) discusses how budgeting bailouts might not always be beneficial and they provide the following four main reasons:

1. The threat of bankruptcy and loss of private benefits can motivate managers to exert effort and improve the performance of the firm.
2. The possibility of a bailout reduces this incentive effect and indirectly encourages managerial

shirking and risk taking.

3. In emerging markets, moral hazard problems are widespread, and the economy relies in an important way on the monitoring effort of bankers who provide finance to entrepreneurial projects.
4. A time-consistent policy by the Central Bank may lead to excessive bailouts.

To summarize, economists agree that this currency brings about lower rates of inflation and an increase in stability of the country. They also agree that the credibility of regulatory institutions is enhanced and that the currency risk disappears along with the currency itself. They also agree that with the loss of monetary policy and the national currency countries lose a measure of sovereignty that might affect the country both monetary and politically. The matter is not so clear in terms of macroeconomic growth. Economists disagree on whether more growth is achieved or if there is no difference. They also disagree on how growth volatility is affected. Surprisingly, there is no focus on specific sectors of the economies that might help answer some of these questions.

So, with the preamble, the national currency, the Sucre, suffered hyperinflation in the year 1999. The hyperinflation was partly due to a combination of exogenous and climatic factors in the years 1997 and 1998. Among these were declining oil export prices and the El Niño weather phenomenon.

The East Asian financial crisis led to a decline in currencies and other assets in countries outside the region, which in turn, affected Ecuador's economy (Beckerman & Hernan Cortes, 2002, pág. 18). In February 1999, in order to limit international-reserve loss caused by the devaluation in Brazil, the Ecuadorian Central Bank floated the exchange rate. Over the following four weeks, the exchange rate lost 30% of its U.S. dollar value. In addition, consumer prices were 13.5% higher in March than in February, only one month after the decision to float the exchange rate, which only intensified the fear of hyperinflation (Beckerman & Hernan Cortes, 2002, págs. 54-55).

After President Jamil Mahuad announced the bank deposit freeze in the year 1999, there was anticipation of a liquidity crisis in March 2000, when the deposits were due to be unfrozen and people would start to withdraw their money from their bank accounts (Beckerman & Hernan Cortes, 2002, pág. 58). The anticipated liquidity crisis, in turn, was expected to make your banking sector collapse (Beckerman & Hernan Cortes, 2002, pág. 55). In addition to the loss of cash, capital and foreign reserves, the government exacerbated the domestic rate of inflation by printing excess quantities of money as an attempt to insure the deposits of increasingly unstable banking institutions. The rate of inflation rose from 52% on an annual basis in the years 1999 to 96% on an annual basis in the year 2000 (The World Bank, 2007).

On January 21, 2000, following President Mahuad's announcement of dollarization, the military and police refused to enforce public order during demonstrations by indigenous groups in Quito, the capital city (Solimano, 2002, pág. 3). During a night of confusion and negotiations, President Mahuad fled the presidential palace. Vice President Gustavo Noboa took charge and Mahuad went on national television to endorse Noboa as his successor. President Gustavo Noboa continued with full currency exchange to promote a return to low inflation. As a result, the exchange rate was set at 25,000 Sucres per U.S. dollar. Along with full currency exchange, legislation under the name of Economic Transformation Law (ETL) (Ley de Transformación Económica) was approved in March 2000 and fully implemented in September of the same year (Solimano, 2002, pág. 7). The ETL was fiscal and financial legislation that presented the new "banking system, the new accounting systems, the conversion of contracts from sucres to dollars, and labor laws" (Solimano, 2002, pág. 6).

Along with cash changeover, the operations of the Central Bank were restricted. Before change of currency was adopted, the Central Bank functioned as a lender of last resort. The function of lender of last resort allows the Central Bank to issue bailouts and credits to commercial banks. However, once this currency was adopted in the country, the function of lender of last resort was significantly

reduced. The Central Bank was only left with a special emergency fund to aid banks in financiers' distress (Solimano, 2002, pág. 10). It also lost the capability to adjust the exchange parity between a national and foreign currency, because those transferred seigniorage to the Federal Reserve Bank of the United States (Solimano, 2002, pág. 10).

The Central Bank "lost the power to carry out monetary policy" as it can no longer print money (Beckerman & Hernan Cortes, 2002, pág. 61). In other words, the risk of inflation has been transferred from Ecuador's government to the government of the USA. Steil (2007) argues, that the government's limitation in printing money results to stability for the country with sound to development and the lowest inflation rate in Latin America since the implementation of dollar took place (Steil, 2007, pág. 83).

DEVELOPMENT.

Edwards & Igal Magendzo (2003) argue, that the growth in dollarized nations does not statistically differ from that of non-dollarized ones (p. 18). The authors' main interest is to take a comparative analysis on real macroeconomic performance (pág. 6). To see the effects have in a country's growth, they use an "outcome equation", and an equation on the probability of being a dollarized country (pág. 6).

Edwards & Igal Magendzo (2003) declare empirical investigation that includes panel data for independent countries with an official dollarized system from the year 1970 to 1998 (p. 3). It is important to note, that the time Edwards & Igal Magendzo (2003) use in their research, does not include recent apparently successful experiences. Both were established in January 2000 and January 2001, respectively (Quispe-Agnoli & Elena Whisler, 2006, págs. 51-62).

Edwards and Magendzo (2003) use the following "outcome equation" to analyze the impact of currency exchange in a country's GDP growth (p. 7):

$$Y_{jt} = x_{jt}\beta + \gamma\delta_{jt} + \mu_{jt}, \quad (1)$$

Where Y_{jt} stands for each of the macroeconomic outcome variables of interest in country j and period t ; x_{jt} is a vector of covariates that capture the role of traditional determinants of the performance. δ_{jt} is a dummy variable that takes a value of one if country j in period t is “strictly dollarized” country, and zero if the country has a currency of its own. μ_{jt} is an error term. β and γ are parameters to be estimated (Edwards and Magendzo, 2003: 7).

For the estimation of GDP growth, Edwards & Igal Magendzo (2003) include the following as their explanatory variables: initial GDP, a measure of openness, a geographical dummy called “tropics,” and the change of currency dummy (pág. 12). The regressors have the expected signs and are significant at conventional levels. The initial GDP has a negative coefficient suggesting that there is “conditional convergence”; openness has a positive coefficient indicating that more open economies have tended to exhibit a higher rate of GDP growth.

The “tropics” variable has an only marginally significant negative coefficient, confirming that geography plays a role in the growth process. In terms of the exchange rate regime, these results show that the coefficient of the “cash changeover” dummy is positive, but not statistically significant (p. 13-14).

Edwards & Igal Magendzo (2003) conclude that the growth in dollarized nations does not statistically differ from that of non-dollarized nations (p. 18). The results and their significance expressed in z-statistics and p-values are presented in Table 1.

	Coefficient	Z-Statistic	[Probability]
Log(GDP0)	-.509	-2.92	[0.0035]
Openness	1.495	2.80	[0.0051]
Tropics	-3.002	-1.95	[0.0512]
Dollarization Dummy	0.605	1.21	[0.2263]

Source: (Edwards and Magendzo, 2003: 27).

An important difference between Edwards and Magendzo's (2003) study and the authors are that instead of using panel data for different countries from the years 1970-1998, we will use time series data from the years 1975-2017. Also, this study focuses on this effect has had in the fiscal growth, specifically.

We use time series data for the years 1975-2017 to uncover the effect, among other determinants; therefore, estimated the effect on growth using the growth accounting technique on a static linear econometric expression:

$$\dot{A} = B_0 + B_1 \ln(Oil) + B_2 \ln(Trade) + B_3 Dollarization + Error, \quad (2)$$

where \dot{A} is the growth rate of total factor productivity (TFP), B_0 is the intercept; $\ln(Oil)$ is the natural log of the annual real price of oil, and $\ln(Trade)$ is the natural log of the annual sum of exports and imports in constant 2000 US\$. Finally, cash changeover is the dummy variable that takes the value of one if our country is dollarized in that year.

By using the growth accounting technique in the mathematic expression, the main purpose is to pull out the effects of both capital (K) and labor (L) on output (GDP); that is, we subtract from output the part of the growth rate than can attributable to the growth rates of both K and L . Consequently, it is estimate of A , often called the growth "residual" (Barro & Xavier Sala-i-Martin, 1995, págs. 346-347). The reason that A is often called the residual is because it is computed as the amount of output

growth that remains after having accounted for the determinants of growth that can be measured directly by changes in K and L (Mankiw, 2007, pág. 247). According to Mankiw (2007), TFP “captures anything that changes the relation between measured inputs and measured output” (p. 247). In other words, TFP leaves out the effect of all variables other than capital and labor that could possibly affect GDP.

In order to further understand the concept of growth “residual”, it goes on to explain how to derive A in the model. Based on total capital/output ratio values for the time period from the years 1985-2002, which obtained from the International Monetary Fund (IMF) Ecuador’s Country Report (2003), we assumed a 35% for capital’s share of output (α).⁵ Similarly, are assumed a 65% for labor’s share of output ($1 - \alpha$), to obtained the growth rates of the output (GDP in constant 2000 US\$), L (Employment in thousands), and K (Real net capital stock in millions, adjusted for depreciation); that is, to divided the value for the current year by the value from the previous year (Barro & Xavier Sala-i-Martin, 1995, págs. 346-347). Finally, to subtracted from the growth rate of output (\dot{Y}), the part of the growth rate that can be accounted for by the growth rate of the inputs, K (\dot{K}) and L (\dot{L}) (Barro & Xavier Sala-i-Martin, 1995, pág. 347) [See Equation (3)].

$$\dot{A} = \dot{Y} - \{a(t)\dot{K} + [1 - a(t)]\dot{L}\} \quad (3)$$

In addition, to transform the independent variables, except for the new currency dummy, by their natural logarithm, because it is now a lin-log expression, note that the parameters B_1 and B_2 represent the 1% increase in x [*i.e. Oil, Trade, and Dollarization*] that leads to a $B_1/100$ and $B_2/100$ unit change in y [*i.e. Total Factor Productivity*] (Hill, William E. Griffiths, & Guay C. Lim, 2008, pág. 87). In other words, the slope changes at every point and it represents the marginal product of the independent variables (p. 87). The advantage of transforming the variables by the natural logarithms is that non-uniform residuals become uniform (McDonald, 2009). Put

simply, to avoid heteroskedasticity which takes place when the variances for all observations are not the same (Hill, William E. Griffiths, & Guay C. Lim , 2008, pág. 198).

To estimate Equation (2), to use the Ordinary Least Squares (OLS) procedure in order to minimize the sum of squared differences between the observed values of y_i and its expected values (Hill, William E. Griffiths, & Guay C. Lim , 2008, pág. 111) and (Verbeek, 2008, pág. 325).

- Data.

Time series data for what appears to be a sufficiently long period of time seemed suitable for my study; therefore, the time series annual data of the variables during the period of the years 1975-2008 is adopted. Note, that the period of 33 years used in the study is the longest for which the desired data are available. The time-series data for my variables have been obtained from the World Development Indicators, or WDI (2007), and the United States Energy Information Administration's website, or EIA (2017).

- Description of the variables.

- Oil. The data used for this variable were obtained from the United States Energy Information Administration's (2018) website for the time period from the years 1975-2017.
- Trade. The data used for this variable were obtained from the World Development Indicators (WDI) for the time period from the years 1975-2017.
- Dollarization. It is a dummy variable with a value of 1 in the presence of dollar for the years 2000-2017. It takes a value of 0 for the remaining years from 1975-1999 (Arellano & Solorzano, 2009) describe the dollar as a significant variable for explaining the growth.

Table 2. Description of the variables.

Variables	Support for the use	Sources	Measurement	Expected Sign
Oil	IMF Country Report (2006); United States Energy Information Administration (2009)	United States Energy Information Administration's website (2009)	Annual average of the monthly data adjusted for inflation.	Negative
Trade	(Feng, 1997) (Quispe-Agnoli & Elena Whisler, "Official Dollarization and the Banking System in Ecuador and El Salvador.", 2006)	World Development Indicators (2007)	Annual sum of exports and imports of goods and services in constant 2000 billion of US\$.	Positive
Dollarization	(Arellano & Solorzano, 2009)	Constructed	Dummy variable with a value of 1 in the presence of new currency for the years 2000- 2008. It takes a value of 0 for the remaining years from 1975-1999.	Unknown

Specifically, Hill et al. (2008) determine that the state that dummy variables are "significant tools for capturing qualitative characteristics" (p. 167), because the significance and the sign for the dummy variable new currency vary throughout other studies (Edwards & Igal Magendzo , 2003); (Arellano & Solorzano, 2009).

Table 2 provides a list of the independent variables, including support for the use of the corresponding variable, sources, measurement, and the expected sign for each of the variables.

Having employed the growth accounting technique in the expression, we proceed to explain the results after running an OLS regression; the explanatory variables explain over 30% of the variations in TFP. This is given by the Adjusted R-Squared [.31513]. There is no serial autocorrelation given that the Durbin Watson statistic [2.4820] is within the acceptable bound ≈ 2 (Hill, William E. Griffiths, & Guay C. Lim , 2008, pág. 261). Therefore, we assume the functional

form is appropriate for the expression. In addition, the probability of the F-Statistic [.003] suggests that the mathematic expression has a very good fit.⁸

Interpretation of variables.

- Oil.

We find that 1% increase in the real price of oil is associated with a .025 unit decrease in the country's TFP. The result is statistically significant at the 3% level. My results are supported by the Energy Information Administration (EIA) Country Analysis Brief (2009). Also, it is important to note, that whenever the price of oil, hence, the currency appreciates, this is tied with a rise in the exchange rate (Mankiw, 2007, pág. 132).

When the real exchange rate is high, domestic goods are more expensive relative to foreign goods. Consequently, net exports decrease (Mankiw, 2007, pág. 135). In sum, an increase in the real price of oil has a negative effect in net exports, which supports the negative sign on the coefficient of the variable Oil.

- Trade.

We find that 1% increase in trade is associated with a .002 unit increase in the country's TFP. The result is nearly statistically significant at the 10% level given it is 11% significant. My results are supported by Quispe-Agnoli and Whisler(2006) and Feng (1997) who also obtained a significant positive coefficient for the variable Trade in their empirical studies.

Table 3. Full Report of OLS Regression for A (dependent variable), 1975-2008.

Regressor	Coefficient	Standard Error	T-Ratio	[Probability]
Oil	-.025526	.011276	-2.2639	.031
Trade	.0029661	.012343	2.9178	.007
Dollarization	.036015	.0018233	1.6268	.114

R-Squared = .31513 R-Bar Squared = .26947 F-Stat F(2, 30) 6.9020 [.003]

Diagnostic Tests.

Test Statistics	LM Version	F Version
A. Serial Correlation	CHSQ (1) = 2.0240 [.155]	F(1,29) = 1.8949 [.179]
B. Functional Form	CHSQ (1) = .090626 [.763]	F(1,29) = .079860 [.779]
C. Normality	CHSQ (2) = 1.4667 [.480]	Not Applicable
D. Heteroskedasticity	CHSQ (1) = .62420 [.429]	F(1,31) = .59768 [.445]

Table 4. Summary of expected and actual signs for each variable included in the expression.

Variable	Expected Sign	Actual Sign
Oil	Negative (-)	Negative (-)
Trade	Positive (+)	Positive (+)
Dollarization	Unknown (+)	Positive (+)

(Quispe-Agnoli & Elena Whisler, 2006) state that currency exchange “lowers transaction and information costs, encouraging trade and financial integration (p. 58). Nevertheless, one can argue that the negative coefficient of the variable Oil supports the positive, yet significant effect of Trade on TFP, as the negative effect of Oil offsets the positive effect of our Trade.

- Dollarization.

We find that the presence is associated with a significant positive effect of a .036 unit increase in the country’s TFP. The result is statistically significant at the 1% level. My results differ to those of (Arellano & Solorzano, 2009) since the authors conclude that is not statistically significant in their model. Nevertheless, we concur with the authors that serve as a stabilizing factor in our economy.

Table 3 offers the results of the OLS Regression for \dot{A} , years 1975-2017. Table 4 presents the summary of the expected signs for each variable and the actual sign obtained from the regression.

CONCLUSIONS.

The purpose of this paper has been to analyze the development in financial matter to provide by dollarization. We coincide with Edward (2001) on giving the benefit of the doubt, depending on the country in which it is being established. Also, it is very difficult to separate the role of cash changeover from that of other factors, which explains the inconclusiveness of previous studies on the effect on countries.

The regression analysis outcome has asserted the prediction of the negative effect of Oil to growth at the 1% significance level. Likewise, regression analysis outcome has asserted the prediction of the positive effect of Trade to development at the 11% significance level. Currency exchange has a statistically significant positive impact on the Ecuadorian economy at the 1% level. Given the results of the study, the conclusion is that our economy has, in fact, become more stable since the adoption.

Note that the results could change depending on the dynamics of the economy in a specific country.

In sum, we invite the readers to learn more about Ecuador and further study to development of this and other developing countries as an attempt to reduce negative disparities worldwide.

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RECIBIDO: 10 de septiembre del 2018.

APROBADO: 3 de octubre del 2018.