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EFFECT OF OFFICAL DOLLARIZATION ON MACROECONOMIC PERFORMANCE AND MONEY-PRICE RELATIONSHIP IN ECUADOR

Bedri Kamil Onur Taş and Selahattin Togay

May, 2009

Effect of Official Dollarization on Macroeconomic Performance and Money-Price Relationship in Ecuador*

Bedri Kamil Onur Taş** and Selahattin Togay***

Abstract

This paper investigates effects of official dollarization on the macroeconomic performance of Ecuador using a time series perspective. More specifically, we investigate how dollarization effects inflation, GDP, inflation uncertainty and money-price relationship in Ecuador. There are four main findings of this study. First, inflation is lower after official dollarization. Second, GDP growth is higher after official dollarization when controlling for several other factors like rising oil prices and increase in the equity markets of emerging economies. Third, inflation uncertainty measured by inflation variance through GARCH is lower during official dollarization. Finally, money supply is endogenous after official dollarization and exogenous before official dollarization. As a result, we conclude that dollarization improved the macroeconomic performance of Ecuador and changed the money-price relationship in Ecuador.

Keywords: Official Dollarization, Ecuador, Inflation uncertainty, GARCH model, Money-price relation, Endogeneity of money

JEL Classification: F31, E51, E42, E31

1. Introduction

The fact that many emerging countries faced currency crises with devastating negative economic effects caused an intense debate on exchange rate policies for emerging countries. Many economists proposed hard pegs (Summers (2000) and Fischer (2001)). Official Dollarization, in the sense that the country should abandon its national currency and adopt an advanced nation's currency as legal tender (US Dollar for Ecuador), has been implemented by many countries. Ecuador undertook official dollarization in March 2000 by dropping its own currency, the sucre, and adopting the US dollar. This paper empirically investigates the effects of dollarization on the macroeconomic performance of Ecuador. As mentioned by Jameson (2003a), Ecuador is the longest-lasting of the recent dollarizers and has the most extreme contemporary dollarization program. This makes Ecuador an excellent candidate to investigate the effects of dollarization on developing economies. As presented in table I, we find that dollarization has significant positive effects on the economic performance of Ecuador.

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Table I

Effect of Dollarization on Macroeconomic Performance and Money-Price
Relationship in Ecuador

Summary of the Empirical Results

	Effect of Dollarization
CPI Inflation	Lower after dollarization
GDP Growth	Higher after dollarization
Variation of Inflation	Lower after dollarization
Money-Price Relationship	Money becomes endogenous after dollarization

As mentioned in Calvo (2001) and Minda (2005) theoretically there are pros and cons of dollarization. Thus, extensive empirical analysis is required to investigate whether dollarization achieves what it promises: improvements in macroeconomic conditions through financial and exchange rate stability. Alesina and Barro (2001) have argued that adopting another nation's currency 'eliminates the inflation bias problem of discretionary monetary policy'. Dornbusch (2001) indicates that countries that give up their currency will tend to grow faster than non-dollarized countries. This paper is the first study that investigates effects of dollarization on the macroeconomic performance of Ecuador using a time series perspective. More specifically, we investigate how dollarization effects inflation, GDP growth, inflation uncertainty and money-price relationship (endogeneity of money). There are four main results of this study. First, inflation is lower after dollarization. Second, GDP growth is higher after dollarization. Tests of Equal Mean and Variance among different subsamples and artificial regressions construct these results. We control for oil production growth, rise in oil prices and increase in the MSCI emerging market index while investigating GDP growth. Third, inflation uncertainty measured by inflation variance through GARCH is lower during dollarization. Finally, money supply is endogenous after dollarization and exogenous before dollarization. Section 5 explains the intuition behind this result.

Edwards and Magendzo (2006) examines the effect of dollarization using a yearly panel of 169 countries that covers 1970 through 1998. They find that GDP growth is not statistically different in dollarized and in non-dollarized ones. Since the dataset of Edwards and Magendzo (2006) ends in 1998, it does not identify Ecuador as dollarized. The dollarized countries in their dataset is mostly non-independent countries and independent countries are small countries. In their dataset 20 out of 169 countries are identified as dollarized. In our study, we use monthly and quarterly data and analyze the effects of dollarization on a relatively large independent country, Ecuador, using a time series perspective.

Quispe-Agnoli and Whisler (2006) indicate that the expected benefits of full dollarization include the elimination of exchange rate risk, contributing to the decline of the country risk premium and interest rates, as well as the reduction of the inflation rate and inflationary expectations. Some initial conditions could be relevant in the decision to implement official dollarization. Minda (2005) and Edwards and Magendzo (2006) observe that small countries with close trade or financial ties to the United States could favor official dollarization, as Panama did in 1904. Ecuador, El Salvador, and Panama, the largest countries that have implemented official dollarization, are still relatively small and are very open to U.S. trade

and finance, with an average gross domestic product (GDP) of \$11 billion (in 2000 dollars) and an average population of 7 million in 2004.

There are several studies that investigate the macroeconomic performance of Ecuador. The economic crisis in 1998-1999 period led to dollarization in Ecuador. Nazmi (2001), Jacome (2004), Beckerman (2002), Martinez (2006) analyzed the process that led to this economic crisis. They argue that mainly institutional weaknesses, rigidities in public finances, and high financial dollarization amplified the financial crisis in Ecuador. Beckerman and Douglas (2002) and Solimano (2002) examines the pros and cons of dollarization in Ecuador. Jameson (2004) argues that orthodox perspectives are inadequate to explain dollarization decision of Ecuador and uses a "Post-Keynesian institutionalist" explanatory framework. Jameson (2003a and 2003b) argues that dollarization is not suitable for Ecuador and will lead Ecuador to crisis since it does not solve any fundamental economic problems about the structure of the economy. Jameson (2003a) examines how a process of de-dollarization might be implemented. Jameson (2003b) examined the macroeconomic performance of Ecuador using yearly data from 1997 till 2002. This paper argues that macroeconomic performance of Ecuador has improved during 2000-2002 period. Dollarization played a role in this improvement by encouraging both private and capital flows. From a political-economic standpoint, dollarization has succeeded in providing access to international dollar resources. Jameson (2003b) indicates that although dollarization improved the economic performance of Ecuador, the fundamental structural economic problems like political instability and disappearance of independent monetary policy remain. These problems leave Ecuador susceptible to crisis. These studies use only yearly data because of data limitations and do not conduct a time series investigation of macroeconomic performance of Ecuador.

Our analysis differs from other related studies in the literature in several aspects. First of all, this study is the first extensive time-series analysis of the effects of dollarization on the macroeconomic performance of Ecuador. We use monthly and quarterly data to investigate effects of dollarization on macroeconomic performance of Ecuador. Earlier studies could not conduct these studies because of data limitations. Second, to best of our knowledge, this is the first study that analyzes the impact of dollarization on inflation uncertainty using a GARCH model. Third, we investigate the effect of dollarization on money-price relationship in Ecuador which has not been done in the literature before. Fourth, this study is the first study that uses high frequency (monthly and quarterly) data to investigate dollarization. Fifth, we implement a test of exogeneity in the context of GMM and instrumental variables to investigate endogeneity of money before and after dollarization which has not been used in the literature before to investigate money-price relationship. Finally, using several time-series methods and statistical tests we contribute to better understanding of the macroeconomic effects of dollarization using monthly and quarterly data.

The rest of the paper is organized as follows: In section 2, we explain the data and methodology used in this study. In section 3, we present the results about macroeconomic performance of Ecuador namely inflation and output growth. In section 4, we analyze effects of dollarization on inflation uncertainty. In section 5, we examine the impact of dollarization on money-price relationship in Ecuador. Finally, in section 6, we present concluding remarks and policy implications of the results.

2. Data and Methodology

2.1. Data

We use monthly and quarterly data for 1990-2007. The source of the data is IFS, St. Louis Fed FRED and Reuters Ecwin databases. The variables used in this study are:

2.1.1. Monthly Data

- CPI Inflation: Inflation is calculated as the log difference of CPI. (IFS)
- Money Supply: Reserve money, M1 and M2 are used for the analysis of money supply. (IFS)
- Spot Oil Price: West Texas Intermediate (FRED)
- MSCI Emerging Markets Index Growth: Index growth is calculated as the log difference of the index created by Morgan Stanley Capital International (MSCI). MSCI is designed to measure equity market performance in global emerging markets. (Reuters Ecwin)

2.1.2. Quarterly Data

- Real GDP: Level of GDP at 2000 prices in US Dollars. (IFS)
- GDP Growth: GDP growth is calculated as the log difference of Real GDP. (IFS)
- Oil Production Growth: Log difference of quarterly total oil production. (IFS)

Oil production growth, spot oil price and MSCI index growth are used as control variables in regressions that measure the effect of dollarization on real GDP and real GDP growth.

2.2. Methodology

This study investigates three important aspects of Ecuadorian economy: macroeconomic performance (inflation and GDP growth), inflation uncertainty and money-price relationship.

2.2.1. Macroeconomic Performance

Tests of equal mean among different subsamples (before and after dollarization) and artificial regressions that are designed to measure the change before and after dollarization (March 2000) are used. Test of equal mean is based on a single-factor, between-subjects, analysis of variance (ANOVA). The basic idea is that if the subgroups have the same mean, then the variability between the sample means (between groups) should be the same as the variability within any subgroup (within group).

We implement an OLS methodology with dollarization dummy (artificial regression) to measure exact effects of dollarization on macroeconomic performance variables of Ecuador. The dollarization dummy takes value of 1 after March 2000 (2nd quarter of 2000 for quarterly data) and zero before March 2000. This methodology is implemented by Mishkin and Schmidt-Hebbel (2007) to measure effects of inflation targeting on macroeconomic

performance. The coefficient of the dollarization dummy variable gauges the exact effect of dollarization. We use several control variables to make sure that changes in GDP growth is caused by dollarization not by other variables that can affect GDP.

2.2.2. Inflation Uncertainty

As in Fountas (2001), we implement a GARCH (1,1) model to investigate the impact of dollarization on inflation uncertainty. Consider an ARMA model of inflation, π_t , with time-varying conditional variance:

$$\begin{aligned}\pi_t &= \beta_0 + \beta_1\pi_{t-1} + \beta_2\varepsilon_{t-1} + \varepsilon_t \\ \text{Var}(\varepsilon_t/\theta_{t-1}) &= \sigma_t^2 \\ \sigma_t^2 &= \alpha_0 + \alpha_1\varepsilon_{t-1} + \lambda_1\sigma_{t-1}^2 + \delta_1\text{dollarizationdummy}_t\end{aligned}$$

As in Andersen et.al. (2003), we use the dummy variable as an explanatory variable in the variance equation and investigate effect of dollarization on inflation uncertainty. Andersen et.al. (2003) use announcement dummies in the variance equation of exchange rates to measure the effects of macroeconomic announcements on exchange rate volatility. The coefficient of the dollarization dummy shows the effect of dollarization on inflation uncertainty in Ecuador.

2.2.3. Money-Price Relationship

Many studies like Pinga and Nelson (2001) and Özmen (2003) use Granger causality or cointegration tests to investigate the relationship between money supply and price level or inflation. But these methods test causality not exogeneity of a variable. As argued in the literature, the existing causality studies do not make a clear distinction between exogeneity and causality. Thus, the presence of causal relationship from price to money supply is neither necessary nor a sufficient condition for testing endogenous money hypothesis. Engle, et. al. (1983) define exogeneity in three ways: weak, strong and super. As recommended by Baum et. al. (2007), we implement a test of overidentifying restrictions to test endogeneity of money.

As shown in Hayashi (2000), a regressor is endogenous if it is not predetermined (i.e., not orthogonal to the error term), that is, if it does not satisfy the orthogonality condition. Following this argument, we test whether money is endogenous using the C statistic (also known as a GMM distance or difference-in-Sargan statistic). Under the null hypothesis that the specified endogenous regressors can actually be treated as exogenous, the test statistic is distributed as chi-squared with degrees of freedom equal to the number of regressors tested. The endogeneity test is, like the C statistic, defined as the difference of two Sargan-Hansen statistics: one for the equation with the smaller set of instruments, where the suspect regressor(s) are treated as endogenous, and one for the equation with the larger set of instruments, where the suspect regressors are treated as exogenous. Also like the C statistic, the estimated covariance matrix used guarantees a nonnegative test statistic. Under conditional homoskedasticity, this endogeneity test statistic is numerically equal to a Hausman test statistic; see Hayashi (2000, 233-234). We conduct the test for the pre and post-dollarization periods.

3. Macroeconomic Performance of Ecuador and Dollarization

This section investigates the effects of dollarization on inflation and GDP growth. Table II presents the summary statistics of monthly inflation for dollarization and non-dollarization periods. Table III displays the summary statistics for Real GDP and Real GDP growth using quarterly data.

Table II

Summary Statistics of CPI Inflation in Different Periods (Monthly Data)

	Whole Period (Jan. 1990 – Nov. 2007)	Before Dollarization (Jan. 1990- March 2000)	Dollarization (April 2000 – Nov. 2007)
Mean	0.02	0.03	0.01
Standard Deviation	0.02	0.021	0.015

Table II shows that mean and standard deviation of CPI inflation is lower after dollarization. Similarly, using quarterly data Table III shows that mean of Real GDP and Real GDP growth is higher.

Table III

Summary Statistics of GDP Growth in Different Periods
(Quarterly Data)

		Whole Period (1994 Q1 – 2007 Q3)	Before Dollarization (1994 Q1 – 2000 Q1)	Dollarization (2000 Q2 – 2007 Q3)
Real GDP (At 2000 Prices USD)	Mean	4374	3912	4758
	Standard Deviation	578	147	517
Real GDP Growth	Mean	0.008	0.002	0.01
	Standard Deviation	0.016	0.02	0.01

Table IV presents the tests of equal mean of monthly inflation for dollarization. Table IV concludes that mean of inflation is significantly different for the two subsamples. Table V exhibits the tests of equal mean for inflation and GDP using quarterly data. Table V shows that the means of inflation, Real GDP and Real GDP growth are different for the two subsamples.

Table IV

Tests of Equal Mean and Variance among different subsamples: (Monthly)
 Test for Equality of Means: Ho: Subsample means of inflation are equal.

Method	Degrees of Freedom	Value	Probability
t-test	210	7.74	0.00
Anova F-statistic	(1, 210)	59.9	0.00

Table V

Tests of Equal Mean among different subsamples: (Quarterly)
 Test for Equality of Means: Ho: Subsample means of (Inflation, Real GDP, GDP Growth) are equal.

Method	Inflation		Real GDP		GDP Growth	
	Value	Probability	Value	Probability	Value	Probability
t-test	5.1	0.00	7.9	0.00	2.3	0.03
Anova F-statistic	26.1	0.00	62.6	0.00	5.5	0.03

Following the methodology in Mishkin and Schmidt-Hebbel (2007), table VI and VII measures the change in inflation and GDP growth before dollarization and after dollarization. In table VI, for monthly data the coefficient of dollarization dummy variable is negative and significant for the inflation equation. In table VII, for quarterly data the coefficient of dollarization dummy variable is negative and significant for the inflation equation. For the analysis of Real GDP and Real GDP growth, table VII displays alternative regression specifications with different sets of control variables. Table VII shows that the dollarization dummy is significant with positive coefficient for the Real GDP and Real GDP growth equations. Thus, we conclude that inflation is significantly lower in Ecuador after dollarization and Real GDP and Real GDP growth is significantly higher after dollarization. These results are robust to different regression specifications with alternative control variables.

Table VI

Analysis of Changes in Macroeconomic Variables
 (Dollarization-Dummy =1 after March 2000)

	CPI Inflation	
	Dollarization-Dummy	-0.02 (-7.74)**
Lag of Dependent Variable		0.55 (9.7)**
Constant	0.03 (17)**	0.01 (0.002)**
R-Squared	0.22	0.46
Number of Obs.	212	211

Table VII
 Analysis of Changes in Macroeconomic Variables (Quarterly)
 (Dollarization-Dummy =1 after 2000 Q1)

	CPI Inflation		Real GDP				Real GDP Growth			
	(1)	(2)	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
Dollarization Dummy	-0.06 (-5.1)**	-0.03 (-3.3)**	846.2 (7.9)**	67.4 (2.7)**	234.6 (3.1)**	795.9 (7.45)**	0.01 (2.3)**	0.01 (2.05)*	0.01 (2.08)*	0.01 (2.73)**
Lag of Dependent Variable		0.62 (7.2)**		0.98 (43.8)**				0.03 (0.22)		
Oil Production Growth						-38 (-0.15)				0.02 (1.82)
World Oil Price					25.2 (11.4)**				-0.000 (-0.58)	
MSCI Emerging Market Index Growth					216.4 (0.96)				-0.003 (-0.17)	
Constant	0.09 (12)**	0.04 (3.7)**	3912.2 (49.5)**	108 (1.22)**	3429.2 (57.8)**	3914 (50.6)**	0.002 (0.69)	0.002 (0.66)	0.004 (0.89)	0.001 (0.4)
R-Squared	0.28	0.59	0.54	0.99	0.88	0.54	0.09	0.09	0.1	0.16
Number of Obs.	69	68	55	54	55	53	54	53	54	52

4. Inflation Uncertainty and Dollarization

Inflation uncertainty have been extensively investigated in the literature. It is found that inflation uncertainty significantly affects macroeconomic performance like inflation and GDP growth. Cukierman and Meltzer (1986) and Cukierman (1992) construct a game-theoretic model and show that higher inflation uncertainty will raise average inflation rate. Using GARCH methodology and granger causality tests Apergis (2004) provides empirical support that inflation uncertainty increases inflation in the G7 countries. Grier and Perry (1998) find that a rise in inflation uncertainty significantly affects inflation in more than half of the countries they analyze. Elder (2004) theoretically and empirically investigate effects of inflation uncertainty on real economic activity. He finds that a shock to inflation uncertainty decreases output growth. Friedman (1977) indicates that uncertainty about future inflation distorts the efficient allocation of resources and this leads to lower output. Stockman (1981) showed that anticipated inflation reduces the demand for real balances, implying that the demand for capital and output growth decreases. His results find empirical support in Zhang (2000).

As mentioned in Fountas(2001), autoregressive conditional heteroskedasticity (ARCH) and generalized ARCH (GARCH) approaches proxy uncertainty using the conditional variance of unpredictable shocks to the inflation rate. Fountas (2001) uses annual data and implements GARCH (1,1) model to investigate inflation uncertainty in UK. Daal et.al. (2005) use monthly inflation rates based on log differences of CPI. They implement PGARCH methodology to estimate inflation uncertainty and use Granger causality tests to investigate the relationship between inflation and inflation uncertainty for both developed and emerging countries.

As explained in section 2, we implement GARCH methodology to investigate effect of dollarization on inflation uncertainty. As described above, low inflation uncertainty has meaningful positive implications on macroeconomic conditions of a country.

First, we conduct ARCH LM test and unit root tests to verify whether we can implement the GARCH methodology. The ARCH LM test indicate the presence of ARCH effects for inflation. Unit root tests reject the null hypothesis of a unit root for inflation at 1 percent. Table in Appendix A shows that inflation do not have a unit root.

Figure I: Variability of Inflation

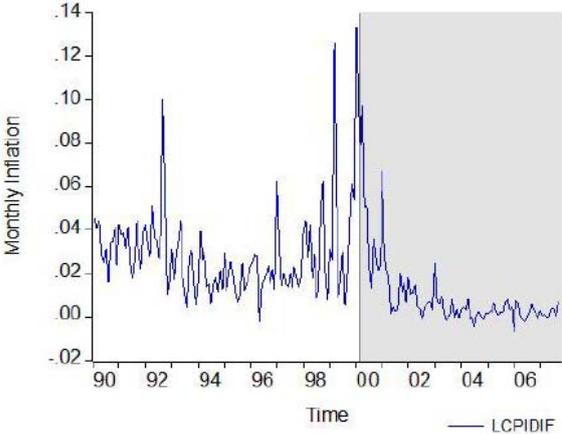


Figure I displays monthly inflation. It can be seen that variability of inflation is much lower after dollarization (March 2000).

Table VIII shows different specifications results of GARCH(1,1) for inflation. We estimated various ARCH and GARCH models. The Akaike Information Criterion (AIC) and Schwarz Bayesian Criterion (SBC) of these alternative models are displayed in section B of the Appendix. GARCH(1,1) specification for the variance of inflation in Ecuador is selected by the SBC. Several studies of inflation uncertainty like Apergis (2004), Fountas (2001) and Grier and Perry (1998) implement GARCH(1,1) specification. As in Andersen et.al. (2003) and Fountas (2001), we investigate changes in the variance of inflation by using the variable of interest (dollarization dummy) as an explanatory variable in the variance equation. In all of the regression specifications, the coefficient of the dollarization dummy is significant and negative. This result concludes that inflation uncertainty (variance) is lower after dollarization.

Table VIII (GARCH(1,1))
Inflation Uncertainty and Dollarization
(P-values are presented under the coefficients in parantheses.)

Inflation Equation				
	(1)	(2)	(3)	(4)
C		0.0046 (0.02)*	0.004 (0.34)	0.03 (0.5)
AR(1)		0.74 (0.00)**	0.78 (0.00)**	0.97 (0.00)**
MA(1)				-0.72 (0.00)**
Variance Equation				
C	0.001 (0.01)**	0.00005 (0.00)**	0.0002 (0.00)**	0.00003 (0.00)**
RESID(-1)^2	0.12 (0.02)*	0.017 (0.14)	0.03 (0.55)	0.05 (0.00)**
GARCH(-1)	0.8 (0.00)**	0.88 (0.00)**	0.2 (0.18)	0.87 (0.00)**
Dollarization-Dummy	-0.0001 (0.01)**	-0.00005 (0.00)**	-0.0002 (0.00)**	-0.00003 (0.00)**
CPI Inflation			0.002 (0.00)	
Adjusted R-square		0.36	0.36	0.4
AIC	-5.2	-5.92	-5.99	-6.06
SIC	-5.1	-5.83	-5.88	-5.96

Figure II: Conditional Variance of Inflation Before and After Dollarization

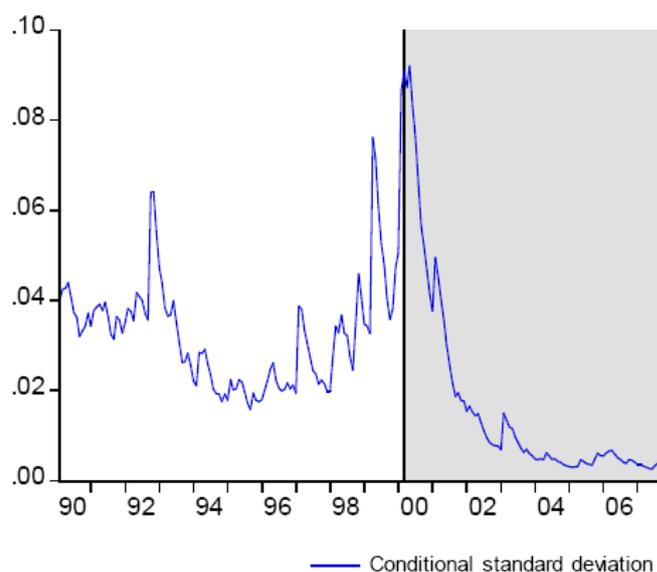


Figure II presents that standard deviation of inflation is much lower after dollarization. Thus, the results of this section infer that inflation uncertainty is significantly lower after dollarization.

5. Money-Price Relationship in Ecuador

Is inflation a monetary phenomenon? This question has been extensively analyzed theoretically and empirically. Several studies in the literature investigate money-price relationship empirically: Belrs and Jones (1993) for Algeria; Pradhan and Subramanian (1998) for India; Sun and Ma (2004) for China and Pinga and Nelson (2001) for 26 countries. Vymyatnina (2006) conducts the analysis from a post-Keynesian perspective for Russia. To the best of our knowledge, there are no studies that investigates money-price relationship for Ecuador and this study is the first study that examines effect of dollarization on money-price relationship.

Dollarization is expected to effect money-price relationship because in the full dollarization system a country abandons its monetary and exchange rate policies. The amount of money is determined internally (endogenously) according to balance of payments. In other words, as Schuler (2005) argues the supply demand dynamics in the exchange rate market determines the money supply. This argument indicates that dollarization endogenezies money supply.

In that context, we expect and find money supply to be endogenous after dollarization (after March 2000)¹. Before dollarization, (1990-2000 period) there has been different exchange rate regimes in Ecuador. During pre-dollarization period, we expect and find money supply to be exogenous in Ecuador. This is partly caused by the fact that most of the money supply is determined by financing government expenditures and financing troubled banks.

We conducted endogeneity test using different measures of money supply: M1, M2 and reserve money. Different specifications and estimations techniques are implemented (2SLS, GMM). The lagged values of dependent and independent variables are used as instruments. The underidentification tests of all regressions have p-values of 0.00 indicating that instruments are significantly related with the endogenous variable. The Sargan and Hansen J statistics of all the regressions have p-values between 0.38 and 0.99. Thus, for all of the instrumental variable regression specifications, we accept the null hypothesis that the instruments are valid instruments, i.e., uncorrelated with the error term.

Table IX displays the GMM test of exogeneity of M1 before and after dollarization. Table IX shows that the null hypothesis that M1 is exogenous is accepted before dollarization and rejected after dollarization. Thus, M1 is endogenous after dollarization.

Table IX

Endogeneity Test of Money (defined as M1):
The C statistic (also known as a GMM distance or difference-in-Sargan statistic)

	Before Dollarization		Dollarization	
	Ho: M1 is Exogenous			
Regressor	Test Statistic	Chi-sq P-Value	Test Statistic	Chi-sq P-Value
2SLS without lag Inflation	0.48	0.49	48.2	0.000
2SLS with lag Inflation	0.006	0.94	16.7	0.000
GMM without lag Inflation	0.5	0.48	6	0.01
GMM with lag Inflation	0.12	0.73	4.5	0.03

¹ In that respect, two items should be explained. First, full dollarization system is the most rigid version of the fixed exchange rate regime. Thus, under this regime money supply is endogenized. The results of this study should be valid for other countries that implement full dollarization (El Salvador, Panama etc.). Also, the results should hold for currency board regimes. For example, Togay ve Köse (2009) show that in the currency board regime of Argentina money supply becomes endogenous. Second, compared to full dollarization the currency board regime has both currency and country risks since the official money of the country is not abandoned. In the full dollarization case, only the country risk remained and currency risk is eliminated. Under the current circumstances of the global market, if the US dollar becomes more volatile the full dollarization countries will suffer from the currency risk of the US dollar

For robustness reasons the same analysis conducted with alternative measures of the monetary base, M2 and reserve money. Table X show that the null hypothesis that M2 is exogenous is accepted before dollarization and rejected after dollarization. Thus, M2 is endogenous after dollarization. As shown in table XI, the null hypothesis that Reserve Money is exogenous is accepted before dollarization and rejected after dollarization. Thus, Reserve Money is endogenous after dollarization.

Table X
 Endogeneity Test of Money (defined as M2):
 The C statistic (also known as a GMM distance or difference-in-Sargan statistic)

	Before Dollarization		Dollarization	
Ho: M2 is Exogenous				
Regressor	Test Statistic	Chi-sq P-Value	Test Statistic	Chi-sq P-Value
2SLS without lag Inflation	0.003	0.96	47.9	0.000
2SLS with lag Inflation	0.6	0.43	16.7	0.000
GMM without lag Inflation	0.042	0.84	5.2	0.02
GMM with lag Inflation	0.6	0.43	4.6	0.03

Table XI
 Endogeneity Test of Money (defined as Reserve Money):
 The C statistic (also known as a GMM distance or difference-in-Sargan statistic)

	Before Dollarization		Dollarization	
Ho: Reserve Money is Exogenous				
Regressor	Test Statistic	Chi-sq P-Value	Test Statistic	Chi-sq P-Value
2SLS without lag Inflation	1.14	0.27	53	0.00
2SLS with lag Inflation	2.5	0.11	22.5	0.00
GMM without lag Inflation	0.84	0.36	4.5	0.03
GMM with lag Inflation	2	0.16	7.1	0.01

Finally, from the endogeneity tests conducted for M1, M2 and reserve money we deduce that money is endogenous after dollarization and exogenous before dollarization in Ecuador. As explained above, dollarization endogeneizes money.

6. Conclusion and Policy Implications

This paper is the first study that investigates effects of dollarization on the macroeconomic performance of Ecuador using a time series perspective. More specifically, we investigate how dollarization effects inflation, GDP growth, inflation uncertainty and money-price relationship (endogeneity of money). There are four main results of this study. First, inflation

is lower after dollarization. Second, GDP growth is higher after dollarization. Third, inflation uncertainty measured by inflation variance through GARCH is lower during dollarization. Finally, money supply is endogenous after dollarization and exogenous before dollarization. As explained in Section 6, this is caused by the fact that the amount of money is determined internally (endogenously) according to balance of payments .

The results of this paper has many policy implications. We provide evidence that dollarization improves macroeconomic performance of Ecuador by lowering inflation, increasing GDP growth and lowering inflation uncertainty. Endogeneity of money in Ecuador after dollarization raises some arguments about economic policy in Ecuador. Production in Ecuador highly depends on oil production. The percent of oil production in GDP is significantly higher for the 2000-2006 period. Before dollarization mining (including oil production) constitutes 11.6% of GDP and after dollarization percentage of mining increases to 20.4%. Thus, during the dollarization period the Ecuadorian economy depends more on oil production. Rising oil prices help Ecuadorian government financing. In that sense, endogenous money supply and inability of Ecuador to use money supply as a policy tool do not cause any serious economic problems when Ecuador is earning high oil revenues.

Unstable oil prices and very low oil price (9 dollars per barrel in 1999) were among the reasons of economic crisis in 1999. Besides, as mentioned in Jameson (2003a and 2003b) the instable political conditions and fundamental structural problems still remain in Ecuador. These inadequate economic conditions for dollarization might lead Ecuador into another crisis unless economic reforms are made. As a result, macroeconomic conditions significantly improved after dollarization but instable oil prices might be followed by a decline in oil prices. To avoid crisis, Ecuadorian authorities should rapidly conduct structural economic reforms which are compatible with dollarization. These reforms are required to maintain the improved macroeconomic conditions achieved by dollarization.

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