AN ESTIMATION OF ECUADOR'S EXPORT DEMAND FUNCTION WITH THE US

Ranjini L Thaver, Stetson University
Christina Bova, Stetson University

ABSTRACT

This paper employs the bounds testing approach to cointegration to estimate Ecuador's export demand function with the US between 1965 and 2011 with special emphasis on dollarization's impact on expors . We develop two different export demand models based on previous empirical studies of this nature. Model I defines real exports as a function of the US real GDP, relative prices, exchange rate volatility, and dollarization. Model II relates real exports to US real GDP, real exchange rate, volatility, and dollarization. Results confirm a unique cointegration relationship between exports and its regressors in Models I & II. In the long run, in both models, GDP is positive and elastic, while volatility is positive and inelastic. Relative prices in Model I and real exchange rate in Model II are not statistically significant. Both models reveal that dollarization has had a significant, but negative and inelastic long-run and short-run impact on Ecuador's exports to the US. Further, Model I seems to be superior to Model II in terms of the strength of cointegration, long-run and short-run elasticities, adjusted R^2, and in satisfying diagnostic tests.

JEL: F14, F31

KEYWORDS: Ecuador, Export Demand, Dollarization, Elasticity, Cointegration

INTRODUCTION

While Ecuador is a geographically diverse country, it has been fraught by an imposing concurrence of natural, economic and political events in the last forty years that culminated in a perfect storm of economic collapse in the latter 1990's, forcing it to abruptly dollarize its economy. Within a few months of dollarization, the monetary system steadied, calming currency speculation, financial risk, and exchange rate volatility. While numerous studies (among them, Matthews et al, 2006; Quispe-Agnoli & Whisler, 2006, Minda, 2005, Schuler, 2005) have explained the macroeconomic benefits of dollarization in Ecuador, no study exists to quantify these benefits. Furthermore, scholars have argued that dollarization has impacted Ecuador's trade function positively through greater integration into the global economy, especially with respect to its adoptive country, the US, no studies have to date empirically tested this premise. This study aims to fill the gap in the literature by estimating the impact of dollarization on Ecuador's export demand function with the US.

Empirical research on export demand functions rapidly expanded after the adoption of flexible exchange rates in 1973. These studies were provoked by three main economic developments: (a) both the real and nominal exchange rates had undergone periods of substantial volatility since 1973; (b) during the same period, international trade declined significantly among industrialized countries, while they increased with developing economies; and (c) macroeconomic instability in terms of output, inflation, interest rates, and employment began to surface. A large cross-section of studies found that volatility borne of flexible exchange rates reduced the level of trade (Onafowara and Owoye, 2008; Byrne, Darby, and MacDonald , 2008; Choudhry , 2005; Bahmanee-Oskooee , 2002; Arize, *et al.*, 2000; Arize, 1995; Chowdhury,1993; Bahmani-Oskooee and Hegerty, 2009). According to these studies, volatility may affect exports directly through uncertainty and adjustment costs for risk-averse exporting investors. Further, it may have an indirect effect through its impact on the structure of output, investment and government policy.

On the other hand, Doyle (2001), Chou (2000), McKenzie and Brooks (1997), Qian and Varangis (1994), Kroner and Lastrapes (1993), and Asseery and Peel (1991) find evidence for a positive effect for volatility on export volumes of some developed countries because exchange rate volatility makes exporting more attractive to risk-tolerant exporting firms. Yet other scholars such as Aristotelous (2001), Bahmani-Oskooee and Payestch (1993), Bahmani-Oskooee (1991), and Hooper and Kohlhagen (1978) have reported no significant relationship between volatility and exports.

Countries that have experienced a negative volatility-trade relationship, high transaction costs, high currency speculation, devaluation of the domestic currency and capital account disturbances, creating greater financial risk and political instability, have tended towards formal and informal forms of dollarization (Chang, 2000; Duett and Zuniga, 2001; Solimano & Beckerman, 2002; Beckerman, 2004; Ize and Powell 2005; Minda, 2005). This is the case especially of countries such Ecuador that have strong economic ties to the adopted country, which in the case of Ecuador, is the US. However, there are adverse effects of dollarization, among them, the loss of independent monetary policy, the abandonment of exchange policies, the loss of seigniorage rights, the disappearance of the function of the central bank as lender of last resort, and the limits to the use of counter-cyclical instruments. It also loses regional trade competitiveness as other currencies devalue, while its dollar-base does not (Hira & Dean, 2004; Minda, 2005, Schuler, 2005; Matthews et al., 2006). This study, the first of its kind, investigates the impact of Ecuador's dollarization on its export demand function with the US. We proceed in the next section by explaining the economic history of Ecuador leading to dollarization. Thereafter we provide a review of the literature on export demand functions and dollarization. In the section thereafter, we specify the econometrics model employed in the study, and following that, the results of our study. The final section concludes the paper and gives suggestions for future research on this topic.

A BRIEF ECONOMIC HISTORY OF ECUADOR WITH SPECIAL REFERENCE TO THE PROCESS OF DOLLARIZATION

Ecuador, the second-smallest country in South America, is one of the most geographically diverse countries in the world, consisting of rain forest, jungle, mountains, coastal regions, and the Galapagos Islands (Republic of Ecuador, 2011). Its rich biodiversity contributed to a brisk agricultural economy with trade ranging from commodities such as bananas, cacao, coffee, sugar, timber, and cut flowers to fish, shrimp, petroleum, gold, and copper (World Bank, 2012). However, while fostering economic prosperity, biodiversity's soft underbelly rendered the economy susceptible to natural disasters such as earthquakes (1987), flooding, droughts, and oil spills. In addition, Ecuador's dependence on exports rendered it susceptible to international price fluctuations, the international oil crises, and exchange rate volatility (Jameson, 2004; Quispe-Agnoli &Whisler, 2006). Moreover, more than most other Latin American countries, Ecuador has been plagued by ethnic conflict and political turmoil from as early as 1463 when the Inca Empire overthrew the indigenous Cañaris clan. Even after independence in 1830, the country endured frequent revolutions and coups d'état, the latest unsuccessful attempt having taken place in 2010. As of 2012, independent Ecuador has already had 54 presidents and 27 interim/acting presidents or military governments (World Bank, 2012; Republic of Ecuador, 2011). Despite its natural and economic vulnerabilities, ethnic cleavages, and a lack of political accord, Ecuador's economy remained relatively stable until the discovery of oil in 1969 set it on a course that would allow a combination of negative and unpredictable circumstances to culminate onto a perfect storm of economic collapse thirty years later (Jameson, 2004; Hira and Dean, 2004).

The discovery of oil transformed Ecuador from a largely agrarian economy to one dominated by oil. The breakdown of the Bretton Woods system spiked revenues from oil exports dramatically, allowing GDP to more than double to 9.7% per annum in the 1970's (Jameson, 2004; Quispe-Agnoli &Whisler, 2006). This newfound prosperity gave way to an increase in population and with it, greater demand for imports, and a lower national savings rate. Government spending also increased drastically as did government borrowing

(Matthews, Leavell, and Burke, 2006). In 1982 the effects of the first El Niño and plunging world oil prices (Jameson, 2004; Falconi-Benitez, 2001) led to greater government borrowing, which thrust the economy into a foreign debt crisis. To confound matters, a major earthquake in March 1987 interrupted oil production, decreased oil exports, and negatively affected trade with the US, thus forcing the economy to head into a major and protracted downward spiral (Russi et al., 2008). These combined factors contributed to severely anemic GDP growth of 2% per annum in the 1980's, lower than any other period in the previous 50 years, and below any other Latino country. At the same time, government debt increased to 98% of GDP from 20% in 1973 (Jameson, 2004).

The 1990's witnessed a further succession of cycles of droughts and excessive rain, the most intense of which was the second El Nino of the decade, with damages amounting to 13% of GDP in 1998 (Beckerman, 2004). In addition, internal and external macroeconomic shocks yielded the economy to severe depression. Sweeping bank failures, falling and volatile exchange rates, hyperinflation, mounting unemployment, falling export revenues, and a huge balance of payments deficit became a part of the economic debacle. Escalating political mayhem and ethnic conflict led to political rent-seeking behavior that hijacked sound economic policy and further undermined the economy. In the process, government expenditures soared, intensifying the public debt, and triggering higher interest rates. Confidence in the economy plummeted, provoking capital flight (Solimano and Beckerman, 2002; Beckerman, 2004; Quispe-Agnoli &Whisler,2006; Matthews et al., 2006).

By 1998, the public debt rose to 67% of GDP, which was higher than any one of the top ten Latino countries. By the end of 1999, the plunging value of the sucre and feeble GDP growth increased the debt ratio to 90% of GDP (Beckerman, 2004), and the external debt ratio to 106% (up from 20% in 1973); these factors together consumed 50% of government expenditure (Jameson, 2004). While the rest of Latin American hyperinflation was dwindling, Ecuador's inflation rate skyrocketed at a rate of 30% per month. Interest rates soared while unemployment rose dramatically from 11 to 15%, and poverty rates increased from 12% to 46% between 1995 and 1998 (Beckerman, 2004). Foreign direct investment decreased from $2.0 billion per year in 1995 to less than $1.1 billion by 1999 (Jameson, 2004).

The current account deficit increased from 3.6% of GDP in 1997 to 11% in 1998 (Beckerman, 2004). The real exchange rate depreciated from 3.5% in 1998 to 40% in 1999, compelling the government to default on its domestic and international loans. International agencies including the IMF and World Bank began to withhold aid (Solimano & Beckerman, 2002). The sucre went into a free-fall, and with it, its major function as the unit of account, medium of exchange, and store of value (Solimano & Beckerman, 2002; Beckerman, 2004; Hira & Dean, 2004; Quispe-Agnoli &Whisler, 2006; Matthews et al., 2006; Russi et al., 2008). By January 9, 2000, Ecuador's government surrendered the sucre and adopted the dollar as its legal tender, in what is referred to as dollarization (Minda, 2005; Beckerman, 2004; Chang, 2000; Ize and Powell, 2005). By April 2000, despite the ousting of yet another president, dollarization took hold and the economy began to stabilize (Quispe-Agnoli &Whisler, 2006). International agencies renewed their aid and lending commitment to the new regime – the IMF authorized a loan of $304 million, making way for an additional $2 billion of multilateral funds (Jameson, 2004).

The banking system stabilized and devaluation abated, lowering interest and inflation rates. In turn, capital repatriated, enhancing foreign investment and borrowing, while remittances from emigrants increased. These forces improved the current account from a deficit of 11% in 1998 to a 5% surplus in 2000 (Matthews et al., 2006; Duett and Zuniga, 2001; Solimano & Beckerman, 2002). By 2004 the inflation rate had decreased to historically low levels at 2.7%, converging to US rates. Interest rates declined from 10.9% to 5.1% (Matthews et al, 2006; Quispe-Agnoli & Whisler, 2006). Economic growth increased to 5.4% in 2001 (Beckerman, 2004; Duett and Zuniga, 2001) and then to 7% in 2004 (Hira and Dean, 2004; Schuler, 2005). Between 2000 and 2004, deposits and loans grew to 86.4% and 111.7% of GDP respectively in response to the rebound in investor confidence and robust economic growth.

While numerous studies (among them, Matthews et al, 2006; Quispe-Agnoli & Whisler, 2006, Minda, 2005, Schuler, 2005) have explained the macroeconomic benefits of dollarization in Ecuador, no study exists to quantify these benefits, in particular in terms of international trade, and in this case with its host country, the US. The objective of this study is to estimate Ecuador's export demand function with the US from 1965-2011, with particular emphasis on the impact of dollarization on these functions.

LITERATURE REVIEW

Export demand functions in developed countries have been widely studied since the 1960's. In the early 2000's when data on developing countries became more prevalent and reliable, studies on export demand functions in those countries began to surface, contributing to the literature. Moreover, the methods employed in studying these functions became more sophisticated and refined over time. This section of the paper will selectively review the different methods used in developed and developing countries.
Grullon (2012) employs the bounds testing approach to cointegration to empirically examine the Dominican Republic's export demand function between 1960-1984 and 1985-2005. Two different export demand functions are estimated under different economic regimes, and both reveal that cointegration exists between the dependent variable and its regressors, foreign income, and relative prices. Results reveal that during the autarkic period, from 1960-1984, exports are relatively price elastic to changes in relative prices. In contrast, during the period of economic liberalization, exports become price inelastic so that devaluation does not significantly impact economic growth.

Ekanayake and Thaver (2011) utilize Pesaran's bounds testing approach to study the impact of exchange rate volatility of the top ten export industries from the US to South Africa between 1990 and 2010. Their results confirm a cointegrated relationship between exports of seven of the ten industries (machinery, passenger vehicles, aircraft and spacecraft, optical and medical instruments, organic chemicals, cereals, and plastic) and their associated regressors, while electrical machinery, mineral fuel and oil, and miscellaneous chemical products are not cointegrated. They then analyze the effects of exchange rate volatility on the exports of the former seven industries and find five exhibiting a negative relationship between exchange rate volatility and exports in the long run. In the short run, the impact of exchange rate volatility on exports in these seven industries is mixed. The authors contend that these results point to South Africa's success in finding alternative markets in Europe and especially in Asia in the last decade.

In a study on Nigerian non-oil export trade, Rano Aliyu (2010) empirically investigates the impact of exchange rate volatility on trade from 1986 to 2006. The author adopts the Johansen (1991) cointegration test, which involves the co-integrated vector error correction method in analyzing the effect of exchange rate volatility on exports. Results prove that volatility is stationary, while other determinants of exports are not. Further, the author proves the existence of a long-run equilibrium relationship between real non-oil exports and the fundamentals in the model. Tenreyro (2007) investigates the impact exchange rate variability on the exports of 87 countries on an annual basis from 1970 to 1997 using two different methods of analysis, namely the Ordinary Least Squares and the pseudo-maximum likelihood technique.

Results point to the lack of any statistically significant causal effect from exchange rate variability to trade. The authors infer from their results that exchange rate fluctuations may not only create uncertainty that tends to discourage risk-averse agents from trade across borders, but they might also create profitable opportunities for risk-loving agents.Athukorala and Riedel (1996) empirically analyze the export demand function of South Korea from 1977:Q1 to 1993:Q4 using the unrestricted error correction model. They regress exports on export price, the price of competing goods in the import markets, real income in importing countries, price of exports in the domestic market, variable cost of production, and production capacity. Their results indicate price elasticities are the same as other studies on the country's exports. The authors suggest that South Korea could increase exports without depressing world prices by expanding its production to include small-country commodities.

Few scholars have analyzed the impact of currency unions on trade. Among them, Scrimgeour (2002) empirically examines the effects of a currency union on exchange rate volatility, and in turn, on export demand for New Zealand which is part of a currency union. The author uses two measures of volatility, namely, short-term and cyclical volatility, and concludes that short-term exchange rate volatility would be similar among countries in a currency union when the host country, in this case Australia, has robust economic growth. The author also argues that cyclical volatility may lead to expanded trade and investment as well as lower interest rates. Frankel and Rose (2000), using data for more than 200 countries, employ the Gravity-based cross-sectional model to test whether that currency union stimulates trade, and in turn, output. Their estimates suggest that belonging to a currency union more than triples trade with the other members of the zone. Moreover, they reveal that every 1% increase in trade positively affects income per capita by 1/3% over twenty years.

Their results support the theory that currency unions' positive impact on economic performance come mainly through the promotion of trade, rather than through a monetary and fiscal policies. Kurihara, (2003), Frankel and Rose (2000), use the Gravity model to evaluate the effect that the APEC currency union has had on trade and on GDP per capita in the presence of exchange rate volatility. They discover that eliminating the nominal exchange-rate variability through a currency union impacts trade by less than 1%, and in turn, raises income per capita by 0.3% over twenty years. They also argue that adopting the dollar currency union yields more benefits than the yen currency union for APEC countries. However, to date, we are unaware of any study that investigates the effects of dollarization on trade. Since many countries in South America have either gone through the process of dollarization, or have considered this a viable economic strategy, an understanding of the impact of dollarization on trade is important. This paper contributes to the literature by being the first of its kind to study the export demand function of Ecuador, and moreover, by investigating the effects of dollarization on Ecuador's export demand function with the US.

METHODOLOGY, DATA SOURCES, DESCRIPTIVE STATISTICS

Earlier time-series studies on import and export demand functions assumed that economic data are stationary, displaying constant means and/or variances over time. Hence the classical linear regression model was utilized in empirically testing import and export demand functions. This simplistic assumption led to misspecification of models and spurious regressions, in which variables, though unrelated, sometimes appeared to be statistically significant, leading to forecasting errors (Hendry & Juselius, 2000). In reality economic data are influenced by such factors as technological change, political chaos, legislation, nominal and real economic growth, and other structural changes in the economy, leading to non-stationary processes, or stochastic trends.

More recent scholars have been able to develop sophisticated time series models that allow for the elimination of non-stationarity by applying transformations in a process called cointegration analysis. The rationale behind the theory of cointegration is that while the dependent variable and its regressors may be individually non-stationary, they will nonetheless tend to move together over time, rendering a linear combination of them stationary, with the variables cointegrated (Engle and Granger, 1987).

One method of cointegration, the bounds testing approach developed by Pesaran, Shin, and Smith (2001), has been widely used by scholars, among them, Grullon (2012), Thaver, Ekanayake, and Plante (2012), Modeste (2011), Hye and Mashkoor (2010), Thaver and Ekanayake (2010), Ghorbani and Motalleb (2009), Jeon (2009), Acharya and Patterson (2005), and Chang, Ho and Huang (2005). The bounds test method is considered more appropriate for economic models because unlike other models such as by Engle-Granger (1987), it is suitable whether the independent variables are purely stationary (i.e. I(0)), purely integrated of order 1 (unit-root) (i.e. I(1)), or mutually cointegrated. In addition, this model bypasses the pre-steps of determining the order of integration of the underlying regressors prior to testing

for cointegration, which is a central tenet of the Engle-Granger model (Pesaran, *et al.*, 2001; Hendry and Juselius, 2000). As Sekuma (2011) suggests, making an error during a pre-step can lead to unreliable and invalid results. In addition, unlike the Engle-Granger and Johansen (1991) models, the bounds method to cointegration is robust for small and finite samples (Kurihara, 2003), which is the case in this study.

Empirical studies of export demand functions have taken two primary functional forms, the first model (Model I) being that real exports (REXP) is a function of the real GDP (RGDP) of a country's trading partner, relative prices (RP), and exchange rate volatility (VOL). The second form (Model II) relates REXP to RGDP, VOL, and the real exchange rate (RER) between the country and its trading partners. Further, several studies have used the effective real exchange rate in measuring RER, while others have used the nominal exchange rate multiplied by the relative prices between trading partners. Empirical studies have demonstrated that results yielded are similar irrespective of the method used and the measurement of the RER employed. In this study we will empirically test both Model I and Model II, and will define RER as the nominal exchange rate, multiplied by the relative prices between trading partners. We add a dummy variable in both models to capture the impact of dollarization on Ecuador's exports to the US. In order to estimate Ecuador's export demand function with the US, we first specify Model I in Equation (1) and Model II in Equation (2). Equations (1) and (2) may in turn be expressed as an Error Correction Model (ECM) following Pesaran, *et al.* (2001) as in Equations (3) and (4).

$$\ln REXP_t = \beta_0 + \beta_1 \ln RGDP_t + \beta_2 \ln RP_t + \beta_3 \ln VOL_t + \beta_4 D_t + \varepsilon \tag{1}$$

$$\ln REXP_t = \varphi_0 + \varphi_1 \ln RGDP_t + \varphi_2 \ln RER_t + \varphi_3 \ln VOL_t + \varphi_4 D_t + \varepsilon \tag{2}$$

$$\begin{aligned}\Delta \ln REXP_t = {} & \alpha_0 + \sum_{i=1}^{n} \vartheta_i \Delta \ln REXP_{t-i} + \sum_{i=0}^{n} \gamma_i \Delta \ln RGDP_{t-i} + \sum_{i=0}^{n} \delta_i \Delta \ln RP_{t-i} + \sum_{i=0}^{n} \eta_i \Delta \ln VOL_{t-i} + \\ & + \alpha_1 D_{1t} + \lambda_1 \ln REXP_{t-1} + \lambda_2 \ln RGDP_{t-1} + \lambda_3 \ln RP_{t-1} + \lambda_4 \ln VOL_{t-1} + \omega_t\end{aligned} \tag{3}$$

$$\begin{aligned}\Delta \ln REXP_t = {} & \alpha_0 + \sum_{i=1}^{n} \omega_i \Delta \ln REXP_{t-i} + \sum_{i=0}^{n} \psi_i \Delta \ln RGDP_{t-i} + \sum_{i=0}^{n} \kappa_i \Delta \ln RER_{t-i} + \sum_{i=0}^{n} \pi_i \Delta \ln VOL_{t-i} + \\ & + \nu_1 D_{1t} + \theta_1 \ln REXP_{t-1} + \theta_2 \ln RGDP_{t-1} + \theta_3 \ln RER_{t-1} + \theta_4 \ln VOL_{t-1} + \omega_t\end{aligned} \tag{4}$$

In the above equations, the symbols ln, $REXP_t$, t, $RGDP_t$, RP_t, RER_t, VOL_t, ε_t and ω_t denote respectively, the natural logarithm, real export value, time, real GDP, relative price of exports, real exchange rate, exchange rate volatility, error term and white noise. Δ is the first difference operator, and D_t is a dummy variable representing the period of dollarization in Ecuador beginning in 2000.

In our models, $REXP_t$ is calculated by dividing Ecuador's nominal exports by its export price index. $RGDP_t$ is measured as the nominal GDP of the US divided by its GDP deflator. RP_t is calculated as the ratio of domestic price to foreign price as measured by each country's CPI. RER_t is measured as the ratio of the domestic price to the foreign price, multiplied by the nominal exchange rate between the foreign currency and domestic currency. The base period is 2005. Following Bredin, Fountas, and Murphy (2003), VOL_t is measured as

$$VOL_t = \left[\frac{1}{m} \sum_{i=1}^{m} (\ln RER_{t+i-1} - \ln RER_{t+i-2})^2 \right]^{1/2} \tag{5}$$

Where RER_t signifies the real exchange rate, and $m = 4$ is the order of the moving average. D_t represents dollarization in Ecuador, and is defined to take the value 0 for years between 1965 and 1999 and 1 between 2000 and 2011. Based on previous empirical studies, we expect β_1 (φ_1) to be positive (Grullon , 2012; Jeon, 2009), β_2 to be negative (Hibbert et al., 2012, Thaver et al., 2012), and β_3 to be either positive

or negative (Bredin, et al. 2003). Since dollarization is assumed to impact exports positively (among them, Matthews et al, 2006; Quispe-Agnoli & Whisler, 2006, Minda, 2005, Schuler, 2005), we expect β_4 to be positive. We use annual data from 1965 to 2011 to estimate Models I and II. The data series on Ecuador's nominal exports and its export price index, US nominal GDP and price index, domestic price index, and nominal exchange rates are taken from the International Monetary Fund's *International Financial Statistics* and the *Direction of Trade Statistics* databases (http://elibrary-data.imf.org).

Table 1 presents the descriptive statistics and correlation matrix for the dependent variable, REXP, and the independent variables, RP, RER, VOL, and RGDP. The correlation among the independent variables is low, except in the case of the simple correlation between RP and RGDP. However, multicollinearity does not appear to be a problem in our regression analysis.

Table 1: Summary Statistics and Correlation Matrix for All Variables

	Mean	**Std. deviation**	**REXP**	**RP**	**RER**	**RGDP**	**VOL**
REXP	2444.4	1274.8	1.000				
RP	306.21	347.64	-0.8723	1.000			
RER	180.2	612.61	0.2194	-0.2609	1.000		
RGDP	8031896	316.02	0.9195	-0.8771	0.2319	1.000	
VOL	0.2595	0.4495	0.2067	-0.3585	0.3721	0.2488	1.000

The table reports mean and standard deviation of the variables from 1965-2011. Correlations are provided for the sample of all observations. The matrix shows the correlation between the dependent variable and the independent variables and among the different independent variables.

RESULTS

Cointegration among Variables

In accordance with Pesaran et al. (2001), we undertake two procedural steps in Equation (3). The first employs the Wald test for the lagged level explanatory variables to inquire into the joint significance of the no-cointegration hypothesis H_0: $\lambda_1 = \lambda_2 = \lambda_3 = \lambda_4 = 0$ against an alternative hypothesis of cointegration H_a: $\lambda_1 \neq 0$, $\lambda_2 \neq 0$, $\lambda_3 \neq 0$, and $\lambda_4 \neq 0$. Equation (4) goes through the same process. Pesaran, et al. (2001) provide two sets of critical values, seen in Table 2, for a given significance level. One assumes that the regressors are stationary I(0), and the other assumes that they are cointegrated of order 1, I(1). H_0 is rejected if the calculated Wald F-value exceeds the upper critical bound, indicating a cointegrated relationship among the explanatory variables, whereas if the computed Wald F-value falls below the critical bounds value, we fail to reject H_0. Results are inconclusive when the computed value falls within the critical bounds.

Table 2: Cointegration Results–Ecuador's Export Demand Function, Models I &II

Critical value bounds of the F-statistic: intercept and no trend:						
	10 percent level		5 percent level		1 percent level	
k	I(0)	I(1)	I(0)	I(1)	I(0)	I(1)
4	2.45	3.52	2.86	4.01	3.74	**5.06**
Calculated F-statistic:						

*Note: This table shows the results of the ARDL bounds test for cointegration. Critical values are taken from Pesaran, Shin, & Smith (2001, Table CI(iii) Case III, p. 300). k is the number of regressors. *** indicates statistical significance at the 1% level. As Table 2 reveals, the calculated Wald F-statistic is 14.408 for Model I and 10.48 for Model II, both of which are above their critical upper bound values at the one percent level. Thus, cointegration exists between the dependent variable and its regressors in both models, and we reject the null hypothesis, making way for estimating the long-run and short-run partial elasticities.*

Long-Run and Short-Run Elasticities

The second step after establishing cointegration, according to Pesaran et al., is to estimate the long-run partial elasticities of the dependent variable with respect to each regressor, as well as the corresponding short-run dynamics using the Error Correction Model (ECM). In ECM the movement of any of the regressors in time *t*, is related to the gap of that same regressor in time *t-1* from its long-run equilibrium. This step integrates the reality that economic and political forces are in constant flux so that export functions are seldom in equilibrium. The lagged error correction term (ECM_{t-1}) is important for the cointegrated system as it allows for adjustment back to long-run equilibrium after a shock in the system. We do this for Models I & II.

Table 3: Ecuador's Long-Run Elasticities - Export Demand Function, Models I &II

Dependent variable: LnREXP,					
	Model I			**Model II**	
Explanatory Variables	**Coefficient**	***t*-statistic**	**Explanatory Variables**	**Coefficient**	***t*-statistic**
Constant	-12.488	-1.701	Constant	-8.800	-1.489
$lnRGDP_t$	1.372***	2.718	$lnRGDP_t$	1.125**	2.459
$lnRP_t$	-0.017	-0.313	$lnRER_t$	-0.0022	-0.1148
$lnVOL_t$	0.2311***	5.396	$lnVOL_t$	0.1757***	3.828
D_{1t}	-0.4163***	-2.602	D_{1t}	-0.3015*	-1.662
Adjust. R-squared ($\bar{R}^2$)	**0.666**		Adjust. R-squared ($\bar{R}^2$)	**0.6294**	

*Note: This table shows Ecuador's long-run elasticities of the two models of the estimated export demand function. ***, ** and * indicate statistical significance at eh 1%, 5%, and 10% level, respectively.*

Table 3 reveals the long-run export elasticities estimates for Models I and II. In Model I, except for RP, all other variables are significant at the 1% level. RP is negative and inelastic, but insignificant in determining exports, which may be due to the large percentage of oil representation in Ecuador's exports. RGDP is positive and elastic with a 10% change affecting REXP by 13.7%, while VOL is positive and inelastic, both of which meet theoretically expected and empirically confirmed signs. Similarly, in Model II, RGDP is positive and elastic, RER is negative and inelastic but insignificant, and VOL is positive and inelastic. Interestingly, both models reveal that dollarization has had a significant but negative and inelastic long-run impact on Ecuador's export demand function, with a 10% change in dollarization leading to between 3% and 4% negative change in export demand, depending on the model used. These results confirm arguments by Hira and Dean (2004), Beckerman (2004), and Jameson (2004), that dollarization negatively affected Ecuador's competitiveness as its exchange rate appreciated, making its goods more expensive. In fact, as several opponents of dollarization declared, dollarization did negatively affect trade in the long run.

able 4: Error-Correction Model and Short-run Elasticities in Export Demand Function

Dependent variable: ΔlnREXP					
Model I			**Model II**		
Regressors	**Coefficient**	**t-statistic**	**Regressors**	**Coefficient**	**t-statistic**
Constant	0	0.0631	Constant	0	0
$\Delta lnREXP_{t-3}$	0.3881***	0.1024	$\Delta lnREXP_{t-3}$	0.3291***	1.052
$\Delta lnRGDP_{t-4}$	-5.385***	1.0300	$\Delta lnRGDP_{t-4}$	-5.383***	1.137
$\Delta lnRP_{t-2}$	0.5530**	0.2024	$\Delta lnRER_{t-4}$	-0.0596***	0.0153
$\Delta lnVOL_{t-4}$	-0.1395***	0.0250	$\Delta lnVOL_{t-4}$	-0.1366***	0.045
D_t	-0.2863***	0.0437	D_t	-0.1680***	0.0446
ECM_{t-1}	-0.6878***	0.0852	ECM_{t-1}	-0.5571***	0.0811

*Note: This table shows the results of the short-run elasticities of the error-correction model.***, **, and * indicate statistical significance at the 1% 5%, and 10% level, respectively.*

Table 4 suggests that, in the short run, irrespective of the model used, the partial elasticities of all regressors with respect to export demand are statistically significant, mostly at the 1% level. RGDP contradicts theory in that it affects exports negatively in the short run. Similarly, RP in Model I is positive and inelastic, implying that a 10% change will increase REXP by 5.5%. RER in Model II is also positive and inelastic, but exports are less responsive to changes in RER than to changes in RP. As in the long run, dollarization has a negative and inelastic short-run impact on exports. This may explain the continued discussion by analysts of the wisdom of dollarizing Ecuador's economy. The coefficient for ECM_{t-1} in Model I is negative, signifying that the system is converging to equilibrium, and high at -0.6878, indicating that once the model in Equation (3) is shocked, convergence to equilibrium is relatively fast with 69% of the adjustment occurring within the first year. In Model II, convergence to equilibrium is slower, with 56% of the correction occurring within the first year.

While we assume that the ECM complies with the classical normal linear regression model specifications, including no serial correlation and no perfect multi-colinearity, we perform diagnostic tests to determine if this is indeed the case. The Durbin-Watson (D-W) and Breusch-Godfrey tests check for autocorrelation, or in other words, for similarity between observations in the residuals. As can be seen in Table 5 these tests have high *p*-values and are statistically insignificant indicating no true autocorrelation in both Models I and II. The augmented Dickey-Fuller test is a unit root test that is essential for cointegration analysis, and its *p-value* in Table 4 reveals that Model I is nonstationary as expected, but Model II is questionable. The Ramsey RESET results indicate that our estimated models display correct functional form, are serially uncorrelated, are normally distributed, and are homoskedastic. The Jarque Bera test in both models indicates that the errors are normally distributed, as is assumed in the ECM. Finally, the adjusted R^2 of 0.70 in Model I (0.67 in Model II) indicates that 70% (67%) of the variation in export demand is explained by the variables within the model. Hence, based on these statistical properties, it is reasonable to say that the models are well behaved.

Table 5: Results of the Diagnostic Test for the Selected ARDL Model

	Exports Model I		**Exports Model II**	
Explanatory Variables	**Coefficient**	**p-value**	**Coefficient**	**p-value**
R^2	0.8079		0.7776	
Adjusted R^2	.7045		0.6706	
Durbin Watson Test	2.522	0.8605	2.200	0.6111
Breusch-Godfrey Test	4.589	0.6676	1.250	0.3181
Reset Test	1.187	0.3225	0.308	0.7377
Jarque Bera Test	0.567	0.7533	0.354	0.8379
Augmented Dickey-Fuller Test	-3.074	0.1487	-3.592	0.0050

This table shows the results of diagnostic tests.

CONCLUSIONS, LIMITATIONS, AND FUTURE RESEARCH

This paper utilized the bounds testing approach to cointegration developed by Pesaran et al. (2001) to empirically estimate the aggregate export demand function for Ecuador between 1965 and 2011. We develop two different export demand models based on previous empirical studies of this nature. In Model I we define real exports as a function of the world real GDP, relative prices, exchange rate volatility, and dollarization. Model II relates exports to world real GDP, the real exchange rate, exchange rate volatility, and dollarization. Our results confirm a unique cointegration relationship between exports and its regressors in Models I & II, permitting us to estimate the short-run and long-run elasticities of Ecuador's export demand function using both models. Our results reveal that most of the regressors in both models, in the short run and the long run, meet theoretical expectations and are significant at the 1% level. In the

long run, in both models, GDP is positive and elastic, while volatility is positive and inelastic. Relative prices in Model I and real exchange rate in Model II are not statistically significant, which may point to the large percentage of oil, the demand for which is inelastic, in Ecuador's exports. Both models reveal that dollarization has had a significant, but negative and inelastic, long-run and short-run impact on Ecuador's exports to the US. However, the responsiveness in the long run is more elastic than in the short-run adjustment process. This result further endorses the theory that while the demand for oil is inelastic in the short run, in the long run consumers seek other alternatives, and thereby increase their responses to changes in the economy. With a 10% change in dollarization leads to between 3% and 4% negative change in export demand, depending on the model employed. These results also confirm empirically the arguments by several scholars that contrary to neoclassical expectations, dollarization had a negative impact on trade in the short and long runs. The error correction coefficient in both models reveals that once they are shocked by changes, they converge to equilibrium relatively quickly within the first year. Diagnostic tests reveal that both estimated export demand models display correct functional form, are neither autocorrelated nor serially correlated, are normally distributed, and are robust, suggesting that that our results are valid and reliable. Adjusted R^2 in both models in the short and long run indicate that variation in export demand is explained sufficiently well by the variables within the models. Consequently, it is reasonable to say that the models are well behaved. However, Model I seems to be superior to Model II in terms of the strength of cointegration, long-run and short-run elasticities, adjusted R^2 and in satisfying the diagnostic tests. This means that relative prices are a better determinant of export demand than the real exchange rate.

To our knowledge, this is the only study that not only estimates Ecuador's export demand function, but also incorporates an analysis of dollarization on it. Because quarterly data was not readily available, we used annual data, which could have veiled seasonal effects on the export demand function. Future research may focus on Ecuador's aggregate export demand function in general, rather than its exports to the US only. For policy-making, it may also be beneficial to estimate an export demand function for export intensive commodities such as bananas, fish, and oil. Future studies may also wish to empirically investigate the export and import demand functions of other dollarized countries in Latin America and elsewhere, to facilitate predictive results on the virtues or vices of dollarization in trade.

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BIOGRAPHY

Dr. Ranjini Thaver is Professor of Economics at Stetson University, Deland, Florida. She earned her Ph.D. in Economics in 1995 and an M.A. degree in Economics in 1989 at the Notre Dame University. She is currently the Chair of Economics Department at Stetson University. Dr. Thaver is also the Director of Center for Holistic Microcredit Initiatives (CHOMI), and the Director of CHOMI Tanzania. Contact information: Department of Economics, Stetson University, Box 8392, Deland, FL 32723, USA. Phone: (386) 822-7573. E-mail: rthaver@stetson.edu.

Christina Bova graduated from Stetson University with a BA in Economics. Contact information: Department of Economics, Stetson University, Box 8392, Deland, FL 32723, USA. Phone: (386) 822-7573.