

**Effects of Exchange Rate Uncertainty on the Mexican Economy
1980-2000**

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I. Introduction

The Mexican economy is of interest because of its role as a developing country and its status as a key-trading partner of the United States. Mexican GDP in 2001 was \$574.5 billion and exports comprised 28%, or \$178 billion of GDP. Of the \$178 billion, 85% is exported to the US (Worldbank.org). While the United States is Mexico's number one trading partner, Mexico is also important economically to the United States. Mexico purchases 75% of its imports from the United States and is the third largest trading partner of the US (CIA Factbook). Much of recent Mexican-American political dialogue has been devoted to strengthening economic and political ties in order to increase trade between the two nations.

This paper will examine the effects of exchange rate volatility, or the variability of the exchange rate, real exchange rate, and US economic growth on Mexican foreign trade over a period of 20 years. During this time period, Mexico experienced tremendous volatility in its exchange rate. Three devaluations occurred, the first in 1982, the second in 1988, and the third in 1994. The last devaluation caught international financial markets by surprise. After 1988, Mexico enjoyed a temporary period of economic and exchange rate stability, however internal economic problems combined with severe political shocks caused pressure on the exchange rate. Mexico attempted to maintain the nominal exchange rate, but the reserves were not sufficient to stabilize the peso. The flight of capital out of Mexico caused the peso to spiral downwards again. The amount of short-term dollar debt held by Mexico was greater than Mexico's ability to pay, and only the US led bailout (in 1994-1995) prevented default. Since the Peso Crisis, Mexico's economy and exchange rate have been stable (Ramirez de la O, 1996).

Recently, debt agencies, such as Standard and Poor's, upgraded Mexico's debt to investment class.

The US-Mexico trade links are codified by the North American Free Trade Agreement (NAFTA). Years of negotiations among the United States, Mexico, and Canada resulted in the adoption of NAFTA in 1994. The provisions of NAFTA have resulted in the lowering and eventual elimination of tariffs and quotas on goods traded between NAFTA members. Trade has tripled between NAFTA members since ratification, however, Mexico has taken steps to lessen its dependence on the US economy by negotiating agreements with the European Union and nations from Latin America and Asia to lower trade barriers.

In section II of the paper, relevant literature will be surveyed. In section III, the model will be presented. In section IV, the results of the regression model will be analyzed. Section V will contain the conclusions reached with regards to exchange rate volatility, real exchange rate, and the US economy, and their effects on Mexican exports.

II. Survey of Literature

Marquez (1990) estimates the income and price elasticities of imports and exports. The United States income elasticity for imports from less-developed countries is 3.04. The price elasticity is 0.45. If the elasticities for US imports from less-developed countries are similar to the elasticities for imports from Mexico, then Mexican export levels will be more sensitive to changes in GDP in the United States than to the exchange rate. If the effects of exchange rate change are fully passed on to the consumer then they are fully reflected in prices. Haynes and Hutchinson (1989) report that US imports from Japan during 1975-1982 were insensitive to changes in the exchange rate. They attribute

this insensitivity to Japan's production of finished and differentiated goods such as machinery and transport. Mexico's major exports are similar. Mexico primarily exports manufactured goods and transportation goods. If the export of these goods leads to exchange rate insensitivity, then Mexican exports should be less sensitive to exchange rate variability.

Levine and Carkovic (2001) study the effect of exchange rate volatility on growth in seventy-three countries from 1960-1995, and find that volatility is statistically insignificant. They conclude that the effect of exchange rate volatility is hidden in other variables. He argues that the volatility causes a risk premium to be assessed to Mexico, pushing up the interest rate. This will indirectly reduce investment, tax revenues, economic growth, and the ability of exporters to produce and sell goods abroad. Levine also cites evidence that the Mexican exchange rate was not determined by the inflation gap between the US and Mexico. While the inflation gap was 49%, the peso dipped by twice that amount. He argues that the exchange rate is determined by flows of capital, and that monetary and fiscal policies are much more important than inflation in determining exchange rate.

The exchange rate can be seen as the price of a currency. The demand for a currency is not just determined by foreign importers, but also by banks and investors. If a nation utilizes monetary policy to raise interest rates, this will almost certainly attract capital inflows into interest bearing investments. If a nation utilizes fiscal policy to stimulate the economy, this will attract capital inflows from investors. These inflows and outflows based on monetary and fiscal policy have the effect of increasing or decreasing

demand for a currency. When the capital flows into a country it must be changed from foreign to domestic currency.

III. Model

The theoretical basis of this empirical work is a model incorporating a measure of exchange rate risk in the foreign trade relation. A simple, one period model with one commodity is assumed. A country is assumed to produce at home, but sells only abroad.

It's profit function is

$$\Pi = PX - C(X)$$

Where P is the domestic price, X is the quantity of goods produced and C(X) is the general cost function and

$$P = P^* R$$

Where P* is the foreign market price of X and R is the exchange rate which is random with finite mean and variance. From the profit maximization hypothesis, we can find that relation between X and \mathfrak{R} (mean of R); σ_R (standard deviation of R) and X. The nature of the relation is, in general, ambiguous. So, from this model, we can show that the function can be written as

$$MEXX = f(RER, ERV, USGDP)$$

Where

MEXX = Real Mexican exports in millions of US dollars

RER = Real peso to dollar exchange rate, measured as a rolling average

ERV = Exchange rate volatility, measured as a rolling average of the standard deviation

US GDP = Real gross domestic product of the United States in billions of US dollars

We have collected data about the variables from OECD economic indicators available on disk. The initial examination of the data reveals that the time series data used here may be non-stationary in nature (see graphs.) To test the non-stationary properties of these four economic data series we have estimated a first order autoregression model

$$X_t = \alpha_0 + \alpha_1 X_{t-1} + u_t$$

Where X_t is the current observation and X_{t-1} is a one period lagged observation. The initial estimates are reported in Table 1

Table 1

Estimate

VARIABLE	CONSTANT	COEFFICIENT
MEXX	-1.236	1.0385
ER	0.0960	1.0371
σ_R	0.0478	0.8990
USGDP	-25.3233	1.0118

After taking the first difference we get

$$\Delta X_t = \delta_0 + \delta_1 X_{t-1} + u_t$$

The t-statistic of the coefficient δ_1 , will test whether the variable is stationary or not. The initial results are given in Table 2.

Table 2
Test for Unit Roots

Variable	DF Statistic
MEXX	2.77
RER	6.49
σ_R	-2.18
USGDP	2.97

The critical values for the test statistic are: 1% = -3.43; 5%, = -2.80; and 10% = -2.57.

The null hypothesis is that the variable is non-stationary. The unit root test is a one-tailed test. None of the values fall below the critical values above. We fail to reject the null hypothesis. It seems that all of these variables are non-stationary.

The test for unit roots assumes the presence of the unit root and non-stationary.

The test statistic is significant at a 1% level and the null hypothesis is rejected. Figures 2-4 show that the variables are non-stationary. Although the variables are non-stationary, we can still use this set of data to find out whether there exist any meaningful relations, if the residual from the estimated model is stationary. So we have set a multiple regression equation based on a reduced form equation of the model as

$$Y_t = \beta_0 + \beta_1 \mathfrak{R}_t + \beta_2 \sigma_{Rt} + \beta_3 \text{USGDP}_t + \epsilon_t$$

where

\mathfrak{R}_t = the mean of R (exchange rate)

σ_{Rt} = the standard deviation of R

USGDP_t = US gross domestic product (proxy for world gross domestic product)

Initial estimation by OLS reveals the existence of serial correlation. To correct for that, we have used an autoregressive procedure. The estimated results are shown in Table 3 below. Standard errors appear in parenthesis.

Table 3
Estimation Results

Dependent variable: MEXX

Variable	OLS Estimate	Autoreg Estimate
Constant	16.76 (28.0491)	-56.5509 (61.1744)
RER	11.5625*** (0.8616)	10.013*** (1.9431)
ERV	13.4752 (6.3035)	-4.9482 (4.9073)
USGDP	0.0109** (0.004707)	0.0241** (0.0102)
R ²	0.9879	0.9436
Durbin-Watson	0.2714	2.077

** = significant at the 0.05 level

*** = significant at the 0.01 level

The estimates for real exchange rate and American GDP are significant at a 5% level. The estimate for exchange rate volatility is statistically insignificant at a 5% level. We can state that there is no statistical evidence that exchange rate volatility is related to Mexican export volume. The R^2 value is 0.9436. The variables in the regression equation explain almost 95% of all variation in Mexican export volume. This regression has been corrected for autocorrelation. Multicollinearity is not a concern because the independent variables do not seem to be correlated, and because two of the t statistics are significant.

In spite of the fact that the dependent and independent variables are all non-stationary, if the residuals are stationary then the variables are non-stationary together and inferences can be made about their relationship. The residuals are computed from the first order autoregressive model. A lag is created and the difference of residual is regressed on the lagged residual.

$$\Delta e = f(e_{t-1})$$

$$\Delta e = \delta_0 + \delta_1 e_{t-1} + v_t$$

The estimated result is

$$\Delta e = -0.33432 - 1.0705 e_{t-1}$$

$$(-0.29) \quad (-9.46)$$

The t -statistic of δ_1 indicates that the residual process is stationary.

IV. Analysis of Model

The regression equations stated in the previous section show that the autoregressive equation has been corrected for autocollinearity. The variables are non-stationary, however, the residual is stationary. This means that the autoregressive

function is valid and can be used to examine the relationship between the dependent and the independent variables.

The estimate β_1 estimates the relationship between the real exchange rate average and Mexican export volume. We predicted that the coefficient would be positive. As the peso-dollar exchange rate becomes larger, the peso depreciates. Theory holds that depreciating currency will have a positive affect on exports. The cheaper currency means that exports will be cheaper for foreign consumers to buy. These lower prices should result in increased consumption of the nation's exports. The parameter is positive as predicted by theory. The regression parameter estimates the partial effect of the real exchange rate on export volume. It estimates that if the real exchange rate increases by 1 peso to the dollar, then Mexican exports will increase by \$10 million.

The real exchange rate is statistically significant, however, it appears that it is not an economically significant cause of Mexican export growth. Mexican exports have grown to \$178 billion. An increase or decrease of \$10 million is not an amount that will significantly impact the volume of real Mexican exports, especially when one considers that a depreciation of one peso per dollar would be a 10% depreciation. Real exchange rate will probably play an economically insignificant role in the future. Changes in the exchange rate will most likely be small. Recent stability bolstered by debt upgrades, the near certainty of US intervention if a future crisis were to arise, freer trade and a more open economy, and the peaceful transfer of power from the PRI to the PAN makes the possibility of capital flight and a large depreciation unlikely. The elasticities cited in Section II also imply that real exchange rate will not have the greatest effect on consumption of Mexican exports.

β_2 estimates the relationship between the volatility of the exchange rate and Mexican export volume. The estimate is statistically insignificant. The sign of the coefficient implies that a negative relationship may exist between the two variables. This would be consistent with Levine's findings, however, one could argue that volatility could have a positive or a negative effect on export volume. Volatility is normally associated with large depreciation.

For example, during a volatile depreciation, there are moments of stability and moments of rapid loss in currency value. This could result in lower prices for foreign importers and an increase in the volume of exports. Volatility could result in the assignment of a risk premium to debt and domestic assets. This premium would result in higher interest rates causing lower economic output and as a result of lower tax revenues, budget deficits. Volatility and its consequences could result in a decrease of capital needed for investment. During the 1994 Peso Crisis, a series of economic and political problems led to a devaluation. Investors, who had not expected a devaluation, were unsure how much the peso would depreciate. Wishing to limit their exposure to unpredictable swings in the peso, investors withdrew their funds from Mexico. Volatility may also hinder trade because buyers will not want to buy until the price of a currency settles. Buyers will not want to be locked into exchange rates that may be radically different by the time that delivery on a contract is due. In spite of the positive effects of depreciation on exports, the lack of funds impeded investment and resulted in a short-term decline in real exports. Over the long-term, funds for investment reappeared and real exports expanded. We expected that, since this paper studies Mexican exports over a

twenty year period, the long-term relationship between export volume and exchange rate volatility would be positive.

β_3 estimates the relationship between the GDP of the United States and the export volume of Mexico. The United States, as stated earlier in the paper, is a proxy for the rest of the world because it purchases over 85% of all Mexican exports. We expect that there will be a positive relationship between Mexican export volume and US GDP. An increase in GDP in the United States, all else equal, implies an increase in income. As income increases demand increases. This will result in increased demand for imports. Therefore, as US GDP increases, Mexican export volume should also increase. Mexico's main exports are manufactured goods. These tend to be normal goods. An increase in demand will result in an increase in their consumption. The elasticities cited earlier also show that US demand for imports from lesser developed countries are highly income elastic.

The parameter is, as expected, positive. An increase of \$100 billion of US GDP (slightly over 1%) will coincide with an increase of \$2.41 million in Mexican exports. In an average year (growth of about 3%, or \$300 billion), US economic growth will contribute \$7.23 million to Mexican export volume, *ceteris parabus*. This is a statistically significant variable, but will not make a noticeable difference in Mexico's \$178 billion export volume. Mexico is seeking to make US economic growth much more important to its export volume. It is wooing manufacturers and car-makers from around the globe to manufacture their products in Mexico for tariff-free export to the United States. This has been successful as manufacturing has grown to be Mexico's largest export industry.

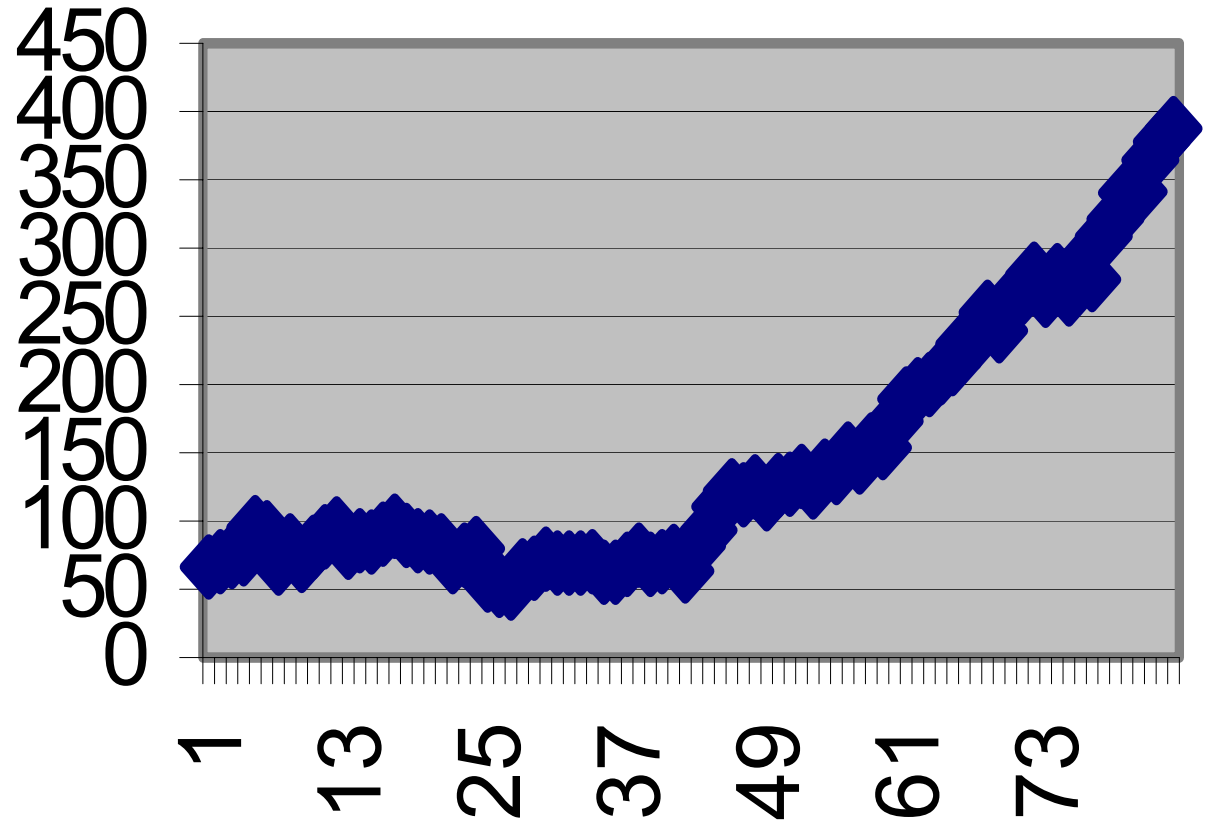
V. Conclusion

Mexico's real export volume was tested as a function of the real exchange rate, exchange rate volatility, and the GDP of the United States. The estimated autoregressive function was corrected for autocorrelation and tested for unit roots. The independent and dependent variables were found to be non-stationary, however, the residual from the regression model was found to be stationary. This allows for the unbiased estimation of the parameters, and for inferences to be made concerning them. It cannot be said that exchange rate volatility had any measurable effect on the Mexican exports or economy from 1980-2000. The effects of exchange rate volatility may be indirect and found in other areas of the economy, such as interest rates. The real exchange rate was found to have a statistically significant effect on export volume. The relationship measured is consistent with theory. As the exchange rate depreciates, real exports increase.

The US GDP was also found to be statistically significant. The relationship measured is consistent with theory. US GDP and Mexican export volume have a positive relationship. Mexico's transition from one of the world's most closed countries into one of the most open has allowed it to take advantage of American economic growth. An implication of these results is that, as Mexico's currency benefits from economic and political stability, Mexico could maximize its export volume by increasing economic ties to the United States and other trading partners. Mexico's recent efforts to reach trade agreements with Israel, the EU, and nations in Central and South America indicate that it is taking that course of action.

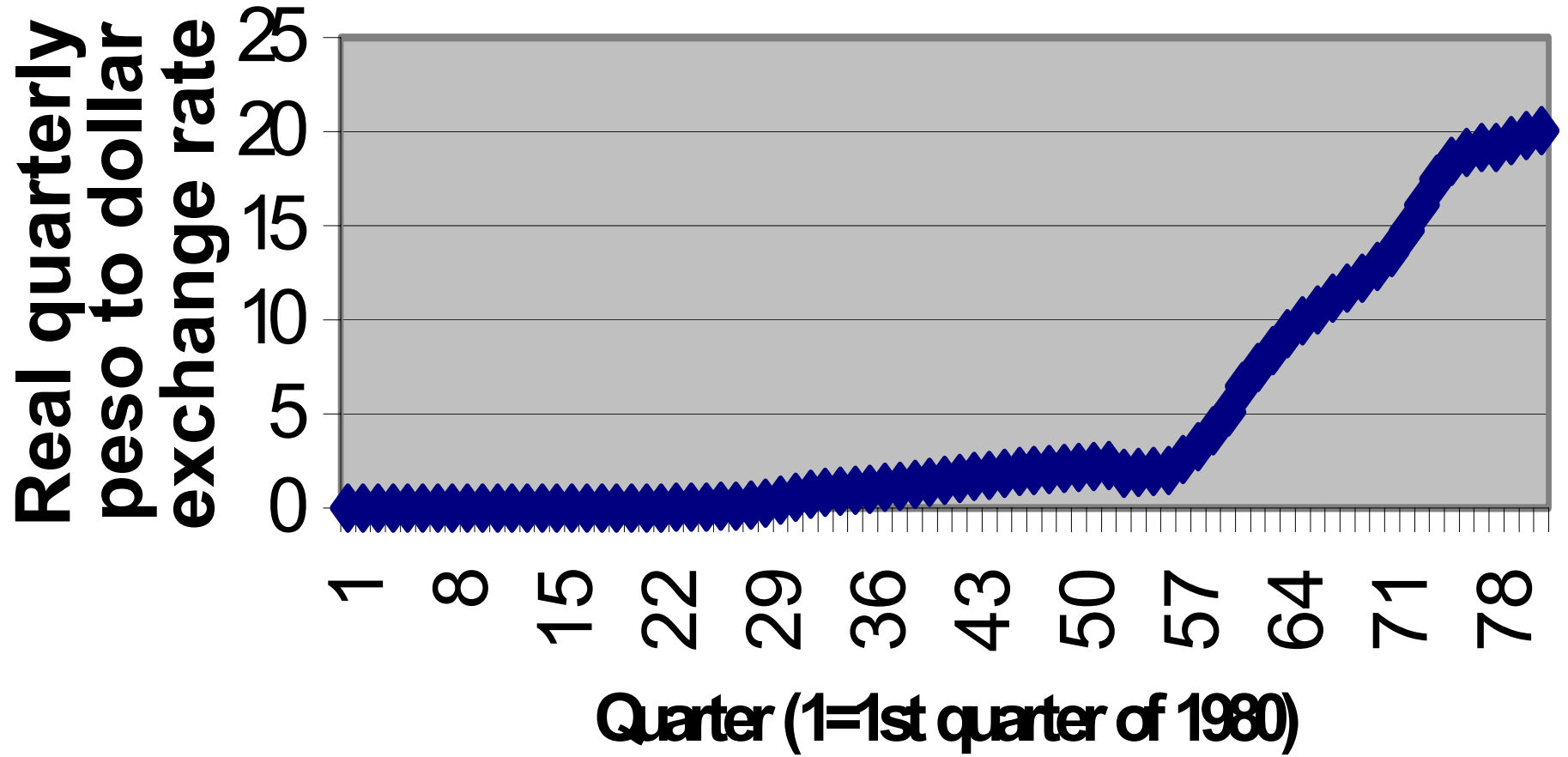
Graph 1 (Real Mexican Exports)

**Real Mexican
Quarterly Exports in
Millions of US
Dollars**

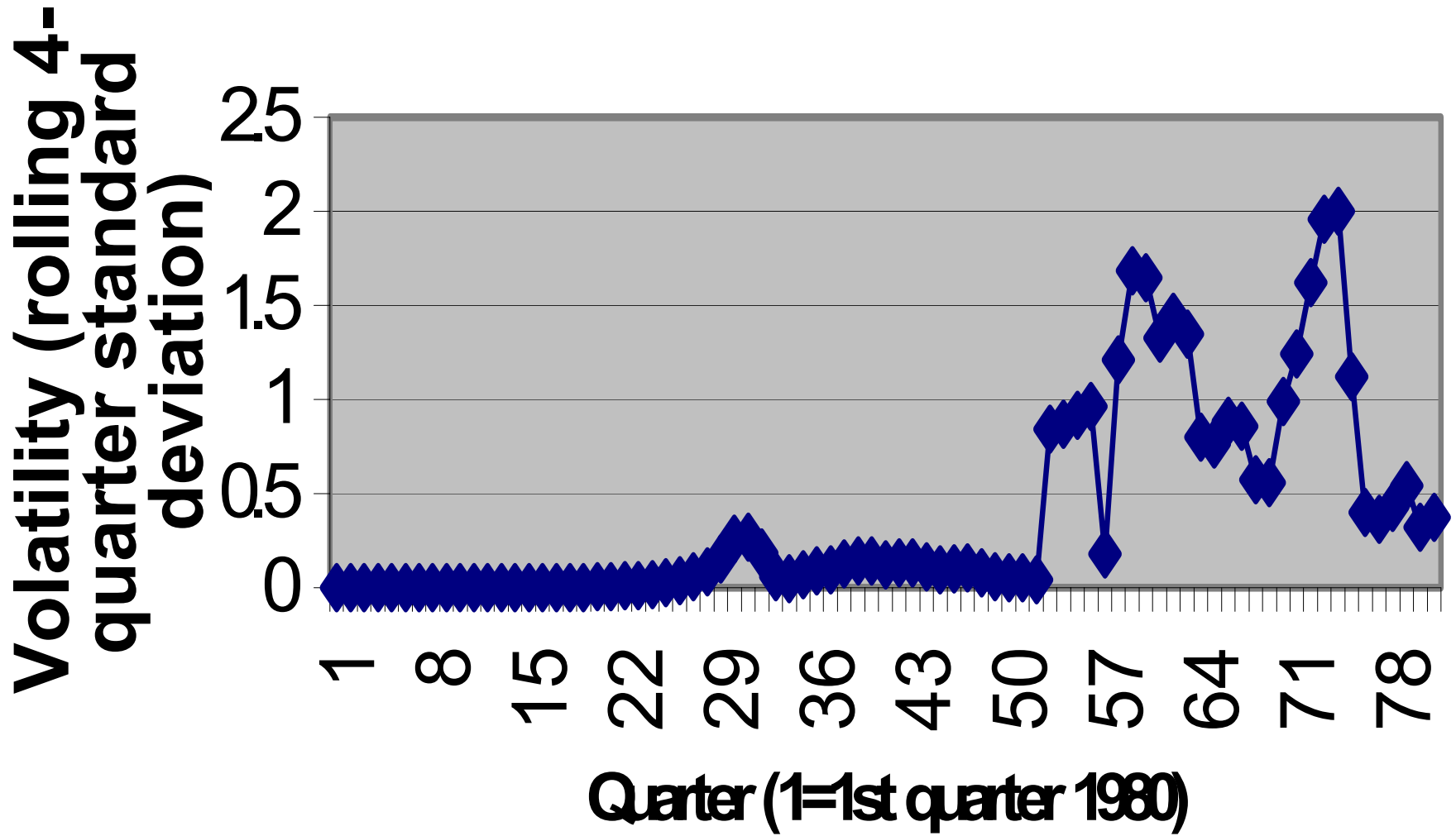


Quarter (1=1st quarter of 1980)

Graph 2 (Real Exchange Rate)

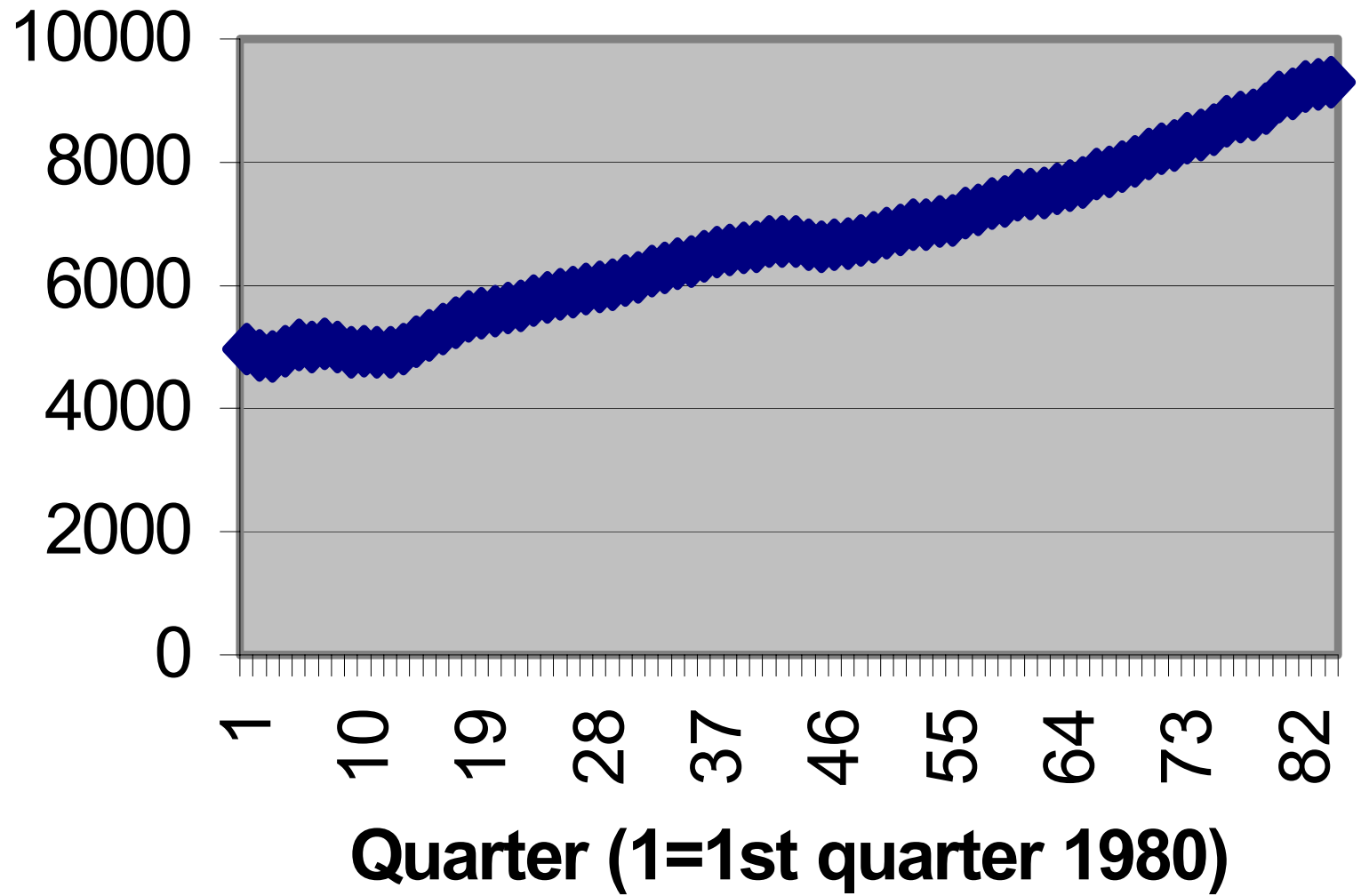


Graph 3 (Exchange Rate Volatility)



Graph 4 (US GDP)

**real US GDP in billions
of US dollars**



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