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The Effect of Oil Prices on Exchange Rates: A Case Study of the Dominican Republic

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I. Introduction

Oil imports represent a significant fraction of the trade balance for energy-dependant economies. In the case of small open economies with floating exchange rates, the variability in oil prices is expected to have a large impact on the relative value of the currency. This relationship between the price of oil and the exchange rate has been established by the literature for oil-producing countries but not for oil-importing countries. This paper uses the case of the Dominican Republic, an energy dependant small open economy with a floating exchange rate, to illustrate this connection.

In the case of the Dominican Republic, oil imports in 2003 represented 27% of total imports, which is up from 10% in 1994. Thus, the international price of oil is of great relevance to the Dominican economy. Because oil contracts, both in spot values and in future contracts, are denominated in US dollars, Dominican importers must sell their Pesos in the foreign exchange market in order to obtain liquidity in U.S. dollars. It follows that an increase in the world price of oil would put depreciating pressure on the Dominican Peso, whereas a decrease in the world price of oil would allow for an appreciation of the Dominican currency.

Akram (2004), Bergvall (2004), Amano and van Norden (1998), Chadhuri and Daniel (1998) find that oil prices significantly affect the relative value of currencies in Norway, the four Nordic countries, several industrialized countries, and the United Arab Emirates, respectively. Some studies, including Cooper (1994) and Brown (1986), establish causation in the opposite direction finding that in the case of OPEC members and large industrial economies, respectively, exchange rates influence the price of oil. The literature in this area is mostly available for oil-exporting large developed economies. It is scarce for oil-dependent small open economies like that of the Dominican Republic.

This research question has gained increased importance in the last two years. In September 2003, Venezuelan Tia Juana crude oil traded at $27 per barrel and by September 2005 it traded at over $60 per barrel. The price has roughly doubled. The Dominican Republic is largely supplied by Venezuela and Mexico, therefore the prices of Tia Juana, Isthmus, and Mayan crude oils, as well as the price of gasoline, are relevant for this analysis. Both spot and future contract prices are considered. This study employs a unique dataset from the Central Bank of the Dominican Republic. It uses a multivariate regression model to test the hypothesized relationship between oil prices and exchange rates.

This paper is organized as follows. Section II reviews the relevant literature. Section III develops my theoretical model. Section IV provides a partial snapshot of the Dominican Republic's economy. I explain my data in Section V and develop my empirical model in Section VI. Section VII presents my results, and I discuss my conclusions and major policy implications in Section VIII.

II. Literature Review

Amano and van Norden examine whether the price of oil causes permanent movement in the real exchange rates for the United States, Germany, and Japan. They reason that supply-side shocks, which cause huge swings in the price

of oil, are perhaps causing a permanent shift in the real equilibrium of exchange rates. Their research design is a two step process that first looks for cointegration between oil prices and exchange rates and then looks for causality. They find significant cointegration for all three currencies and also find significant results that the price of oil causes fluctuations in the real exchange rate. Amano and van Norden find no evidence of opposite causality; in other words, they find no evidence that the real exchange rate caused variation in the price of oil (Amano and van Norden, 1998).

Chaudhuri and Daniel find very similar results as Amano and van Norden, except for 16 OECD countries. Like Amano and van Norden, Chaudhuri and Daniel also use cointegration and causality tests. They find that cointegration exists between oil prices and exchange rates and that variation in the U.S. dollar real exchange rate are caused by variations in the real price of oil (Chaudhuri and Daniel, 1998).

Several other papers arrive at the same conclusion but use different models. For example, Akram investigates whether a non-linear relationship exists between oil prices and the Norwegian exchange rate. The author finds that fluctuations in oil prices do significantly affect the Norwegian exchange rate in a negative non-linear way, especially when oil prices are below 14 USD. Akram also uses an equilibrium corrections model that controls for other factors that determine the Norwegian exchange rate (Akram, 2004). In many ways, the multivariate model I use resembles Akram's.

Another example is the work done by Bergvall. He considers both supply and demand factors in determining the real exchange rate. He uses an intertemporal optimizing model and variance decomposition to show that terms-of-trade shocks are most influential for Denmark and Norway, and demand shocks are most influential for Sweden and Finland. He also finds that as oil prices rise, the exchange rates for Denmark, Finland, and Sweden (oil importers) depreciate. However, the exchange rate for Norway (an oil exporter) appreciates (Bergvall, 2004).

Finally, Joyce and Kamas look at the real and nominal factors that determine the real exchange rates in Argentina, Colombia, and Mexico. The model uses cointegration analysis and variance decompositions. More important than the nominal variables are the real variables that cause variation in the exchange rates. The authors find that, especially in Colombia and Mexico, the terms of trade significantly affect the real exchange rate (Joyce and Kamas, 2003).

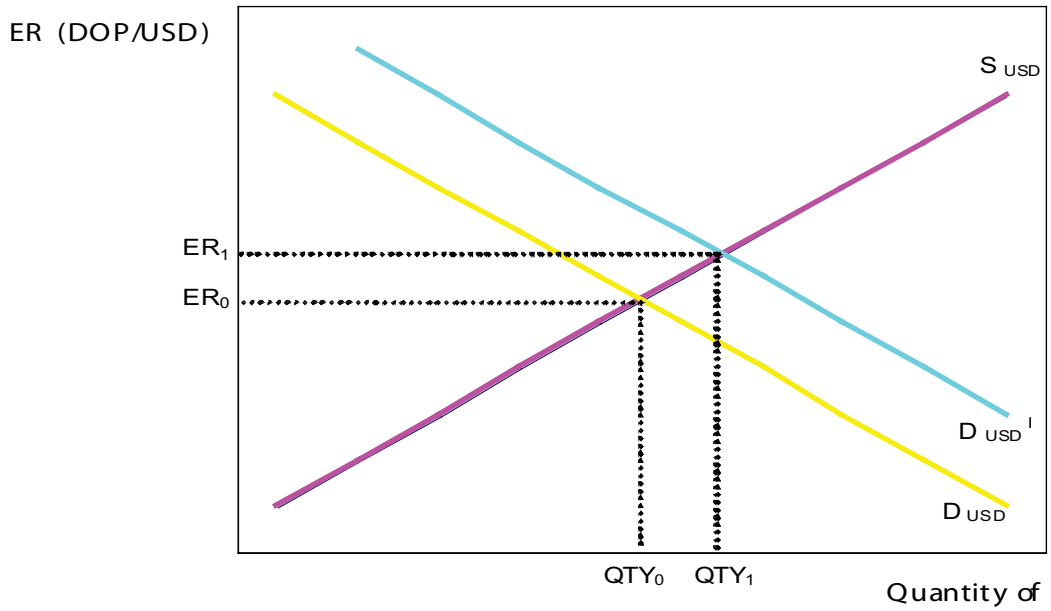
Some literature also finds the opposite direction of causation from all these articles previously mentioned. In other words, these papers find that it is exchange rates which affect oil prices, instead of the other way around. Cooper finds two examples in the 1980s of significant short run effects on the price of oil from movements in the exchange rates (Cooper, 1994). Brown also tests if the exchange rate, or value of the U.S. dollar, affects the price of oil during the 1980s. He finds that, among other things, the appreciation of the dollar caused the price of oil to be 20% lower in 1984 than it would have been if there was no dollar appreciation (Brown, 1986). The Dominican Republic's economy is small relative to the world oil markets, so it is difficult to expect that the Dominican Republic's exchange rate would affect world oil prices. Indeed, this opposite direction of causation that Cooper and Brown find is not what I find.

Overall, the literature is mostly available for large oil-exporting economies. Literature for oil-importing economies is much scarcer. This paper adds to the literature by surveying the effects of oil prices on exchange rates for a small open economy that is an oil importer.

III. Theoretical Model

The market for U.S. dollars is the base of my theoretical model. This market is shown in Figure 1. Because I study how the world price of oil, priced in U.S. dollars, affects the Dominican Republic's exchange rate, I model the market for U.S. dollars that has the exchange rate of the

Figure 1: Market for U.S. Dollars



Dominican Republic peso over the United States dollar (ER DOP/USD). This exchange rate is on the vertical axis and the quantity of U.S. dollars is on the horizontal axis. The demand (D_{USD}) and supply (S_{USD}) curves of U.S. dollars are drawn.

As the price of oil increases, more U.S. dollars are demanded by the Dominican Republic in order to pay for their oil imports. This is shown on the graph above by the rightward demand shift from D_{USD} to D_{USD}^{I}. The rightward demand shift raises the exchange rate from ER_0 to ER_1. This represents a depreciation of the Dominican Republic's currency. Thus, my hypothesis is that as the price of oil increases, the Dominican Republic's currency will depreciate.

IV. Snapshot of the Dominican Republic's Economy

There are two types of oil that the Dominican Republic imports: crude oil and gasoline. It imports a substantial amount of each relative to total imports. Let me explain how each type of oil is important to the Dominican Republic's economy.

The Dominican Republic has two crude oil refineries. These are Falconbridge Dominicana in the city of Bonao and Refineria Dominicana de Petroleo in the city of Haina. Together they have a capacity of about 48,300 barrels of oil per day (Country, 9). In 2003, crude oil accounted for 23.7% of the Dominican Republic's total dollar volume of raw material imports. In 1994, this percentage was 24.0% ("National," 1). Thus, this percentage has not changed much over the past ten years.

However, a more interesting part of the picture is gasoline. The Dominican Republic does not have enough crude oil refining capacity to satisfy the refined oil demands of its own country. It must import refined oil, or gasoline, to make up that difference. In 1994, gasoline accounted for 20.5% total dollar volume of consumer goods imports, and in 2003, it accounted for 39.4% total dollar volume of the Dominican Republic's consumer goods imports ("National," 1). This percentage has roughly doubled in the past ten years. Gasoline is an extremely important product to the Dominican Republic's developing economy.

Thus, as the world prices of both crude oil

and gasoline increase, the Dominican Republic will require more foreign currency to purchase gasoline on the world market. So, as more foreign currency is demanded, the demand for foreign currency shifts right, which corresponds to a depreciation of the Dominican Republic's currency.

It is important to know that the Dominican Republic imports roughly 2/3s of its crude oil from Mexico. The other 1/3 comes from Venezuela. The San Jose Accord is an agreement that allows for the Dominican Republic, as well as other countries in Latin America, to import crude oil from Venezuela and Mexico under favorable terms. These favorable terms allow the Dominican Republic to have a certain percentage of the amount they spend on oil back as a very low interest loan that can be used to fund projects that stimulate domestic energy production (Grayson, 1988). The San Jose Accord has been in operation since it was established in 1980 and continues to this day. The Accord was most recently renewed this past August 2005 (EFE, 2005).

Another important part of the picture in the Dominican Republic's economy is the banking crisis of 2003. In the second quarter of 2003, people lost confidence in the banking system as bank frauds broke out. Large capital flights and increased dollarization occurred. Inflation reached 42.7%, and the Dominican Republic's peso depreciated 74% ("Dominican," 295). This banking crisis severely affected the exchange rate during this time. My first model includes observations during this time period. However, that model is not able to explain the variation in the exchange rate due to this crisis. Thus, I adjust my dataset to correct for this event by using observations only until October of 2002. This second model is much more effective in explaining the relationship that my research focuses on: the relationship between oil prices and the Dominican Republic's exchange rate.

V. Data

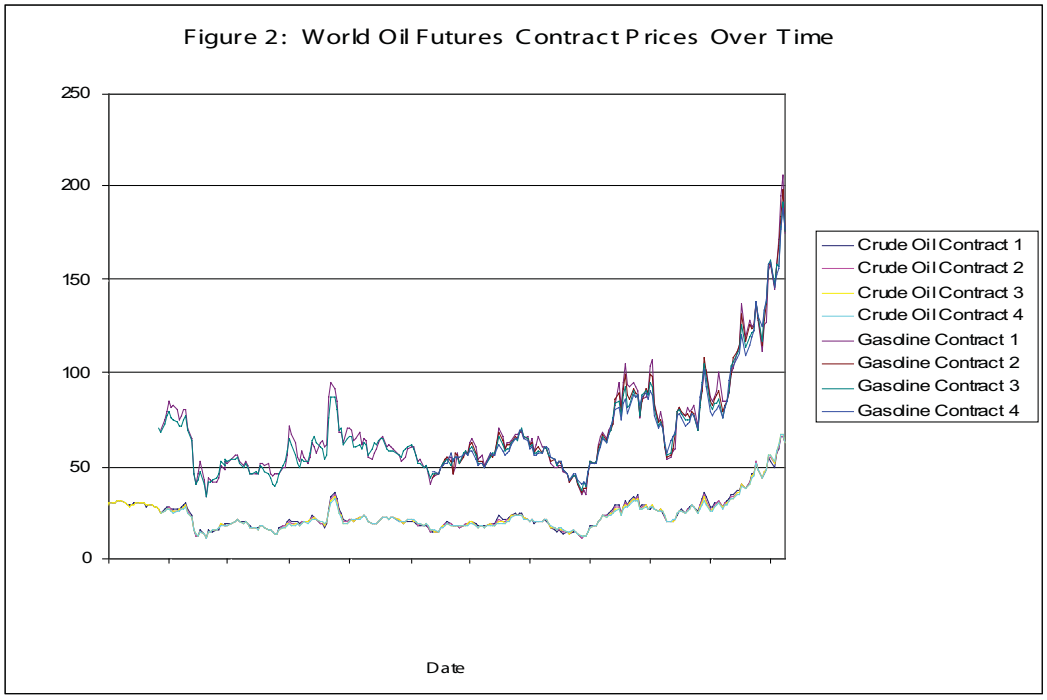
Data on the Dominican Republic come from a special dataset from the Central Bank of the Dominican Republic. Consumer Price Index data for the United States comes from the Bureau of Labor Statistics. Interest Rate data for the United States comes from the Federal Reserve, and exchange rate data comes from the International Monetary Fund's International Financial Statistics. Data for spot and future oil and gas prices comes from the Department of Energy's Energy Information Administration. All data are monthly observations for the period August 1991- October 2002.

VI. Empirical Model

This study researches the following hypothesis. As the price of oil that the Dominican Republic imports increases, the exchange rate (DOP/USD) should increase. Thus, the Dominican Republic's currency depreciates/weakens. This hypothesis is representative of both types of oil: crude oil and gasoline. They are virtually substitutes for one another when it comes to modelling them. Please refer to Figure 2.

This chart shows two important things. Firstly, crude oil and gasoline prices move up and down together. They do not move with the same magnitude of variation, but since they exhibit such collinearity, I model only one. Including both crude oil and gasoline futures prices would cause econometric issues. Secondly, contract 1 corresponds to a futures contract that has delivery in one month. Contract 2 corresponds to a futures contract with delivery in two months, etc. Notice that all of the crude oil contracts, as well as all the gasoline contracts, move almost exactly together. Using one of these contracts is representative of the variation in all the other contracts of its kind. In my model, I use the gasoline contract 3 because it includes the greatest number of observations out of all the data on world oil futures contracts.

To test these hypotheses, I use a multivariate technique, which includes controls, similar to Akram (2004), to account for other factors that influence the exchange rate. The model is as follows:



$$ER(DOP/USD)_t = \beta_0 + \beta_1(Poil)_{t-1} + \beta_2(CPI\text{-}CPI^*)_{t-1} + \beta_3(r\text{-}r^*)_{t-1} + \beta_4(TB/GDP)_{t-1} + \beta 5(ER)_{t-1} + \beta 6(2003) + \beta_t$$

The dependent variable is the exchange rate of the Dominican Republic's Peso over the United States Dollar. Variables with an asterisk represent values for the foreign country, which is the United States in this case. Logs are taken of all variables to get rid of the periodic variation inherent in time series data.

It is important to realize that oil markets are not markets of only spot prices but that most traders engage in futures contracts. Thus, futures contract prices are a reflection of what direction and magnitude the market believes the oil prices will move. Since this type of pricing is much more relevant to the Dominican Republic, the prices of futures contracts for oil are used instead of spot prices. It follows that the Dominican Republic will engage in the foreign exchange market to purchase U.S. dollars with their Pesos when their futures contracts expire and they have to purchase the oil they are pledged to buy. So, if engaging in the foreign exchange market is what affects the Dominican Republic's exchange rate, as I expect, then the Dominican Republic's exchange rate is determined by variables that are lagged. Hence, I believe that each of these independent variables will affect the exchange rate with a lag.

The variable CPI-CPI* accounts for deviations from the equilibrium values of relative prices between the Dominican Republic and the United States that would affect the exchange rate. This is a reflection of the Purchasing Power Parity theory of exchange rate determination, which says that the ratio between two countries' fixed baskets of goods and services determines the relevant exchange rate between those two countries. The CPI used for the United States is the CPI-U, which accounts for about 87% of the population. It is the expenditures of urban people, including clerical, technical, professional, managerial, self-employed and unemployed workers, as well as retirees and some others not in the labor force.

Similarly, the term R-R* controls for deviations from the equilibrium values of the relative interest rates. This variable is a reflection of the Asset Market Model theory of exchange rate determination and the Covered Interest Rate Parity condition, which says that the relative returns between foreign and domestic interest

rates will be the same. I use the interest rates on 3 month certificates of deposit for the United States, which is directly comparable with a similar 3 month monetary instrument for the Dominican Republic.

I also control for the trade balance as a share of the Dominican Republic's GDP. "Exchange rates tend to appreciate when the demand for domestic assets increases relative to the demand for foreign assets. This is likely to take place when a country runs a currency account surplus" (Akram, 2004). Thus, this variable controls for this effect. It is interesting to know that the current account, during the entire time period used in this study and continuing today, is negative or in deficit. So, another way to look at this variable is as controlling for the magnitude of the current account deficit.

In the first half of the 1990s, trade liberalization allowed for the establishment of Free Trade Zones, which largely affected what the Dominican Republic imported compared to what it exported. During this time, there were some accounting issues in gathering complete current account data. Only annual current account data is available for years 1993 to 1995, and for all years, only quarterly current account data is available, not monthly. So, in establishing the time series for the variable of the trade balance as a share of the Dominican Republic's GDP, I make monthly current account observations by a weighting system determined by the average relative weights for each month for the 3 years following the unavailable period. This is a slight weakness in the dataset.

Finally, the exchange rate is probably influenced the most by what its value was in the previous period. So, I include the variable ER_{t-1} in the model to control for this effect. Also, the variable 2003 is a dummy variable for the fiscal crisis that the Dominican Republic experienced during 2003, which is explained above in Section IV. The variable is coded 1 if the Dominican Republic is in a crisis and 0 if it is not in a crisis. I include this variable to control for the significantly irregular behavior the Dominican Republic's exchange rate exhibited during this fiscal crisis.

VII. Results

Please refer to Figure 3 for the variable coefficients and tests statistics. Model A includes observations from 1991 to 2005. This model has some significant results but does not show a significant relationship between the price of oil and the exchange rate. This is likely because of the erratic behavior of the exchange rate during the fiscal crisis. Thus, I readjust my sample to include observations only up until October 2002 before this fiscal crisis hit the Dominican Republic's economy. This way I observe the true relationship between the price of oil and the exchange rate. In doing this, I necessarily drop the d2003 dummy variable since observations for 2003 are not included in Model B.

Figure 3: Multivariate Model Results

	Model A	**Model B**
Variable	Coefficient	Coefficient
constant	-0.003	0.002
	-0.209	(0.061)*
dlog_cpis	1.978	-0.76
	(0.000)***	(0.000)***
dlog_rc3s(-2)	0.08	0.02
	(0.004)**	(0.035)**
dlog_tb_gdp(-2)	0.051	0.039
	-0.478	(0.097)*
dlog_pgas_f3(-1)	0.011	0.026
	-0.724	(0.038)**
dlog_er(-1)	-0.177	0.177
	(0.020)**	(0.049)**
d2003	-0.045	n/a
	(0.000)***	
Sample Size	162	132
Adjusted R-squared	0.433	0.378
Sample	1991:11	1991:11
	2005:04	2002:10
Dependent Variable	dlog_er	dlog_rer

Model B indicates that the price of gasoline does cause the ER(DOP/USD) to significantly rise. This is especially evident with a one-period lag for futures contracts of 3 months. This confirms the hypothesis that as the price of gasoline the Dominican Republic imports increases, the exchange rate (DOP/USD) increases. Likewise,

because crude oil and gasoline prices move so similarly, it also confirms the hypothesis that as the price of oil, gasoline or crude, that the Dominican Republic imports increases, the exchange rate (DOP/USD) increases.

My results also indicate that a positive CPI gap and a positive interest rate gap cause the exchange rate to significantly rise. For the interest rate gap variable, this is especially evident with a two-period lag in the spread of interest rates for 3 month certificates of deposit. Also, as the trade balance deficit grows, the exchange rate significantly increases. Like the case of the interest rate spread, the effect is especially evident with a two-period lag.

All of my variables in Model B were significant to at least the 10% confidence level, and most were significant to the 5% confidence level. The adjusted R-squared is 0.378. The Durbin-Watson statistic is 1.788, which indicates that there is still some autocorrelation present. This is an issue that may still require some refining.

VIII. Conclusion

My results are consistent with Akram (2004), Bergvall (2004), Amano and van Norden (1998), and Chadhuri and Daniel (1998), who each find that oil prices significantly affect the relative value of currencies in Norway, the four Nordic countries, several industrialized countries, and the United Arab Emirates, respectively. Previous literature has established this relationship mostly for large developed oil exporting economies. This paper is unique in that it documents this effect for a small open economy which is an oil importer. I show that rising world oil prices place depreciating pressure on the Dominican Republic's currency. Also, this research employs a unique dataset from the Central Bank of the Dominican Republic.

Recall from earlier that as the exchange rate (DOP/USD) rises, the Dominican Republic's currency, the Peso, depreciates. This is because it costs the Dominican Republic relatively more to purchase the same amount of dollars in the foreign exchange market. So, as the trade balance deficit grows, and most importantly as crude oil and gasoline prices increase, the peso is losing value.

This has tremendous impacts for the Dominican Republic because the country is a net importer. Thus, increasing oil prices make it relatively more expensive for the country to purchase all of its imports. The Dominican Republic should consider decreasing its dependency on imports. Perhaps one way to do this in the energy sector is to create additional refineries inside the Dominican Republic. An even better suggestion might be looking for alternative sources of energy and decreasing its dependence on oil and oil products.

REFERENCES

Akram, Q. Farooq. "Oil Prices and Exchange Rates: Norwegian Evidence." The *Econometrics Journal,* 2004, *7*(2), p. 476.

Alexander, Gwendolyn M. "Exchange Rate Variability and its Effect on Trade: a case study of the CFA Franc Zone." Bloomington, IL: Illinois Wesleyan University, 1996.

Amano, Robert A. and Simon van Norden. "Exchange Rates and Oil Prices." *Review of International Economics*, 1998, *6*(4), p. 683.

Bergvall, Anders. "What Determines Real Exchange Rates? The Nordic Countries." *The Scandinavian Journal of Economics*, 2004, *106*(2), p. 315.

Brown, Stephen P. A. "Exchange Rates and World Oil Prices." *Economic Review*. 1986, *0*(0), p. 1.

Chaudhuri, Kausik and Betty C. Daniel. "Long-Run Equilibrium Real Exchange Rates and Oil Prices." *Economics Letters*, 1998, *58*(2), p. 231.

Cooper, Ronald. "Changes in Exchange Rates

and Oil Prices for Saudi Arabia and Other OPEC Members." *The Journal of Energy and Development,* 1994, *20*(1), p. 109.

Country Analysis Briefs: Caribbean Fact Sheet. 6 July 2005. Energy Information Administration, Department of Energy. 12 October 2005. <http://www.eia.doe.gov/emeu/cabs/carib.html>.

"Dominican Republic." *Economic Survey of Latin America and the Caribbean*. 2003-2004 ed. Chile: United Nations ECLAC, 2004.

EFE. "Mexico and Venezuela renew San Jose Accord." *LatinPetroleum.Com*. 4 August 2005. Top Petroleum News, LatinPetroleum.Com. 1 November 2005. <latinpetroleum.com>.

Golub, Stephen S. "Oil Prices and Exchange Rates." *The Economic Journal,* 1983, 93(371), p. 576.

Grayson, George W. "Mexico and the San Jose Accord." *Oil and Mexican Foreign Policy*. Pittsburgh, PA: University of Pittsburgh Press, 1988.

"National Imports by Use or Economic Destination 1994-2003." Chart. *Central Bank of the Dominican Republic*. 20 October 2005.

Joyce, Joseph P and Linda Kamas. "Real and Nominal Determinants of Real Exchange Rates in Latin America: Short-Run Dynamics and Long-Run Equilibrium." *The Journal of Development Studies*, 2003, *39*(6), p. 155.

Salvatore, Dominick. "Exchange Rate Determination." *International Economics*, 8th ed. United States of America: John Wiley & Sons, Inc., 2004.