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Three Essays on The Effects of Reverting Capital Flows on U.S. Financial Markets

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THREE ESSAYS ON THE EFFECTS OF REVERTING

CAPITAL FLOWS ON U.S.

FINANCIAL MARKETS

A DISSERTATION

By

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ABSTRACT

Lizardo, Radhamés A., Three Essays on the Effects of Reverting Capital Flows on U.S. Financial Markets. Dissertation, Doctor of Philosophy in Business Administration, May, 2009, 182 pp., 20 tables, 28 figures, 208 references. The United States has been running, for a long time now, an-increasing current account deficit. In fact, the U.S. has a current account deficit with most countries in the world. The implication is that Americans have been enjoying an ever-increasing standard of living by consuming way more than what they produce, not only manufactured goods, but also important commodities such as oil. In other words, a significant fraction of our prosperity is based on borrowing rather than increased production. These persistent deficits, which translate into additional indebtedness by the U.S. and an-ever increasing amount of dollars reserves by countries such as China, Japan, South Korea and others, have damaging economic consequences in the long-run. Historically, studies concerning transmission of financial shocks have been unidirectional, going from the U.S. to other nations or regions of the world. However, conditions are now ripe to investigate how this remarkable amount of financial flows reverting to the United States from these "surplus" countries impacts the U.S. financial markets. This dissertation explores the effects of reverting financial flows using financial modeling and forecasting as a research design platform to shed light on three specific issues: (1) the impact of Chinese purchases of U.S. Treasury securities on the U.S. Treasury Yield Curve, (2) the impact of foreign purchases of U.S. corporations' stocks on the U.S. stock market, and (3) the impact of recent oil and other macroeconomic shocks on the U.S. dollar exchange rates. This study finds support for the notion that the decision of China to invest a considerable portion of their positive net cash flow from trade and foreign investments directly into the U.S. Treasury securities has a significant lowering and flattening effect on the U.S Treasury Yield Curve. The study also finds that there exists a short-run as well as a long-run positive and significant relationship between the U.S. stock market and net purchases of U.S. stock by foreign investors. Finally, the study finds that oil price shocks significantly contribute to the explanation of movements in the value of the U.S. dollar relative to key currencies of net oil exporters and other widely traded currencies.

DEDICATION

I dedicate this dissertation with all my heart to my dear wife, Nidia G., and my beloved sons, Radhamés E., and Reny E. along with their wives Sara and Stephanie. They have given me the strength and courage necessary to confront the challenges that a PhD program poses. Their abundant love, support, and prayers have made this journey bearable and the conclusion of this project possible. This humble effort is made as a testament of my unending love for them, so that when I am gone, my children and grandchildren will have a remembrance of one whom they abundantly blessed and whose life they made worth living.

This dissertation is also dedicated with much love to my father, Ronaldo A., mother, Petronila A., and to my sisters Rosalba F. and Aura E. and brothers Ranfis A. and Ronaldo F., who along with their families have been a source of pride, strength, courage, and determination in my life. My parents have instilled in me values that have shaped my character. Their unyielding love, care, and concerns for my wellbeing have fueled my determination to bring this effort to fruition. I will never be able to repay them for the incredible sacrifice they made in raising and educating me; however, this is humbly given to them as a token of gratitude, respect, and affection.

Finally, I want to dedicate this work to the memory of my father-in-law, Elder Eligio Gonzalez and his wife, Guadalupe Gonzalez, who taught me about the power of prayer and the value of faith and showed me that with hard work and dependence on God, anything is possible.

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CHAPTER I

INTRODUCTION

The United States emerged after World War II with an economy larger and richer than that of any other country in the world. For several years, it was the sole functioning major industrialized nation, giving the United States an absolute advantage over most countries. Former great industrial powers such as Germany, the United Kingdom, France, Italy, and Japan were basically in ruin. The result was that the U.S. economy expanded very rapidly, producing a significant share of world output and making the United States the center of the postwar world economy. The creation of the International Monetary Fund and the World Bank also widened the U.S. influence on key aspects of international economic affairs, including standards for currency convertibility for the development of nations. As a consequence, most national economies were susceptible to U.S. financial shocks. With the passing of time, other nations have significantly advanced their technological and production capacities, leading to the world becoming more economically integrated.

Because the U.S. economy has been a dominant global force since World War II, many of the studies concerning spillover effects of macroeconomic shocks have been unidirectional, concentrating on analyzing transmission of U.S., economic shocks to other countries or regions. Studies of how foreign economic forces affect the U.S. financial markets are less abundant. Until recent profound international economic and geopolitical shifts, it was broadly assumed that the U.S. economy was resistant to foreign shocks. In fact, during the 1990s the U.S. economy was so strong and stable that many economists believed that the U.S. had reached a “new paradigm.” The “new economy” was considered to be an Industrial Revolution equal in importance to or even more important than, the Industrial Revolution of 1860-1900 (Gordon, 2000). Everything that should be up was up—GDP, capital spending, incomes, the stock market, employment, exports, and consumer spending. And everything that should be down was down—unemployment, inflation, and interest rates (Zuckerman, 1998). External shocks such as the Mexican peso meltdown of 1994 and the Asian crisis of 1997 had a very small, if any, negative effects on the U.S economy. Several years of extremely favorable U.S. economic performance, in contrast to some of the crises and setbacks elsewhere (including economic stagnation in Japan and Europe), made it seem possible that the American economy was destined to continue to be the leading global economy for the next century (Krugman, 2000).

Recent economic shifts, such as the rise of China as an economic power, the profound reliance of the United States on foreign oil to fuel its economy, and the significant amount of reverting financial flows into the U.S., have created an opportunity for investigating the impact that those forces have on the U.S. financial markets. According to Friedman (2005), globalization has leveled the competitive playing fields between industrial and emerging market countries. The convergence of technology with current events that allows countries such as China and India to become part of the global supply chain for services and manufacturing is creating an explosion of wealth for the middle classes of the world's two biggest nations. These changes are giving them a huge new stake in the success of globalization. With the "flattening" of the global economy, the direction of the waves created by country-specific financial shocks is changing. This study plays a pioneering role in attempting to assess how specific shocks from other geographical areas affect the U.S. stock, bond, and currency markets. This study contributes to the literature in three specific areas. First, it analyzes and presents evidence about the linkage between the Chinese purchases of U.S. Treasuries and the U.S. Treasury Yield Curve. Second, it provides evidence of the dynamic relationship between purchases by foreign investors of U.S. stocks and the U.S. stock market performance. Lastly, it provides evidence of the magnitude of the impact that variation in oil prices has on the price of the USD relative to key currencies of net oil exporters and other widely traded currencies.

Three persistent, long-term, deteriorating macroeconomic dislocations in the United States can be associated with the phenomena that are the object of this dissertation. First, the United States has sustained a prolonged current account deficit. In fact, by 2007 the deficit was approaching 800 billion or about 6 percent of GDP. This persistent and protracted long-run trend has facilitated the accumulation of a remarkable amount of liquidity by countries such as China, Japan, and other creditor nations. For example, American consumers have snapped up everything that the Chinese have manufactured, from **a**ppliances to **z**ephyr t-shirts, and in return the Chinese have helped to finance America's deficits by accumulating ever larger amounts of U.S. debt. Second, the U.S. exhibits a stochastic, rising, long-term fiscal deficit. By 2007 the deficit was approaching half a trillion dollars, and given the ongoing economic crisis and recently approved $700 billion Troubled Assets Relief Program (TARP) and the 2009 $787 billion stimulus package, the situation is expected to become much worse. The result is the United States Federal Government's balance sheet reflects rising leverage, posting a gross federal debt of about eleven trillion dollars by the end of 2008. This has given countries like China an opportunity to position themselves as key financiers to the United States. In fact, China is lending the U.S. an average of one billion dollars a day. Third, the United States, the third largest producer of oil in the world, with a production of more than eight million barrels of oil a day, is, by far, the largest importer of oil, importing, on average, thirteen million barrels of oil a day.

Friedman (2005) uses the "world is flat" metaphor to suggest that globalization has leveled (flattened) the competitive playing field and that the gap between rich and poor countries is shrinking. Friedman's arguments are based on observable global production and trade shifts. An extensive, economic-based review of Friedman's "world is flat" metaphor is presented in Leamer (2007), but an important issue that has not been answered yet is how the very large amount of reverting financial flows, which mirrored the current account deficit, affects the U.S. financial markets, especially the bond and stock markets. Another issue that must be answered, given the behavior of oil price hikes during the last seven years or so, is the effect on the value of the U.S. dollar of the very large sum of dollars that the United States spends for oil every year.

Is the world getting flatter in financial flows? In other words, can creditor nations and nations with important commodities influence the biggest bond and stock market in the world and the most important currency in circulation today? To shed light on these issues, this dissertation explores the effects of reverting financial flows using financial modeling and forecasting as a research design platform. The strategy calls for the identification and testing of an existing theoretical predicting model of bonds valuation, stocks valuation, and exchange rates determination and the elaboration of a proposed augmented composite model that contains the hypothesized variable of interest. The intention is twofold: (1) to assess whether or not the hypothesized variable contributes to the explanation of the phenomenon in question, and (2) whether or not the augmented or composite model outperforms the basic theoretical model in forecasting the direction of the phenomenon of interest. As stated by Stock and Watson (1999), time series models and forecasting methods, however appealing from a theoretical point of view, ultimately must be judged by their performance in real economic forecasting applications. Consequently, three essays are included to address these issues. Since financial modeling and forecasting is emphasized, the essays are constructed on a common research design platform.

In essence, this dissertation intends to test the following hypotheses: (1) Purchases of U.S. Treasuries by China are strong enough to significantly *flatten* the U.S. Treasury Yield Curve. (2) Purchases of U.S. Treasuries by China also lower the U.S. Treasury Yield Curve. (3) There exists a long-run relationship between the U.S. Treasury yields and a linear combination of the fundamental yields' determinants, including the log of Purchases of U.S. Treasuries by China. (4) The effect of foreign purchases of stocks of U.S. Corporations is significant enough to *flatten* the traditional resistance of the U.S. Stock Market to foreign influence. (5) The effect of foreign purchases of U.S. Corporations' stocks on the U.S. Stock Market is time-variant. (6) There exists a long-run equilibrium relationship between the U.S. Stock Market performance and a linear combination of the traditional macroeconomic forces, including foreign purchases of U.S.

Corporations' stocks. (7) The amount of imported oil is so significant that it has a *flattening* impact on the U.S. dollar exchange rate relative to currencies of net exporters of oil. (8) There exists a long-run equilibrium relationship between the log exchange rate of the U.S. dollar and a linear combination of the exchange rate's fundamentals, including the log of oil price.

The empirical analyses conducted in this study reveal that lending activities by China exert a considerable influence on the U.S. Treasury Yield Curve. In general, an increase in the purchase of U.S. Treasuries by China leads to a significant reduction in the U.S. Treasury yields, specially the mid to long term securities such as in the i_2, i_3, i_5, i_7, and i_{10} Treasury Constant Maturity Securities as the amount of U.S. Treasury securities purchased by China increases, their price goes up as well and their yield comes down. The evidence supports the notion that the decision of China to invest a considerable portion of their positive net cash flow from trade and foreign investments directly into the U.S. Treasury securities has a significant lowering and flattening effect on the U.S Treasury Yield Curve.

The study also finds that there exists a short-run as well as a long-run positive and significant relationship between the U.S. stock market and net purchases of U.S. stock by foreign investors. It is also shown that their relationship is time-variant. These results indicate that the U.S. market is affected not just by demand in the home market, but also foreign demand for domestic stock.

Finally, the study finds that the oil prices, which are influenced by OPEC's actions, significantly contribute to the explanation of movements in the value of the U.S. dollar in all of the included countries. In general, an increase in the real price of oil leads to a significant depreciation of the U.S. dollar relative to net oil exporter countries such as Canada, Mexico, and Russia. On the other hand, the currencies of importers of oil, such as Japan and Denmark suffer a depreciation of their own currency relative to the U.S. dollar when the real price of oil goes up. In addition, the values of the U.S. dollar relative to currency of countries that are not net exporters or significant importers (such as the United Kingdom) tend to go down.

CHAPTER II

METHODOLOGY

Given that financial modeling and forecasting serve as the framework of this dissertation, the essays presented in subsequent chapters are constructed on a common research design platform. The strategy calls for the identification and testing of an existing theoretical predicting model (the basic model) of bonds valuation, stocks valuation, and exchange rates determination and the elaboration of a proposed augmented (composite) model that contains the hypothesized variable of interest. For the sake of conciseness, this chapter exposes the fundamental econometric tools used to investigate the issues discussed in subsequent chapters.

The basic and composite models in each essay are estimated by ordinary least squares (OLS), dynamic OLS (DOLS) (Saikkonen 1991; Stock and Watson 1993), and by the multivariate maximum likelihood procedure of Johansen (1988, 1991): JOH-ML. As discussed in Phillips and Hansen, (1990) and others, OLS estimates of cointegrating coefficients are super-consistent. However, they are not asymptotically efficient, and the OLS covariance matrix for the estimated coefficients is inappropriate for inference, as it is asymptotically biased. In contrast, the DOLS, and JOH-ML estimates are asymptotically efficient and yield covariance matrices appropriate for inference. See Rapach and Wohar (2002). Since estimations using OLS may suffer from spuriousness due to heteroscedasticity and autocorrelation, the Newey and West (1987) variance-covariance estimator is employed because it provides consistent estimates in the presence of both heteroscedasticity and autocorrelation.

In the first stage of the analyses, the presence of unit roots in the time-series studied is investigated. A battery of unit root tests is conducted to assess whether or not the series are $I(1)$ at levels and turn $I(0)$ when first differenced. Since the unit root null not can be rejected in levels, the studies proceed with the testing for the existence of a stable long-run relationship among the proposed dependent variables and the predictors in the basic models as well in the composite models using the Johansen (1988, 1991) trace and maximum eigenvalue tests. The objective is to assess whether or not deviations of the dependent variables from a linear combination of the predictors in both the basic and composite models are stationary.

After the unit root and cointegration tests, the research proceeds with the second stage of the analyses, this entails estimating the cointegrating coefficients of the basic models. Such a procedure is needed to obtain a clear picture of how each of the included determinants in the basic models influences the performance of the dependent variables. The third stage of the analyses requires the estimation of the cointegrating coefficients of the composite models to assess whether or not the proposed addition to the models contributes to the explanation of the phenomena of interest.

In order to gain insight into how the long-run equilibrium is restored, and to test for weak exogeneity of the predictors in these models, an estimate is made of a Vector Error Correction Model (VECM) in the following form:

$$\Delta Y_t = \Pi Y_{t-1} + \sum_{i=1}^{k-1} \Gamma_i \Delta Y_{t-i} + \Phi D_t + \varepsilon_t, t = 1,\ldots,T \tag{2.1}$$

If the long-run impact matrix Π in (2.1) is less than full rank, it can be decomposed as follows:

$$\Pi = \alpha\beta' \qquad (2.2)$$

where α is an *n* x *r* matrix of speed of adjustments and β' is an *r* x *n* matrix of cointegrating coefficients. Negative and statistically significant speed of adjustments (α) would indicate that when deviations from the long-run equilibrium occur, it is primarily the dependent variables that adjust to restore long-run equilibrium over our sample, rather than the included predictors. The implication would be that the included determinants are (*weakly*) exogenous: the explanatory variables are uncorrelated with the error terms (Engle et.al, 1983).

When analyzing macroeconomic phenomena with time-series equations such as those proposed in this dissertation, one needs to always consider the issue of direction of influence or the presence of feedback. As suggested by Sims (1980) one should ask: Do the variables that appear on the right-hand side of the equation belong in principle on the right-hand side? In other words, do fluctuations in the predictors included in each model contain useful information about the future values of the proposed dependent variables, or is it the other way around or both? For example, it can be argued that the price of oil is driven by the value of the U.S. dollar and not the other way around. In such a scenario, depreciation of the USD would drive oil prices upward and appreciation of the USD would drive the oil prices downward. However, since the United Sates is a large net importer of oil, it follows that net exporter countries control global oil supply. As discussed elsewhere, the behavior of oil prices over our sample period is dominated by major supply shocks (e.g. OPEC embargo, Iraq-Iran War, first Gulf War, the Iraq War, etc) and most recently by significant increased demand by emerging markets, especially from China and India.[1] These forces are exogenous in our macroeconomic model.

However, the direction of influence in the oil-exchange rate relationship is the object of debate, empirical controversies, and contradictions. For example, Chen and Rogoff (2003) look at real exchange rate behavior by focusing on three OECD economies (Australia, Canada, and New Zealand), where primary commodities constitute a significant share of their exports, and find that commodity prices has a strong and stable influence on their floating real exchange rates. Under this argument, commodity prices are treated as explanatory (exogenous) variables and the exchange rates as dependent variables, and, even though possible channels of endogeneity are considered, they conclude that they are not likely to be dominating their results. On the other hand, Chen et al. (2008) analyze the relationship between exchange rate and commodity prices for the same countries as in Chen and Rogoff (2003) plus Chile, and South Africa, but now they show that "exchange rates have remarkable robust power in predicting commodity prices." Engel and West (2005) enrich the broader debate over exchange rates and fundamentals by suggesting that exchange rates help predict fundamental variables such as relative money supplies, outputs, inflation, and interest rates. This is an alternative position to the theoretical framework used in this analysis and the stance of many of the empirical studies discussed in Chapter 5.

From a pragmatic economic point of view, if oil price hikes are clearly associated with economic recessions and decline in stock market values in the United States (Hamilton 1983, 1996, 2000), then intuitively, one can, a priori, expect oil price shocks to

[1] By the end of 2008 worldwide demand for oil, including that of the U.S. significantly decreased due to the global economic meltdown. A parallel improvement in the value of the USD has also been observed.

be detrimental to the value of U.S. currency. Even if it can be shown that during some recessionary periods the U.S. dollar has strengthened relative to widely traded currencies, historical data show that most recessions have been preceded by weakening of the U.S. dollar (as the most recent recession shows). Furthermore, as previously mentioned, most U.S. recessions have also been preceded by oil price hikes. It is counterintuitive to argue that economic recessions and declined stock market values in the United States, *ceteris paribus*, cause the value of the U.S. dollar to go up.

The same argument can be presented concerning the relationship between the U.S. stock market performance and the foreign demand of U.S. corporations' stocks. For example, the case can be made that appreciation of equity securities in the United States drives purchases of U.S. corporations' stocks by foreigners.

One way of disentangling these dilemmas would be to check for Granger causality. Granger causality is absent when $f(x_t | x_{t-1}, y_{t-1})$ equals $f(x_t | x_{t-1})$. The definition states that in the conditional distribution, lagged values of y_t add no information to explanation of movements of x_t beyond that provided by lagged values of x_t itself (Greene, 2003). The testing procedure for the identification of causal directions becomes, however, more complex when, as is common in macroeconomic time series, the variables are cointegrated $I(1)$ processes. In such cases the conventional Granger causality tests are not valid because statistically the presence of cointegration rules out non-causality between the variables (Granger and Lin, 1995).

As pointed out by Miller (1991), if two variables are cointegrated, then there must be temporal causality in the Granger sense between them in at least one direction. The implication is that in cointegration of unit root processes, there are two forces that might cause the changes in the variables: the response of one variable due to the changes in another variable (i.e. the cointegrating coefficient), and the adjustment taken by the variables to correct any deviation from an equilibrium path (i.e. the speed of adjustments or feedback coefficients). As a result, conventional Granger causality test are mis-specified if the second force is not taken into consideration, which may be done using an error correction model (Engle and Granger 1987). The mis-specification is due to the fact that if the nonstationary variables are cointegrated, a Granger causality test would involves the coefficients of Π in (2.1), and since these coefficients multiply nonstationary variables, it is not appropriate to use an *F*-statistic to test for Granger causality.

Block exogeneity tests are also ruled out if the nonstationary variables are cointegrated (Enders 2004). The implication is that if the long-run impact matrix Π in (2.1) is less than full rank, it can be decomposed as in (2.2), which yields in essence the two sources of causality: the cointegrating coefficients and the speed of adjustments. The direction and magnitude of causation would be a function of the magnitude and sign of those metrics. For example, if it is found that the speed of adjustments (α) are negative and statistically significant, one would be able to conclude that the direction of causality goes from the predictors included in the models to the dependent variables.

Therefore, testing for causality in case of regression with integrated $I(1)$ variables entails testing for long-run causality in the sense of Engle et al. (1983), followed by estimation and testing of α under restriction. The tests can be done using the likelihood-ratio procedures described in Johansen and Juselius (1990) by imposing additional zero restrictions on α (which contains the feedback coefficients). Hypotheses on the feedback coefficients can be expressed as $\alpha = G\gamma$, where γ is a $s \times r$ matrix of free parameters and G

is a known *k x s* matrix of ones and zeros. See Bruggemann (2002). For example, if one has a four dimensional system (*k=4*) with one cointegrating relation (*r*=1) and wish to test weak exogeneity of the second variable, the null hypothesis can be written as

$$\alpha = \begin{bmatrix} \alpha_1 \\ 0 \\ \alpha_3 \\ \alpha_4 \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} \gamma_1 \\ \gamma_2 \\ \gamma_3 \end{bmatrix} \tag{2.3}$$

which can be tested by solving a modified eigen value problem as described by Johansen (1995).

The final step in the analyses involves the comparison of the forecasting performance of the basic against the composite model by assessing whether or not the composite model's Mean Square Error (MSE) for both in-sample and out-of-sample forecasts is statistically lower than that of the basic model. In-sample forecasts are those generated for the same set of data that was used to estimate the model's parameters. However, since a model might provide a good fit to the predictor in the sample used to estimate the parameters, which might not translate to good forecasting performance, we go one step further and perform one-step-ahead out-of-sample comparison as well. A one-step-ahead forecast is a forecast generated for the next observation only. Then a recursive window is used to generate a series of out-of-sample forecasts for the last twelve months, the holdout sample. In a recursive forecasting model, the initial estimation date is fixed, but additional observations are added one at a time to the estimation period.[2]

The mean square errors (MSE) are calculated as follows:

$$MSE = \frac{1}{T-(T_1-1)}\sum_{t=T_1}^{T}(y_{t+s} - f_{t,s})^2 \tag{2.4}$$

where T is the total sample size (in-sample + out-of-sample), and T_1 is the first out-of-sample forecast observation. Thus in-sample model estimation initially runs from observation 1 to ($T_1 - 1$), and observations T_1 to T are available for out-of-sample estimation, i.e. a total holdout sample of T - ($T_1 - 1$). In addition, I calculate the Theil's (1966) U-statistic which is defined as follows:

$$U = \sum_{t=T_1}^{T}\sqrt{\frac{\left(\frac{y_{t+s} - f_{t,s}}{x_{t+s}}\right)^2}{\left(\frac{y_{t+s} - fb_{t,s}}{x_{t+s}}\right)^2}} \tag{2.5}$$

where: $fb_{t,s}$ is the forecast obtained from a benchmark model (the composite model in our analyses). A U-statistic of one implies that the model under consideration and the benchmark model have equal forecasting abilities, while a value of more than one implies

[2] For example, in Chapter III, the observations used to estimate the parameters and the one-step-ahead forecasts were as follows: the one step-ahead forecast for 2007M6 used data to estimate model parameters from 1985M5 to 2007M5; the one step-ahead forecast for 2007M7 used data to estimate model parameters from 1985M5 to 2007M6; and so on, until the one step-ahead forecast for 2008M5 which used data to estimate model parameters from 1985M5 to 2008M4.

that the benchmark model is superior to the basic model, and vice versa. Although the measure is clearly useful, as Makridakis and Hibon (1995) argue, it is important to use metrics that can be evaluated in a more objective way. Consequently, the MSE metrics is reported along with the Diebold and Mariano (1995) test used to compare the accuracy of forecasts predictions. The Diebold and Mariano (1995) test aims to test the null hypothesis of equality expected forecast accuracy against the alternative of different forecasting ability across models. The null hypothesis of the test can be, thus, written as:

$$d_t = E\left| g(e_t^A) - g(e_t^B) \right| = 0 \tag{2.6}$$

where e_t^i refers to the forecasting error of model *i* when performing *h*-steps ahead forecasts. As indicated in Diebold and Mariano (1995), the "equal accuracy" null hypothesis is equivalent to the null hypothesis that the population mean of the loss-differential series is 0.

A battery of diagnostics tests is performed throughout to assure compliance with generally accepted statistical standards. For example, the VARs associated with the VECMs were deemed to be free of serial correlation (based on Lagrange Multiplier tests). They were also found to be free of misspecification problems (as reflected by the residual correlation matrices). In addition, no instability problems were found (all roots have modules less than one and lie inside the unit circle). The lag-length for the VARs are chosen by a combination of minimization of the Likelihood Ratio (LR), Final Prediction Error (FPE), Akaike (AIC), Schwarz-Bayes (SBIC), and Hannan Quinn (HQ) information criteria. Since estimations using OLS may suffer from spuriousness due to heteroscedasticity and autocorrelation, the Newey and West (1987) variance-covariance estimator that is consistent with the presence of both heteroscedasticity and autocorrelation is used in each essay.

CHAPTER III

THE IMPACT OF CHINESE PURCHASES OF U.S. TREASURY SECURITIES ON THE U.S. TREASURY YIELD CURVE

INTRODUCTION

With the emergence of the U.S. economy as the largest and richest in the world, most economies became subject to U.S. financial shocks. With time, however, other nations have significantly advanced their technological and production capacities, and the world has become more economically integrated, or "flatter" as proposed by the metaphor in Friedman (2005). Some economies, such as China, have even turned out to be the new engines of global or regional growth. Figure 3.1 shows the growth path of the Chinese economy relative to that of the United States. China has been growing at a ratio between three and four-to-one relative to the U.S. A significant positive co-movement between these two series can be observed from 1980 to about 2001. After 2001, China's economy began to diverge from that of the U.S. and kept moving upward while that of the U.S. moved below its historic 3% growth rate. As a result, China has emerged as a significant economic player in the world and a dominant force in northeast Asia.

Figure 3.2 shows that South Korea exports to China are now surpassing exports to the United States and that Japan is currently buying more from China than from the United States. The implications are that China has become, for the first time in modern history, a more important market for South Korea's products and a larger source of goods and services for Japan, the world's second largest economy, than the United States. These are profound regional economic shifts, as further documented by Lall and Albaladejo (2004). The recent recovery in Japan, after many years of stagnation, can be linked to the Chinese economic growth. In addition, the U.S. and the rest of the world's imports from China have skyrocketed. Figure 3.3 clearly documents an increasing Chinese current account surplus while the U.S. current account deficit has intensified. The contrast between these two series is confirmed in the bottom graph of Figure 3.3. The current account surplus of China has climbed to over 9% of their GDP while the current account deficit of the U.S. has reached 6% of their GDP. All these trends explain, to a large extent, the increasing importance of China in the world economy.

[Figures 3.1, 3.2, and 3.3]

This expanding trade surplus has helped China accumulate an ever-increasing amount of international reserves. The growth in China's reserves is driven, however, not only by the rapid growth of its exports, but by the billions of foreign direct investment (FDI) entering the country. One trend is followed by the other: as China becomes the supermarket of the world, global producers open factories in China, which expand China's ability to export more, which attracts more FDI, and this could potentially become an unstoppable avalanche of exponentially increasing proportion. Figure 3.4 shows the drastic increase in China's total reserves. By 2007 China's "total reserves minus gold" approached 1.6 trillion U.S dollars whereas the U.S. reserves have stayed at a constant level. There is no doubt that China is catching up with the developed world.[3]

With this change, the directions of the waves created by country-specific financial shocks are shifting. While the basic underpinnings of a "flat world" were originally envisaged within the context of trade and labor movements, there is nothing that precludes the concept from being applied in the financial world as well. In fact, since financial markets adjust faster to new information, the adjustment should in principle be more visible than in the goods or labor market. The paucity of evidence with financial flows and this redirection of financial flows from China into the developed world provide the motivation to analyze, in this essay, the linkage between the Chinese purchases of U.S. Treasuries and the U.S Treasury yield curve.

[Figure 3.4 here]

The "flatter world" has made China recycle its trade surplus with the U.S. back into dollars, especially into U.S. Treasury bonds. China has become one of the largest financiers of the U.S. huge budget and trade deficits. As depicted in Figure 3.5, China holds over $500 billion of U.S. Treasury Securities, which represents close to 20% of the $2,613.3 billion of U.S. Treasury Securities held by foreigners. This makes China the

[3] One point of view is that the world is becoming flatter. According to Friedman (2005), globalization has leveled the competitive playing fields between industrial and emerging market countries. The convergence of technology and events that is allowing countries such as China and India to become part of the global supply chain for services and manufacturing is creating an explosion of wealth in the middle classes of the world's two biggest nations, giving them a huge new stake in the success of globalization. For an extensive and economic-based review of the "world is flat" metaphor, see Leamer (2007). Empirical evidence is far from conclusive at this stage. For an example on the impact of China on Latin American exports, FDI inflows and terms of trade see Jenkins et al. (2008); for labor market effects on Mexican maquiladoras, see Mollick and Wvalle-Vázquez (2006).

second largest foreign holder of U.S. Treasury Securities.[4] (Just less than Japan, holder of $578.7 billion). The implication is that China can exert a great deal of influence on both the value of the U.S. dollar and also on the U.S. Treasury yields. One question posed has been: What if China decides to get rid of the large amount of U.S. dollar assets it holds, including the possible negative effects on the U.S. economy. Some have argued that China may liquidate its vast holding of U.S. Treasuries if Washington imposes trade sanctions to force a Yuan revaluation (China Brief, 2008).

[Figure 3.5 here]

Figure 3.6 depicts the long-term trends between Purchases of U.S. Treasuries by Chinese Investors (PUSTC) and the U.S. 10-year Treasury Constant Maturity Rates (i10). An inverse relationship between these two series is observed: as PUSTC goes up, i10 goes down.[5] It suggests that the amount of purchases of U.S. Treasuries by China is significant enough to put upward pressure on the price of the U.S 10-year Treasury security. As a result of the increased price, the yield (i10) goes down.

To illustrate the connection further, Figure 3.7 shows rolling correlations between i10 and PUSTC based on a moving-window of 120-month periods. The first 120-month correlation coefficient was computed from month 1 to month 120; the second 120-month correlation coefficient was computed from month 2 to month 121; and so on. Figure 2.7 suggests that there has been an increasing negative rolling correlation between PUSTC

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[4] With China's purchases of T-bills during the month of September, 2008, the country surpassed Japan to become the No. 1 owner of U.S. Treasury debt. China increased its Treasury investments by $43.6 billion in September, lifting the total to $585 billion. Japan, by contrast, reduced its Treasury holdings by $12.8 billion, to $573.2 billion during the same month.

[5] An inverse relationship between net purchases of U.S. Treasury securities and U.S. interest rates is observed as well. Net purchases are defined as purchases minus sales of assets; they can therefore be negative if in a given month Chinese purchases are outstripped by sales. Purchases are, on the other hand, always positive.

and i10. Starting about the end of 2002 and onwards, the rolling coefficients of correlation between these two variables have been consistently below -0.50.

[Figures 3.6 and 3.7 here]

Contagion of regional and country specific financial shocks has been the subject of many studies. For example, Levin, (1974) demonstrated that the financial sectors of the United States and the outside world are not immune to movements in each other's interest rates, even when central banks completely sterilize exchange reserve movements in order to control bank reserve aggregates. Such interdependence arises when the bank liabilities of one area substitute for the securities of another or for an asset whose yield fluctuates in response to foreign security rates. Daniel (1981) examined the international transmission of disturbances in a two country rational expectations world. His analysis generalizes the existing literature by combining three significant attributes within the same model. First, the two country, two good, perfect capital mobility model permits expectations of the exchange rate and of the prices of both goods to be formed rationally. Second, it allows endogenous determinants of the terms of trade, and third, it permits examination of the cause of a foreign price disturbance. He demonstrates that it is essential to look at the cause of a change in the foreign price. The implication is that the effect of foreign prices on domestic prices depends on their accompanying real effects and therefore on the source of the disturbance.

On the other hand, Calomiris and Schweikart (1991) examined the spread of the Panic of 1857 shock to other regions. They show that bank performance depends not only on regional conditions and links to eastern banks, but on the ability to coordinate behavior. Mathur and Subrahmanyam (1990) used the concept of Granger causality examine the interdependencies among the stock market indices for four Nordic countries and the U.S. The vector autoregressive model results indicate that the U.S. market affects only the Danish, but not the Norwegian, Finnish, or Swedish markets. The Swedish market was causally prior to both the Norwegian and Finish markets. The Norwegian, Danish, and Finnish markets did not “Granger cause” any other market. The implication of this study is that the Nordic stock markets are less than fully integrated.

Karolyi (1995) examined the short-run dynamics of returns and volatility for stocks traded on the New York and Toronto stock exchanges and finds that inferences about the magnitude and persistence of return innovations that originate in either market or that transmit to the other market depend importantly on how the cross-market dynamics in volatility are modeled. These results have important implications for the global pricing of securities, hedging and other trading strategies. The implication is that if one accepts that the short-run cross-market dependence in the security returns and volatility is significant, then one needs to assess the impact of these international spillovers for the understanding of the degree of integration in the pricing of securities within the global context. Ammer and Mei (1996) developed a framework for measuring financial and real economic linkages between countries. They find that news about future dividend growth is more highly correlated between countries than contemporaneous output measures. This suggests that there are lags in the international transmission of economic shocks and that contemporaneous output correlation may understate the magnitude of integration.

Miller (1998) associated the financial crisis in Southeast Asia to international transmission of economic shocks. They show that the falling yen relative to the U.S.

dollar caused currencies linked to the dollar to become overvalued, and as the balance of payments of those countries deteriorated, their currencies became ripe for speculator attacks, particularly so after a new Asian Tiger, mainland China, began to enter the export markets in a big way. Anoruo et al. (2002) show that economic exposure is a long-term systemic effect that is important to equity investors in all countries included in the study and has two broad components. Real excess stock returns reflect changes in the real terms of trade as well as an orthogonal real exchange rate factor that captures the macroeconomic effects of productivity, aggregate demand, and interest rates.

Baig and Goldfajn (1999) suggested discernible patterns of contagion during the East Asian Crises. Comparing correlations in tranquil versus crisis periods, they present evidence in favor of substantial contagion in the foreign debt markets, whereas the evidence on stock market contagion is more tentative. Pagan and Soydemir (2000) analyzed the extent of interdependency of equity markets in Latin America. Their results suggest a strong linkage between the equity markets of Mexico and the U.S., and weaker but significant linkages between the stock markets of Argentina, Brazil, and Chile. They argue that these cross-country differences in transmission patterns may result from country-specific differences in both the financial market structure as well as economic fundamentals.

Because the U.S. economy has been a dominant global force since World War II, many studies have concentrated on specifically analyzing transmission of U.S. economic shocks to other countries or regions. For example, Eun and Shim (1989) investigated the international transmission mechanism of stock movements. They find that innovations in the U.S. are rapidly transmitted to other markets in a clearly recognizable fashion, whereas no single foreign market can significantly explain the U.S. market movements. On the other hand, Hamao et al. (1990) examined the short-run interdependence of prices and price volatility across three major international stock markets using daily opening and closing prices of major stock indexes for the Tokyo, London, and New York stock markets and find evidence of price volatility spillovers from New York to Tokyo and New York to London, but no price volatility spillover effects from Tokyo to New York or London to New York are found for the analyzed period.

Cochran and Mansur (1991) examined the interrelationships between yields on the U.S. and several foreign market portfolios. Their empirical analysis revealed that the yields on the U.S. and foreign market portfolios are largely contemporaneously determined. The significance levels of the contemporaneous relationships were found to have increased over the 1980-1989 period, although a decreasing and increasing pattern in significance was observed. In summary, they present evidence of a greater degree of international market integration. The cyclical behavior of economic activity, the levels of equity market volatility, expectations of future market movements, and the greater degree of economic and monetary policy coordination among nations were shown as factors affecting the significance of the contemporaneous relationships.

Mann et al. (2004) examined the short-term sensitivity of six international stock indices to two major groups of U.S. monetary policy indicators: the U.S. discount rate and the federal funds rate. They conclude that Fed operating procedures and/or target variables impact the sensitivity of international stock returns to these historical monetary policy indicators. On the other hand, Ng (2000) examined the magnitude and changing nature of volatility spillovers from the U.S. to six Pacific-Basin equity markets. The author constructs a volatility spillover model which allows the unexpected return of any particular Pacific-Bain market to be driven by a local idiosyncratic shock. He finds that over and above the impact of the world factors, there are significant spillovers from the U.S. to many of the Pacific-Basin countries. Liberalization events (such as capital market reform and country fund launching), exchange rate changes, sizes of trade, and country fund premium are shown to affect the relative importance of the world and regional market factors over time.

Soydemir (2002) related the changes in the U.S. Treasury Bill yields to equity market movements in Latin America, using data prior to the 1994 Mexican financial crisis. He finds evidence of a strong and immediate negative impact of T-Bill yields on the U.S. equity market, but a slow and varying impact on the equity markets of Mexico, Argentina, Venezuela, Columbia, and Brazil. The results provide support for the view that policies at the national level may not always be enough to achieve macroeconomic stability in the region. Kim (2005) investigated the stock market linkages in stock markets of Australia, Hong Kong, Japan, and Singapore with the U.S. and the information leadership of the U.S. and Japan in the region since the early 1990s. He finds significant dynamic information spillover effects from the U.S. in all the Asia-Pacific markets, but the Japanese information flows were relatively weak.

Studies that specifically focus on analyzing how foreign economic shocks affect the U.S. are less abundant. Until recent profound international economic and geopolitical shifts, it was broadly assumed that the U.S. economy was resistant to foreign shocks. In fact, during the 1990s the U.S. economy was so strong and stable that many economists believed that the U.S. economy had reached a "new paradigm."[6] Peek and Rosengren (1997) found that the decline in Japanese stock prices results in a decrease in lending by Japanese banks in the U.S. that is both economically and statistically significant. More recently, Mollick and Soydemir (2008) found that a one-time increase in net Japanese purchases of U.S. Treasury securities has an immediate negative effect on U.S. long bond yields but short-lived yen depreciation.

This empirical study adopts a similar perspective and focuses on the impact that purchases of U.S. Treasuries by China has on the Treasury Yield Curve. As shown in Figure 3.8, the United States has been enjoying a declining cost of borrowed funds. Cheap capital has fueled the growth of both the government as well as the private sector. This is so because interest rates tend to co-move as documented by Sarno and Thornton (2003). Therefore, interest on corporate and other types of bonds has also moved downward. While the U.S. disinflation and U.S. monetary policy perhaps explain most of the downturn, it is also possible that exogenous forces (such as the recent Chinese appetite for U.S. fixed income assets) have had an impact. Evidence is provided in this essay - both with cointegration analysis and with in-sample and out-of-sample forecasts - that the purchases of U.S. Treasuries by Chinese have significantly lowered and flattened the U.S. Treasury Yield Curve.

[Figure 3.8 here]

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[6] Gordon (2000) compares the "new economy" to be an Industrial Revolution equal in importance, or even more important, than the Industrial Revolution of 1860-1900. Everything that should be up was up: GDP, capital spending, incomes, the stock market, employment, exports, and consumer spending. And everything that should be down was down: unemployment, inflation, and interest rates. See Zuckerman (1998). External shocks such as the Mexican Peso crisis of 1994 and the Asian crisis of 1997 had very small, if any, negative effect on the U.S. economy. Several years of extremely favorable U.S. economic performance, in contrast to some of the crises and setbacks elsewhere (including economic stagnation in Japan and Europe), made it seem possible that the American economy was destined to continue to be the leading global economy for the next new century. See also Krugman (2000).

The remainder of the essay is organized as follows: Section 2 describes the theoretical framework, Section 3 describes the data and presents descriptive statistics, Section 4 presents the empirical results, and Section 5 summarizes.

THEORETICAL FRAMEWORK

Finance theory posits that the interest rate on a debt security, such as a corporate bond, is determined by a real risk-free rate of interest, θ, plus several premiums that reflect expected inflation (*EI*), maturity risk premium (*MRP*), default risk premium (*DRP*) and liquidity risk premium (*LRP*). See Brigham and Ehrhardt (2005). The interest rate function can be expressed as follows:

$$i_t = \theta_t + EI_t + MRP_t + DRP_t + LRP_t . \qquad (3.1)$$

Because Treasuries have essentially no default or liquidity risk, the restriction *DRP* = *LRP* = 0 can be imposed in (3.1). However, even Treasury bonds are exposed to a significant risk of price decline and a maturity risk premium is included in the yield function to reflect this risk on long-term securities. Therefore, the interest on a Treasury bond that matures in *t* years can be expressed as a function of the following determinants:

$$i_t = \theta_t + EI_t + MRP_T \qquad (3.2),$$

where θ_t represents the interest rate that would exist on a riskless security if zero inflation were expected. Since the closest interest rate to a riskless, zero-inflation yield we have is the effective federal funds rate (*FF*), θ in (3.2) is proxied by *FF*.[7] Maturity Risk Premium is derived as follows:

$$MRP_t = MAX\left[0, i_{LT} - i_{ST}\right] \qquad (3.3),$$

where: i_{LT} represents the yield on the 10-year Constant Maturity Treasury yield and i_{ST} represents the yield on the 3-month Treasury bill rate. This component is present extensively in studies of the yield curve, such as Diebold and Li (2006).

In the past, most of the empirical work focused on testing the Expectation Hypothesis (EH) of the term structure of interest rates using cointegration and equilibrium correction models. See, for example, Engle and Granger (1987), Stock and Watson (1988), Simon (1990), Campbell and Shiller (1991), Hall et al. (1992), Engsted and Tanggaard (1994), Roberds et al. (1996), Lanne (1999, 2000), and Thornton (2005). The EH posits that the interest rates on long-term securities are simply a weighted average of current and expected future short-term interest rates. Several papers have explored the behavior of the shortest term rate (FF) and the 3-month TB and conclude that they behave in accordance with the EH. See for example Cook and Hahn (1989), Goodfriend (1991), Poole (1991), Woodford (1999), and Rudebush (2002). Sarno and Thornton (2003) examine the dynamic relationship between FF and the 3-month TB as well and find a long-run relationship between these two rates that is remarkably stable across monetary policy regimes of interest rate and monetary aggregate targeting.

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[7] As in Sarno and Thornton (2003), the real, risk-free rate of interest θ can also be proxied by the difference between the 3-Month Treasury bill and the corresponding inflation rate. However, this calculation often resulted in negative rates; therefore FF is chosen as proxy for θ instead.

This study focuses on the impact that purchases of U.S. Treasuries by China (PUSTC) has on the U.S. Treasury Yield Curve. I first estimate *the basic model* (3.2), which can be empirically specified as follows:

$$i_T = \beta_0 + \beta_1 FF_t + \beta_2 EI_t + \beta_3 MRP_t + \varepsilon_t . \qquad (3.4),$$

where: T = the One-year, Two-year, Three-year, Five-year, Seven-year, and Ten-year constant maturity yield, respectively; in symbols, i_1, i_2, i_3, i_5, i_7, and i_{10}. (3.4) is then expanded and include the log of purchases of U.S. Treasuries by China (PUSTC) as a predictor of U.S. Treasury yields, with *the composite model* augmented by this factor:

$$i_T = \beta_0 + \beta_1 FF_t + \beta_2 EI_t + \beta_3 MRP_t + \beta_4 \log(PUSTC_t) + \varepsilon_t \qquad (3.5)$$

There are two important theoretical considerations to ponder regarding model (3.5). First, what is the transmission mechanism between *PUSTC* and i_T? Second, assuming a world of rational expectations as in Daniel (1981), what motivates China to invest so heavily in U.S. Treasuries? A logical answer to the first question is the fundamental economic theory of supply and demand: as demand of U.S. Treasuries by China goes up in a significant way, the prices of these securities, *ceteris paribus*, increase, and vice versa. Such price movements might exert pressure on the yields that are ultimately reflected in the yield curve. The second question is more difficult to answer. Is it rational for a relatively poor country such as China with still significant needs of investments in infrastructure and other basic necessities to lend so much capital to the largest economy on earth at such a low rate of return? As Larry Summers, former U.S. Treasury Secretary recently argued in the Washington Post, the returns on these Treasuries, after inflation and currency changes are factored in, are zero or even negative. What about the notion that rational investors should use diversification to secure a portfolio that minimizes risk while commanding an average rate of return? Are China's foreign-exchange reserves, the world's largest, being subject to extra risk due to this seemingly counterintuitive investment policy?

One can make use of the optimal portfolio selection theory to try to shed light on this important issue. The optimal portfolio selection theory is closely associated with utility theory applicable to individuals. This concept has been extrapolated to the firms as well. See Copeland et al.2005. The firm can be conceived as a portfolio of risky assets and liabilities. The fundamental issue concerning the firm is: how can a manager select the best combination of risk and return to maximize the utility of shareholders? This same concept can be taken to the next level: how can the financial leader (i.e. central banker) of a country (i.e. China) select the best combination of portfolio investment and consumption, to maximize the aggregated utility of the nation (i.e. citizens)? Since any portfolio payoff pattern can be constructed from the existing market securities or from a full set of pure securities in a complete capital market, one can phrase the optimal portfolio problem in terms of pure securities and write an investor's expected utility of end-of-period wealth as follows:

$$E[U(W)] =_{1} \Sigma \pi_s U(Q_s) \tag{3.6}$$

where Q_s represents the number of pure securities paying $1 if state s occurs and

π_s represents the probability state s is realized. Now consider the problem an individual (or nation) faces when deciding how much of the current wealth, $W_{0,}$ to spend for current consumption, C, and the portfolio of securities to hold for the future. One needs to solve the following problem:

$$\max[u(C) + \sum_s \pi_s U(Q_s)] \tag{3.7}$$

Subject to

$$\sum_s p_s Q_s + C = W_0 \tag{3.8}$$

where $p_s Q_s$ is the price of the investment and C is the cost of consumption. Using the Lagrange multiplier method one can proceeds as follows:

$$L = u(C) + \sum_s \pi_s U(Q_s) - \lambda(\sum_s p_s Q_s + C - W_0) \tag{3.9}$$

From the first order conditions:

$$\frac{\partial L}{\partial C} = u'(C) - \lambda = 0 \tag{3.9a}$$

$$\lambda = \frac{u'(C)}{\$1} = u'(C)$$

$$\frac{\partial L}{\partial Q_1} = \pi_t U'(Q_t) - \lambda p_t = 0 \tag{3.9b}$$

$$\lambda = \frac{\pi_t U'(Q_t)}{p_t}$$

where $\pi_t U'(Q_t)$ = expected marginal utility of an investment Q_t in pure security.

$$\frac{\partial L}{\partial \lambda} = (\sum_s p_s Q_s + \$1C - W_0) = 0\,. \tag{3.9c}$$

In a complete capital market a number of portfolio optimality conditions can be obtained. These conditions hold for any risk-averse expected utility maximizer. One set of portfolio optimality condition is presented below:

$$\frac{\pi_t U'(Q_t)}{u'(C)} = \frac{p_t}{\$1} \quad \text{for any state} \qquad (3.10)$$

which implies that the optimal allocation of wealth represents choosing C and the Q_s 's so that the ratio of expected marginal utilities equals the ratio of market prices for the C and the Q_s's. That is, the optimal consumption and investment choices involve choosing points on the various indifference curves (curves of constant expected utility) that are tangent to the associated market line as illustrated in Figure 3.9.

[Figure 3.9 here]

Since China may perceive the United States as rival rather than a friend, it follows that the country might derive significant utility from amassing huge amount of U.S. Treasuries as a potential economic defense mechanism that can be used for deterrence, intimidation, and against perceived overreaching conduct. Such a condition could explain, in part, China's investment behavior concerning U.S. Treasuries and the willingness to give up current consumptions for the possibility of acquiring more U.S. Treasury securities. It can be speculated that such a policy feeds the notion of national pride and legitimize the continuity of the current regime and economic system.

Regarding the coefficients in (3.5), theory suggests an inverse relationship between interest rate and the price of a bond. When the real, risk-free rate (i.e. FF) moves higher, the market interest rate on debt securities should increase and the price of existing bonds, *ceteris paribus*, should decrease (which results in an increased yield). Therefore β_1

is expected to be positive. The same applies to inflation premium (*EI*), and maturity risk premium (*MRP*); therefore β_2 and β_3 are expected to be positive as well. On the other hand, a *significant* increase in purchases of U.S. Treasuries by China should put upward pressure on the price of the Treasuries, which should result in a lowered yield. As a result, β_4 is expected to be negative.

DATA AND DESCRIPTIVE STATISTICS

The data are monthly observations on the U.S. 10-year, U.S 7-year, U.S. 5-year, U.S. 3-year, U.S. 2-year, and U.S. 1-year Treasury Constant Maturity Rate yields (series ID: GS 10, GS 7, GS 5, GS 3, GS 2, and GS 1) from May, 1985, to May, 2008, which come from the Board of the Governor of the Federal Reserve System, downloaded from the U.S. Federal Reserve of Saint Louis (http://research.stlouisfed.org/fred2/categories/115). The release is the H.15 "Selected Interest Rates," monthly rate, in percentage and average of business days.

Monthly observations on the U.S. effective Federal Funds (FF) are used, which is a weighted average of the rates on federal funds transactions of a group of federal funds brokers who report their transactions daily to the Federal Reserve Bank of New York. The Series ID is the FEDFUNDS from May, 1985, to May, 2008, which come from the Board of the Governor of the Federal Reserve System. The release is H.15 "Selected Interest Rates", monthly rate, in percent and average of daily figures. The series was downloaded from the U.S. Federal Reserve of Saint Louis (http://research.stlouisfed.org/fred2/categories/118)

Monthly calculations of the Maturity Risk Premium are computed by subtracting the Series GS 10 from the Series TB3MS (3-month Treasury bill rate) for the months of

1985:5 to 2008:5. These series were downloaded from the U.S. Federal Reserve of Saint Louis (http://research.stlouisfed.org/fred2/categories/119).

Monthly observations of Purchases of U.S. Treasury bonds by China (PUSTC) for the months from 1985:5 to 2008:5 come from the *Treasury International Capital* (TIC) and are downloaded from http://www.treas.gov/tic/. The TIC data represent foreign investor's purchases and sales of U.S.'s long-term securities as reported by commercial banks, bank holding companies, brokers and dealers, foreign banks, and non-banking enterprises in the U.S.

Monthly observations of University of Michigan inflation expectation over the period from May of 1985 to May of 2008 come from the Board of the Governor of the Federal Reserve System. The Series ID is MICH and was downloaded from http://research.stlouisfed.or/ fred2/categories/98. This measure of inflation expectations, obtained from the University of Michigan's Survey of Consumers, asks participants what they expect inflation to be over the next 5 to 10 years.[8]

Table 3.1 presents key descriptive statistics of the series used. The positive slope of the yield curve can be seen by the increasing range in the means from 5.01% (FF) to 6.33% (i10). To make the data used in this study comparable, MRP has a mean in our sample of 1.28, which is close to the slope of 1.62 reported by Diebold and Li (2006) in their study of the yield curve from 1985:1 to 2000:12. Therefore, the eight additional years in the data added by this study (until May 2008) suggests some flattening of the slope has occurred with respect to the sample in Diebold and Li (2006). Tests of the

[8] In theory, the yields on two different kinds of Treasury securities - nominal treasury notes and treasury inflation protected securities (TIPS) - can be used to calculate market-based estimates of expected inflation. However, market-based estimates of expected inflation based on the difference between the nominal treasury notes and TIPS are available only starting in 1997. For details, see http://www.clevelandfed.org/research/data/TIPS/bg.cfm.

shape of the distributions indicate that all series are leptokurtic, which implies that these distributions are higher or more peaked than the normal distribution. Some of the series are moderately skewed as well. The Jarque-Bera tests reject the null ($p < 0.10$) of underlying normal distribution for most of the series. Due to the sample size (277 observations) and the implications of the central limit theorem, non-normality is considered not to be an impediment for this analysis. See Sarno and Thornton (2003).

[Table 3.1 here]

EMPIRICAL RESULTS

Table 3.2 shows the unit root tests of the different yields and the interest rate determinants. Since some tests are more robust than others with respect to the presence of heteroscedaticity, we include the traditional approach of the augmented Dickey and Fuller (1979) test, in addition to the modified augmented Dickey and Fuller test proposed by Elliott et al. (1996), and the KPSS method suggested by Kwiatkowski et al. (1992). Additional information concerning these tests has been included at the bottom of Table 3.2. As can be seen, *FF, EI, MRP,* and *PUSTC* are clearly non-stationary series in levels. On the other hand, all series included are clearly stationary when first differenced. This is an important finding because non-stationary at levels is a necessary condition for this analysis. All control series appear to be $I(1)$: they have a unit root in levels, but are stationary when first differenced.

[Table 3.2 here]

Table 3.2 also shows the unit root tests of the different constant maturity rates. As with the other variables, i_1, i_2, i_3, i_5, i_7, i_{10}, are clearly non-stationary in levels under the KPSS method suggested by Kwiatkowski et al. (1992). However, there are 5% level rejections of the unit root in levels of i_7 and i_{10} by the augmented Dickey and Fuller test, which are not confirmed by the DF-GLS. The conclusion is that the interest rate and other series in the table are I (1) process. This conclusion is supported by the traditional findings of most of the empirical work concerning interest rates, which finds them to be integrated of order one, such as: Campbell and Shiller (1987), Hall et al. (1992), Mishkin (1992), and Balz (1998). This allows this study to proceed with testing for the presence of a long-run relationship among the variables.

There is strong support for the existence of a stable long-run relationship among *i, FF, EI, and MRP* as given by the Johansen (1988, 1991) trace and maximum eigenvalue tests. The hypothesis of no cointegration is consistently rejected throughout at conventional significance levels.[9] Cointegrating coefficient estimates for the basic model (3.4) are presented in Table 3.3. As can be seen, the cointegrating coefficient estimates of β_1 and β_3 are in agreement with the theoretical expectation. It seems that the effective federal funds rate (*FF*), and the maturity risk premium (*MRP*) as specified in (3.4) significantly explains variation in the U.S. Treasury yields. Expected Inflation over the next 5 to 10 years (*EI*), however, as measured by the University of Michigan's Survey of Consumers is not capturing the theorized effect on U.S Treasury yields.

[Table 3.3 here]

Table 3.4 presents the estimation of (3.5) for alternative maturities. Purchases of U.S. Treasuries by China significantly lower the U.S. Treasury Yield Curve. In general, an increase in the purchase of U.S. Treasuries by China leads to a significant reduction in

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[9] The results of the cointegrating analysis can be summarized as follows. For the basic model, cointegration was mixed for i_1 and i_2: trace statistics and maximum eigenvalue tests did not coincide; but decisive cointegration was found for i_3, i_5, i_7 and i_{10}. For the composite model, cointegration was found for i_1, i_2, and i_3,, while it was also found for i_5, i_7 and i_{10} with two cointegration vectors for the high-end of the curve (7 and 10-year maturities).

the U.S. Treasury yields, especially the yields on the mid to long term securities, such as the i_2, i_3, i_5, i_7, i_{10} Treasury Constant Maturity Securities. This seems to be a logical outcome: as the amount of Treasury securities purchased by China goes up, their price goes up as well and their yield comes down, *ceteris paribus.* It is important to notice that the effect of purchases of U.S. Treasuries by China is stronger as the term of the security increases. For example, a one percent increase in purchases of U.S. Treasuries by China lowers the i_2 Treasury Constant Maturity Rate yield by, on average, 10 to 38 basis points (*ceteris paribus*), while a one percent increase in purchases of U.S. Treasury Constant Maturity securities by China lowers the i_{10} Treasury Constant Maturity Rate yield by, on average, 39 to 55 basis points (*ceteris paribus*). Therefore, not only is the U.S. Treasury Yield Curve lowered by purchases of U.S. Treasuries by China, but also flattened.

[Table 3.4 here]

Figure 3.10 supports the notion that the U.S. Treasury Yield Curve has not been only lowered by purchases of U.S. Treasuries by China but also flattened.[10] As can be seen, a hypothesized 1% increase in Treasury Constant Maturity Treasury Securities purchased by China significantly lowers and flattens the U.S. Treasury Yield Curve. The implication is that the effect is stronger on longer term securities than on shorter term securities, as a result the slope of the Yield Curve is lowered: With longer term securities the gap between the two curves increasingly widens.

[Figure 3.10 here]

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[10] Figure 10 was derived by taking a linear average of the extreme points of the range of results obtained from OLS, DOLS, and JOH. For example, for i10 the range was -39bp to -55bp for an increase of 1% in PUSTC, the mid-point of that range is 47bp, and so on. Using the observations for 2008:05, the complete series was calculated as presented. In this way the figure reflects the middle of the estimation of all the methods. However, if one chooses one particular method, the result will be similar because the effect of PUSTC on the yield curve gets stronger as the term to maturity increases regardless of the method.

Column 14 of Table 3.4 shows the speeds of adjustments (feedback coefficients). As can be seen, except for i_1, the null hypothesis as presented in (2.3) that the speeds of adjustments are zero can be rejected at any conventional significance level. They are negative and statistically significant throughout. The implication is that when deviations from the long-run equilibrium occur, it is primarily the yields that adjust to restore long-run equilibrium over our sample, rather than the included predictors. The range of adjustments goes from 5% to 12%, indicating that about 5 to 12 percent of the deviations from the long-run relationship are corrected the next month by the reduction in yields. This would imply that if the yields were higher than expected a priori in the last month, in the current month it would be decreased by 5 to 12 percent to restore the long-run relationship between the yields and the included yields determinants. In other words, the included determinants are (*weakly*) exogenous. The other implication is that unidirectional Granger causality going from the predictors to the yields is supported in two ways: First, in the long-run, the cointegrating coefficients are driving the yields with no feedback. Second, the temporal deviations from the long-run path are corrected by changes in the yields. In summary, the study finds long-run and short-run unidirectional causation.

In order to assess the stability of the cointegrating relationship between purchases of U.S. Treasuries by China and the yields (while controlling for the traditional interest rate determinants), a recursive estimate of the unrestricted parameter on *PUSTC* in relationship to i_5[11] is plotted in Figure 3.11. The estimated cointegrating relationship appears insignificant from 1985:5 to about 1995:5 when purchases of U.S. Treasuries by

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[11] Similar results were obtained for the other yields. The five-year U.S. Treasury yield is presented because it represents the mid term yield.

China took off as depicted in Figure 3.12. However, as post-1995:5 observations are added, the relationship becomes significant and correctly signed. As can be seen, the relationship turns stronger over time with no drastic reversal or episode of insignificancy. The implication is that no structural breaks are observed, and as such the need to split the included sample into different subsamples was deemed to be unnecessary, since it would not change the overall conclusion.

[Figures 3.11 and 3.12 here]

Meese and Rogoff (1983) compare the forecasting performance of the basic monetary model of exchange rate determination against a naïve random walk model for U.S. dollar exchange rates for several countries. Mark (1995) compares performance of the basic monetary model at longer horizons relative to that of shorter horizons. One way of comparing one model performance relative to another is accomplished through Theil's (1966) *U*-statistic as determined by (2.5). A value of the *U*-statistic larger than one indicates that the basic model does worse than the composite model in minimizing the RMSE.

The upper part of Table 3.5 shows the in-sample Theil's *U*-statistic for the basic and composite models as presented in (3.4) and (3.5). Theil's *U*-statistic is, except for i_1, greater than 1 throughout and the ratio increases linearly with the term of the securities. This lends support to the hypothesis that the composite model is superior to the basic model in predicting variation in the U.S. Treasury Yield Curve. The Mean Square Error (MSE) is computed and compared as defined by (2.4) for both models and tests the null hypothesis that the MSE obtained from the basic model is equal to the MSE of the composite model against the alternative hypothesis that one MSE is smaller than the other.

[Table 3.5 here]

One-sided (upper–tail) t-tests of H_0: $MSE_B=MSE_C$ versus H_1: $MSE_B>MSE_C$ are presented in column 5 of the upper Table 3.5. The null hypothesis is rejected at conventional levels for the mid-to-long-term securities. However, the null cannot be rejected for both the one-year and two-year securities. This is in line with the cointegration findings presented in Table 3.4, which shows that the effect of the purchases of U.S. Treasuries by China on the U.S. Treasury Yield Curve is significantly stronger on the mid to long term securities.

In addition to the in-sample forecasts, the one-step-ahead out-of-sample comparison as done by Rapach and Wohar (2002), and the Diebold and Mariano (1995) statistics are computed. In the spirit of Rapach and Wohar (2002), the null hypothesis is tested that the Mean Square Error of the Composite Model (MSE_C) is equal to the Mean Square Error of the Basic Model (MSE_B) against the alternative hypothesis that MSE_B > MSE_C, using a recursive window to generate a series of out-of-sample forecasts, in our case, for the last twelve months of the full sample. The holdout sample encompasses the last twelve months of data observations.

The lower part of Table 3.5 shows the one-step-ahead out-of-sample Theil's *U*-statistic for the basic and composite models as presented in (3.4) and (3.5). Again, Theil's *U*-statistic is, except for i_1, also greater than 1 throughout and the ratio increases linearly with the term of the securities as well. As before, this lends support to the hypothesis that the composite model is superior to the basic model in predicting variation in the U.S.

Treasury Yield Curve, even when using one-step-ahead observations to evaluate the forecasting precision of the models. The test performed in the previous section is repeated to test that $MSE_C = MSE_B$ against the alternative hypothesis that $MSE_B > MSE_C$ when out-of-sample observations are used for prediction.

One-sided (upper-tail) t-tests of H_0: $MSE_B=MSE_C$ versus H_1: $MSE_B>MSE_C$ are presented in column 5 of the lower part of Table 3.5. The null hypothesis is rejected at conventional levels for the mid-to long-term securities. However, the null cannot be rejected for the one-year, two-year, and three-year securities. Out-of-sample, the evidence is stronger for the augmented model improving forecasting power at longer maturities. The Diebold-Mariano (1995) statistic reported in the sixth column of the lower part of Table 3.5, however, strongly suggests that the composite model forecasts beat the ones from the basic model for all maturities, except the One-Year yield.

Diebold and Lee (2006) find that their “Nelson-Siegel” factorization model of the U.S. Yield Curve is inferior to the random walk when the horizon is only one period, with improving results for longer horizons. The central point of this essay is not, however, to “beat the random walk.” Rather, the cointegration analysis and the battery of forecasting exercises provide a clear picture. The evidence supports the notion that Chinese investors have a significant flattening effect on the U.S. Yield Curve.

The empirical findings presented in this essay support the following hypotheses: (1) Purchases of U.S. Treasuries by China are strong enough to significantly *flatten* the U.S. Yield Curve; (2) purchases of U.S Treasuries by China lower the U.S Yield Curve as well; and, (3) there exists a long-run relationship between the U.S. Treasury yields and a linear combination of the fundamental yields' determinants, including the log of Purchases of U.S. Treasuries by China.

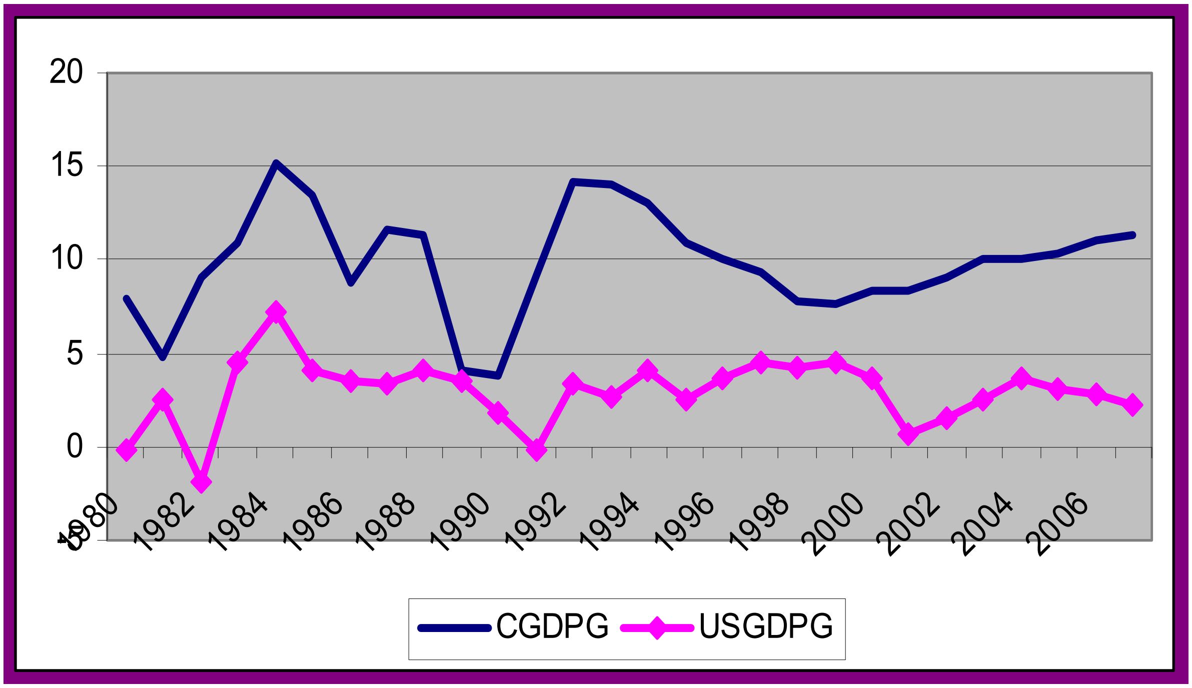
SUMMARY

China is now said to exert considerable influence on the U.S. Treasury Yield Curve. This broad assessment is confirmed in this essay using monthly data from 1985 to 2008 on several grounds. An increase in the purchase of U.S. Treasuries by China leads to a significant reduction in the U.S. Treasury yields, specially in the mid to long-term securities: as the amount of U.S. Treasury securities purchased by China goes up, the price of longer-term securities goes up, driving yields down, *ceteris paribus.*

Not only is the U.S. Treasury Yield Curve lowered through purchases of U.S. Treasuries by China, but also flattened: a hypothesized 1% increase in Treasury Constant Maturity Treasury Securities purchased by China significantly lowers and flattens the U.S. Treasury Yield Curve. Using the metaphor by Friedman (2005) and reviewed by Leamer (2007), the flat world is observed in financial flows as well, with a stronger effect on longer term securities than on shorter term securities. The explanatory power of purchases of U.S. Treasuries by Chinese investors on the behavior of the U.S. Treasury Yield Curve is corroborated by several forecasting techniques.

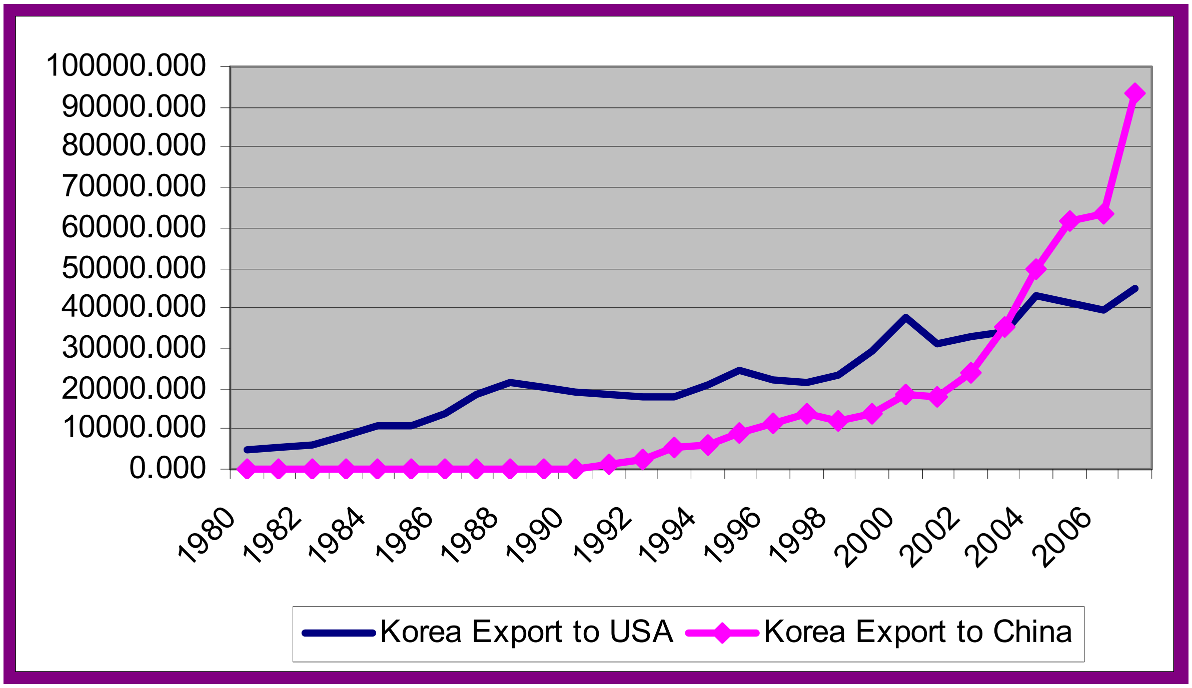
The findings of this essay have important policy implications. Even though the analyses support the notion that the amount of purchases of U.S. Treasuries by China has contributed to the lowering of the U.S. cost of debt, the price to pay for such a benefit in the long run may be too costly. First, even if at the moment a drastic action by China looks unlikely, the U.S. could become prey to a run by China, against the dollar if such an action could serve China's ambitions, or if economic forces not foreseen at the moment dictate such an action. Such a move could be followed by other holders of U.S. Treasuries with potentially devastating economic consequences. Second, the greater the influence a particular foreign power has on the interest rate of any other nation, the lesser is the relevance of national monetary policy for the influenced country. A country gives up sovereignty when the government of that nation allows exogenous forces to significantly determine important monetary policy tools, such as the level of interest on debt securities. Therefore, it might be in the best interest of the United States to better control both the budget and the current account deficits and to try to live within its means.

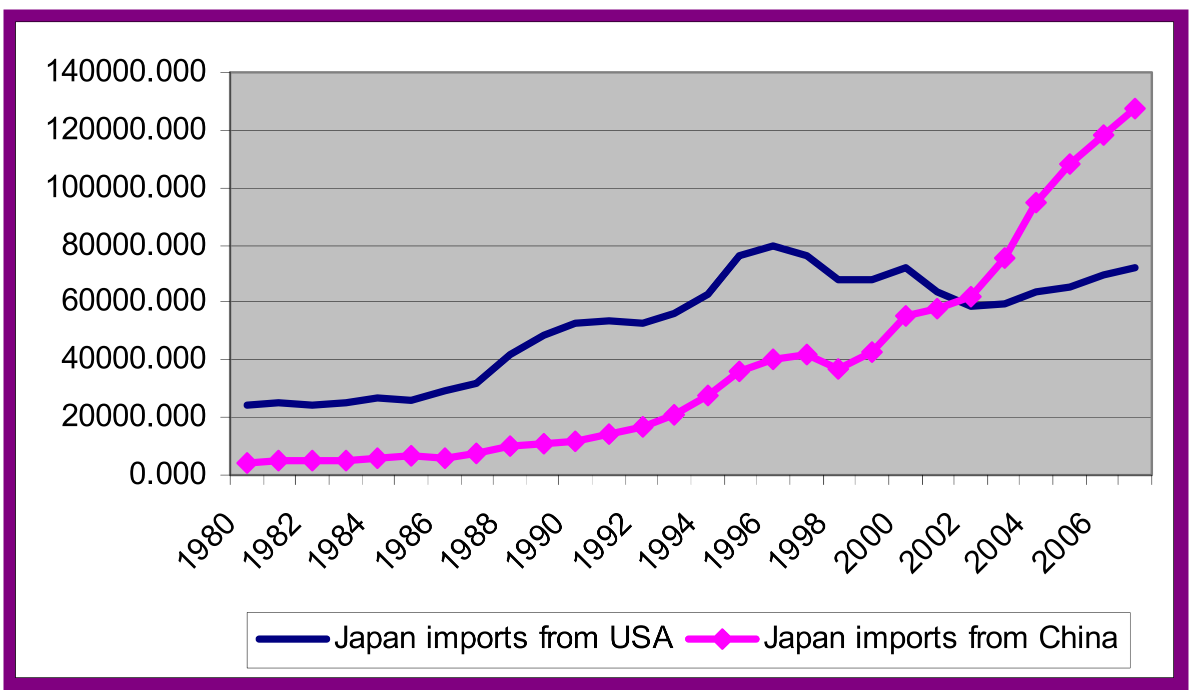
Figure 3.1. China's Gross Domestic Product Growth (CGDPG) vs. Gross Domestic Product Growth of the U.S. (USGDPG).



Note. Constructed by the author, using data from International Financial Statistics (IFS) of the International Monetary Fund (IMF), downloaded from http://www.imfstatistics.org.

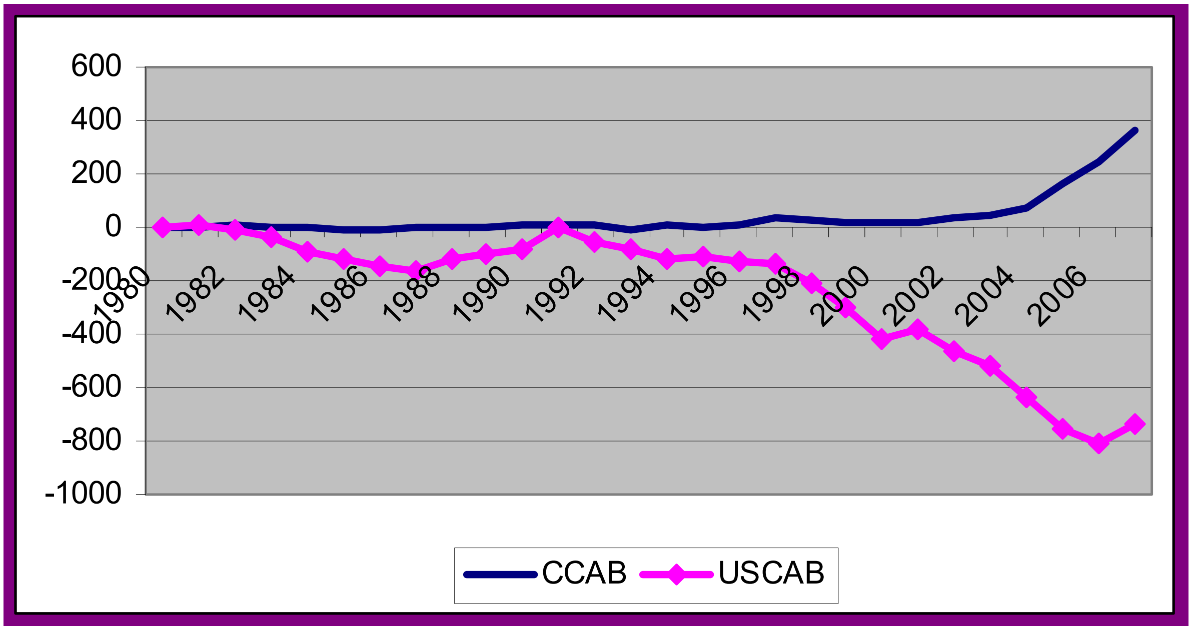
Figure 3.2. South Korea's exports to China and the United States and Japan's imports from China and the United States.

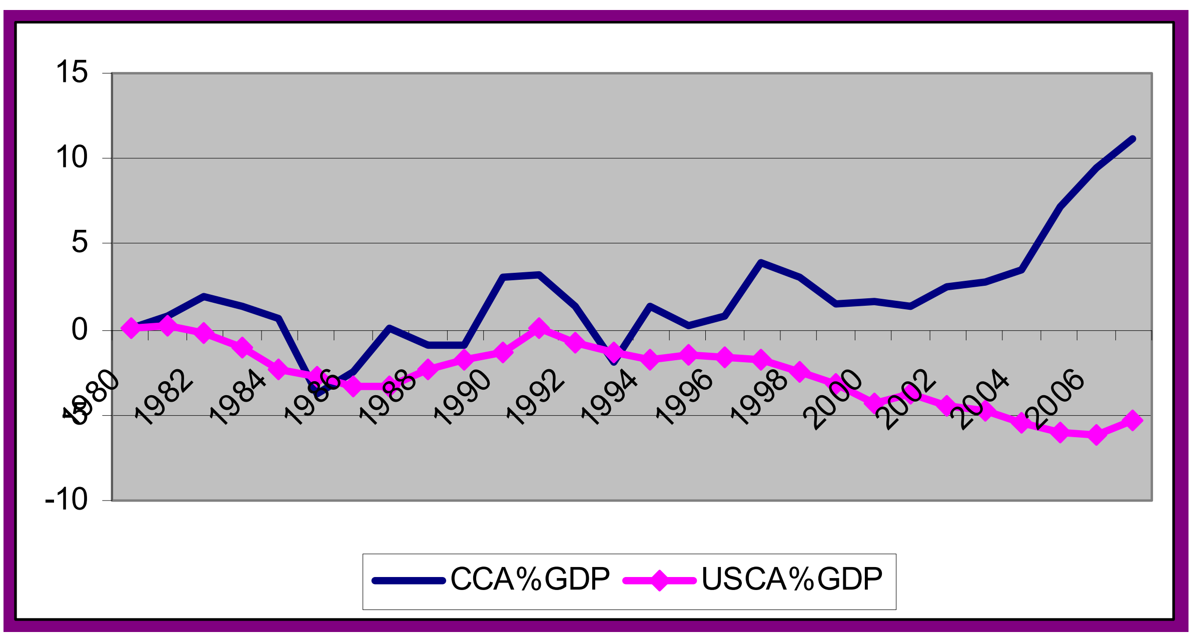




Note. Constructed by the author, using data from Direction of Trade Statistics (DOT) of the International Monetary Fund (IMF), downloaded from http://www.imfstatistics.org.

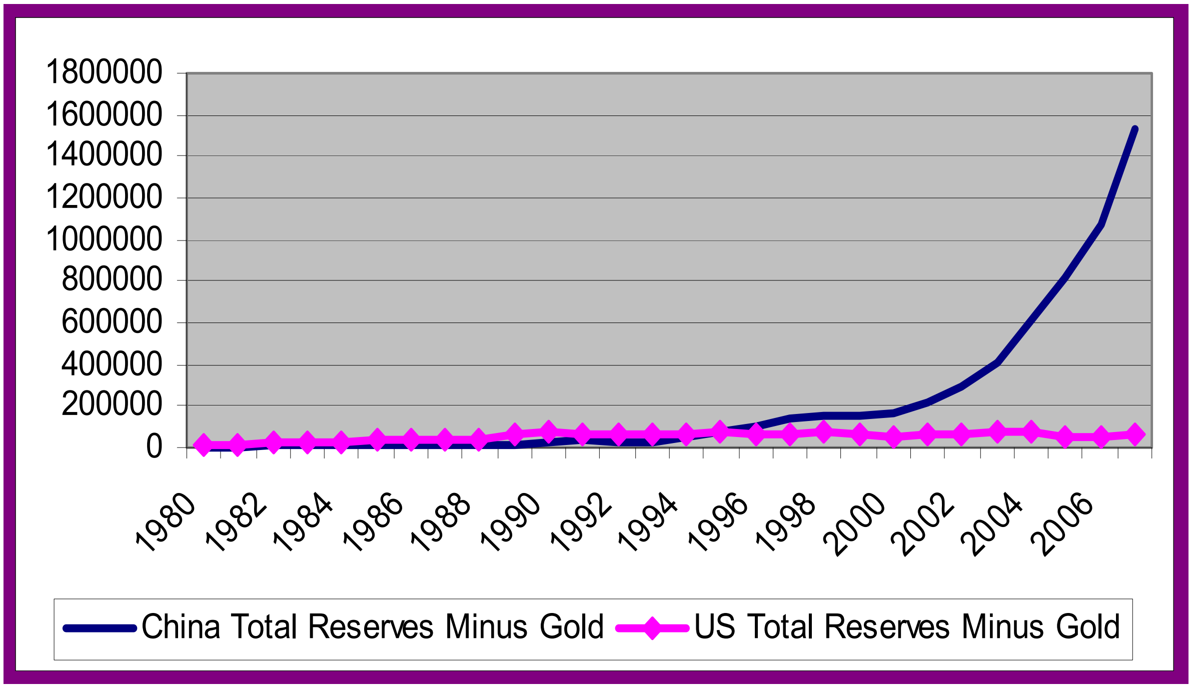
Figure 3.3. Current Account Balance for China (CCAB) and the United States (USCAB) and as % of GDP.





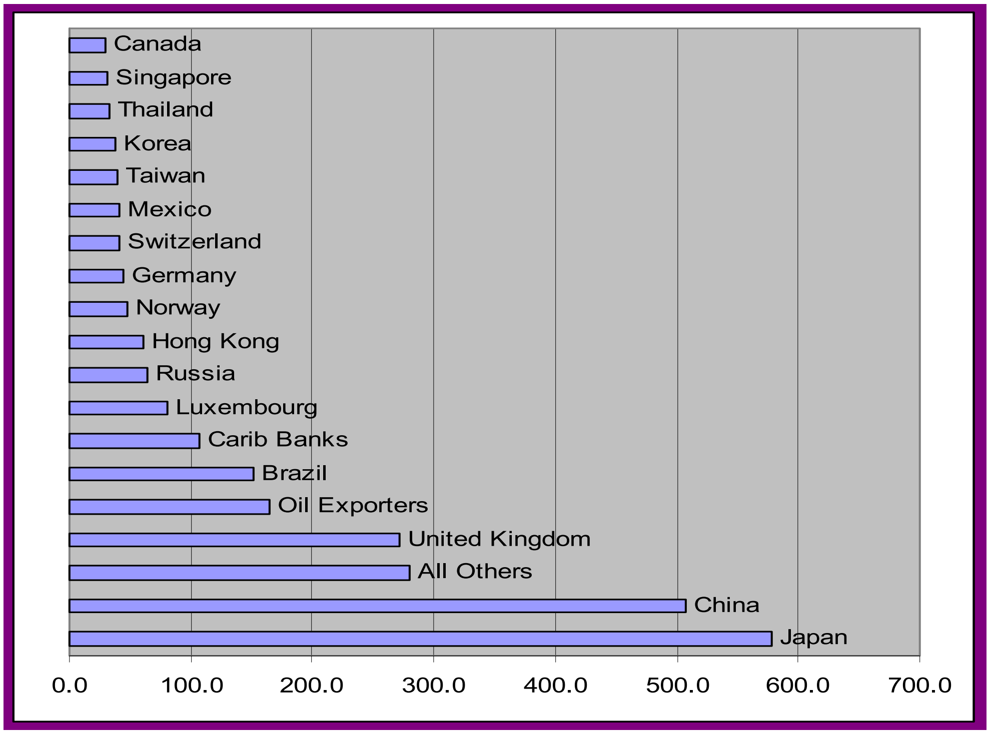
Note. Constructed by the author, using data from International Financial Statistics (IFS) of the International Monetary Fund (IMF), downloaded from http://www.imfstatistics.org.

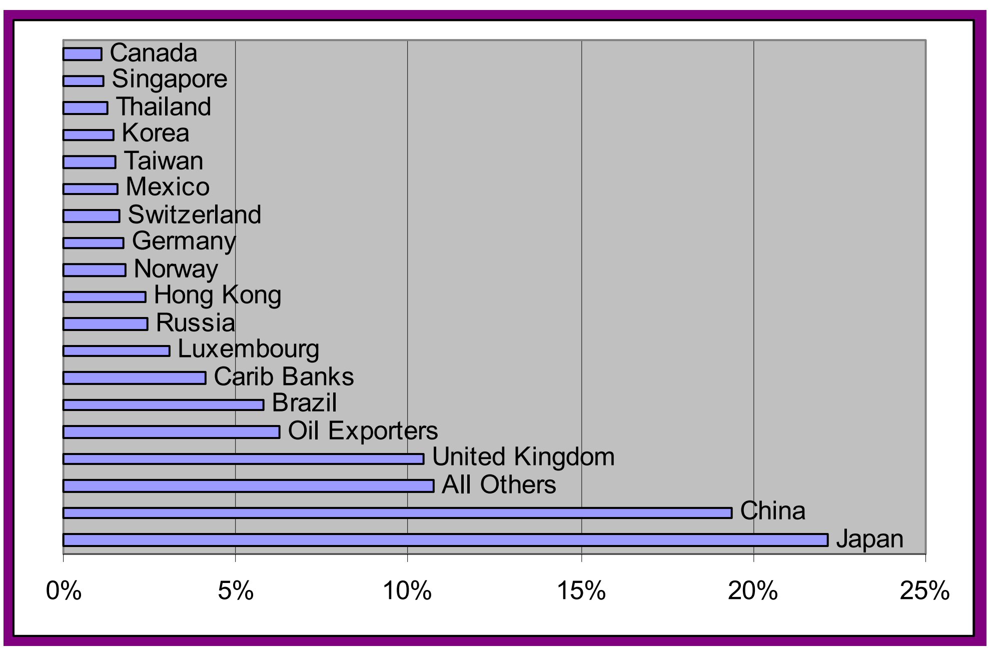
Figure 3.4. Total Reserves minus Gold for China and the United States (000,000)



Note. Constructed by the author, using data from International Financial Statistics (IFS) of the International Monetary Fund (IMF), downloaded from http://www.imfstatistics.org.

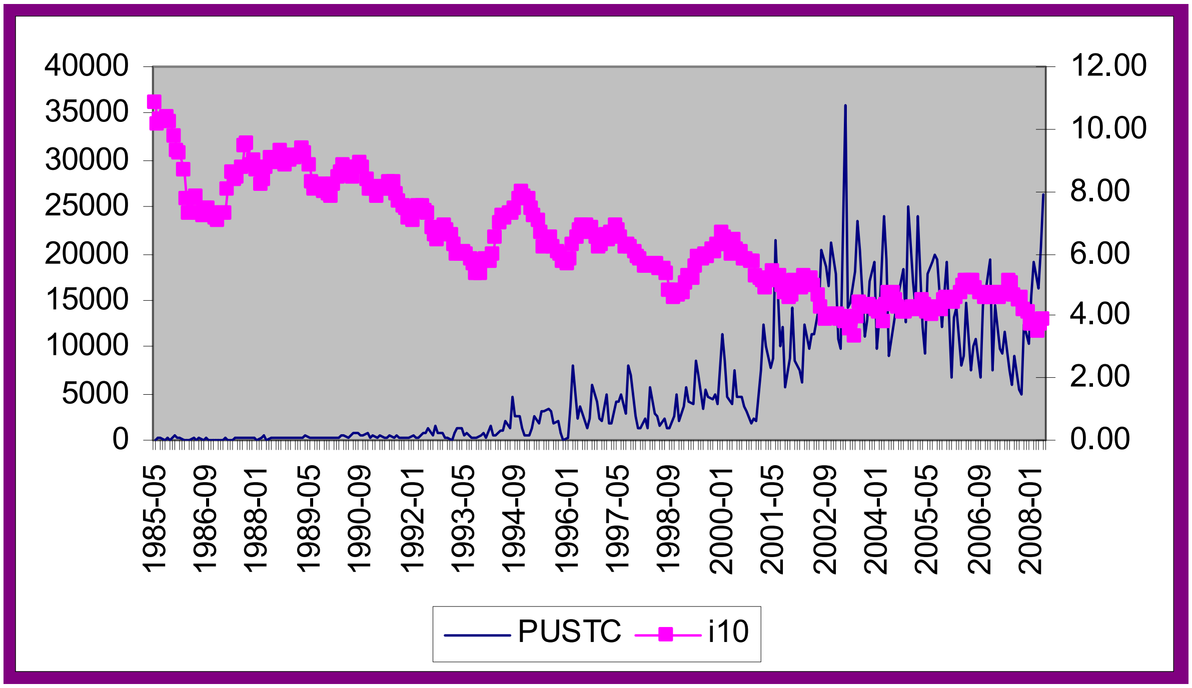
Figure 3.5. Major Foreign Holders of U.S Treasury Securities: in billions of U.S. dollars and as share of total as of May, 2008.





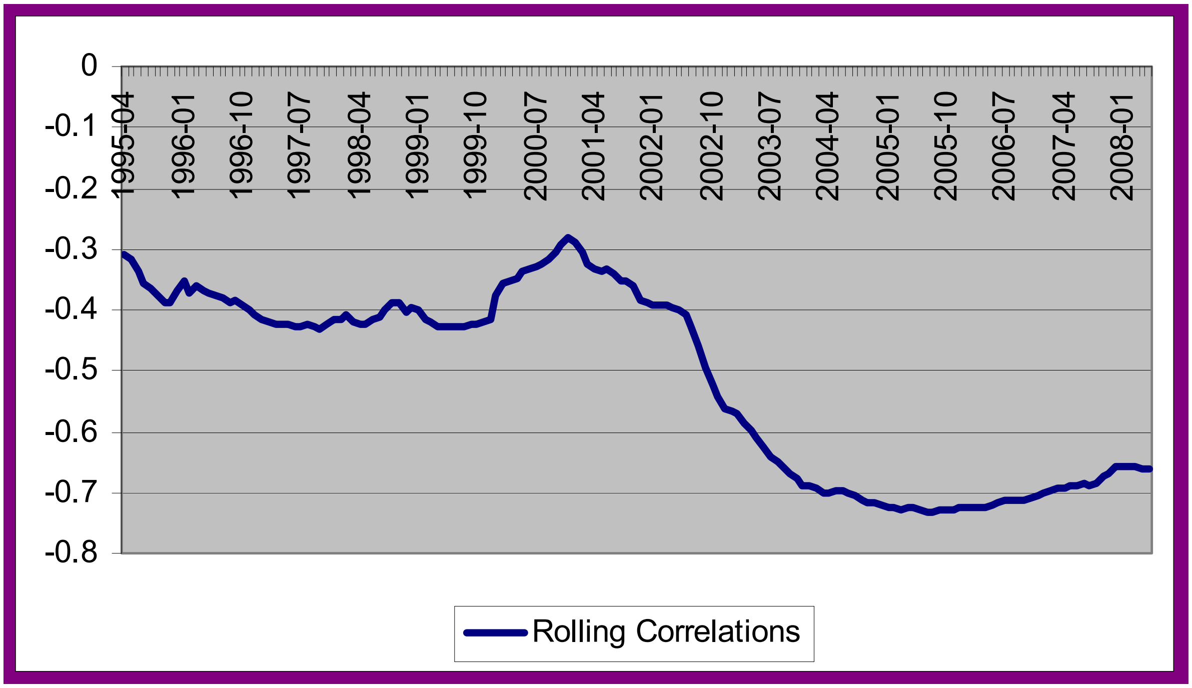
Note. Constructed by the author, using data from the Treasury International Capital (TIC) reports, downloaded from http://www.treas.gov/tic/.

Figure 3.6. Long-Term Trends between Purchases by Chinese Investors of U.S. Treasuries (PUSTC) and i10 (left scale in USD millions, right scale in %).



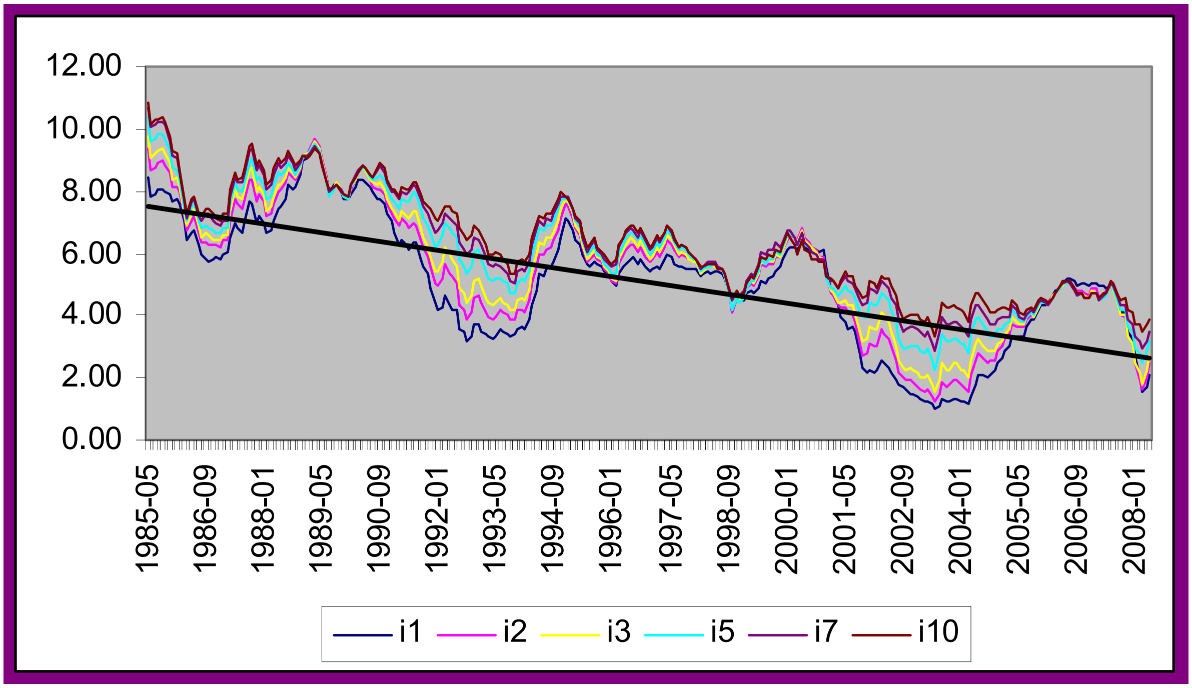
Note. Constructed by the author, using data from the Treasury International Capital (TIC) reports, downloaded from http://www.treas.gov/tic/ and data from the Federal Reserve Bank of St. Louis, downloaded from http://www.frbstlouis.com.

Figure 3.7. Purchases of U.S. Treasuries and i10 Correlations using a moving-window of 120-month periods.



Note. Constructed by the author, using data from the Treasury International Capital (TIC) reports, downloaded from http://www.treas.gov/tic/ and data from the Federal Reserve Bank of St. Louis, downloaded from http://www.frbstlouis.com.

Figure 3.8. Long-term trend of U.S. Treasury Yields in percent.



Note. Constructed by the author, using data from the Federal Reserve Bank of St. Louis, downloaded from http://www.frbstlouis.com.

Figure 3.9. Optimal consumption and investment choices

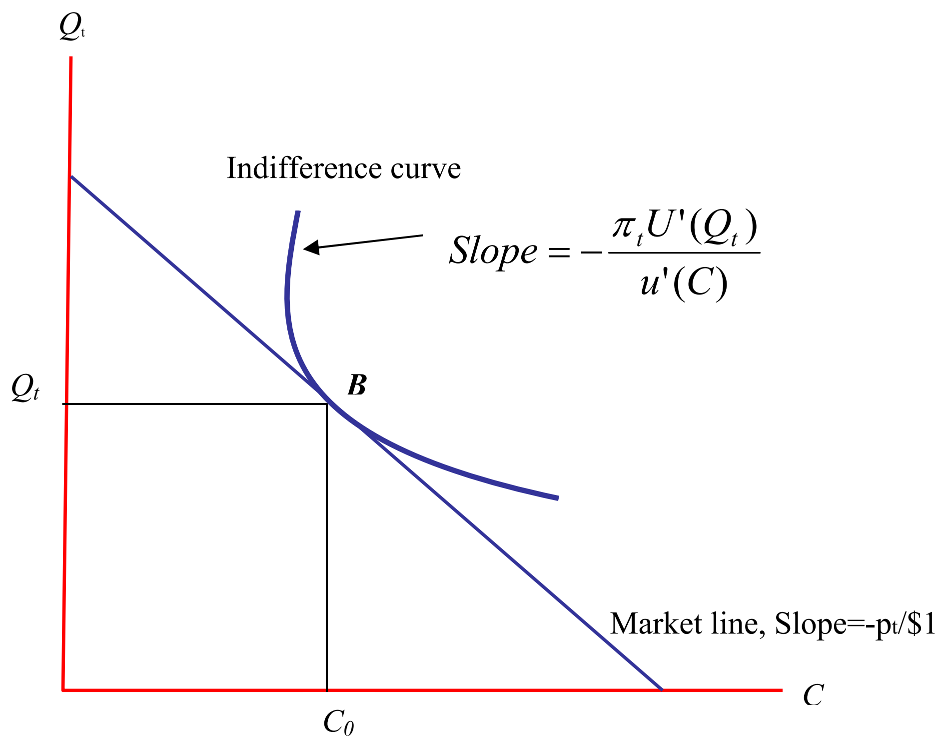
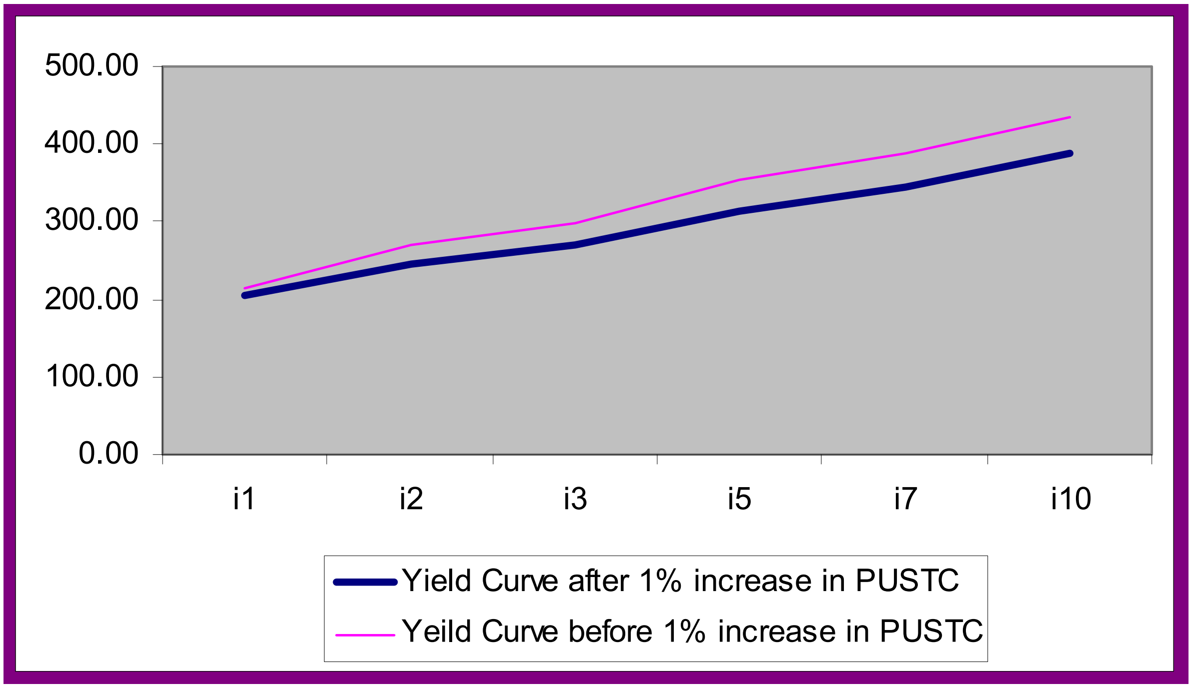
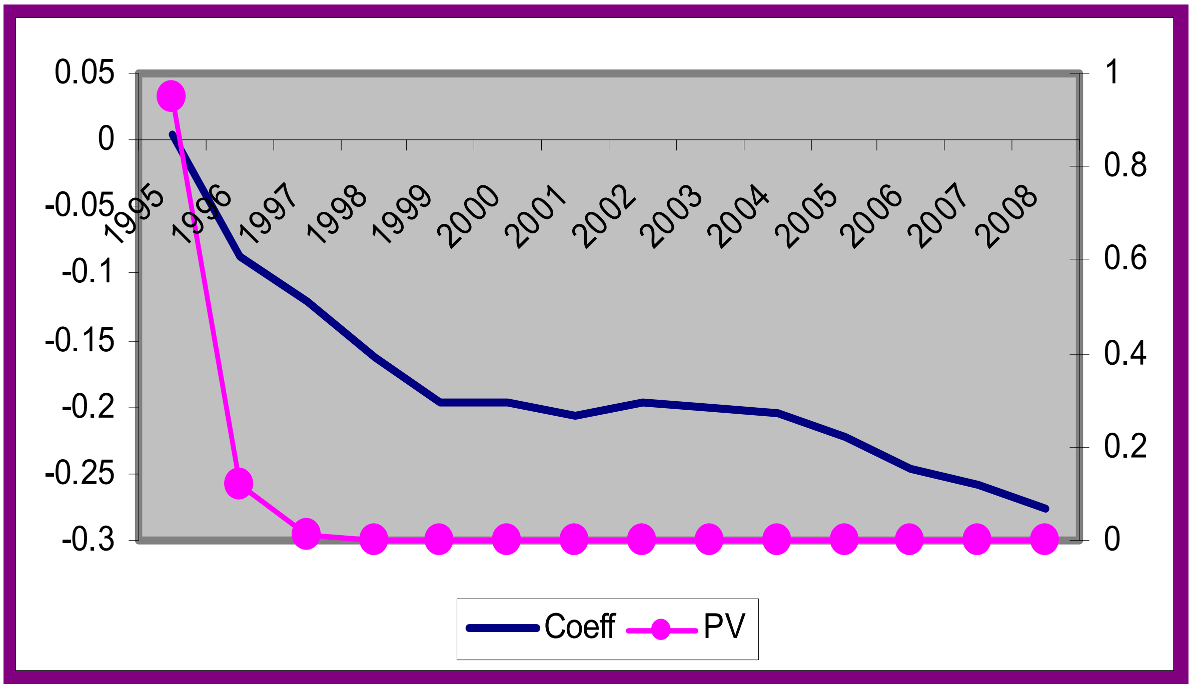


Figure 3.10. Average Effect of 1% Increase in Purchases by Chinese Investors of U.S. Treasuries on the U.S. Treasury Yield Curve (left scale in Basis Points).



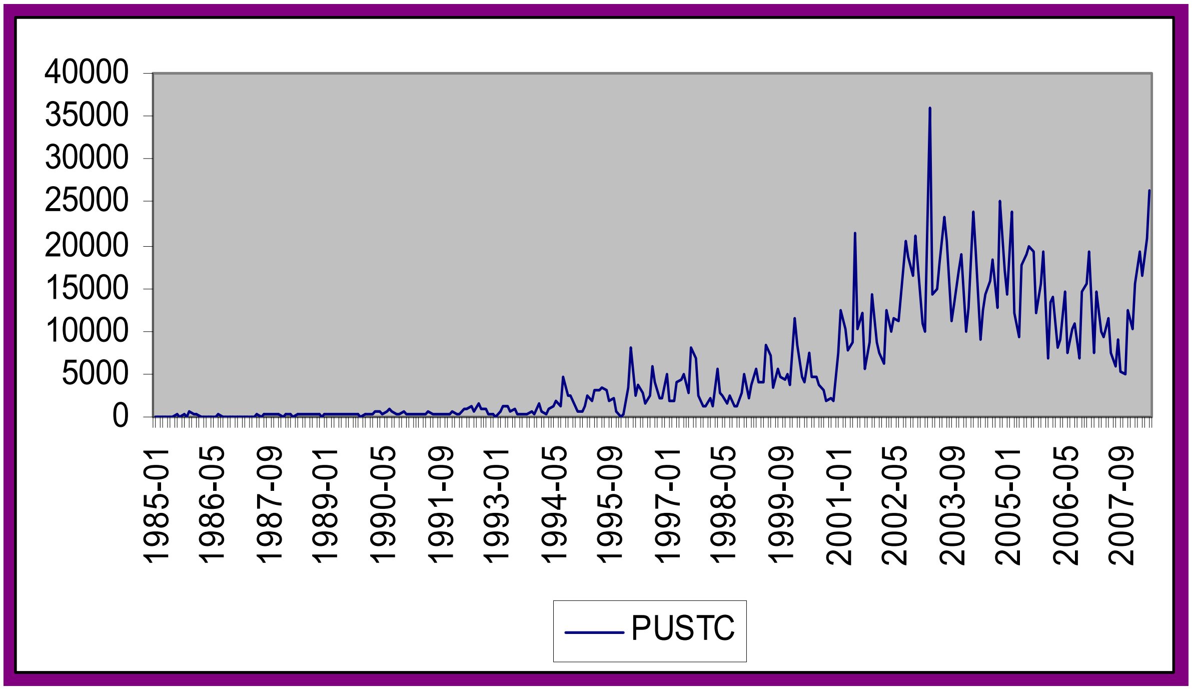
Note. See footnote 9.

Figure 3.11. Recursive estimate of the cointegrating parameter on PUSTC (left scale) and P-values (right scale)



Note. Constructed by the author, using data as described in Section 3.

Figure 3.12. Purchases of U.S. Treasuries by China (in USD millions)



Note. Constructed by the author, using data from the Treasury International Capital (TIC) reports, downloaded from http://www.treas.gov/tic/.

Table 3.1. Descriptive Statistics.

	i1	i2	I3	I5	I7	I10	FF	EI	MRP	PUSTC
Mean	5.07	5.43	5.63	5.94	6.18	6.33	5.01	3.06	1.28	5563.9
Median	5.31	5.56	5.74	5.93	6.12	6.10	5.25	3.00	1.08	2355.0
Maximum	9.57	9.68	9.75	10.34	10.72	10.85	9.85	5.20	3.29	35824.0
Minimum	1.01	1.23	1.51	2.27	2.84	3.33	0.98	0.40	0.00	25.0
Std. Dev.	2.01	2.01	1.95	1.83	1.78	1.72	2.16	0.56	1.00	6737.9
Skewness	-0.15	-0.09	-0.01	0.15	0.26	0.37	-.08	0.50	0.35	1.36
Kurtosis	2.39	2.33	2.28	2.20	2.21	2.18	2.43	7.01	1.85	4.35
Jarque-Bera	5.37	5.59	5.96	8.36	10.33	14.13	4.04	197.2	20.76	107.01
(P-value)	(0.07)	(0.06)	(0.05)	(0.02)	(0.01)	(0.00)	(0.13)	(0.00)	(0.00)	(0.00)

Notes: The total number of observations is 277 from May 1985 to May 2008. The symbols i1 to i10 denote U.S 1-year, 2-year, 3-year, 5-year, 7-year, and 10-year Treasury Constant Maturity Rate, respectively. FF, EI, MRP, and PUSTC denote the U.S. effective Federal Funds, Expected Inflation, Maturity Risk Premium, and purchase of U.S. Treasury bonds by China, respectively. P-values for the Jarque-Bera tests are reported below the statistics.

Table 3.2. Unit Root Tests.

Series	Trend?	ADF (k)	DF-GLS (k)	KPSS (4)	Determination
		H_0: Series has a unit root	H_0: Series has a unit root	H_0: Series is stationary	
FF	Yes	-2.69(3)	-2.68(3)	0.22(4)***	*I*(1)
MRP	Yes	-2.59(3)	-2.34(3)	0.18(4)**	*I*(1)
EI	Yes	-2.07(5)	-1.96(6)	0.45(4)***	*I*(1)
PUSTC	Yes	-3.01(3)	-2.56(3)	0.54(4)***	*I*(1)
i1	Yes	-2.73(3)	-2.62(3)	0.18(4)**	*I*(1)
i2	Yes	-2.72(1)	-2.52(1)	0.16(4)**	*I*(1)
i3	Yes	-3.09(1)	-2.73(1)*	0.15(4)**	*I*(1)
i5	Yes	-3.63(1)*	-2.81(1)*	0.13(4)**	*I*(1)
i7	Yes	-3.92(1)**	-2.69(1)*	0.12(4)*	*I*(1)
i10	Yes	-4.09(1)**	-2.17(2)	0.15(4)**	*I*(1)
Δ*(FF)*	No	-5.37(2)***	-1.82(4)*	0.08(4)	*I*(0)
Δ*(MRP)*	No	-6.49(2)***	-6.32(2)***	0.10(4)	*I*(0)
Δ*(EI)*	No	-14.01(1)***	-1.91(10)**	0.11(4)	*I*(0)
Δ*(PUSTC)*	No	-16.38(2)***	-16.36(2)***	0.07(4)	*I*(0)
Δ*(i1)*	No	-6.48(2)***	-1.96(2)**	0.06(4)	*I*(0)
Δ*(i2)*	No	-11.11(1)***	-1.13(6)	0.06(4)	*I*(0)
Δ*(i3)*	No	-11.35(0)***	-1.00(7)	0.05(4)	*I*(0)
Δ*(i5)*	No	-11.27(1)***	-0.90(7)	0.05(4)	*I*(0)
Δ*(i7)*	No	-11.52(1)***	-0.95(7)	0.06(4)	*I*(0)
Δ*(i10)*	No	-11.70(1)***	-0.80(7)	0.07(4)	*I*(0)

Notes: Data are of monthly frequency from 1985:5 to 2008:5. The symbol Δ refers to the first-difference of the original series. We include the deterministic trend only when testing in levels as suggested from graph inspection. ADF(k) refers to the Augmented Dickey-Fuller t-tests for unit roots, in which the null is that the series contains a unit root. The lag length (k) for ADF tests is chosen by the Campbell-Perron data dependent procedure, whose method is usually superior to k chosen by the information criterion, according to Ng and Perron (1995). The method starts with an upper bound, k_{max}=13, on k. If the last included lag is significant, choose k = k_{max}. If not, reduce k by one until the last lag becomes significant (we use the 5% value of the asymptotic normal distribution to assess significance of the last lag). If no lags are significant, then set k = 0. Next to the reported calculated t-value, in parenthesis is the selected lag length. DF-GLS (k) refers to the modified ADF test proposed by Elliott et al. (1996), with the Schwarz Bayesian Information Criterion (BIC) used for lag-length selection. The KPSS test follows Kwiatkowski et al. (1992), in which the null is that the series is stationary and k=4 is the used lag truncation parameter. The symbols * [**] (***) indicate rejection of the null at the 10%, 5%, and 1% levels, respectively.

Table 3.3. Cointegrating coefficient estimates, $i_t = \beta_0 + \beta_1 FF_t + \beta_2 EI_t + \beta_3 MRP_t + \varepsilon_t$. (4)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	OLS estimates			DOLS estimates[a]			JOH-ML estimates		
	β_1	β_2	β_3	β_1	β_2	β_3	β_1	β_2	β_3
i_1	0.88***	-0.04	1.19***	0.88***	-0.05	0.99***	0.93***	-0.17	0.04
	(0.017)	(0.077)	(0.141)	(0.017)	(0.074)	(0.122)	(0.037)	(0.164)	(0.263)
i_2	0.83***	-0.11	1.85***	0.84***	-0.12	1.77***	0.50***	-0.58	7.53***
	(0.021)	(0.095)	(0.152)	(0.023)	(0.122)	(0.153)	(0.197)	(0.888)	(1.390)
i_3	0.78***	-0.130	2.10***	0.77***	-0.136	2.13***	0.52***	-0.66	6.40***
	(0.025)	(0.114)	(0.169)	(0.029)	(0.155)	(0.184)	(0.146)	(0.659)	(1.031)
i_5	0.672***	-0.12	2.31***	0.67***	-0.10	2.52***	0.47***	-0.86	6.90***
	(0.033)	(0.142)	(0.203)	(0.039)	(0.193)	(0.234)	(0.143)	(0.623)	(0.998)
i_7	0.62***	-0.14	2.39***	0.61***	-0.11	2.70***	0.39***	-0.92	7.75***
	(0.04)	(0.161)	(0.228)	(0.045)	(0.215)	(0.258)	(0.158)	(0.694)	(1.107)
i_{10}	0.56***	-0.07	2.45***	0.54***	-0.01	2.94***	0.32**	-0.69	8.11***
	(0.044)	(0.172)	(0.242)	(0.050)	(0.226)	(0.301)	(0.162)	(0.713)	(1.137)

Notes: The dependent variables are the U.S Treasury yields. Newey-West heteroskedasticity and autocorrelation consistent (HAC) standard errors are reported in parenthesis for both OLS and DOLS. The symbols * [**] (***) attached to the figure indicate rejection of the null of β=0 at the 10%, 5%, and 1% levels, respectively. [a]One lead and lag of the first-differenced FF, EI, and MRP are included in the DOLS regressions.

Table 3.4. Coefficient estimates of the composite model, $i_T = \beta_0 + \beta_1 FF_t + \beta_2 EI_t + \beta_3 MRP_t + \beta_4 \log(PUSTC_t) + \varepsilon_t$ (5).

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
	OLS estimates				DOLS estimates[a]				JOH-ML estimates				
	B_1	β_2	β_3	β_4	β_1	β_2	β_3	β_4	β_1	β_2	β_3	β_4	α
i_1	0.88***	-0.04	1.20***	-0.01	0.88***	-0.05	0.96***	-0.01	0.85***	-0.07	0.53*	-0.15***	-0.01
	(0.02)	(0.07)	(0.14)	(0.02)	(0.02)	(0.07)	(0.14)	(0.03)	(0.05)	(0.18)	(0.33)	(0.06)	(0.030)
i_2	0.67***	-0.08	1.70***	-0.09***	0.78***	-0.10	1.51***	-0.12***	0.66***	-0.14	0.51	-0.38***	-0.07***
	(0.02)	(0.09)	(0.15)	(0.03)	(0.02)	(0.10)	(0.17)	(0.04)	(0.07)	(0.24)	(0.44)	(0.08)	(0.031)
i_3	0.69***	-0.08	1.85***	-0.16***	0.68***	-0.10	1.71***	-0.18***	0.53***	-0.13	0.24	-0.44***	-0.12***
	(0.03)	(0.114)	(0.16)	(0.03)	(0.03)	(0.13)	(0.19)	(0.04)	(0.06)	(0.22)	(0.41)	(0.8)	(0.034)
i_5	0.52***	-0.04	1.88***	-0.28***	0.51***	-0.04	1.86***	-0.29***	0.34***	0.56*	2.66***	-0.47***	-0.07***
	(0.03)	(0.12)	(0.18)	(0.05)	(0.04)	(0.15)	(0.22)	(0.06)	(0.08)	(0.29)	(0.54)	(0.10)	(0.025)
i_7	0.45***	-0.04	1.87***	-0.34***	0.43***	-0.03	1.92***	-0.35***	0.24***	0.58*	3.45***	-0.51***	-0.05***
	(0.03)	(0.13)	(0.19)	(0.05)	(0.04)	(0.16)	(0.22)	(0.06)	(0.09)	(0.34)	(0.62)	(0.12)	(0.020)
i_{10}	0.35***	-0.05	1.83***	-0.39***	0.33***	0.09	2.03***	-0.40***	0.14*	0.37	3.64***	-0.55***	-0.07***
	(0.04)	(0.13)	(0.19)	(0.06)	(0.04)	(0.17)	(0.23)	(0.06)	(0.09)	(0.33)	(0.62)	(0.12)	(0.031)

Notes: The dependent variables are the U.S Treasury yields. Newey-West heteroskedasticity and autocorrelation consistent (HAC) standard errors are reported in parenthesis for both OLS and DOLS. α represents the speed of adjustments. The symbols * [**] (***) attached to the figure indicate rejection of the null of β=0 at the 10%, 5%, and 1% levels, respectively.

[a]One lead and lag of the first-differenced FF, EI, MRP and log(PUTC) are included in the DOLS regressions.

Table 3.5. Root Mean Square Errors (RMSEs) for the Basic and Composite Models for In-sample Forecasts and for One-Step Ahead, Recursive Out-of-sample Forecast Comparisons.

In-sample forecasts:

(1) Dependent Variable	(2) $RMSE_B$	(3) $RMSE_C$	(4) U^a	(5) MSE-t^b
i_1	0.262	0.263	0.99	-0.005
i_2	0.353	0.332	1.06	0.749
i_3	0.429	0.377	1.14	1.786**
i_5	0.583	0.467	1.25	3.632***
i_7	0.669	0.520	1.29	4.336***
i_{10}	0.742	0.553	1.34	5.090***

Out-of-sample forecasts:

(1) Dependent Variable	(2) $RMSE_B$	(3) $RMSE_C$	(4) U^a	(5) MSE-t^b	(6) DM^c
i_1	0.7313	0.7390	0.99	0.057	-3.08**
i_2	0.9756	0.9187	1.06	0.399	4.09***
i_3	1.0754	0.9701	1.11	0.690	4.02***
i_5	1.0820	0.8896	1.22	1.501*	3.97***
i_7	1.1019	0.8597	1.28	2.021**	3.96***
i_{10}	1.0220	0.7318	1.40	2.618***	3.94***

Notes: [a]U is the ratio $RMSE_B/RMSE_C$, where $RMSE_B$ is the root mean square error for the basic model and $RMSE_C$ is the root mean square error for the composite model.

[b]One-sided (upper–tail) test of H_0: $MSE_B=MSE_C$ versus H_1: $MSE_B>MSE_C$; 10, 5, and 1 percent critical values equal 1.28, 1.64, 2.33, respectively. Negative statistics imply that the basic model forecast beats the composite model forecast. Positive statistics imply that the composite model forecast beats the basic model forecast.

[c]The Diebold-Mariano (1995) statistic (DM) is obtained by regressing the loss differential series on an intercept and a MA (1) term to correct for serial correlation. Negative statistics imply that the basic model forecast beats the composite model forecast. Positive statistics imply that the composite model forecast beats the basic model forecast.

*, **, *** indicate significant at the 10, 5, and 1 percent levels, respectively.

CHAPTER IV

THE IMPACT OF FOREIGN PURCHASES OF U.S. CORPORATIONS' STOCK ON THE U.S. STOCK MARKET

INTRODUCTION

In a seminal paper, Chen et al. (1986) tested whether innovations in macroeconomic variables are risks that are rewarded in the stock market. They found that the spread between long and short interest rates, inflation, industrial production, and the spread between high and low grade bonds are significantly priced. They also found that market portfolio, oil prices, and aggregate consumption risks are not separately rewarded in the stock market. Identification of the determinants of the variability of stock returns has been the object of many other studies. For example, Grossman and Shiller (1981) consider whether the variability of stock prices can be attributed to information regarding discount factors (i.e., real interest rates), which are in turn associated with current and future levels of economic activity. They link consumption to real interest and conclude that stock prices respond to variation in consumption in a significant way. Shiller (1981) shows evidence that the variability of stock price indices cannot be accounted for by information regarding future dividends, since dividends do not seem to vary enough to justify the price movements. Shapiro (1988) found that about forty to seventy percent of the variability of the dividend-price ratio can be explained by the rational expectation of future dividends and interests in the context of the conventional valuation model.

Kaul and Seyhun (1990) investigated the effects of relative price variability on output and the stock market and gauged the extent to which inflation proxies for relative price variability in stock return-inflation regressions. They show that the negative stock return-inflation relations proxy for the adverse effects of relative price variability on economic activity, particularly during the seventies, when the U.S. experienced oil supply shocks. Lee (1992), using a multivariate vector-autoregression approach, investigates causal relations and dynamic interactions among asset returns, real activity, and inflation in the postwar U.S. He finds a significant relationship between stock returns and real activity. On the other hand, Fama and French (1993) argue that stock returns are significantly explained not only by macroeconomic factors such as the market risk premium (the spread between the market return and a risk-free rate) but also by microeconomic factors, such as the size of the corporation and the book-to-market ratio.

Marshall (1992) found that nominal stock prices are negatively related to the contemporaneous velocity of money. Kwon and Shin (1999) investigated whether current economic activities in Korea could explain stock market returns and found that the Korean stock market reflects macroeconomic variables on stock price indices. They found a long-run equilibrium relation between the production index, exchange rate, trade balance, and money supply on one hand and the stock price indices on the other. Balduzzi (1995) looked at quarterly data on industrial-production growth, monetary-based growth, CPI inflation, three-month Treasury-bill rates, and returns on the equally-weighted NYSE portfolio, using time-series techniques, and found a weak negative correlation between inflation and stock returns and explains less of the covariance between the two series than inflation and interest-rate innovations. Kaneko and Lee (1995) investigated economic state variables as systematic influences on U.S. and Japanese stock market returns and compares their sway on stock returns. They find that economic news about risk premiums, term premiums, and the growth rate in industrial production is most significant in U.S. stock market returns. However, they also found that international factors, such as changes in oil prices, are most significant in Japanese stock market returns.

Poitras (2004) estimated the impact of public announcements of macroeconomic variables on industrial production, unemployment, money stock, price level, trade balance and the discount rate and found that announcements that are anticipated generally do not have significant explanatory power for changes in the S&P 500. This finding concurs with theories of market efficiency. On the other hand, unanticipated announcements explain a fraction of variation in stock prices that is statistically significant. Ewing (2002) examined the response of the NASDAQ Financial 100 index to macroeconomic news. The results identify the magnitude and persistence of the response of stock returns arising from shocks to the stance of monetary policy, real output, inflation, and risk. He found that monetary policy shock reduces financial sector returns, while unexpected changes in economic growth have a positive impact effect but exhibit no persistence. In addition, the stocks respond immediately to an unanticipated rise in risk but the effect does not persist into the future. Flannery and Protopapadakis (2002) found that three nominal macroeconomic variables (CPI, PPI, and a Monetary Aggregate) and three real macroeconomic variables (Balance of Trade, Employment, and Housing

Starts) are significantly associated with stock market returns. Thorbecke (1997) examined how stock return data respond to monetary policy shocks. Monetary policy is measured by innovations in the federal funds rate and non-borrowed reserves. In every case, the evidence indicated that expansionary policy increases ex-post stock returns. Results from estimating a multi-factor model also indicate that exposure to monetary policy increases an asset's ex-ante return.

Poon and Taylor (1991) re-considered the results in Chen et al. (1986) to see if they are applicable to UK stocks. They carry out a similar set of tests using UK data, to discover if the findings reported by Chen et al (1986) can be extended to the UK market. Their results show that macroeconomic variables similar to those of Chen et al (1986) do not affect share prices in the UK. They concluded that other macroeconomic factors are at work, or the methodology in Chen et al (1986) is inadequate for detecting such pricing relationships, or possible both explanations apply. On the other hand, Gjerde and Saettem (1999) investigated to what extend important results on relations among stock returns and macroeconomic factors from major markets are valid in a small, open economy and find that real interest rate changes affect both stock returns and inflation, and that the stock market responds to oil price changes. Furthermore, they found that the stock market shows a delayed response to changes in domestic real activity.

Hondroyiannis and Papapetrou (2001) studied the dynamic interaction among indicators of economic activity, such as industrial production, interest rate, exchange rate, the performance of the foreign stock market, oil prices, and stock returns. Their aim was to examine whether economic activity movements affect the performance of the stock market in Greece. The empirical evidence suggest that stock returns do not lead changes in real economic activity while the macroeconomic activity and foreign stock market changes partially explain stock market movements. Oil price changes explain stock price movements and have a negative impact on macroeconomic activity.

On the other hand, Wei (2003) evaluated the effect of energy cost increases on the market value of the firms through capital obsolescence. He found that the energy price effect on the market value of capital is very small. Holding the real wage fixed an eighty percent permanent increase in the real energy price can explain a ten percent decline in the market value of assets. The paper studied the impact of the energy price shock in isolation. However, the author admits that it is possible that the energy price shock, combined with other shocks, might have had a different effect on the securities market. For example, the market decline in 1974 can be associated with a tightening of the monetary policy, the arrival of information technology, and the rise in uncertainty.

Because from the late 1960s to the late 1970s the U.S. economy suffered from high and volatile inflation, significant work has been done about the specific relationship between stock returns and inflation. For example, Lintner (1975) found that an increase in anticipated future inflation involved a large reduction in the current period's real returns on equity ownership (and in the end-of-period market value of equity). Nelson (1976) investigated empirically the relation between returns on common stocks and the rate of inflation over the post-war period and found a negative relation between returns and both anticipated rates of inflation and unanticipated changes in the rate of inflation. Fama and Schwert (1977) found that common stock returns are negatively related to the expected component of the inflation rate, and probably also to the unexpected component. Ram and Spencer (1983) found evidence of unidirectional causality from inflation to stock returns. Regarding the correlation structure between stock returns, on the one hand, and inflation and money growth, on the other, Bakshi and Chen (1996) found that stock returns are negatively correlated with inflation and positively correlated with money growth. Fama (1981) found that the negative relations between stock returns and inflation are proxying for positive relations between stock returns and real variables, which are more fundamental determinants of equity values. The negative stock return-inflation relations are induced by negative relations between inflation and real activity, which in turn are explained by a combination of money demand theory and the quantity theory of money. As predicted by the proxy effect hypothesis, the more anomalous of the stock return-inflation relations disappear when both real variables and measures of expected and unexpected inflations are used to explain stock returns. Geske and Roll (1983) found that stock returns are negatively related to contemporaneous changes in expected inflation because they signal a chain of events which results in a higher rate of monetary expansion. Exogenous shocks in real output, signaled by the stock market, induce changes in tax revenue, in the deficit, in Treasury borrowing and in Federal Reserve "monetization" of the increased debt. They argue that rational investors realize this will happen, which causes an adjustment in prices with no delay.

James et al. (1985) investigated simultaneously the relations among stock returns, real activity, inflation, and money supply changes, using a vector autoregressive moving average model, and find strong support for the notion that stock returns are negatively related to contemporaneous changes in expected inflation. Hess and Lee (1999) account for the relationship between stock returns and inflation with two independent disturbances: supply shocks and demand shocks. Supply shocks reflect real output shocks and cause a negative relation between stock returns and inflation, while demand shocks are mainly due to monetary shocks and generate a positive relation between stock returns and inflation.

Since oil is such a pervasive commodity and a significant driver of most economies, the relationship between the stock market performance and oil price shocks has also been the object of many studies. For example, Hamilton (1983) showed that all but one of the U.S. recessions since World War II have been preceded, typically, with a lag of around three-fourths of a year, by a dramatic increase in the price of crude petroleum. Recessions are associated with decreased equity prices. Burbidge and Harrison (1984) examined the influence on five OECD economies of the large oil-price rises in the 1972. The impulse response to an oil-price shock reveals that industrial production is significantly influenced by the price of oil in both the U.S. and also U.K., with resulting declines in equity prices.

Jones and Kaul (1996) tested whether the reaction of international stock markets to oil shocks can be justified by current and future changes in real cash flows and/or changes in expected returns. They find that in the postwar period, the reaction of United States and Canadian stock prices to oil shocks can be completely accounted for by the impact of these shocks on real cash flows alone. In contrast, in both the United Kingdom and Japan, innovations in oil prices appear to cause larger changes in stock prices than can be justified by subsequent changes in real cash flows or by changing expected returns. Sadorsky (1999) showed that oil prices and oil price volatility both play important roles in affecting real stock returns. The author showed evidence that oil price dynamics have changed. For example, after 1986, oil price movements explain a larger fraction of the forecast error variance in real stock returns than do interest rates. He also presents evidence that oil price volatility shocks have asymmetric effects on the economy.

More recently, Park and Ratti (2008) showed that oil price shocks have a statistically significant impact on real stock returns contemporaneously and/or within the following month in the U.S. and thirteen European countries over 1986:1-2005:12. The median result from variance decomposition analysis is that oil price shocks account for a statistically significant 6% of the volatility in real stock returns. For many European countries, but not for the U.S., increased volatility of oil prices significantly depresses real stock returns. The contribution of oil price shocks to variability in real stock returns in the U.S. and most other countries is greater than that of interest rate. On the other hand, Driesprong et al. (2008) showed that changes in oil prices predict stock market returns worldwide. They find significant predictability in both developed and emerging markets. These results cannot be explained by time-varying risk premia as oil price changes also significantly produce negative excess returns. A rise in oil prices drastically lowers future stock returns. Finally, Mohan and Faff (2008) examined whether and to what extent the adverse effect of oil price shocks impacts stock market returns and found that oil prices rises have a negative impact on equity returns for all sectors except mining, oil, and gas industries.

One important and yet so far neglected factor in the literature is the foreign appetite for U.S. stocks and the impact that such demand may have on the stock market. There are a number of studies showing that local stock prices of several countries, especially emerging markets, are sensitive to foreign inflows in a positive and large manner. See, among others, Clark and Berko (1996), Brennan and Cao (1997), Bekaert and Harvey (1998), Choe et al. (1999), Froot et al. (2001), and Bekaert et al. (2002). However, the issue of how foreign purchases of U.S. equity affect the stock market is only lightly considered in these studies. On the one hand, using data from 1994 to 1998, Froot el al. (2001) found a positive correlation between inflows and stock returns in developing markets, while in developed markets inflows do not forecast positive returns. Brennan and Cao (1997) examined net purchases by U.S. residents of equities in sixteen emerging markets over the period 1989.1 to 1994.4. They also look at the equity flows between the U.S. and four developed countries (Canada, Germany, Japan, and the United Kingdom). They found empirically that portfolio flows from the U.S. to these countries are associated with returns on national market indices. They also found that while U.S. purchases of equities in the four developed foreign markets tend to be positively associated with their market returns, purchases of U.S. equities from these four countries have no significant impact on U.S. market returns.

Another strand of literature examines local and foreign purchases of equity on the basis of discerning the behavior of portfolio investors. Kim and Wei (2002) studied the Korean case and find that foreign investors outside Korea are more likely to engage in positive feedback trading strategies and are more likely to engage in herding than the branches of foreign institutions or foreign individuals living in Korea. They suggest that the difference in trading behavior is related to the difference in their information set. Brennan and Cao (1997) showed that when domestic investors possess a cumulative information advantage over foreign investors about their domestic market, investors tend to purchase foreign assets in periods when the return on foreign assets is high and to sell when the return is low.

This study attempts to assess whether foreign purchases of U.S. corporations' stocks (*FPUSC*) affect U.S. stock market performance (*S*), while controlling for key macroeconomic variables that are associated with the traditional finance theoretical model of stock valuation. While information on U.S. stock flows is certainly available to home and foreign investors, there is the natural "safe-heaven" argument for investing in the U.S. market. Foreign investors may perceive the U.S. to be a good place to invest even when the U.S economy suffers due to the implementation of erroneous policies or due to random economic shocks. The notion of investing in U.S. stocks follows directly from diversification strategies by foreign investors.

Figure 4.1 shows that from 1978 to about 1992 the gross amount of foreign purchases of U.S corporations stocks remained relatively low. However, a significant shift in the amount of *FPUSC* can be observed from the mid-1990s onwards. In fact, the series of foreign purchases increased substantially after the mid-1990s. That may, in part, explain why over time foreign purchases of U.S. corporations' stocks has grown faster than the S&P 500 as illustrated in Figure 4.1. *FPUSC* in July of 2008 was about 1,244 times the level of *FPUSC* in January of 1978; however, the S&P 500 ratio for the same time frame was only fourteen times higher. Such an avalanche of money to the U.S stock market provides the motivation to assess whether or not foreign purchases of U.S equities have now a detectable, significant impact on the U.S. market returns.

[Insert Figure 4.1 here]

International capital market development in the past decades has been marked by a series of policy changes under which many cross-border investment restrictions have been reduced or eliminated, and the market structures of many international exchanges were reformed, allowing foreign investors to acquire the liquidity necessary to invest in the U.S. market. See Chou et al. (1994). As Figure 4.2 shows, foreign investors have been pouring money not only into the stocks of U.S. corporations, but also into government securities and corporate bonds. We label this phenomenon *reverting spillover effect of financial flows*: the remarkable quantity of U.S. dollars that the United States pours into the world to buy everything from oil, to machinery, automobiles, electronics, appliances, toys, apparels, and produce, among other; and which has caused a sustained and growing current account deficit as shown in Figure 4.3, has facilitated this significant level of foreign investment in the U.S. In fact, one can visually see the link between capital account components in Figure 4.2 with the current account in Figure 4.3: as the U.S. current account deficit widened in the mid-1990s, the foreign purchases of U.S. assets shot up dramatically.

[Insert Figures 4.2 and 4.3 here]

This study employs monthly data from 1978:1 to 2008:7 under various methodologies to test whether the impact of this inflow of foreign funds into the U.S. stock market has become large enough to have predictive power on the U.S. stock market performance. This study finds that there exists a long-run relationship between the U.S. stock market and purchases of U.S. corporations stocks by foreign investors. It also shows that their relationship varies with time. Controlling for asset prices (interest rates and the yield curve) and inflation, it observes that purchases of U.S. stocks by foreign investors have a positive and statistically significant impact on the U.S. stock-market performance. Overall, the demand-side variable captured by the foreign appetite for U.S. stocks attenuates the negative effects associated with the domestic forces.

The remainder of the essay is organized as follows: Section 2 describes the theoretical framework, Section 3 describes the data and presents descriptive statistics, Section 4 presents the empirical results, and Section 5 presents the conclusions.

THEORETICAL FRAMEWORK

Extant financial literature in, e.g., Copeland et al. (2005) shows that the intrinsic value of a particular stock can be written as expected discounted dividends:

$$P_0 = \sum_{t=1}^{\infty} \frac{Div_t}{(1+k_s)^t} \tag{4.1}$$

Where: P_0 is the theoretical value of stock *P*, Div_t is the dividend stream at time *t*, and k_s is the discount rate. The appropriate discount rate, such as the one suggested by the Capital Asset Pricing Model (CAPM), is the market-determined required rate of return on equity capital. See Sharpe (1963):

$$E(R_i) = R_f + [E(R_m) - R_f]\frac{\sigma_{im}}{\sigma_m^2} \tag{4.2}$$

where: σ_m^2 is the variance of the market portfolio; σ_{im} is the covariance between stocks *i* and the market portfolio, R_f is the risk-free rate of return, and R_m is the return on the market portfolio. According to (4.2), the expected return can be decomposed into a risk-free rate of return, R_f, and a risk premium: $\left[E(R_m) - R_f\right]\frac{\sigma_{im}}{\sigma_m^2}$. On the aggregate, the risk-free rate can be proxied by the U.S. 3-month Treasury Bill rate. Since the risk premium has an expectation component, it can be properly proxied by the spread between long and short interest rates (*SBLS*). The reason is that when the market is pessimistic about future stock-market performance, massive amount of funds are moved to short-term U.S. treasuries, which cause their prices to go up, and the yield to come down, *ceteris paribus*. This widens the spread between the long and the short yields. Combining (1), (2) and the above arguments, a basic theoretical model of the aggregate stock-market behavior function can be expressed as follows:

$$s_t = div_t - (r_{f_t} + sbls_t)\,. \tag{4.3}$$

Hess and Lee (1999) demonstrate that, on the aggregate, dividends can be proxied by total output (y). They also show that output is subject to both supply and demand disturbances and postulate that aggregate demand is a positive function of real stock of money and a negative function of interest rate as follows:

$$y_t^d = m_t - p_t - r_t \tag{4.4}$$

with all variables, except interest rates, expressed in logarithms. On the other hand, the aggregate supply is a function of productivity and employment in:

$$y_t^s = \theta_t + N_t \tag{4.5}$$

where: θ = log of productivity and N = log of employment. Since economic theory posits that the price level is affected positively by money supply and negatively by productivity and interest rate, the current price level is presented as follows:

$$p_t = m_t - \theta_t - r_t \tag{4.6}$$

For simplicity, it is assumed that the demand shock is mainly due to monetary shocks and the supply shock is due to productivity shocks. As a result, demand shocks (e.g., monetary shocks) results in a positive effect on stock returns and inflation, whereas supply shocks (e.g. productivity shocks) cause a negative relation between stock returns and inflation.

The current view regarding the relationship between dividends and stock prices is in line with the dividend clientele effect originally suggested by Miller and Modigliani (1961). Baker and Wurgler (2004) proposed that the decision to pay dividends is driven by prevailing investors demand for dividend payers. Managers cater to investors by paying dividends when investors put a stock price premium on payers, and by not paying when investors prefer non-payers. This theory can be linked to Hess and Lee (1999)'s rationalization of supply and demand shocks: during a times of inflation more people may want dividends to be able to maintain current consumption levels. In such cases, high dividend-yield stocks (income stocks) would be preferred by investors and a positive relationship may be observed between dividend and stock prices. On the other hand, in times of low inflation, people may prefer companies that pay no dividends, which should lead to future growth and potentially significant future capital gains to be used for future consumptions. In such a case of desired future capital gains, the so called “growth” stocks would be preferred by investors and a negative relationship will be found between dividends and stock prices.[12] Replacing *DIV* in (4.3) by inflation (*INF*) as in Fama (1981) results in the following basic model:

$$s_t = \inf_t + r_{f_t} + sbls_t \tag{4.7}$$

and its respective empirical version becomes:

$$\log(S_t) = \beta_0 + \beta_1 INF_t + \beta_2 R_{f_t} + \beta_3 SBLS_t + \varepsilon_t \tag{4.8}$$

The empirical findings on the link between stock returns and inflation is mixed. For example, Lintner (1975), Bodie (1976), Jaffe and Mandelker (1976), Nelson (1976), and Fama and Schwert (1977) find a negative relationship between these two series. Kaul (1987, 1990), Kaul and Seyhun (1990), and Boudoukh et al. (1994) argued that the relationship between stock returns and inflation depends on the money-supply function, whereas Stulz (1986), Marshall (1992), Carmichael (1985), Lee (1989) and Bakshi and Chen (1996) suggested that the negative relationship between stock returns and inflation may be caused by nonmonetary factors. However, theoretical analysis based on

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[12] This can be connected to the traditional finance empirical dilemma concerning market reaction to the payment of dividends by corporations. For example, the effect of dividends on stock prices is considered by Bernheim (1991) and others a “puzzle.” Miller and Modigliani (1961) proved the irrelevance of dividend policy in a world where there were no taxes or transaction costs; however, once corporate and personal income taxes are introduced, the theory suggests that perhaps it would be optimal to pay no dividends at all, because the tax disadvantage of ordinary income over capital gains makes dividend payment economically undesirable. See Copeland et al. (2005).

equilibrium models by Hess and Lee (1999) showed that the relationship between stock returns and inflation could be either negative or positive.

Equation (4.8) is based on Hess and Lee (1999). The underlying theory is that the relationship between stock returns and inflation can be explained by a combination of two shocks: one due to supply disturbances and the other due to demand disturbances. Supply disturbances are primarily due to real output shocks and cause a negative stock return-inflation relationship, whereas demand disturbances are mainly due to monetary shocks and give rise to a positive stock-return-inflation relationship. If the relationship between inflation and stock returns is found to be negative, given the time horizon in the included sample, then it can be concluded that real output shocks dominated monetary shocks. On the other hand, if the relationship is found to be positive, then it can be assumed that monetary shocks dominated real output shocks.

Equation (4.8) is expanded by including the log of foreign purchases of U.S. corporations' stocks (*FPUSC*) as a predictor of the U.S. stock market performance and use a composite model as presented below:

$$\log(S_t) = \beta_0 + \beta_1 INF_t + \beta_2 R_{f_t} + \beta_3 SBLS_t + \beta_4 \log(FPUSC) + \varepsilon_t \qquad (4.9)$$

The rationale for the β_4-coefficient follows from several of the studies reviewed in the Introduction. Hondroyiannis and Papapetrou (2001) included the performance of foreign stock markets as a predictor of the stock-market performance for Greece, Froot et al. (2001) have shown that local stock prices of several countries are sensitive to foreign inflows in a positive and significant manner, and Kim and Wei (2002) found that foreign investors outside Korea are more likely to engage in positive feedback trading strategies and are more likely to engage in herding than the branches of foreign institutions or foreign individuals living in Korea.

There are two important theoretical considerations that need to be further examined regarding model (4.9). First, what is the transmission mechanism between *FPUSC* and S_t? Second, assuming a world of rational expectations as in Daniel (1981), what motivates foreigners to invest in U.S. equity securities? A logical answer to the first question is the fundamental economic theory of supply and demand: as demand of U.S. equity securities by foreigners goes up in a significant way, the prices of these securities, *ceteris paribus*, increase, and vice versa. It can be argued that a contributing factor of this effect becoming detectable and significant over time is that the world is getting flatter, not only in output and trade as proposed by Friedman (2005) but also in financial flows, including stock-market capitalization. Figure 4.4 shows the relationship between World Market Capitalization on the one hand and U.S. Market Capitalization as a percent of World Market Capitalization on the other.[13] As can be seen, World Market Capitalization has gone from about $10 USD trillions to about $63 USD trillions in just 15 years. That is a gain in World Market Capitalization of about $53 USD trillions or 530%! However, the United States market capitalization as a percent of world capitalization has shrunk from over 44% in 1992 to less than 32% in 2007.

[Insert Figures 4.4 here]

Table 4.1 adds support to the notion that the world is getting flatter in regard to world equity market capitalization. It is obvious that rich countries such as the United

[13] Data for this graph was obtained from the World Federation of Exchanges, http://www.world-exchanges.org and include observations from 1992 to 2007.

States, Netherlands, Japan, the United Kingdom, and Italy have experienced drastic losses of wealth (as measured by equity value) while emerging markets and oil-producing countries such as Saudi Arabia, Brazil, China, Russia, India, and South Korea have experienced an extraordinary growth in wealth. This can explain, along with the other macroeconomic factors previously mentioned, the increasing foreign purchases of U.S. corporations' stocks as illustrated by Figure 4.2. It can be conjectured that these inflows have become sufficiently big to have some kind of impact on the U.S. stock-market performance.

The second question might be linked to the concept of "safe-haven" previously mentioned. But another explanation that needs to be further explored and was briefly mentioned before is the finance theory of diversification. It has been shown that diversification reduces risk (i.e. the standard deviation of returns) while providing average return performance. The principle applies to worldwide diversification as well: adding international stocks across world markets to a portfolio reduces volatility as long as the movements in international stock markets are not perfectly positively correlated. It can be argued that the observed decoupling of several economies from the influence of the United States has produced some market segmentation. Even a small reduction in the degree of international stock markets' positive correlation improves the benefit of international diversification. As stated by Solnik et al. (1996), diversifying across national markets with low correlation of returns allows investors to reduce their total portfolio risk, presumably without sacrificing returns.

Testing market segmentation with multifactor asset pricing models yields mixed results. See for example Wheatley (1988), Gultekin et al. (1989), Domowitz et al. (1997), Foerster and Karolvi (1999), and Fauver et al. (2003). However, even if the segmented market hypothesis is rejected, one can generally assume that risk unique to a specific country's equities can be potentially different from global market risk (Bodurtha, 1986). Therefore, diversification across world markets, even if such markets are partially integrated, yields reduced standard deviations of returns. If international investors pursue an allocation strategy based on global market capitalization, then it follows that a lot of foreign equity investments would come to the United States, since about 30% of the global equity market capitalization is in U.S. companies. Even though the U.S. Market Capitalization as a percentage of world market has come down in a significant way, it is still the largest equity market in the world. In other worlds, although 32% is a lot less than 44%, the U.S. stock market is currently more than three times the market cap of the second largest economy, Japan.

In regard to the determinants included in (4.9), the following rationalization of parameter behavior is made: when inflation (*INF*) moves higher, the required rate of return on equity capital should also increase and the intrinsic value of existing stocks, *ceteris paribus*, should decrease. As a result, β_1 is expected to be negative. The implication of this statement is that real output shocks are expected to dominate monetary shocks. The same applies to the risk-free rate (*Rf*), and the spread between long and short rates (*SBLS*); therefore, it is expected that β2 and β_3 will be negative as well. On the other hand, a *significant* increase in purchases of U.S. corporations' stocks by foreigners should put upward pressure on the price of stocks. As a result, β4 is expected to be positive.

DATA AND DESCRIPTIVE STATISTICS

This study utilizes monthly observations of the S&P 500 from *DataStream* for the period 1978:1 to 2008:7. Monthly calculations of the spread between long and short interest rates (*SBLS*) are computed by subtracting the U.S. 3-Month Treasury Bill from the U.S. 10-year Treasury Constant Maturity Rate Yields (Series TB3MA and GS10) for the sample period. The series were downloaded from the website of the Federal Reserve Bank of Saint Louis (http://www.frbstlouis.com). The Release is H.15 Selected Interest Rates, monthly rates, in percentage and average of business days.

Monthly observation on the U.S Consumer Price Index for All Urban Consumers: All Items, from the U.S. Department of Labor: Bureau of Labor Statistics (series CPIAUS) for the period are obtained from the Board of Governor of the Federal Reserve System, downloaded from the Federal Reserve Bank of Saint Louis (http://www.frbstlouis.com). The release is the Consumer Price Index. Units: Index 1982-1984 = 100.

Monthly data of purchases and sales of U.S. corporations common stock by foreigners were obtained from the *Treasury International Capital (TIC)* reports and were downloaded from http://www.treas.gov/tic/. The TIC data represent foreign investors purchases and sales of U.S. long-term securities as reported by commercial banks, bank holding companies, brokers and dealers, foreign banks, and non-banking enterprises in the U.S. The reports include data on purchases and sales of U.S Treasury Bonds and Notes, U.S Government Agency Bonds, U.S. Corporation Stocks, Foreign Bonds, and Foreign Stocks. Several papers have used *TIC* data in a variety of empirical analysis.[14]

[14] Brennan and Cao (1997) use *TIC*-based data to examine the effect of both purchases of foreign equities by U.S. residents and purchases of U.S. equities by foreign residents on the effect of stock market returns

Table 4.2 presents key descriptive statistics of the series used. Tests of the shape of the distributions indicate that all series are leptokurtic, which implies that these distributions are higher or more peaked than the normal distribution. Some of the series are moderately skewed as well. The Jarque-Bera tests reject the null ($p < 0.10$) of underlying normal distribution for most of the series. Due to the sample size (367 observations) and the implications of the central limit theorem, non-normality is considered not to be an impediment for this analysis as in Sarno and Thornton (2003).

[Insert Table 4.2 here]

Figure 4.5 shows rolling correlations between *S* and *FPUSC* based on a moving window of 120-month periods. The first 120-month correlation coefficient was computed from month 1 to month 120; the second 120-month correlation coefficient was computed from month 2 to month 121 and so on. Figure 4.5 suggests that there has been a significant positive (above +0.50) rolling correlation between foreign purchases of U.S common stocks (*FPUSC*) and the performance of the S&P 500 (*S*). It is interesting to note that the full sample coefficient of correlation between these two variables for the included time horizon has been extremely high (close to +0.80). The rolling correlation breaks the 0.80 level to the downside around December of 2004.

[Insert Figure 4.5 here]

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for Canada, Germany, Japan, and the United States for the period 1982.2 to 1994.4. They also use net purchases by U.S. residents of equities in 16 emerging markets over the period 1989.1 to 1994.4 to demonstrate a positive correlation between these purchases and the emerging stock-market's returns. On the other hand, Bertaut and Griever (2004) use *TIC*-based data to show that the market value of foreign holdings of the U.S. long-term securities has long exceeded that of the U.S. holdings of foreign long-term securities. They also report that residents of Japan and the U.K are the largest portfolio investors in the U.S. long-term securities. More recently, Mollick and Soydemir (2008) use *TIC*-based data to show that a one-time increase in net Japanese purchases of U.S. Treasury securities has an immediate negative effect on U.S. long bond yields but a short-lived yen depreciation.

EMPIRICAL RESULTS

Table 4.3 shows the unit root tests of *S, INF, Rf, SBLS,* and *FPUSC*. It includes the traditional augmented Dickey and Fuller (1979) test, in addition to the modified augmented Dickey and Fuller test proposed by Elliott et al. (1996), and the KPSS method suggested by Kwiatkowski et al. (1992). Additional information concerning these tests has been included at the notes to Table 2. As can be seen in the column to the right, *S, INF, Rf, SBLS,* and *FPUSC* are consistent with I (1) processes: the series have a unit root in levels, but are stationary when first- differenced, in line with the findings by Nelson and Plosser (1982) for several economic and financial series.

[Insert Table 4.3 here]

The next stage entails the testing for the presence of a long-run relationship among the variables in both empirical models. Panel A of Table 4.4 shows a strong support for the existence of a stable long-run relationship among *S, INF, Rf, SBLS* by the Johansen (1988, 1991) trace and maximum eigenvalue tests for the full sample, which includes observations from 1978:01 to 2008:07. The hypothesis of no cointegration is decisively rejected at conventional significance levels. The full sample was divided into three sub-samples to check for cointegration consistency among these four variables. The first sub-sample runs from 1978:01 to 1999:12 and the second sub-sample goes from 2000:01 to 2008:07. The third from 1978:01 to 2004:12 represents the data points in agreement with rolling correlations equal to or above the full sample correlation of +0.80. The selection of the first two time horizons is based on a rolling cointegration analysis which shows that the full sample cointegration was remarkably strong up to 1999 when, it precipitously, albeit temporarily, dropped below the 10% critical-value line. Additional information and graphical representation of this finding is presented later in the essay. The third sub-sample is based on visual inspection of Figure 4.5. For all sub-samples, the hypothesis of no cointegration is decisively rejected at conventional significance levels.

Panel B of Table 4.4 shows the results for the composite model, allowing for the role of foreign investors in the U.S. stock market. As in the case of the basic model, we find strong support for the existence of a stable long-run relationship among *S, INF, Rf, SBLS,* and *FPUSC* as given by the Johansen (1988, 1991) trace and maximum eigenvalue tests. The hypothesis of no cointegration is decisively rejected at conventional significance levels, not only for the full sample but for the two sub-samples as well.

The results shown on Table 4.4 allow the execution of the next step, which is the estimation of models (4.8) and (4.9), using OLS, DOLS, and JOH-ML. Because (4.8) and (4.9) are cointegrating regressions, deviations of S_t from a linear combination of INF_t , Rf_t, and $SBLS_t$, and deviations of S_t from a linear combination of INF_t , Rf_t, $SBLS_t$, and *FPUSC* are respectively stationary: the residuals from the estimation of (4.8) and (4.9) are *I*(0), and the estimated parameters are not spurious. As Granger (1986) notes: "A test for cointegration can be thought of as a pre-test to avoid spurious regression situations."

[Insert Table 4.4 here]

Cointegrating coefficient estimates for the basic model (4.8) are presented in columns (2) to (4) of Table 4.5 for the full sample. The cointegrating coefficient estimates of β_1, β_2, and β_3 are in agreement with the theoretical signs of model (4.8): inflation (INF), the risk-free rate of interest (*Rf*), and the spread between long and short debt (*SBLS*) as specified in (4.8) significantly explains variations in the U.S. Stock

Market. The estimated coefficients have the expected signs and are all statistically significant at conventional significance levels.

[Insert Table 4.5 here]

Columns (5) to (7) of Table 4.5 present the estimation of (4.9). Foreign purchases of U.S. corporation stocks significantly contribute to the explanation of variation in the S&P 500. In general, a 1% increase in *FPUSC* is associated with a 0.13% to 0.38% increase in the S&P 500, *ceteris paribus*. This finding is consistent and statistically significant at any conventional significance level throughout specifications. While becoming lower in absolute value, the coefficient estimates of β_1, β_2, and β_3 are still negative and statistically significant throughout, which is a remarkable sign of parameter stability. Based on the fit of the estimations as evidenced by the R^2 statistic, model (4.9) represents a significant improvement over model (4.8). When one concentrates on columns (4) and (7) of Table 4.5 for the VECM associated with the Johansen estimates, the error-correction term (speed of adjustments) increases in absolute value: from about 1.4% of the adjustment being corrected in the following month for the basic model to about 2.3% of the adjustment being corrected in the following month for the model with foreign purchases. The latter implies, for situations away from the steady-state, a much faster speed of adjustment to long-run equilibrium when purchases of foreign investors are explicitly considered.

The speeds of adjustments are negative and statistically significant throughout. The null hypothesis of these speeds of adjustment being zero as described in (2.3) can be rejected at conventional significance levels. The implication is that when deviations from the long-run equilibrium occur, it is primarily the stock prices that adjust to restore long-run equilibrium over our sample, rather than the included predictors. This would imply that if the stock-market performance was higher than expected a priori in the last month, in the current month it would be decreased by 1.4 to 2.3 percent to restore the long-run relationship between the stock-market performance and the included determinants. In other words, the included determinants are (*weakly*) exogenous. The other implication is that unidirectional Granger causality going from the predictors to the predicted variable is supported in two ways: First, in the long-run, the cointegrating coefficients are driving the stock market with no feedback. Second, the temporal deviations from the long-run path are corrected by changes in the stock market. In summary, this study finds long-run and short-run causation from the predictors to the predicted variables.

In regard to the effects of inflation on the stock market, our findings are in line with most of the studies mentioned in the introduction of this essay: that inflation has a negative effect on the stock market. Seminar papers in this area, including Lintner (1975), Bodie (1976), Jaffe and Mandelker (1976), Nelson (1976), and Fama and Schwert (1977), find a negative relationship between these two series as well. The implication is that for the last three decades or so, real-output shocks have been more prevalent and important to the U.S. economy as a whole than monetary shocks. As a consequence, inflation can be consistently associated with stock-market declines. For example, even when the sample is split as in Table 4.6, the coefficient associated with inflation is negative and statistically significant, except under OLS and DOLS for the 1978:1-1999:12 sub-sample where the β_1-coefficient is found to be not statistically significant.

Based on rolling correlation and rolling cointegration analyses, the scope of Table 4.5 is extended by estimating the composite model for the sub-samples presented in Table

4.4. The results can be compared to the estimation of the full sample presented in Table 4.5. This allows a strong test for consistency of the parameters, especially of β_4 and also as a mean to provide some robustness to the findings reported elsewhere. Table 4.6 contains the results of such estimations. All the coefficients are very stable and consistent throughout. It is interesting to notice that β_4 is positive and statistically significant across specification and sample periods, with the exception of column (4) for the JOH-ML estimator. This is a very important finding: the contribution of *FPUSC* to the explanation of variations in the S&P 500 is well confirmed.

[Insert Table 4.6 here]

As a result, the U.S. market performance is no longer a sole function of domestic stock demand shocks but also depends on foreign stock demand shocks. Reverting foreign financial flows into the United States constitute a significant predictor of the U.S. stock-market performance. The rationalization of this finding can be related to the well-known fact that the U.S. federal government depends on foreign funds to finance many of its programs. For example, foreigners have loaned the U.S. Treasury Department over $2,613.3 billion in the form of purchases of U.S. Treasury Securities. These are significant shifts in financial flows: the United States, which was at one time the largest lender in financial markets, has now become the largest borrower, as Figure 3.3 on the current account balance suggests.

Another finding from Tables 4.5 and 4.6 is that the inclusion of the β_4-coefficient in the vector comes together with a decrease in the absolute value of the domestic macroeconomic forces in the U.S. stock market. This implies that the impacts of inflation, of the prevailing level of the interest rate, and of the yield curve become smaller. While the stock-market effects of inflation and interest rate have been well documented and researched, there is some indication that the yield curve has become less influential in more recent years. A suggested interpretation is that the demand-side variable brought about by the foreign appetite for U.S. stocks attenuates the negative effects of the domestic forces captured in this paper.

One way of providing additional robustness for the previous finding is through the comparison of both in-sample and out-of-sample forecasting abilities of models (4.8) and (4.9). For example, Mark (1995) compared performance of the basic monetary model at longer horizons relative to that of shorter horizons. The comparison of one model performance relative to another is accomplished through Theil's (1966) *U*-statistic as determined by (2.5). A value of the *U*-statistic larger than one indicates that the basic model does worse than the composite model in minimizing the RMSE. Other comparison techniques include the mean absolute error (MAE), and the mean absolute percentage error (MAPE) as discussed before.

Table 4.7 presents the in-sample and a one-step-ahead out-of-sample forecasting performance comparison of these models. Panel A of Table 4.7 clearly shows the forecasting superiority of the composite model over the basic model in the case of in-sample comparison. The mean squared error (MSE), mean absolute error (MAE), and the mean absolute percentage error (MAPE) decisively and overwhelmingly confirm the in-sample forecasting superiority of the composite model. The ratios of these metrics are all above 1. In addition, the Theil's *U*-statistic, represented by the ratio of $RMSE_B/RMSE_C$ as defined in (2.5) is greater than 1 as well. Furthermore, a one-sided (upper-tail) t test of

H_0: MSE_B= MSE_C versus H_1: MSE_B> MSE_C rejects the null (t-statistic = 8.98, 1% critical value = 2.35, p<0.01).

In addition to the in-sample forecasts, the one-step-ahead out-of-sample comparison as done by Rapach and Wohar (2002) is included. (The Diebold and Mariano (1995) statistics are also included for the out-of-sample test of the null hypothesis that the Mean Square Error of the Composite Model (MSE_C) is equal to the Mean Square Error of the Basic Model (MSE_B) against the alternative hypothesis that $MSE_B > MSE_C$. The test is conducted using a recursive window to generate a series of out-of-sample forecasts. The holdout sample encompasses the last twelve months of data observations.

Panel B of Table 4.7 shows the one-step-ahead out-of-sample Theil's *U*-statistic for the basic and composite models as presented in (4.8) and (4.9). Again, Theil's *U*-statistic is also greater than 1. The Diebold-Mariano (1995) procedure to test H_0: MSE_B= MSE_C versus H_1: MSE_B> MSE_C is obtained by regressing the loss differential series on an intercept and a MA (1) term to correct for serial correlation. A negative statistic implies that the basic model forecast beats the composite model forecast, while a positive statistic implies that the composite model forecast beats the basic model forecast. The DM test yields a statistic of 8.8 (p<0.01), a decisive rejection of the null hypothesis that MSE_B= $MSE_{C,}$ and a strong support for the notion that the composite model outperforms the basic model. The other metrics also support this finding.

[Insert Table 4.7 here]

The final stage of this analysis involve graphical inspection of the long-run cointegrating relationship between the U.S. stock-market performance and foreign demand of U.S. corporations' stocks, using rolling cointegrations analysis, as recently developed by Brada et al. (2005). The methodology in this study is based on a recursive, moving-window of 120-month periods to assess how the cointegrating relationship changes over time. Figure 4.6 supports the existence of a long-run equilibrium relationship between *S* and foreign purchases of U.S. corporation stocks. However, the relationship is clearly time variant. For example, cointegration between these two time series was remarkably strong up to 1999, when it precipitously, albeit temporarily, dropped below the 10% critical value line. However, the cointegrating relationship between the two quickly strengthened and stayed above the 1% critical value for the rest of the sampled period. As shown, the full sample trace is above the rolling cointegration trace throughout. The pattern of the rolling cointegrating trace coincides with two major financial periods in the United States: the "dot com boom" of the late-1990s and the real estate boom of the 2000s. The two are roughly separated by the recession that lasted from March 2001 to November 2001.

[Insert Figure 4.6]

This essay's findings provide support for the hypothesis that the effect of foreign purchases of U.S. Corporations' stocks is significant enough to *flatten* the traditional resistance of the U.S. Stock Market to foreign influence. It also supports the hypothesis that the effect of foreign purchases of U.S. Corporations' stocks on the U.S. Stock Market is time variant. Furthermore, the study supports the hypothesis that there exists a long-run equilibrium relationship between the U.S. Stock Market performance and a linear combination of the traditional macroeconomic forces, including foreign purchases of U.S. Corporations' stocks.

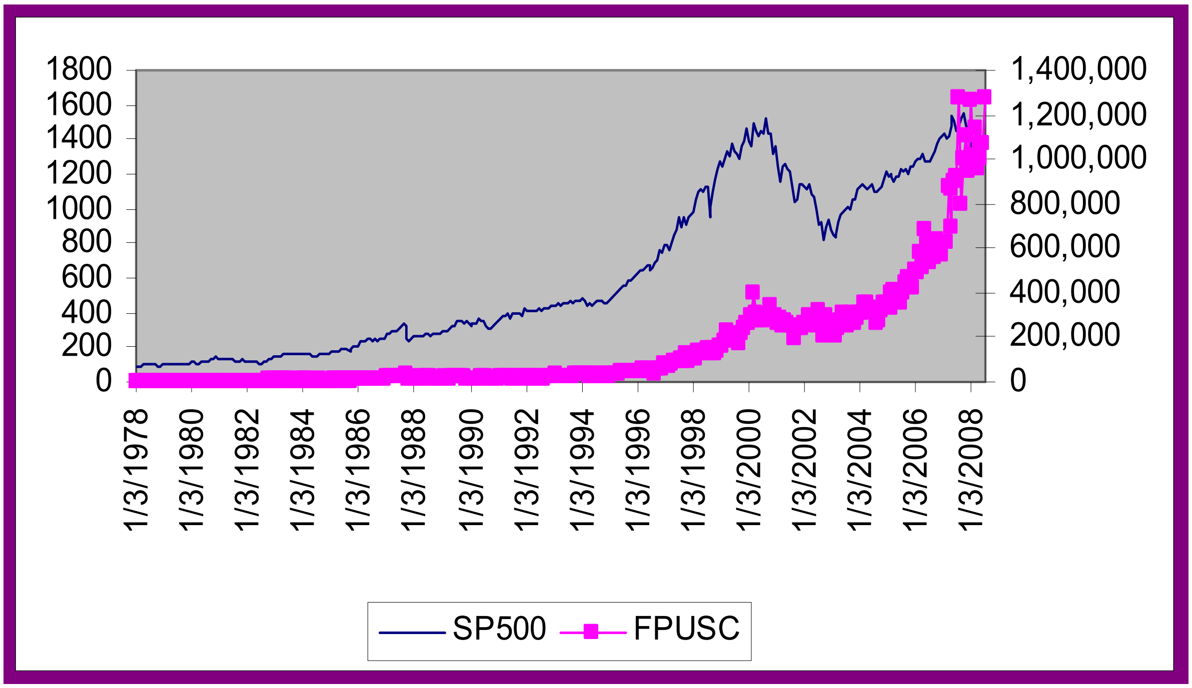
SUMMARY

In investigating the impact of foreign purchases of U.S. corporations' stocks (*FPUSC*) on the U.S. stock-market performance, this study controls for several variables and conducts multiple analyses. It is found that the coefficient for *FPUSC* is positive and statistically significant at conventional significance levels, after having controlled for U.S. macroeconomic variables that have an effect on the stock market. The average long-term parameter estimate across specifications for net purchases of U.S. stock by foreign investors is 0.13 to 0.38, when monthly data is used. The implication is that foreign purchases of U.S. corporation stocks significantly contribute to the explanation of variation in the S&P 500. In general, a 1% increase in *FPUSC* is associated with a 0.13% to 0.38% increase in the S&P 500 (*ceteris paribus*). This finding is consistent and statistically significant at any conventional significance level throughout specification. Based on this analysis, it can be inferred that there exists a long-run positive and significant relationship between the U.S. stock market and net purchases of U.S. stock by foreign investors. It also shows that their relationship is time variant, as indicated by rolling cointegration analysis. These results indicate that the U.S. market is affected not just by demand in the home market, but also foreign demand for domestic stock. Foreign investors might have different intentions than U.S. investors in investing in the U.S. stock market, and their investing decisions may be motivated by more than just the domestic economic climate. These results also imply that the U.S. stock market could now be more robust to negative domestic macroeconomic shocks but also vulnerable to the dismissing influence of domestic policies diminishing influence.

With respect to the control variables, the results are in line with Chen et al. (1986), who found a negative relationship between the stock market and inflation and a negative relationship between the stock market and risk and interest rate as well. It also found that the inclusion of the foreign purchases in the vector comes together with a decrease in the absolute value of the domestic (inflation, interest rates, and the yield curve) forces in the U.S. stock market. The estimates show that, in a world with rapid and interconnecting financial flows, the demand-side variable captured by the foreign appetite for U.S. stocks attenuates the negative effects of the domestic forces. The implications of capital-flow reversals are obvious and have been pointed out by Jackson (2008). Comparison of forecasting abilities of the basic model relative to the composite model (which include *FPUSC* as predictor) further supports the hypothesis that *FPUSC* has become a significant predictor of the U.S. stock-market performance.

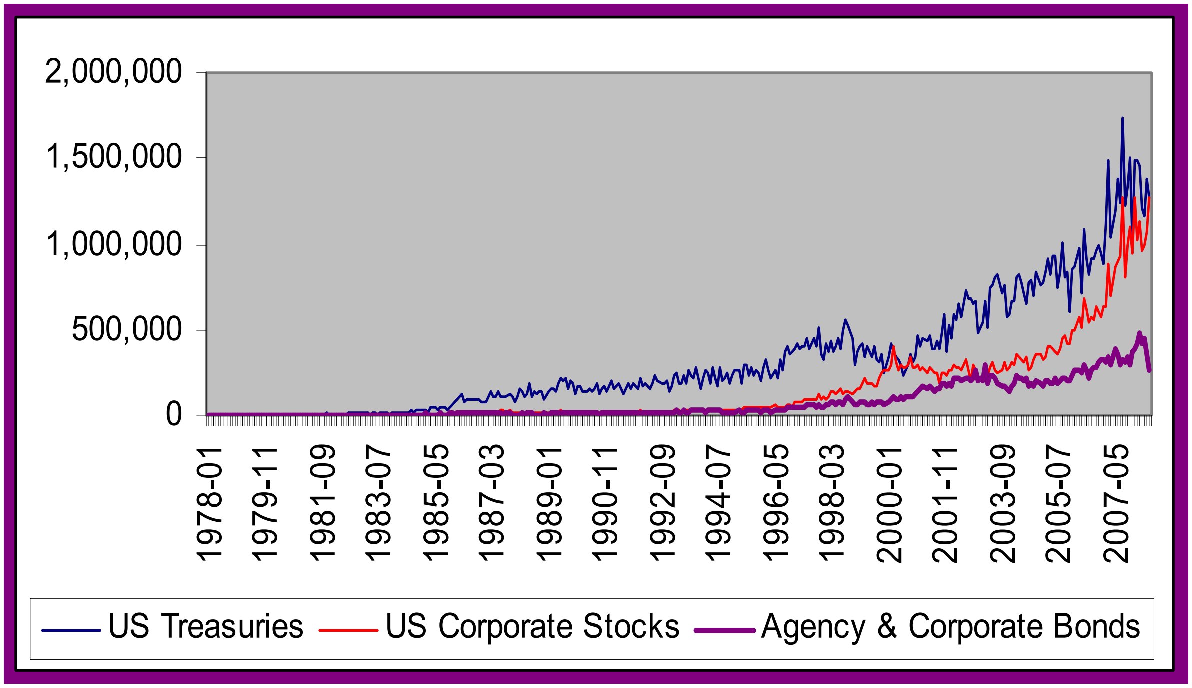
These findings have serious implications for U.S. investors and policy makers. First, assessing the magnitude of the impact that foreign purchases of U.S. corporations' stocks has on the U.S. stock market is essential for risk analysis and asset diversification management. Along with increased liquidity comes increased exposure to exogenous foreign risk. Second, at the policy level, ignoring such a phenomenon can lead to miscalculations. This may partially explain why recent actions to stabilize the U.S. market after the loss of investors' confidence that followed the real estate crash have not worked very well.

Figure 4.1
Long-Term Trends between Foreign Purchases of U.S. Corporations' Stocks (FPUSC) and the S&P 500 (left scale in S&P 500 points, right scale in USD millions).



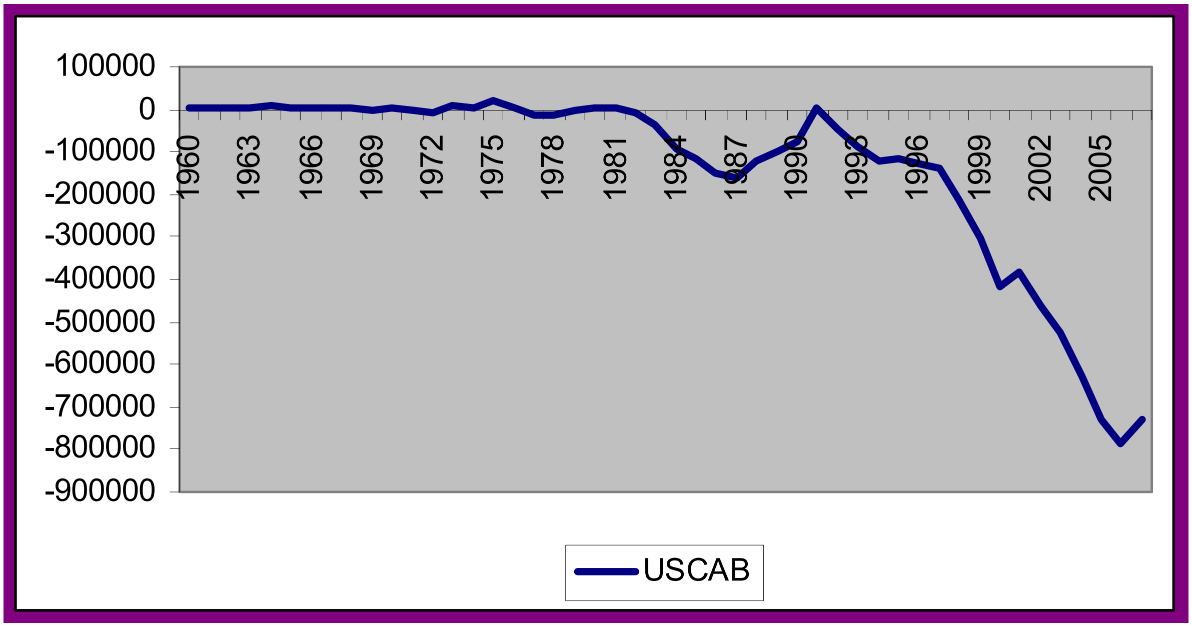
Note: Constructed by the author, using data from the Treasury International Capital (TIC) reports, downloaded from http://www.treas.gov/tic/ and data from *DataStream*.

Figure 4.2
Long-Term Trends of Foreign Purchases of U.S. Treasuries, U.S. Corporation Stocks, U.S. Corporate Bonds, and U.S. Agency Bonds (in USD millions).



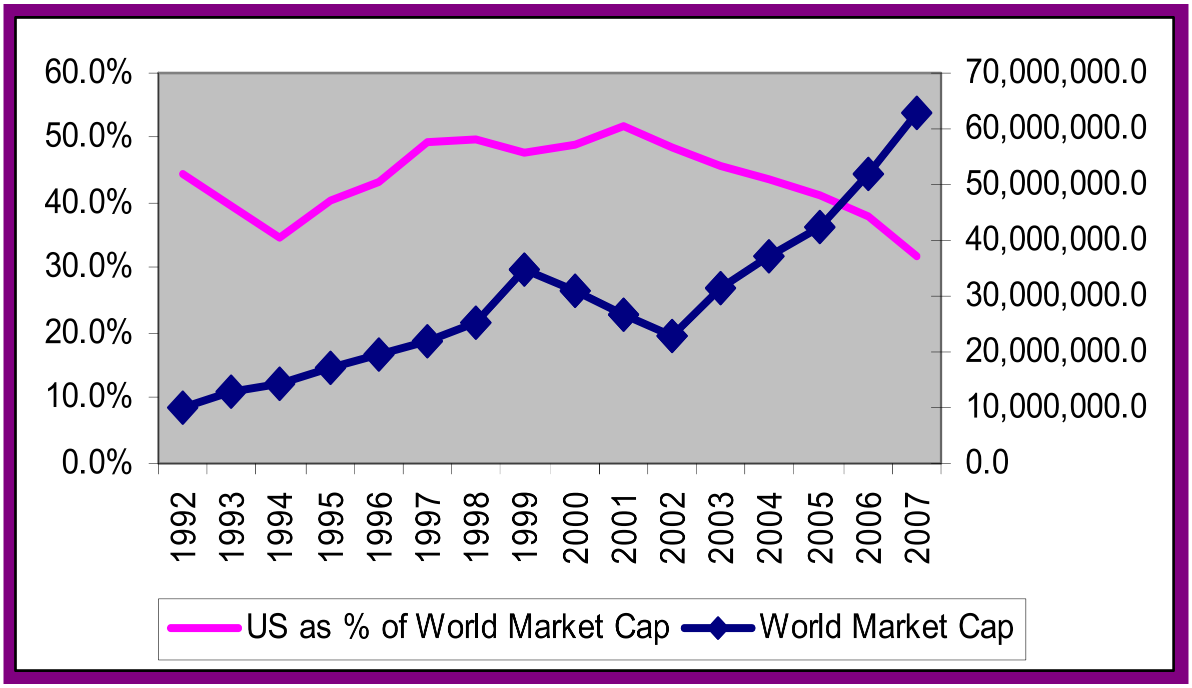
Note: Constructed by the author, using data from the Treasury International Capital (TIC) reports, downloaded from http://www.treas.gov/tic/ .

Figure 4.3
U.S. Current Account Balance (in USD millions).



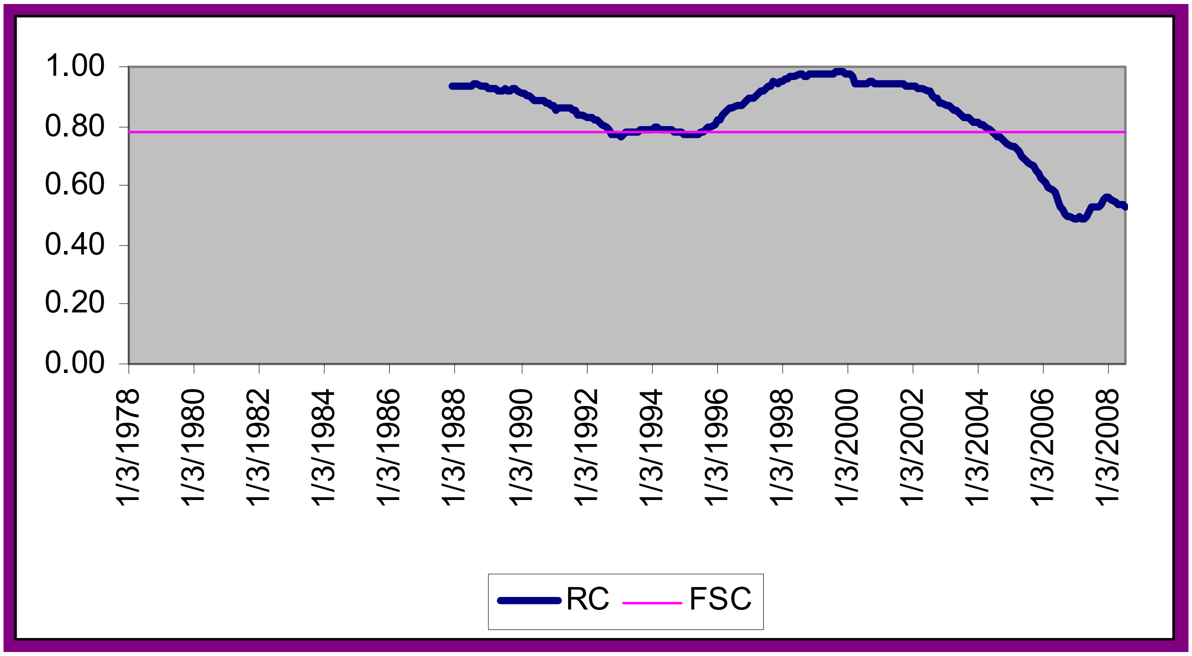
Note: Constructed by the author, using data from International Financial Statistics (IFS) of the International Monetary Fund (IMF), downloaded from http://www.imfstatistics.org.

Figure 4.4
World Market Cap and U.S. Market Cap as % of World: 1992-2007 (left scale in %, right scale in USD millions)



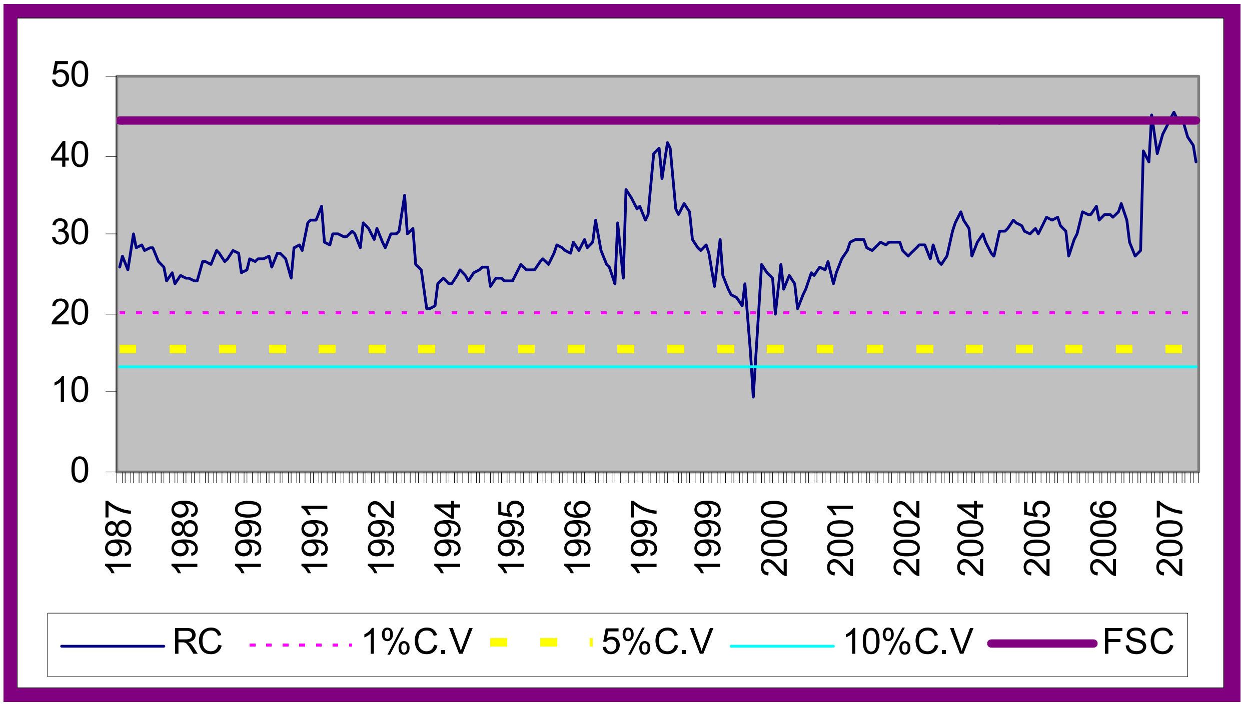
Note: Constructed by the author, using data from the World Federation of Exchanges (WFE), downloaded from http://www.world-exchanges.org.

Figure 4.5
Foreign Purchases of U.S. Corporation Stocks and the S&P500
Rolling Correlations (RC) using a moving-window of 120-Month periods and Full Sample Correlation (FSC).



Note: Constructed by the author, using computations based on the data described in Section 3.

Figure 4.6
Foreign Purchases by foreign Investors of U.S. Corporation Stocks and the S&P500 Rolling Cointegration using a moving-window of 120-Month periods.



RC= Rolling cointegration Trace, C.V= Critical Value, FSC= Full Sample Cointegration Trace

Table 4.1 Market Capitalization Percentage Changes (for selected countries) from 2002 to 2007

Saudi Arabia	877.5%
Egypt	561.6%
Qatar	310.2%
Brazil	266.6%
UAE	241.0%
China	218.7%
Russia	173.5%
India	123.7%
Kuwait	111.0%
Argentina	85.2%
Hong Kong	81.6%
South Korea	67.8%
Mexico	65.9%
Israel	57.0%
Singapore	55.7%
Australia	45.0%
Chile	41.2%
Canada	36.4%
South Africa	34.9%
Spain	10.9%
Taiwan	6.1%
Germany	3.2%
Sweden	1.2%
Switzerland	-0.2%
France	-4.8%
Italy	-10.7%
United Kingdom	-12.3%
Japan	-20.2%
Netherland	-28.2%
United States	-31.6%

Source: data obtained from the World Federation of Exchanges

Table 4.2 Descriptive Statistics.

	S	**FPUSC**	**INF**	**Rf**	**SBLS**
Mean	629.0	150677	4.23	5.90	1.71
Median	444.3	24441	3.26	5.32	1.65
Maximum	1549.4	1278771	14.76	16.30	4.42
Minimum	87.04	826	1.07	0.88	0.00
Std. Dev.	472.1	243170	2.89	3.16	1.17
Skewness	0.48	2.42	1.91	0.84	0.05
Kurtosis	1.67	9.24	6.12	3.77	1.78
Jarque-Bera P-value	40.9 (0.00)	954.7 (0.00)	40.95 (0.00)	51.99 (0.00)	22.99 (0.00)
Observations	367	367	367	367	367

Note: S, FPUSC, INF, Rf, and SBLS denote S&P500, Foreign purchases of U.S. corporations stocks, Inflation, Risk-free rate (proxied by the 3-Month Treasury Bill rates), and the Spread between long-and short-term interest rates respectively. P-values for the Jarque-Bera tests are reported below the statistics.

Table 4.3. Unit Root Tests.

Series	Trend?	ADF (k)	DF-GLS (k)	KPSS (4)	Determination
		H_0: Series has a unit root	H_0: Series has a unit root	H_0: Series is stationary	
S	Yes	-1.99(0)	-1.58(0)	0.66(4)***	*I*(1)
INF	Yes	-2.48(15)	-2.73(15)*	0.75(4)***	*I*(1)
Rf	Yes	-3.56(13)**	-2.44(13)	0.31(4)***	*I*(1)
SBLS	Yes	-3.06(2)	-3.07(2)**	0.28(4)***	*I*(1)
FPUSC	Yes	-3.25(14)	-0.29(14)	1.16(4)***	*I*(1)
Δ*(S)*	No	-19.09(0)***	-18.67(0)***	0.12(4)	*I*(0)
Δ*(INF)*	No	-3.98(14)***	-1.42(12)	0.14(4)	*I*(0)
Δ*(Rf)*	No	-4.69(12)***	-4.64(12)***	0.06(4)	*I*(0)
Δ*(SBLS)*	No	-13.56(1)***	-13.17(1)***	0.03(4)	*I*(0)
Δ*(FPUSC)*	No	-2.60(13)*	-2.65(13)***	1.15(4)***	*I*(0)

Notes: Data are of monthly frequency from 1978:1 to 2008:7. The symbol Δ refers to the first-difference of the original series. We include the deterministic trend only when testing in levels as suggested from graph inspection. ADF(k) refers to the Augmented Dickey-Fuller t-tests for unit roots, in which the null is that the series contains a unit root. The lag length (k) for ADF tests is chosen by the Campbell-Perron data dependent procedure, whose method is usually superior to k chosen by the information criterion, according to Ng and Perron (1995). The method starts with an upper bound, k_{max}=13, on k. If the last included lag is significant, choose k = k_{max}. If not, reduce k by one until the last lag becomes significant (we use the 5% value of the asymptotic normal distribution to assess significance of the last lag). If no lags are significant, then set k = 0. Next to the reported calculated t-value, in parenthesis is the selected lag length. DF-GLS (k) refers to the modified ADF test proposed by Elliott et al. (1996), with the Schwarz Bayesian Information Criterion (BIC) used for lag-length selection. The KPSS test follows Kwiatkowski et al. (1992), in which the null is that the series is stationary and k=4 is the used lag truncation parameter. The symbols * [**] (***) indicate rejection of the null at the 10%, 5%, and 1% levels, respectively.

Table 4.4
Results of Cointegration Tests

Panel A: Basic Model

(1) Estimation Sample	(2) Lags	(3) Trace	(4) 0.05 Trace C.V	(5) Max-Eigen	(6) 0.05 Max-Eigen C.V
1978:01 – 2008:07	3	61.16***	47.85	34.72***	27.58
1978:01 – 1999:12	3	54.59***	47.85	30.29***	27.58
1978:01 – 2004:12	3	55.38***	47.85	31.65***	27.58
2000:01 – 2008:07	7	56.23***	47.85	31.86***	27.58

Panel B: Composite Model

(1) Estimation Sample	(2) Lags	(3) Trace	(4) 0.05 Trace C.V	(5) Max-Eigen	(6) 0.05 Max-Eigen C.V
1978:01 – 2008:07	14	79.11***	69.82	38.72***	33.88
1978:01 – 1999:12	5	75.92***	69.82	35.57***	33.88
1978:01 – 2004:12	3	70.58***	69.82	37.60***	33.88
2000:01 – 2008:07	10	118.03***	69.82	45.06***	33.88

Notes: The symbols * [**] (***) attached to the figure indicate rejection of the null of no cointegration at the 10%, 5%, and 1% levels, respectively. The lag length is chosen by the FPE, AIC, SC, or HQ Criterion.

Table 4.5

Cointegrating Coefficient Estimates of Basic and Composite Models for the Full Sample: 1978:01 – 2008:07

$$\log(S_t) = \beta_0 + \beta_1 INF_t + \beta_2 Rf_t + \beta_3 SBLS_t + \varepsilon_t$$

$$\log(S_t) = \beta_0 + \beta_1 INF_t + \beta_2 Rf_t + \beta_3 SBLS_t + \beta_4 \log(FPUSC_t) + \varepsilon_t$$

(1)	(2) OLS[a] Estimates	(3) DOLS[a, b] Estimates	(4) JOH-ML[c] Estimates	(5) OLS[a] Estimates	(6) DOLS[a, b] Estimates	(7) JOH-ML[c] Estimates
β_1	-0.0875*** (0.0290)	-0.0862*** (0.0270)	-0.0620** (0.0375)	-0.0384*** (0.0108)	-0.0389*** (0.0108)	-0.0562*** (0.0256)
β_2	-0.2102*** (0.0216)	-0.2183*** (0.0197)	-0.2885*** (0.0349)	-0.0315*** (0.0114)	-0.0357*** (0.0123)	-0.2125*** (0.0341)
β_3	-0.3603*** (0.0328)	-0.3835*** (0.0307)	-0.4958*** (0.0665)	-0.0808*** (0.0202)	-0.0898*** (0.02167)	-0.3835*** (0.0642)
β_4				0.3860*** (0.0239)	0.3826*** (0.0257)	0.1338*** (0.0567)
	R^2 =0.79	R^2 =0.82	R^2 in VECM= 0.09 α in VECM= – 0.0143***	R^2 =0.96	R^2 =0.97	R^2 in VECM = 0.21 α in VECM = – 0.0229**

Notes: [a]Newey-West heteroscedasticity and autocorrelation consistent (HAC) standards errors are reported in parentheses for both OLS and DOLS. Chen and Rogoff (2003) have a similar treatment. Since deviations of S_t from a linear combination of INF_t , Rf_t, and $SBLS_t$ are stationary (top part of Table 3) the results presented in columns (2), (3), and (4) are considered to adequately represent the long-run relationship between the U.S stock market performance and the included stock market performance's determinants.

[b]One lead and lag of the first-differenced independent variables are included in the DOLS regressions.

[c]The method of estimation is the vector error correction model with three lags. The lag length is chosen by the FPE, AIC, SC, or HQ Criterion. In the first-stage the Johansen cointegration method is used for estimation of the long-run vector. In the second stage, residuals from the first stage are used in differenced form. The LM t-stat. is a standard Lagrange Multiplier test on the residuals of the regression, calculated under the null hypothesis of no serial correlation.

The dependent variable is the U.S. stock market performance captured by the performance of the S&P 500. The constant term was included in the estimations but is not reported. The symbols * [**] (***) attached to the figure indicates significance at the 10%, 5%, and 1% levels, respectively.

Table 4.6

Cointegrating Coefficient Estimates Composite Models: Full sample and sub-samples

$$\log(S_t) = \beta_0 + \beta_1 INF_t + \beta_2 Rf_t + \beta_3 SBLS_t + \beta_4 \log(FPUSC_t) + \varepsilon_t$$

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
		1978:1 – 1999:12			1978:1 – 2004:12			1978:1 – 2008:07	
	OLS[a]	DOLS[a,b]	JOH-ML[c]	OLS[a]	DOLS[a,b]	JOH-ML[c]	OLS[a]	DOLS[a,b]	JOH-ML[c]
β_1	0.006 (0.008)	0.010 (0.009)	-0.083** (0.039)	-0.025*** (0.009)	-0.027*** (0.009)	-0.081*** (0.023)	-0.038*** (0.011)	-0.039*** (0.011)	-0.056*** (0.026)
β_2	-0.33*** (0.007)	-0.031*** (0.007)	-0.221*** (0.044)	-0.024*** (0.009)	-0.025*** (0.010)	-0.179*** 0.029)	-0.032*** (0.011)	-0.035*** (0.012)	-0.212*** (0.034)
β_3	-0.033* (0.018)	-0.029 (0.020)	-0.434*** (0.087)	-0.082*** (0.0017)	-0.092*** (0.019)	-0.399*** (0.054)	-0.081*** (0.020)	-0.090*** (0.022)	-0.384*** (0.064)
β_4	0.528*** (0.018)	0.543*** (0.019)	0.09 (0.106)	0.446*** (0.020)	0.445*** (0.022)	0.170*** (0.054)	0.386*** (0.024)	0.383*** (0.026)	0.134*** (0.057)
R^2	0.97	0.98	0.13	0.97	0.97	0.20	0.96	0.97	0.21
α			-0.010 (0.009)			-0.018 (0.014)			-0.023** (0.013)

Notes: [a]Newey-West heteroscedasticity and autocorrelation consistent (HAC) standards errors are reported in parenthesis for both OLS and DOLS. Chen and Rogoff (2003) have a similar treatment. Since deviations of S_t from a linear combination of INF_t , Rf_t, and $SBLS_t$ and *FPUSC* are stationary (top part of Table 3) the results presented in columns (2), (3), (6), (6) (8) and (9) are considered to adequately represent the long-run relationship between the U.S stock market performance and the included stock market performance's determinants.

[b]One lead and lag of the first-differenced independent variables are included in the DOLS regressions.

[c]The method of estimation is the vector error correction model with three lags. The lag length is chosen by the FPE, AIC, SC, or HQ Criterion. In the first stage the Johansen cointegration method is used for estimation of the long-run vector. In the second stage, residuals from the first stage are used in differenced form. The LM t-stat. is a standard Lagrange Multiplier test on the residuals of the regression, calculated under the null hypothesis of no serial correlation.

The dependent variable is the U.S stock market performance captured by the performance of the S&P 500. The constant term was included in the estimations but is not reported. The symbols * [**] (***) attached to the figure indicate significance at the 10%, 5%, and 1% levels, respectively.

Table 4.7 Basic Model and Composite Model Forecasting Performance Comparison

Panel A
In-Sample Forecasting Performance Comparison

	Basic Model	Composite Model	Performance Ratios
Root Mean Square Error	227.52	156.41	1.45[a]
Mean Square Error	51765.35	10142.50	5.10[b]
Mean Absolute Error	159.52	100.71	1.58
Mean Absolute Percentage Error	34.37	14.87	2.31

[a]The $RMSE_B/RMSE_C$ ratio is the Theil's *U*-statistic. A *U*-statistic greater than one implies that the composite model is superior to the basic model in predicting variation in the U.S stock market performance. This finding is supported by the MAE and MAPE ratios as well (both are greater than 1).

[b]One-sided (upper-tail) t test of H_0 : $MSE_B = MSE_C$ versus H_1 : $MSE_B > MSE_C$ rejects the null (t-statistic = 8.1, 1% critical value = 2.35, p<0.01).

Panel B
One-Step Ahead, Recursive Out-of-sample Forecast Comparisons.

	Basic Model	Composite Model	Performance Ratios
Root Mean Square Error	0.3891	0.3341	1.16[a]
Mean Square Error	0.1514	0.1116	1.36[b]
Mean Absolute Error	37.84	32.47	1.17
Mean Absolute Percentage Error	5.23	4.47	1.18

[a]The $RMSE_B/RMSE_C$ ratio is the Theil's U-statistic. An U-statistic greater than one implies that the composite model is superior to the basic model in predicting variation in the U.S market performance. This finding is supported by the MAE and MAPE ratios as well since both are greater than 1.

[b]We use the Diebold-Mariano (1995) procedure to test H_0 : $MSE_B = MSE_C$ versus H_1 : $MSE_B > MSE_C$. The DM statistic is obtained by regressing the loss differential series on an intercept and a MA (1) term to correct for serial correlation. Negative statistic implies that the basic model forecast beats the composite model forecast. Positive statistic implies that the composite model forecast beats the basic model forecast. The DM test yields a statistic of 8.8 (p<0.01), a decisive rejection of the null hypothesis that $MSE_B = MSE_C$ and a strong support to the notion that the composite model outperforms the basic model.

CHAPTER V

THE IMPACT OF RECENT OIL AND OTHER MACROECONOMIC SHOCKS ON THE U.S. DOLLAR EXCHANGE RATES

INTRODUCTION

The United States Dollar (USD) has been the most important international reserve currency since the Bretton Woods system was established after World War II. In fact, the USD was the *numeraire* of the system (the standard to which every other currency was pegged to) from 1944 up to 1973, when most countries let their currency float. However; the USD is facing serious challenges. Important commodities, such as petroleum and gold, are priced in USD in international markets, but some leaders of the Organization of the Petroleum Exporting Countries (OPEC) are calling for a change. As can be seen in Figure 5.1, the USD value has been declining for some time against major currencies. It seems that for the past decade, the value of the USD peaked in 2001 and has been consistently falling ever since. From 2001 to 2007 the USD has lost 37% of its value against the Canadian Dollar, 15% against the Japanese Yen, 65% against the Euro, 41% against the Pound, 23% against the Trade Weighted Broad Exchange Index, and 34% against the Trade Weighted Major Currencies Exchange Index.

Exporters of commodities priced in USD, such as oil, are concerned with the falling value of the USD. The main reason is that the purchasing power provided by their exports is declining. Prominent economists believe that, unless drastic economic reforms are put in place, the USD supremacy may fade away. For example, Alan Greenspan in September 2007 said that the Euro could replace the USD as the world's primary reserve currency (International Herald Tribune, Sept. 17, 2007). On the other hand, Paul A. Samuelson and Robert Mundell indicated that persistent trade deficits will precipitate a run against the USD with serious global financial consequences (People's Daily Online, May, 11, 2007).

[Insert Figure 5.1 here]

The U.S. has run a growing current account deficit for a long time (see Figure 5.2). Even after the recent significant increase in the USD competitiveness, which has pushed U.S. exports upward about 12% in 2007, the current account deficit is still above $700 billion. In fact, the U.S. current account deficit has been above 5% of GDP since 2004 (see Figure 5.3), passing the 6% mark in 2005 but retreating back to 5.34% in 2007. The U.S. imports of crude oil has been steadily increasing since 1985 (see Figure 5.4), approaching thirteen million barrels of oil a day, which has significantly contributed to the deterioration of the U.S. trade balance. The current account deficit has been the object of considerable empirical analysis (see for example Hollman 2001). The aim of this analysis is to assess how oil price shocks affect the value of the USD. Specifically, this study concentrates on assessing the magnitude of the impact that variation in oil real prices has on the price of the USD relative to key currencies of net oil exporters and other widely traded currencies.

[Insert Figures 5.2, 5.3 and 5.4 here]

There are other commodities that are going trough a global boom (e.g. wheat, corn, steel, gold); however, the importance of oil, a considerable source of energy in the United States and the rest of the world, is extraordinary. Oil goes into making virtually everything, including steel, aluminum, plastics, rubber, fabrics, and fertilizers. It is used to run the vehicles needed for planting and harvesting, processing and storage of food, and transportation. As a result, oil is a significant driver of the U.S. economy and the standard of living of its citizens. It can be argued that the United States has greatly benefited from being able to consume a disproportional amount of global oil output. In the past, petroleum prices were the first to react to U.S. economic shocks. In other words, it was unlikely for oil to spike if Americans were cutting back their oil consumption. However, the global economic power map is profoundly shifting. Several economies are increasingly decoupling from one nation's fortune. For example, China and India both have sufficient domestic demand-led growth to continue to have vibrant economic growth even if the U.S. economy sustains periods of stagnation. Figure 5.5 clearly shows that Asia and Oceania's share of real world output has significantly increased, going from less than 20% in 1970 to over 30% in 2007, a growth of over 50%. In the meantime, U.S. and Western Europe's share of real world output has gone from close to 70% to less than 55% during the same time. Other regions of the world have either experienced negative growth or have shown little growth in the share of real world output.

[Insert Figure 5.5 here]

Oil is being diverted to satisfy the needs of the economic growing regions. As a result, increased competition for the acquisition of petroleum is putting upward pressure on oil prices and it has created the conditions for speculative activities in the commodity markets. This is a remarkable shift. Now, the United States influence on the price of oil *vis-à-vis* its domestic demand is not the sole determinant of oil price. The implication is that oil-producing countries such as Iran, Russia, and Venezuela, which at the moment are considered not as accommodative to U.S. wishes as in the past, are not limited to the U.S. market. It seems that oil price is an exogenous stochastic phenomenon with enough strength to significantly threaten the U.S. economy and, as consequence, the dominance of the U.S. dollar.

This economic and geopolitical shift is creating a new world order when it comes to oil and other commodities. Producers of natural resources are feeling liberated, and their source of wealth is now being freely floated in the world market. The United States is now forced to pour an increasingly amount of U.S. dollars into the purchase of these commodities. As a result, the USD has been losing value against key currencies due to the basic rule of supply and demand: as the supply of U.S. dollars goes up its price comes down. This becomes a vicious circle, since an-ever decreasing U.S. dollar, *ceteris paribus*, requires an ever-increasing amount of it to keep purchasing the quantity of oil the nation currently consumes.

In October 1973 the world realized how dependent on oil humanity had become. In fact, the 1973 oil-price shock, along with the 1973-1974 stock market crash, have been regarded as the first event since the Great Depression to have a persistent economic effect (Perron, 1988). Since then, oil has had a pervasive impact on economical, political, and military decision-makers. The most recent conflict in Iraq, the brewing quarrel with Iran, and the rise of Venezuela as a regional challenger to the United States lend support to this asseveration. Countries find themselves competing against one another, trying to secure a steady supply of oil to fuel their economies.

Oil has fueled the industrial, agricultural, financial, and technological revolutions and consequently has, in a significant way, improved the standard of living of many people. By Proxy, we can infer that oil has contributed to the formation and development of the existing financial markets. Since most oil producing countries are, in general, very unstable, it can be concluded that there is an increased uncertainty in regard to the stability of the oil supply-demand equilibrium. This added uncertainty influences the behavior of several macroeconomic variables, including the behavior of the USD.

The relationship between oil-price shocks and economic variables has been the subject of many empirical studies and controversies among researchers. Shocks to the price of oil have been blamed for economic recessions, financial crises in different industries, unemployment, depression of investment through its effects on uncertainty, high inflation, low equity and bond values, trade deficits, famine, and other economic ailments. For example, Hamilton (1983) found that all but one of the U.S. recessions since World War II have been preceded, typically with a lag of around three-fourths of a year, by a dramatic increase in the price of crude oil petroleum. Evidence is presented that even over the period 1948-1972 (pre-OPEC embargo) this correlation is statistically significant and nonspurious, supporting the proposition that oil shocks were a contributing factor in at least some of the U.S. recessions prior to 1972. He implies that energy-price increases may account for much of post-OPEC embargo macroeconomic performance.

Burbidge and Harrison (1984) applied the innovation-accounting techniques pioneered by Sims (1980) to the issue of determining the influence on five OECD economies of the large oil-price rises in the 1970s and concentrate on both the price level and industrial output. In the case of the price level, the impact on the U.S. and Canadian economies is substantial, with smaller (but still significant) effects on Japan, Germany, and the U.K. For industrial production, they find that the price of oil exerts a sizeable influence in the U.S. and the U.K., but the responses in other countries are, by comparison, quite small.

Gisser and Goodwin (1986) examined three popular notions about oil and the macroeconomic. First, they find that crude oil prices have had a significant impact on a broad range of macroeconomic indicators, often exceeding that of monetary policy and always exceeding that of fiscal policy. They concluded that oil prices have both real effects and inflationary effects. Second, the authors found no evidence of a dramatic break in the way oil prices affect the macroeconomic after the OPEC embargo of 1973. They also found evidence that prior to 1973 the rate of inflation was strongly informative about the future course of oil prices, but after that time a broader array of indicators of the U.S. economy were weakly informative.

Loungani (1986) showed that a significant fraction of the variation in employment is due to the differential impact of oil shocks across industries and that once dispersion in employment growth due to oil shocks is accounted for; the residual dispersion has no explanatory power for unemployment. Mork (1989) confirmed that the negative correlation with oil price increases persists in the longer sample and is strengthened by the correlation for price controls. On the other hand, an asymmetry in the responses is quite apparent in that the correlation with price decreases is significantly different and perhaps zero. Phelps (1994) associated oil price shocks with the natural rate of unemployment while Ferderer (1992) showed oil price shocks as an irreversible depressor of investment through the effects on uncertainty.

Lee et al. (1995) argued that an oil price change is likely to have greater impact on real GNP in an environment where oil prices have been stable, than in an environment where oil price movement has been frequent and erratic. An oil price shock variable reflecting both the unanticipated component and the time-varying conditional variance of oil price change (forecasts) is constructed and found to be highly significant in explaining economic growth across different sample periods, even when matched against various economic variables and other functions of oil price. The authors found that positive normalized shocks have a powerful effect on growth, while negative normalized shocks do not.

Rotemberg and Woodford (1996) presented a numerical estimate of the predicted effect of an increase in energy prices, using a traditional stochastic growth model, and show that while the oil-price increase is predicted to contract output, the effect is only about a fifth of the size of the response that they estimate using an imperfectly competitive model which involve implicit collusion in the product market. For example, a ten percent innovation in the price of oil is predicted to contract private sector output by about one-half a percent, using the stochastic growth model; but their estimate indicate instead that such an innovation has on average been associated with an output decline of

2.5 percent, five or six quarters after the innovation. In regard to wages, the authors suggest that real wages fall by nearly one percent (five or six quarter after the innovation) for each ten percent innovation in oil prices, which is nearly five times as large an effect as the calibrated stochastic growth model would predict. Hamilton (1996) argued that many of the quarterly oil-price increases observed since 1985 are corrections to even bigger oil-price decreases in the previous quarter. When one looks at the net increase in oil prices over the year, recent data are consistent with the historical negative correlation between oil shocks and recessions.

Keane and Prasad (1996) used micro panel data to examine the effects of oil prices changes on employment and real wages, at the aggregate and industry levels. They also measure differences in the employment and wage responses for workers differentiated on the basis of skill level. They found that oil price increases result in a substantial decline in real wages for all workers, but raise the relative wage of skilled workers. While the short-run effect of an oil-price increase on aggregate employment is negative, the long-run effect is in fact positive. They find that changes in oil prices induce changes in employment shares and relative wages across industries. Raymond and Rich (1997) analyzed the relationship between oil-price shocks and postwar U.S. business cycle fluctuations, using a generalized Markov switching model of output that includes a measure of net real oil-price increases and examine the capabilities of this variable to generate shifts in the mean of GDP growth and to predict transitions between dichotomous growth phases. The results indicate that while the behavior of oil prices has been a contributing factor to the mean of low-growth phases of output, movements in oil prices generally have not been principal determinants in the historical incidence of these phases. Carruth et al. (1998) showed that a simple framework based on only two prices (the real price of oil and the real rate of interest) is able to explain the main postwar movements in the rate of U.S. joblessness. The equations do well in forecasting unemployment many years out of sample, and provide evidence that the oil-price spike associated with Iraq's invasion of Kuwait appears to be a component of the recession that followed.

Hamilton (2000) used a flexible approach to characterize the nonlinear relation between oil-prices change and GDP growth. The author reports clear evidence of nonlinearity, consistent with earlier claims in the literature that oil-price increases are much more important than oil-price decreases, and increases have significantly less predictive content if they simple correct earlier decreases. An alternative interpretation is suggested based on estimation of a linear functional form using exogenous disruptions in petroleum suppliers as instruments.

Hooker (1996) found strong evidence that oil-prices no longer Granger cause many U.S. macroeconomic indicator variables in data after 1973. A number of potential explanations are explored: that sample stability issues are responsible, that oil prices are now endogenous, and that linear and symmetric specifications misrepresent the forms of the oil-price interactions. He found that none of these hypotheses are supported by the data. The OPEC price increases do appear to have had significant impacts, while the effects of the price declines of the 1980s are smaller and harder to characterize.

On the other hand, Davis and Haltiwanger (2001) studied the effects of oil-price shocks on the creation and destruction of U.S. manufacturing jobs from 1972 to 1988. They found that oil shocks account for twenty to twenty-five percent of the variability in employment growth, twice as much as monetary shocks. The two-year employment response to an oil-price increase rises in magnitude with capital intensity, energy intensity, and product durability. Job destruction shows much greater short-run sensitivity to oil and monetary shocks than job creation, except at newer, small plants. On the other hand, employment growth responds asymmetrically to oil price shocks.

Balke et al. (2002) found that rising oil prices appear to retard aggregate U.S. economic activity by more than falling oil prices stimulate it. The authors used a near vector autoregressive model of the U.S. economy to examine where the asymmetry might originate. The analysis uses counterfactual experiments to determine that monetary policy alone cannot account for the asymmetry. They show that an important channel through which oil prices affect economic activity is interest rates. They find that interest rates respond asymmetrically to oil-price shocks. One interpretation of the asymmetry in the interest-rate response is that relatively fluid market rates move in anticipation of asymmetric real effects that will be realized later. Another interpretation is that interest rates reflect increased financial stress brought about by the oil-price change.

Lee and Ni (2002) analyzed the effects of oil price shocks on supply and demand in various industries. The impulse responses indicate that for industries that have a large cost share of oil, such as petroleum refinery and industrial chemicals, oil price shocks mainly reduce supply. In contrast, for many other industries, with the automobile industry as a particularly important example, oil-price shocks mainly reduce demand. The authors suggest that oil-price shocks influence economic activities beyond that explained by direct input cost effects, possibly by delaying purchasing decisions of durable goods. Bernanke et al. (1997) suggested that monetary policy could be used to eliminate any recessionary consequences of an oil-price shock. But Hamilton and Herrera (2004) challenged this conclusion on two grounds. First, they question whether the Federal Reserve actually has the power to implement such a policy; for example, they consider it unlikely that additional money creation would have succeeded in reducing the Fed funds rate by 900 basis points relative to the values seen in 1974. Second, they point out that the size of the effect that Bernanke et al. (1997) attributed to oil shocks is substantially smaller than that reported by other researchers, primarily due to their choice of a shorter lag length than that used by others.

Jones et al. (2004) reported on developments in theoretical and empirical understanding of the macroeconomic consequences of oil-price shocks since 1996, when the U.S. Department of Energy sponsored a workshop summarizing the state of understanding of the subject. Four major insights stand out. First, theoretical and empirical analyses point to intra- and intersectoral reallocations in response to shocks, generating asymmetric impacts, for oil-price increases and decreases. Second, the division of responsibility for post-oil-price shock recessions between monetary policy and oil price shocks has leaned heavily toward oil-price shocks. Third, parametric statistical techniques have identified a stable, nonlinear, relationship between oil-price shocks and GDP from the late 1940s through the third quarter of 2001. Fourth, the magnitude of effect of an oil-price shock on GDP, derived from impulse response functions of oil-price shocks in the GDP equation of a VAR, is around -0.05 and -0.06 as an elasticity, spread over two years, where the shock threshold is a price change exceeding a three-year high.

Guo and Kliesen (2005) found that oil shocks exert influence on macroeconomic activity through various channels, many of which imply a symmetric effect. However, the effect can also be asymmetric. In particular, oil-price changes may reduce aggregate output temporarily because they delay business investment by raising uncertainty or induce costly sectoral resource reallocation. Consistent with these asymmetric-effect hypotheses, the authors found that a volatility measure constructed using daily crude oil futures prices has a negative and significant effect on future gross domestic product growth. Moreover, the effect becomes more significant after oil-price changes are also included in the regression to control for the symmetric effect. Saltzman (2005) found that the current increase in the price of oil is quite different from those experienced in the past. It is driven more by demand pressures than by reduced OPEC quota amounts and/or other disruptions in the supply chain. The author found a significant negative association between oil-price increases and consumer confidence which is linked to a series of economic problems.

Guidi et al. (2006) presented evidence of the effects of OPEC policy decisions on the U.S. and U.K. stock markets, as well as on oil prices, during periods of conflict and non-conflict from 1986 to 2004. Their paper added to the strong body of evidence supporting the hypothesis that market returns are influenced by factors that affect business conditions, such as oil price shocks. The key findings are that there are asymmetric reactions to OPEC policy decisions during conflict periods for the U.S. and U.K. stock markets. During conflict periods, oil markets require time to incorporate OPEC decisions. Conversely, in non-conflict periods the evidence suggests that the oil markets incorporate OPEC decisions efficiently. Sill (2007) examined the effect of changes in oil prices on U.S. economic activity, focusing on how run-ups in the price of oil can affect output growth and inflation. He also discusses the channels by which oil-price increases might affect the economy and the historical evidence on the relationship between oil prices, economic growth, and inflation.

Ewing and Thompson (2007) investigated the cyclical comovements of crude oil prices with output, consumer prices, unemployment, and stock prices. Contemporaneous and cross-correlation estimates are made using the stationary cyclical components of the time series to make inference about the degree to which oil prices move with the cycle. Besides documenting a number of important cyclical relationships using three different time series filtering methods, the results suggest that crude oil prices are procyclical and lag industrial production. Additionally, they find that oil prices lead consumer prices. Bachmeier (2008) provided evidence on the role played by monetary policy in the transmission of oil shocks to the U.S. economy. He showed that for the period since 1986, oil shocks have had a negative effect on stock returns, regardless of whether the oil shock is defined as the percentage change in the price of oil or a nonlinear transformation of that series. He then demonstrated that there is no relationship between the reaction of individual stock prices to oil shocks and to monetary policy shocks. This implies that oil shocks do have effects on the economy beyond their effect on monetary policy. He concludes that systematic monetary policy is not as effective as suggested in some previous studies.

Gronwald (2008) considered the macroeconomics of the oil price for the United States and investigated the impact of large oil-price hikes in a standard VAR framework by introducing a new Markov switching based oil price specification. The explanatory power of this new specification is compared to that of a number of prominent non-linear specifications. The key findings were: (1) the new oil-price specification is appropriate in both empirical and theoretical terms and allows for a well-founded distinction between "large" and "normal" oil-price increases. (2) The observed impact of oil-price shocks on real GDP growth is largely attributable to no fewer than three large oil price increases, namely those of 1973-74, 1979, and 1991, while variables such as consumer and import prices are also affected by normal oil price increases.

On the other hand, Park and Ratti (2008) found that oil-price shocks have a statistically significant impact on real stock returns contemporaneously and/or within the following month in the U.S. and thirteen European countries over 1986:1–2005:12. Norway as an oil exporter showed a statistically significantly positive response of real stock returns to an oil-price increase. The median result from variance decomposition analysis is that oil-price shocks account for a statistically significant 6% of the volatility in real stock returns. For many European countries, but not for the U.S., increased volatility of oil-prices significantly depresses real stock returns. The contribution of oil-price shocks to variability in real stock returns in the U.S. and most other countries is greater than that of interest rate. An increase in real oil-price is associated with a significant increase in the short-term interest rate in the U.S. and eight out of 13 European countries within one or two months. Counter to findings for the U.S. and for Norway, there is little evidence of asymmetric effects on real stock returns of positive and negative oil-price shocks for oil importing European countries. Cong et al. (2008) investigated the interactive relationships between oil-price shocks and the Chinese stock market using multivariate vector auto-regression. Oil-price shocks do not show statistically significant impact on the real stock returns of most Chinese stock market indices, except for manufacturing index and some oil companies. Some “important” oil-price shocks depress oil company stock prices. Increase in oil volatility may increase the speculations in the mining index.

While there are many studies on the link between oil prices and U.S. macroeconomic aggregates as presented above, the relationship between oil-price shocks and the value of the U.S. dollar has not received much attention in the literature. Even though the potential importance of oil prices as an explanatory variable of exchange rate movements has been noted earlier by Krugman (1983) and Rogoff (1991), the relationship has been generally neglected. Aleisa and Dibooglu (2002) investigated the sources of real exchange rate movements in Saudi Arabia by decomposing real exchange rate movements into those attributable to real and nominal shocks. Using a popular structural VAR model and assuming long-run neutrality of nominal shocks, they find that real shocks played a significant role in explaining real exchange rate movements in Saudi Arabia. Using a more disaggregated model, they also found that oil production shocks rather than real oil-price shocks are responsible for real exchange rate movements. The implication is that in order to stabilize the real exchange rate, Saudi Arabia should focus on stabilizing oil production.

More recently, Huang and Guo (2007) investigated to what extent the oil-price shock and three other types of underlying macroeconomic shocks impact the trend movements of China’s real exchange rate. Through the construction of a four-dimensional structural VAR model, the results suggest that real oil-price shocks would lead to a minor appreciation of the long-term real exchange rate due to China’s lesser dependence on imported oil than its trading partners included in the RMB basket peg regime and rigorous government energy regulations. The real shocks, as opposed to nominal shocks, are found to be dominant in the variations of the real exchange rate.

The few studies that directly address the relationship between oil prices and the value of the U.S. dollar relative to widely traded currencies are too old to take advantage of the recent consistency in oil-price hikes or are theoretical papers. For example, Frankel (1979) tried to identify the determinants of exchange rates in a flexible (though managed) regime and showed that the international monetary system had to accommodate extraordinarily large oil related shocks which affected trade flows in goods and assets. Huge oil payments had to be recycled. Uncertainties concerning future developments in international politics reached new heights and the prospects for the world economy became gloomier. These developments have placed unprecedented pressures on the markets for foreign exchange as well as on other asset markets. They have been associated with a large slide in the value of the U.S. dollar against certain currencies, and have resulted in speeding up the creation of new institutions like the European Monetary System, which provides the formal frame work for the management of exchange rates among members.

Golub (1983) developed a stock/flow model of the effect of oil-price increases on exchange rates. This model focuses on the wealth-transfer effects associated with oil-price rises, and the implications of these wealth transfers for portfolio equilibrium, with the exchange adjusting to clear asset markets. For example, if oil-price increases result in a reallocation of world wealth in such a way as to increase the demand for Deutschemarks and lower the demand for U.S. dollars, the mark will appreciate against the dollar. The key parameters turn out to be incremental shares of the oil deficit and portfolio preferences. Shares of the oil deficit in turn vary with the relative dependence on OPEC oil, OPEC's import pattern, and the magnitude of OPEC absorption. The model highlights the importance of both the current and capital accounts of the balance of payments. The empirical section of the paper attempts to explain the differences in the response of the foreign exchange market to oil-price increases between the first and second oil shocks of the 1970s. In 1973-4, the dollar appreciated in the wake of unexpected oil price hikes, but tended to depreciate in 1979, following news about oil-price rises. It was found that the most important factor underlying this shift is a sharp increase in the American dependence on OPEC oil. Secondary factors include some diversification out of the dollar on the part of OPEC and a reduction in the U.S. share of industrial country exports to OPEC. A more effective European energy policy may also have played a part by increasing the European elasticity of demand for oil. The implications of oil-price rises for the pound sterling are also examined, with the recent tendency of sterling to appreciate when oil prices rise, attributed to the benefits of North Sea oil, more than offsetting a very large decline in the share of sterling in OPEC wealth. On the other hand, Caprio and Clark (1983) examined an oil-price shock in a portfolio-balance framework. They showed that the exchange-rate impact of higher oil prices depends importantly on the asset preferences of both, oil importers and oil exporters, as well as exchange rate expectations, which are influenced by countries' abilities to adjust to higher oil-prices.

The goal of this research is to assess the current role that oil-price shocks play in determining the value of the USD in the long run as well as in the short term. This analysis seems very pertinent, given the recent turmoil in the oil market and the behavior of the USD. The effect of oil shocks on output and the stock market has been consistently detected (see above); however, for the first time, the consistency and duration of oil-price hikes as presented in Figure 4.6 facilitate a clearer detection of the effect of oil shocks on the value of the USD. As can be seen, oil price hikes have been bounded, with few well documented historical exceptions[15], by a ceiling of $2 dollars until approximately 2001. After that, the hikes went from high to higher in a prolonged and systematic way, and as shown in Figure 4.7, the value of the U.S. dollar moved consistently contrary to these larger-than-average oil-price hikes.

[Insert Figure 5.6 and 5.7 here]

The criteria for selecting the set of countries for this analysis include: (1) the currency must be actively traded, (2) the set of countries must include net oil-exporting countries, (3) included countries should be important trade partners of the U.S., and (4) there should be data available for the post-Bretton Woods era. Table 5.1 presents the 2007 Top World Oil Producers along with their net oil exports. As can be seen, the United States, the third largest oil producer (8.49 million barrels per day) is the largest oil consumer (20.7 million barrels per day), which created the need of importing 12.21 million barrels per day in 2007.

[Insert Table 5.1 here]

Net exporter countries that satisfy the requirements for the analysis are Canada, Mexico, Norway, and Russia. Non-exporting countries that satisfy our requirements for

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[15] The exceptions include the OPEC embargo of 1973, the Iran-Iraq war that began when Iraq invaded Iran in 1980, and the first Gulf War during 1990/1991.

inclusion are Denmark, Japan, Sweden, the United Kingdom, and the Euro area countries (taken as a block), which includes Germany, France, Italy, Netherlands, Belgium/Luxembourg, Ireland, Spain, Austria, Finland, Portugal, Greece, and Slovenia. The majority of these countries are integrants of the Broad Trade Weighted Exchange Index. Figure 6 shows the behavior of this index since 1973. Significant and consistent decline in the index is observed after about 2001. From 2002 to 2007, the index declined by about 23%.

This study found that when oil is added to the basic monetary model, oil price significantly contributes to the explanation of movements in the value of the USD in all of the included countries. In general, an increase in the real price of oil leads to a significant depreciation of the U.S. dollar relative to net oil exporter countries such as Canada, Mexico, and Russia. On the other hand, the currencies of importers of oil, such as Japan and Denmark, suffer a depreciation of their own currency relative to the U.S. dollar when the real price of oil goes up. In addition, the values of the U.S. dollar relative to the currency of countries that are not net exporters or significant importers (such as the United Kingdom) tends to go down.

The remainder of the essay is organized as follows: Section 2 describes the variables and data, Section 3 describes the theoretical framework, Section 4 presents the empirical results, and Section 5 summarizes.

VARIABLES AND DATA SOURCES

The data used in this study consist of monthly observations for the nominal exchange rate, s_t (USD per one unit of foreign currency, i.e., an increase in the nominal exchange rate; s_t, means a depreciation of the USD, whereas a decrease of s_t means an appreciation of the USD), oil price (deflated by U.S CPI), the U.S. money supply relative to the foreign money supply, $m_t - m_t^*$, where m_t represents the U.S. money stock at time t and m^*_t represents the money stock of the foreign country at time t; and the U.S. industrial production relative to the foreign industrial production, $y_t - y_t^*$ where y_t represents the U.S. industrial production and y^*_t represents the foreign industrial production for the countries of Canada, Denmark, Euro Zone (Germany, France, Italy, Netherlands, Belgium/Luxembourg, Ireland, Spain, Austria, Finland, Portugal, Greece, and Slovenia), Japan, Norway, Mexico, Russia, Sweden, and the United Kingdom.

Nominal exchange rate series are from International Financial Statistics (IFS) of the International Monetary Fund (IMF), downloaded from http://www.imfstatistics.org. The money supply and industrial production are from Organization for Economic Co-operation and Development (OECD) statistical databases, downloaded from www.oecd.org/statsportal. Nominal oil price and U.S. Consumer Price Index series come from Federal Reserve Bank of Saint Louis and were downloaded from http://www.frbstlouis.com. Where applicable, data are seasonally adjusted. Full and consistent data from 1975 onward was found for Canada, Denmark, Euro Zone, Sweden, and the United Kingdom; for Japan and Norway, data are available from 1980 onward; for Mexico, from 1993 onward and for Russia from 1995 onward.

THEORETICAL FRAMEWORK

The literature on exchange rate economics is extensive; however, there is no consensus about adequacy of models of exchange rate determination. Prior to the 1970s the dominant international macro model was an open Keynesian model developed by Meade (1951), Mundell (1963), and Fleming (1962). However, such a model was found to be inadequate (Taylor, 1995). Post 1970, the dominant international macro model has been the monetary approach, propelled by the adoption of floating exchange rates following the collapse of the Bretton Woods system in 1971.

The monetary approach conceives the exchange rate as the relative price of two monies, where the relative price becomes a function of the relative supply of and demand for those monies. Under the flexible price monetary model, the domestic demand for money (i.e. the U.S. domestic demand for money), m, is assumed to depend on the price level, p, real income, y, and the level of interest rate, i, as presented below

$$m_t = p_t + ky_t - \theta i_t. \tag{5.1}$$

Similarly, the foreign demand for money, m^*, is represented as follow

$$m_t^* = p_t^* + k^* y_t^* - \theta^* i_t^* \tag{5.2}$$

with all variables, except interest rates, expressed in logarithm. The flexible price monetary model assumes that purchasing power parity (PPP) holds continuously:

$$s_t = p_t - p_t^*. \tag{5.3}$$

Since the domestic money supply determines the domestic price level, p_t and the foreign money supply determines the foreign price level, p_t^* in (5.3), and the money market is assumed to be in equilibrium (money supply = money demand), then the price level functions can be stated as follow:

$$p_t = m_t - ky_t + \theta i_t \tag{5.4}$$

$$p_t^* = m_t^* - k^* y_t^* + \theta^* i_t^* \tag{5.5}$$

Therefore, the exchange rate, s_t, as given by (5.3) can be restated as follow:

$$s_t = (m_t - ky_t + \theta i_t) - (m_t^* - k^* y_t^* + \theta^* i_t^*) \tag{5.6}$$

This can be simplified as follow

$$s_t = m_t - m_t^* - ky_t + k^* y_t^* + \theta i_t - \theta^* i_t^* \tag{5.7}$$

From (5.7) it can be inferred that an increase in the domestic money supply, relative to the foreign money stock, will lead to a rise in s_t (a depreciation of the domestic currency relative to the foreign currency). A rise in domestic real income, *ceteris paribus,* causes an increase in the demand for domestic goods, which results in an appreciation of the domestic currency relative to the foreign currency. An increase in relative interest rate is associated with a depreciation of the domestic currency relative to the foreign currency. In this study, "domestic" refers to the U.S. whereas "foreign" refers to the other country with which the comparison is being made (i.e. Canada, Japan, etc.)

If one imposes $k = k^*$ and $\theta = \theta^*$ in (5.7) and invokes the uncovered interest rate parity, which implies that $i - i_t^* = E(\Delta s_{t+1} | \Omega_t)$ and where $E(. | \Omega_t)$ denotes the mathematical expectation conditioned on the information set Ω available at time *t*, then (5.7) becomes

$$s_t = (m_t - m_t^*) - (y_t - y_t^*) + E(\Delta s_{t+1} | \Omega_t) \tag{5.8}$$

If s_t is $I(0)$ or $I(1)$,[16] then Δs_{t+1} will be equal to zero in the steady state (Rapach and Wohar, 2002). As a result, (5.8) becomes

$$s_t = (m_t - m_t^*) - (y_t - y_t^*) \tag{5.9}$$

In the first stage of this analysis, tests were made for the existence of a stable long-run relationship among s_t, $(m_t - m_t^*)$ and $(y_t - y_t^*)$, using the popular Johansen (1988, 1991) trace and maximum eigenvalue tests. In other words, we want to assess whether or not deviations of s_t from a linear combination of $(m_t - m_t^*)$ and $(y_t - y_t^*)$ are stationary. In order to proceed with the cointegration analysis, the study investigates for the presence of unit root in the above-mentioned time-series. This is very important because non-stationary series at level that achieve stationary when first differenced is a necessary condition for cointegration analysis. A detailed study of the series is conducted in Table 5.2. A battery of unit root tests, including the Augmented Dickey-Fuller (ADF) test (Dickey and Fuller, 1979), the GLS-DF test (Elliot et al. 1996) and the Kwiatkowski-Phillips-Schmidt-Shin (KPSS) (1992) are conducted to assess whether or not the series are $I(1)$ at level and turn $I(0)$ when first differenced.

On the basis of the previous unit root and cointegration tests, the study proceeds with the second stage of the analysis, this entails estimating the cointegrating coefficients. Such a procedure is needed to obtain a clear picture of how each of the exchange rate determinants influences the value of the domestic exchange rate, in the long run. This is a key step in this study because even though the above mentioned series may be found to

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[16] In our unit root test results reported in Table 2, we find that s_t is either $I(0)$ or $I(1)$ for all the countries we consider.

be cointegrated, as with the case of PPP analysis, it may be that the cointegrating vector has no apparent economic meaning. See for example Hakkio and Rush (1991) and Breuer (1994) for critiques of unit root and cointegation tests of PPP. The following cointegrating relationship is estimated:

$$s_t = \beta_0 + \beta_1(m_t - m_t^*) + \beta_2(y_t - y_t^*) + u_t \tag{5.10}$$

The theoretical implications of the simple form of the monetary model represented in (5.10) is that $\beta_1 = 1$ and that $\beta_2 = -1$ *ceteris paribus.* The aim of this study is not to test whether or not the obtained coefficients are statistically different from the implied values but whether or not the included determinants significantly contribute to the explanation of exchange rate behavior.

As with the related purchasing power parity literature, the empirical evidence concerning the flexible price model for exchange rate determination is mixed. The early studies, such as Meese and Rogoff (1983), find that a naïve random walk model outperforms the flexible price model in predicting the USD exchange rates. Subsequent studies confirm the lack of a long-run relationship among the nominal exchange rates and monetary fundamentals during the early post-Bretton Woods float. For example, Meese (1986), Baillie and Selover (1987), McNown and Wallace (1989), Baillie and Pecchenino (1991), and Sarantis (1994) found no evidence of cointegration among nominal exchange rates and these variables. However, as with the early studies concerning purchasing power parity, these analyses may have been affected by the shortness of the length of time between the termination of the Bretton Woods fixed exchange rate regimes and the time of the analyses. Banerjee et al. (1986) showed that in finite samples, cointegrating regressions can result in substantial bias. They suggest that this problem is likely to plague exchange rate regression over floating rate data. The consensus is that cointegration tests yield much more reliable results when estimated over long sample periods (see Froot and Rogoff, 1995 for a discussion about this issue).

Most recent studies show that support for the long-run monetary model of exchange rate determination is not as elusive as it once appeared. See for example Cheung et al. (2005), Rapach and Wohar (2002), Mark and Sul (2001), and Groen (2000). However, even these studies are not fully supportive of the monetary exchange rate determination. It seems that exchange rates most be affected by a battery of macroeconomic and geopolitical influences. The goal of this research is to assess the role that oil price has on the value of the USD in the long-run as well as in the short term. This research seems very timely given the recent fluctuations in the oil market and the behavior of the USD. It is our conjecture that because the remarkable role that oil plays in the economy in general, oil price shocks should significantly impact the price of the USD, especially after movements in the price of oil became an exogenous phenomenon to the U.S. economy.

Consequently, this study estimates a composite model that incorporates the log of real oil price as a determinant of the U.S. dollar.[17] Determinants other than those presented in (5.10) have been used in other studies. For example Cheung et al. (2005) used government debt, terms of trade, and net foreign assets as exchange rate predictors.

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[17] An alternative point of view is presented by Engel et al. (2005) which show that in a rational expectations present-value model, exchange rate helps predict monetary fundamentals. The implication of their study is that exchange rates and fundamentals are linked in a way that is broadly consistent with asset-pricing models of the exchange rate.

On the other hand, Chen and Rogoff (2003) analyzed how primary commodity prices affect the currencies of Australia, Canada, and New Zealand. In the spirit of Cheung et al. (2005) the following composite model is estimated:

$$s_t = \beta_0 + \beta_1(m_t - m_t^*) + \beta_2(y_t - y_t^*) + \beta_3 lroil_t + u_t \qquad (5.11)$$

where $loil_t$ represents the log of real oil price at time t.

EMPIRICAL RESULTS

Unit root test results

Table 5.2 shows the results of the unit root test. Since some tests are more robust than others with respect to the presence of heteroscedaticity, we include the traditional approach of the augmented Dickey and Fuller (1979) test, in addition to the modified augmented Dickey and Fuller test proposed by Elliott et al. (1996), and the KPSS method suggested by Kwiatkowski et al. (1992). Additional information concerning these tests has been included at the bottom of Table 2. Since, in most cases, at least two methodologies support the notion that the series have a unit root at levels, we conclude that the series are non-stationary at level. On the other hand, all series are clearly stationary when first differenced. This is a very important finding because non-stationary at levels is a necessary condition for our analysis. Variables are $I(1)$, if they have a unit root at level, but are stationary when first differenced. This implies that a variable is stationary when its mean and variance are constant over time and the value of the covariance between the two time periods depends only on the distance or lag between the two time periods and not the actual time at which the covariance is computed (Gujarati, 2003).

[Insert Table 5.2 here]

Cointegration test results

The upper panel of Table 5.3 shows the cointegration test results of the basic model represented in (5.10). There is strong support for the existence of a stable long-run relationship among s_t, $(m_t - m_t^*)$, and $(y_t - y_t^*)$ as given by the Johansen (1988, 1991) trace and maximum eigenvalue tests. Except for Norway, where the hypothesis of no cointegration can not be rejected at any conventional level, the cointegrating relationship among s_t, $(m_t - m_t^*)$, and $(y_t - y_t^*)$ seems to be very strong for Canada, Denmark, Euro Zone (Germany, France, Italy, Netherlands, Belgium/Luxembourg, Ireland, Spain, Austria, Finland, Portugal, Greece, and Slovenia), Japan, Norway, Mexico, Russia, Sweden, and the United Kingdom. The lower panel of Table 3 shows the cointegration test results of the composite model represented in (5.11). There is strong support for the existence of a stable long-run relationship among s_t, $(m_t - m_t^*)$, $(y_t - y_t^*)$, and *lroil*, as given by the Johansen (1988, 1991) trace and maximum eigenvalue tests. Except for Norway, where the hypothesis of no cointegration can not be rejected at any conventional level, the cointegrating relationship among s_t, $(m_t - m_t^*)$, $(y_t - y_t^*)$, and *lroil* seems to be very strong for the other included nations.

[Insert Table 5.3 here]

Cointegrating coefficient estimates

Simple form of the monetary model

Cointegrating coefficient estimates for Canada, Denmark, Euro Zone, Japan, Mexico, Russia, Sweden, and the United Kingdom are presented in Table 5.4. (Norway was excluded on the basis of the cointegration results in Table 5.3). In addition to the cointegration coefficient estimates, Table 5.4 (columns 8 and 9) also contains the first differencing coefficient estimates of the model. As can be seen, the cointegrating coefficient estimates of β_1 and β_2 for Canada, Mexico, and Russia are in agreement with the theoretical expectation. However, the estimates for the other countries, even though statistically significant in many cases, do not make much economic sense. For example, in the countries of Denmark, Japan, and Sweden, β_1 is negative, which is opposite to the theoretical proposition. On the other hand, β_2 is positive for Denmark, Japan, and the United Kingdom. These findings are in agreement with the surveys of the empirical exchange rate literature summarized by Frankel and Rose (1995), which presents the various difficulties in empirically relating exchange rate behavior to shocks in macroeconomic fundamental. See Chen and Rogoff (2003) for additional discussion about this issue. Table 5.4 support the general notion of a long-run relationship among s_t, $(m_t - m_t^*)$, and $(y_t - y_t^*)$. As expected, in the short run, the relationship among these variables is insignificant (see columns 8 and 9 of Table 4.4).

[Insert Table 5.4 here]

Composite model

Table 5.5 presents the estimation of (5.11) for the above mentioned countries. As can be seen, oil price significantly contributes to the explanation of movements in the value of the USD in all of the included countries. In general, an increase in the real price of oil leads to a significant depreciation of the U.S. dollar relative to net oil exporter countries such as Canada, Mexico, and Russia. Except for Russia, where two of the three estimators employed in the analysis (DOLS and JOH) support this conclusion; all the estimators confirm the effect of real oil price shocks on the value of the U.S. dollar relative to the other two countries over our sample period. This seems to be a logical outcome: as the price of oil goes up, the supply of U.S. dollars (as noted earlier, oil is priced in U.S. dollar) relative to the oil exporter's currency goes up, which would lead to a depreciation of the U.S dollar, *ceteris paribus.* The transmission mechanism can be better understood by tracing an oil purchase transaction by the United States from, say Russia. When an American company imports oil from Russia, a remittance of U.S. dollars is made from the American importer to the Russian company. The Russian company, which needs Rubles to finance the cost of its operation in Russia, sells the U.S. dollars in the foreign exchange market for Russian Rubles. As a result, the supply of U.S. dollars increases while the demand for Russian Rubles goes up, *ceteris paribus*. Consequently, the value of the U.S. dollar relative to the Russian Rubles decreases.

On the other hand, the currencies of importers of oil, such as Japan and Denmark suffer a depreciation of their own currency relative to the U.S. dollar when the real price of oil goes up. This is a logical outcome as well: importers of oil need to purchase U.S. dollars in the international currency market in order to pay for the imported oil. As such, the supply of these currencies goes up, which put downward pressure on their values relative to the U.S. dollar, *ceteris paribus*. In addition, the values of the U.S. dollar relative to the currency of countries that are not net exporters or significant importers (such as the United Kingdom) tends to go down. The reason for this outcome may be that since the British Pound is actively traded in the international currency market, an overall increase in supply of U.S. dollars (due to increased purchase by the United States and all other net importers of oil) would put downward pressure on the U.S. dollar value, *ceteris paribus.*

[Insert Table 5.5 here]

Table 5.6 presents the estimates of the speed of adjustments that govern the adjustments to the long-run equilibrium. The speed of adjustments for Japan, Mexico, Russia, Sweden, and the United Kingdom is all negative and statistically significant. This implies that the monetary fundamentals and the price of oil are weakly exogenous for these countries. See Engle et al. (1983) and Rapach and Wohar (2002). In other words, when deviations from the long-run equilibrium occur in Japan, Mexico, Russia, Sweden, and the United Kingdom, it is primarily the exchange rate that adjusts to restore long-run equilibrium over the included sample, rather than the modeled determinants of exchange rates. The null hypothesis as presented in (2.3) that the speeds of adjustments are zero can be rejected at any conventional significance level for these countries. This would imply that if the exchange rates were higher than expected a priori in the last month, in the current month it would be decreased by the given speed of adjustments to restore the long-run relationship between the exchange rates and the included exchange rate determinants. In other words, the included determinants are (*weakly*) exogenous.

When one concentrates on columns (2) of Table 5.6 for the VECM associated with the Johansen estimates, the error correction terms (speed of adjustments) are about 1 percent for Japan and Sweden; about 2 percent for the United Kingdom; close to 6% for

Russia; and a significantly larger 18 percent for Mexico. The latter implies, for situations away from the steady-state, a much faster speed of adjustment to long-run equilibrium for Mexico than the other countries mentioned. One can associate such a finding with the closeness of the United States to Mexico, not only in distance but also the commercial integration between these two countries as facilitated by the North American Free Trade Agreement. The exports of Mexican oil are less diversified or diluted than other net oil exporters. For example, according to the Energy Information Administration, in 2007 Mexico exported 1.79 million barrels of oil per day (bbl/d), of which 1.7 million bbl/d was exported to the United States. In other words, Mexico exported close to 95% of its total oil exports to the U.S. It is reasonable to assume that this increases the sensitivity of the Mexican peso to fluctuations in oil prices.

To strengthen the proposition that when deviations from the long-run equilibrium occur in countries that exhibit significant speed of adjustments it is the exchange rate that adjusts to restore the long-run equilibrium over our sample, the order of the variables in the VAR-based VECM was switched to [$lroil_t$, $m_t - m_t^*$, $y_t - y_t^*$, e_t] and the speed of adjustments (α) was separately estimated. The reestimated α's (not reported in Table 5.6), along with the standard errors and t-statistics for these countries are, Japan: -0.02, 0.006, -0.421; Mexico: -0.02, 0.017, -1.271; Russia: 0.002, 0.022, 0.1097; Sweden: -0.010, 0.016, -1.680; and U.K: -0.021, 0.020, -1.05, which are all not statistically significant. This confirms that oil prices are weakly exogenous in relationship to the exchange rate over our sample (see Engle et al. 1983) and that it is the exchange rate that adjusts to restore the long-run equilibrium.

The other implication is that unidirectional Granger causality going from the predictors to the exchange rates is supported in two ways: First, in the long-run, the cointegrating coefficients are driving the exchange rates with no feedback. Second, the temporal deviations from the long-run path are corrected by changes in the exchange rates. In summary, this study finds a long-run and a short-run unidirectional causation for these particular countries.

With regard to Canada, Denmark, and the Euro, the speed of adjustments is not statistically different from zero. The interpretation of this finding is that, for these countries, when deviations from the long-run equilibrium occur, the adjustments take place during the current month to restore the long-run relationship between the exchange rates and the included exchange rate determinants (Gujarati, 2003). Since the speed of adjustment is not statistically significant one way or the other, one cannot rule out that the exchange rates are weakly exogenous for these countries over the included sample[18].

[Insert Table 5.6 here]

The case of Norway

The unit root test results presented in Table 5.2 indicate that the variables s_t, $(m_t - m_t^*)$, and $(y_t - y_t^*)$ for Norway are nonstationary at levels but become stationary when first differenced. However, Table 3 shows that a long-run relationship among these

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[18] Rapach and Wohar (2002) who, to gain insight into how the long-run equilibrium is restored between nominal exchange rates and monetary fundamentals, estimate differenced models using OLS for both *d(e)* and then *d(f)* separately. They conclude that for Belgium, Finland, and Italy the speed of adjustments in the exchange rate equation is significant for these countries, while the speed of adjustments in the fundamentals equation is insignificant. In other words, they find that the monetary fundamentals are weakly exogenous for these countries. However, for Portugal and Spain, they find a different situation: the null that the speed of adjustment for these two countries is zero cannot be rejected at any conventional confidence level.

variables does not exist (the null hypothesis of no cointegration cannot be rejected at any conventional level). The variable *logroil* is also nonstationary at level but becomes I(0) when first differenced. A long-run relationship does not exist among these four variables either. As a result, we proceed with the estimation of the VAR model: [e_t, $m_t - m_t^*$, $y_t - y_t^*$, $logroil_t$] using first difference of these variables. Next, the generalized impulse response functions are employed to find how each variable responds to shocks by the other variables of the system. Unlike the orthogonalized impulse response functions obtained by using the Cholesky factorization, the generalized variance decomposition and impulse response functions are unique and invariant to the ordering of the variables in the VAR (see Koop et al. 1996, and Pesaran and Shin 1998, for a full discussion concerning this issue). The lag-length for the VAR is chosen by a combination of minimization of the Likelihood Ratio (LR), Final Prediction Error (FPE), Akaike (AIC), Schwarz-Bayes (SBIC) and Hannan Quinn (HQ) information criteria. A maximum lag-length of 12 is assumed. A battery of tests is performed to check for serial correlation, misspecification, and instability problems. The VAR was deemed to be free of serial correlation (based on Lagrange Multiplier tests), misspecification problems (as reflected by the residual correlation matrices), or instability problems (all roots have modules less than one and lie inside the unit circle). If the VAR is not stable, certain results (such as impulse response standard errors) are not valid (Lütkepohl, 1991).

Figure 5.8 shows the plots of impulse responses of the VAR system stated above. As can be seen from the top and middle chart of Figure 5.8, relative money stock and relative industrial production, the key components of the basic monetary model given by (5.10), seem to have little effect on the U.S. dollar exchange rate relative to the

Norwegian Kroner. However, the bottom chart of Figure 5.8 shows that a shock to the real price of oil brings about statistically significant negative impacts on the U.S. dollar, specifically at the time of the shock and even after four months of the shock. This finding is in agreement with the findings concerning the other countries included in our analysis, as shown in Table 5.5: shocks to the price of oil have a profound impact on the value of the U.S. dollar.

[Insert Figure 5.8 here]

Short term effects using more recent data

Figure 5.9 shows the relationship between the values of the U.S. dollar relative to a basket of broad currencies for the post-Bretton Woods era. As can be seen, both series were quite stable and flat from about 1988 to about 2001. However, from 2001 onward, a significant negative relationship is observed between the two. It seems that when the price of oil started to significantly move upward, the value of the USD started to significantly move downward. Figure 5.10 zooms-in and shows the movements of the two series from 2000; one year after the Euro was established. The negative co-movement between the two series is quite obvious.

[Insert Figures 5.9 and 5.10 here]

One way of providing additional robustness to the previous finding is through the comparison of both in-sample and out-of-sample forecasting abilities of models (5.10) and (5.11). For example, Mark (1995) compares performance of the basic monetary model at longer horizons relative to that of shorter horizons. Comparison of performance of one model relative to another is accomplished through Theil's (1966) *U*-statistic as determined by (2.5). A value of the *U*-statistic larger than one indicates that the basic model does worse than the composite model in minimizing the RMSE. Other comparison techniques include the mean absolute error (MAE) and the mean absolute percentage error (MAPE) as discussed before.

Table 5.7 presents the in-sample forecasting performance comparison of these models. Table 5.7 clearly shows the forecasting superiority of the composite model over the basic model in the case of in-sample comparison. The mean squared error (MSE), mean absolute error (MAE), and mean absolute percentage error (MAPE) decisively and overwhelmingly confirm the in-sample forecasting superiority of the composite model. The ratios of these metrics are all above 1. In addition, the Theil's *U*-statistic, represented by the ratio of $RMSE_B/RMSE_C$ as defined in (2.5) is greater than 1.

[Insert Table 5.7 here]

In addition to the in-sample forecasts, a one-step-ahead out-of-sample comparison as done by Rapach and Wohar (2002) is done. Also included is the Diebold and Mariano (1995) statistics for the out-of-sample test. The Diebold and Mariano (1995) procedure is used to test the null hypothesis that the Mean Square Error of the Composite Model (MSE_C) is equal to the Mean Square Error of the Basic Model (MSE_B), against the alternative hypothesis that $MSE_B > MSE_C$, using a recursive window to generate a series of out-of-sample forecasts, in our case for the last twelve months of the full sample. The holdout sample encompasses the last twelve months of data observations.

Table 5.8 shows the one-step-ahead out-of-sample Theil's *U*-statistic for the basic and composite models as presented in (5.10) and (5.11). Again, Theil's *U*-statistic is also greater than 1. The Diebold-Mariano (1995) procedure to test H_0: $MSE_B = MSE_C$ versus

H_1: $MSE_B > MSE_C$ is obtained by regressing the loss differential series on an intercept and a MA (1) term to correct for serial correlation. Negative statistic implies that the basic model forecast beats the composite model forecast. Positive statistic implies that the composite model forecast beats the basic model forecast. In five out of eight countries, the DM tests decisively rejects the null hypothesis that $MSE_B = MSE_C$, supporting the notion that the composite model outperforms the basic model in predicting variation in U.S exchange rates relative to the included currencies. On the other hand, RMSE favor the composite model over the basic model in seven out of eight included countries. Therefore, the superiority of the composite model is confirmed.

[Insert Table 5.8 here]

This empirical study provides support to the hypothesis that the amount of imported oil is so significant that it has a *flattening* impact on the U.S. dollar exchange rate relative to currencies of net exporters of oil. In addition, there is support for the proposition that there exists a long-run equilibrium relationship between the log exchange rate of the U.S. dollar and a linear combination of the exchange rate's fundamental value, including the log of oil price.

SUMMARY

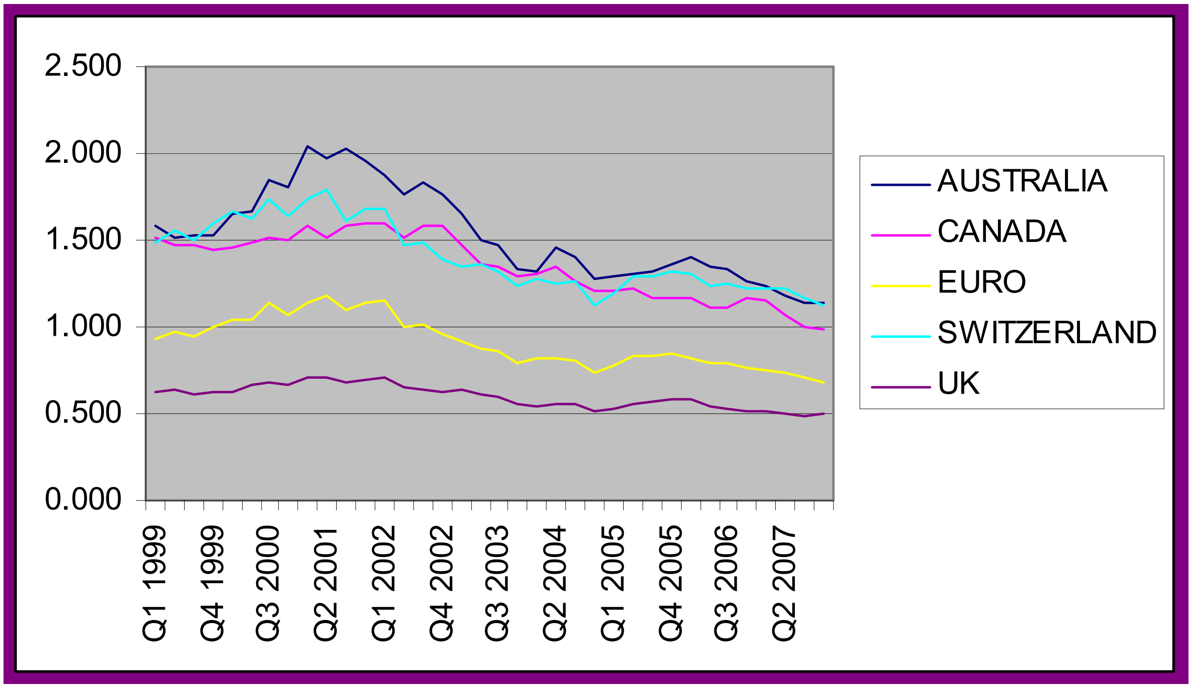
The U.S Dollar (USD) has been continuously losing value against key currencies since 2001. In fact, from 2001 to 2007 the USD has lost 37% against the Canadian Dollar, 15% against the Japanese Yen, 65% against the Euro, 41% against the Pound, 23% against the Trade Weighted Broad Exchange Index, and 34% against the Trade Weighted Major Currencies Exchange Index. Such a condition is of great concern to commodity currency countries such as the exporters of oil and other commodity rich countries. The reason for such a concern is that these natural resources are priced in USD in international markets, and as the USD declines in value so does the purchasing power of these commodities.

Considering the importance of oil to the U.S. economy and the increased of demand for oil by growing economies such as that of China and India, this study tries to assess how oil price shocks affect the value of the USD. Specifically, this study concentrates on assessing the magnitude of the impact that variation in oil prices has on the price of the USD relative to key currencies of net oil exporters and other widely traded currencies. Before assessing the relationship between oil and the USD, tests for the existence of a stable long-run relationship among s_t, $(m_t - m_t^*)$, and $(y_t - y_t^*)$ were done. Except for Norway, where the hypothesis of no cointegration cannot be rejected at any conventional level, the cointegrating relationship among s_t, $(m_t - m_t^*)$, and $(y_t - y_t^*)$ seems to be very strong for Canada, Denmark, the Euro Zone, Japan, Norway, Mexico, Russia, Sweden, and the United Kingdom. However, the cointegrating coefficient estimates are not all in line with theoretical expectations. These findings are in agreement with the surveys of the empirical exchange rate literature summarized by Frankel and Rose (1995), which presents the various difficulties in empirically relating exchange rate behavior to shocks in macroeconomic fundamentals.

When oil is added to the basic monetary model, it was found that, in the long-run, oil price significantly contributes to the explanation of movements in the value of the USD in all of the included countries. In general, an increase in the real price of oil leads to a significant depreciation of the U.S. dollar relative to net oil exporter countries such as Canada, Mexico, and Russia. On the other hand, the currencies of importers of oil, such as Japan and Denmark, suffer a depreciation of their own currency relative to the U.S. dollar when the real price of oil goes up. In addition, the value of the U.S. dollar relative to the currency of countries that are not net exporters or significant importers (such as the United Kingdom) tends to go down.

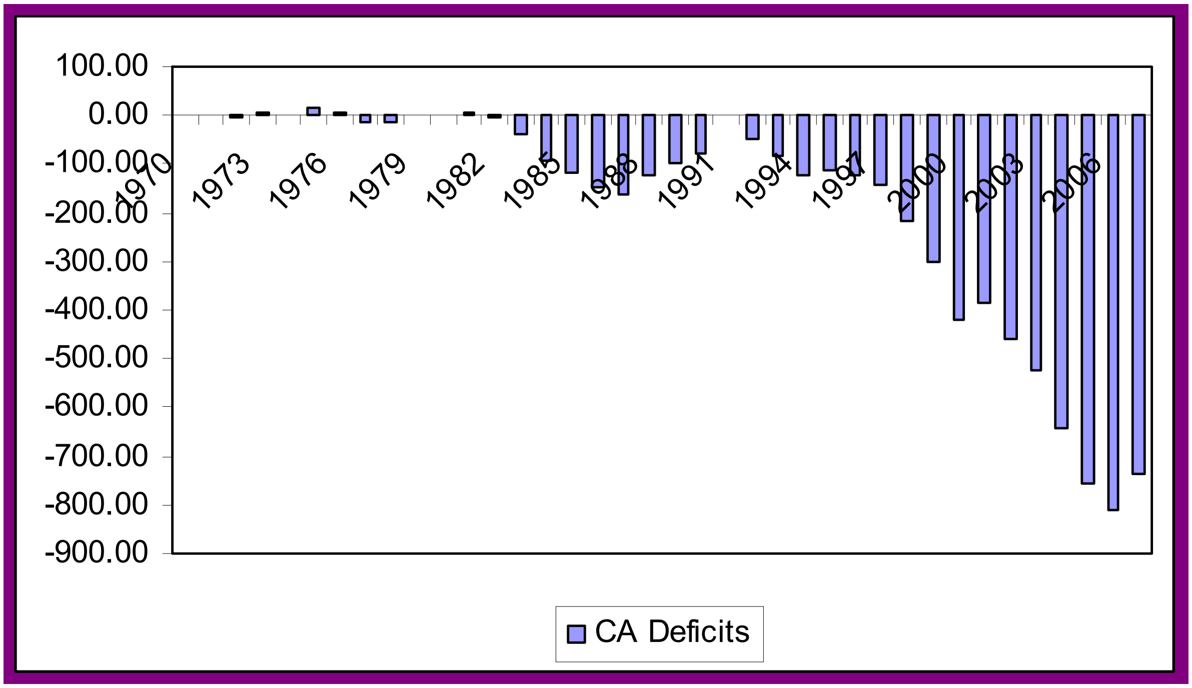
In the short-run, oil price shocks are associated with a decrease in the value of the USD relative to all of the currencies included in the analysis as well as relative to the trade weighted broad and trade weighted major indexes. This finding seems to support the hypothesis that oil is an important determinant of the price of the USD. This study has serious implications for U.S. policy makers. The implication is that in order to stop the weakness of the U.S. dollar, the United States would need to do one or a combination of the following: (1) increase oil production at home, (2) reduce its dependency on oil and find alternative energy sources, (3) reduce its standard of living by decreasing the amount of energy consumption. Since oil is such a pervasive commodity in the global economy and is denominated in U.S. dollars on the international markets, significant purchases of oil by the U.S. causes an increase in the supply of U.S. dollars on foreign exchange markets relative to the currencies of net exporter of oil. Assessing the impact of oil shocks on the U.S. dollar exchange rates should be an important element of our monetary policy framework because the control of imports of oil mimics a direct intervention mechanism.

Figure 5.1
Units of foreign currency for one USD



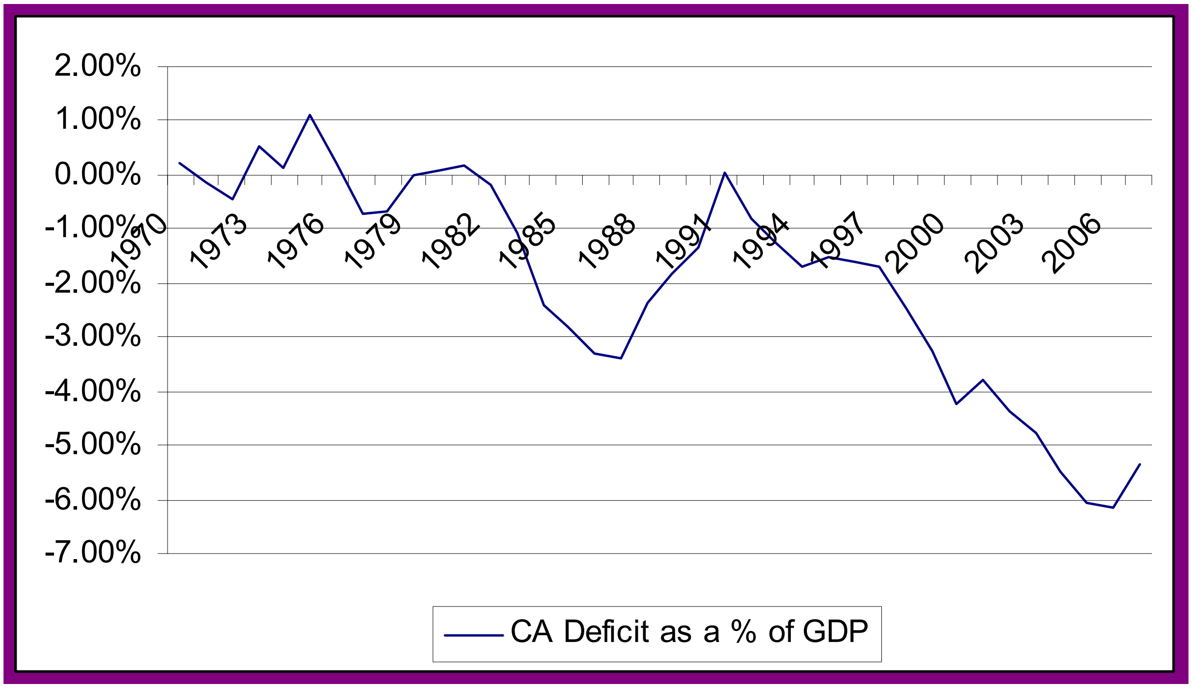
Note: Constructed by the author, using data from International Financial Statistics (IFS) of the International Monetary Fund (IMF), downloaded from http://www.imfstatistics.org.

Figure 5.2
US Current Account Deficits (Billions of US nominal dollars)



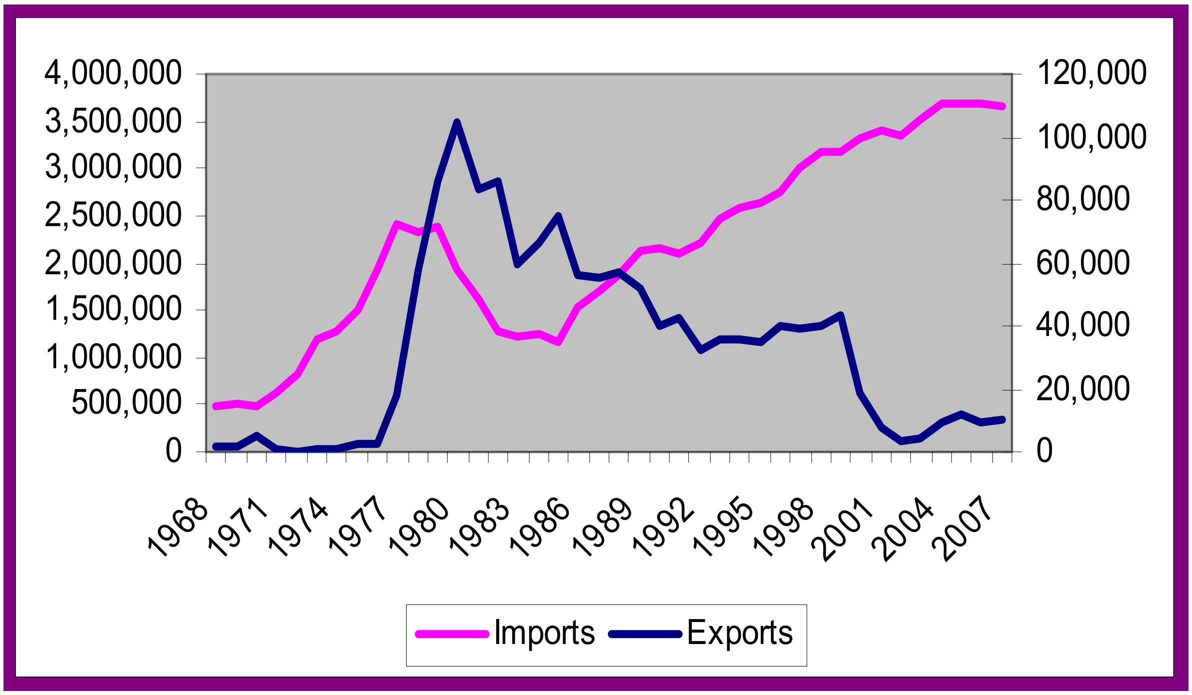
Note: Constructed by the author, using data from International Financial Statistics (IFS) of the International Monetary Fund (IMF), downloaded from http://www.imfstatistics.org.

Figure 5.3
Current Account Deficit as a % of GDP



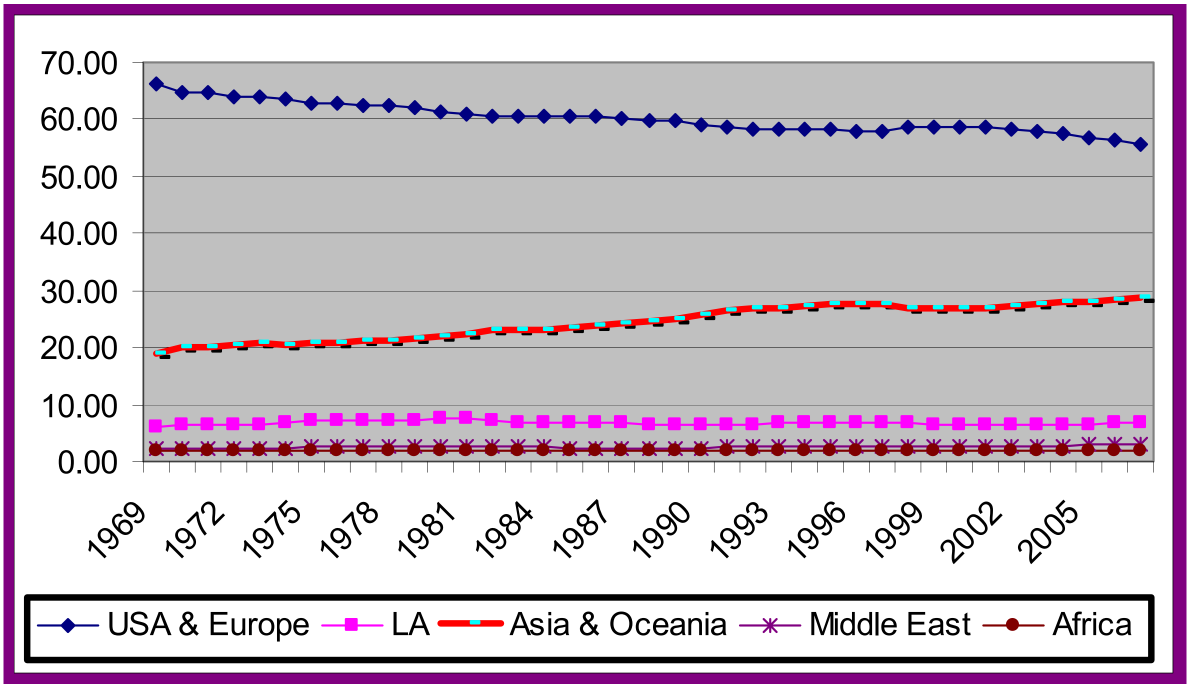
Note: Constructed by the autho, using data from International Financial Statistics (IFS) of the International Monetary Fund (IMF), downloaded from http://www.imfstatistics.org.

Figure 5.4
US Crude Oil Imports and Exports (Thousand Barrels)



Note: Constructed by the author, using data from Energy Information Administration (EIA), downloaded from http://www.eia.doe.gov.

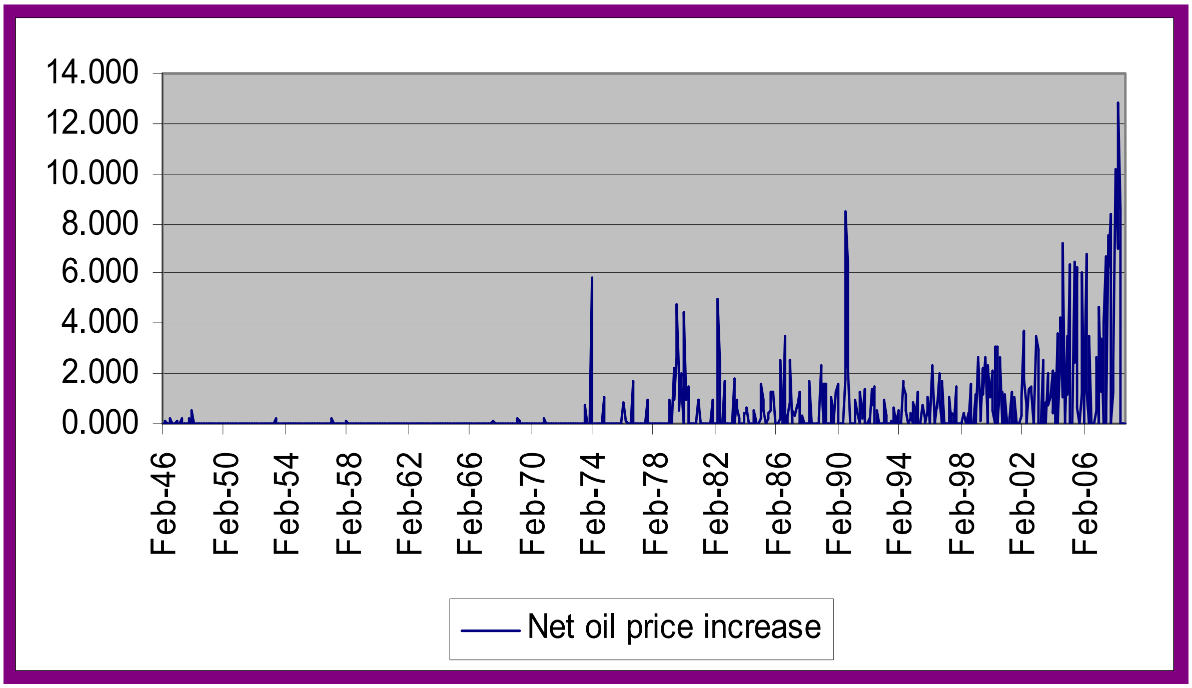
Figure 5.5
World Real Gross Domestic Product Shares



Source: data from the ERS International Macroeconomic Data Set

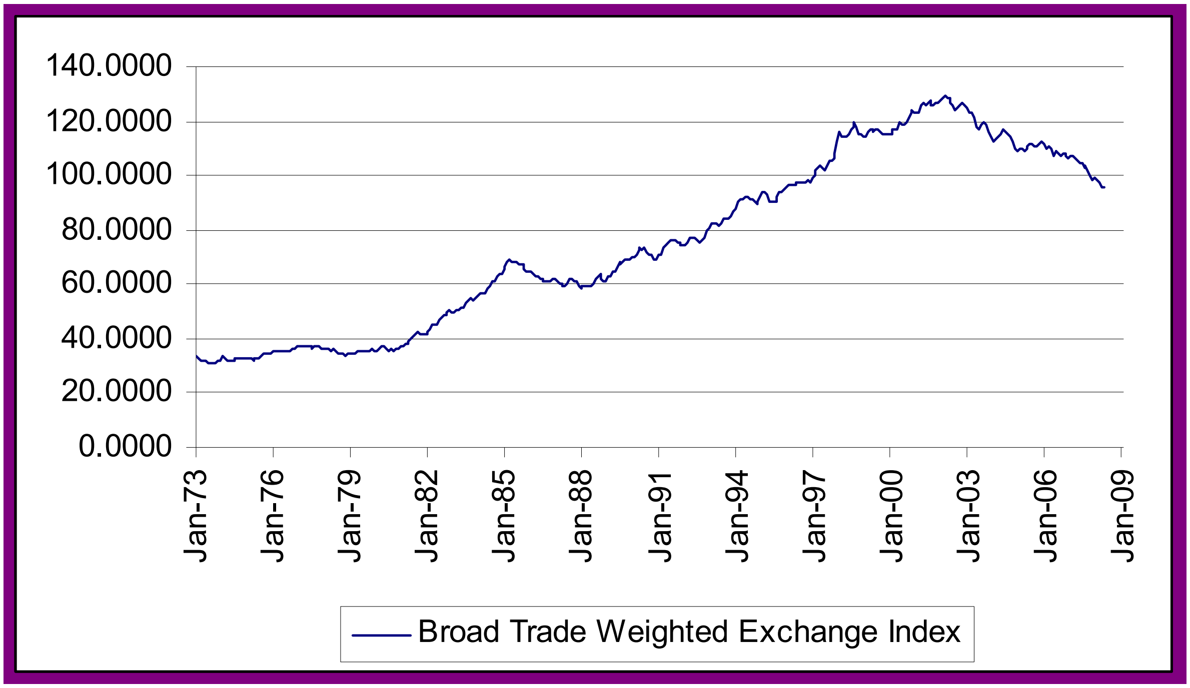
Note: Constructed by the author, using data from the United States Department of Agriculture's Economic Research Service (ERS), International Macroeconomic Data Set, downloaded from http://www.ers.usda.gov/Data/Macroeconomics.

Figure 5.6
Oil price hikes



Note: Constructed by the author, using data from Energy Information Administration (EIA), downloaded from http://www.eia.doe.gov.

Figure 5.7
Broad Trade Weighted Exchange Index



Note: Constructed by the author, using data from the Federal Reserve Bank of St.Louis, downloaded from http://www.frbstlouis.com.

Figure 5.8
Impulse Responses of U.S dollar
VAR [e_t, $m_t - m_t^*$, $y_t - y_t^*$, $logroil_t$]

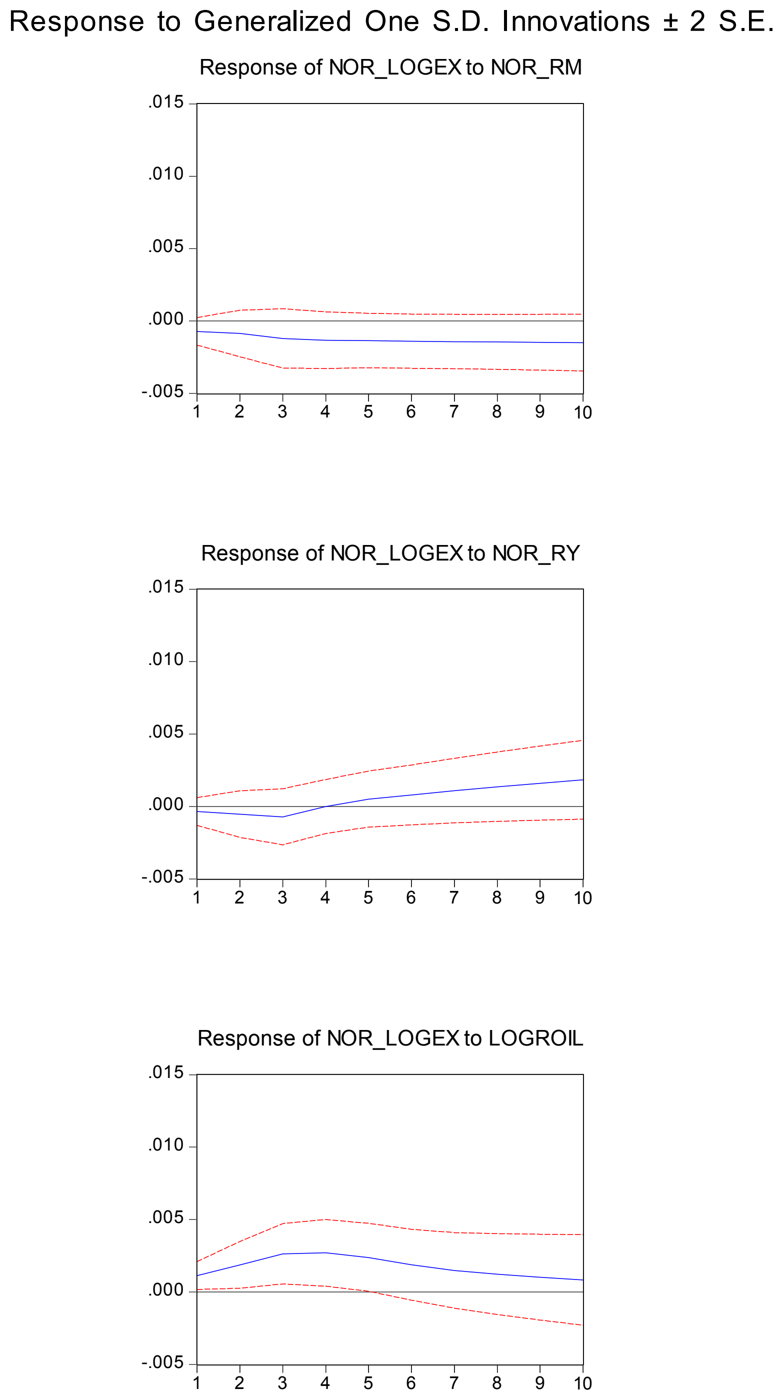
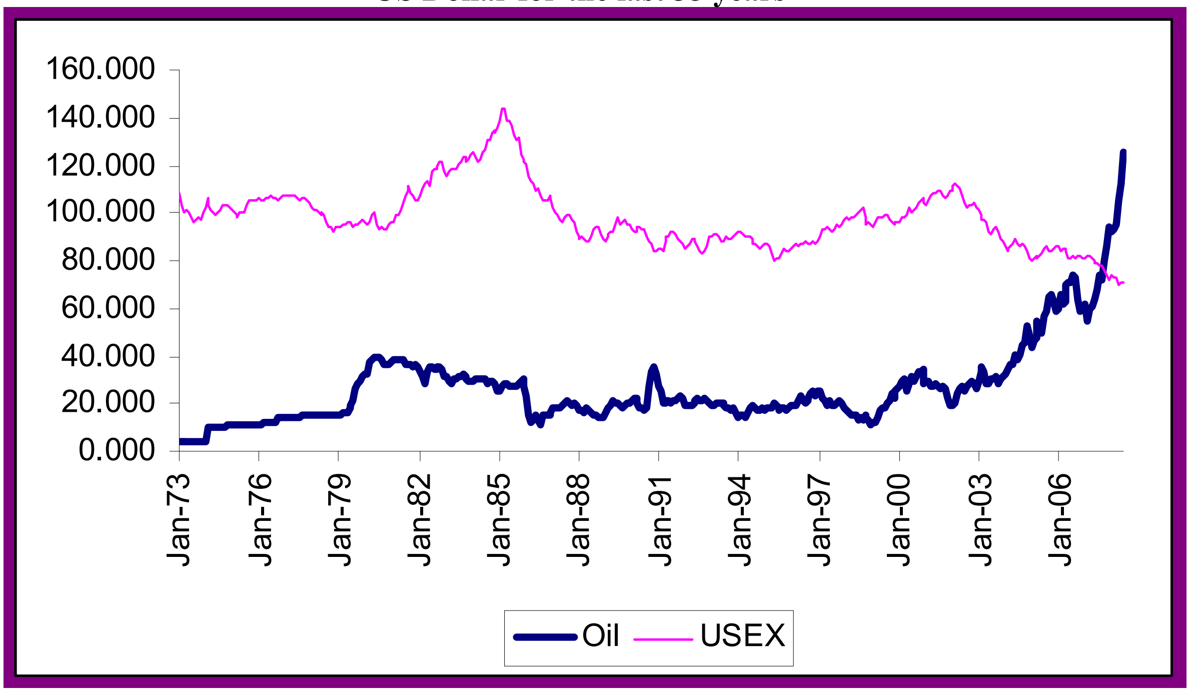
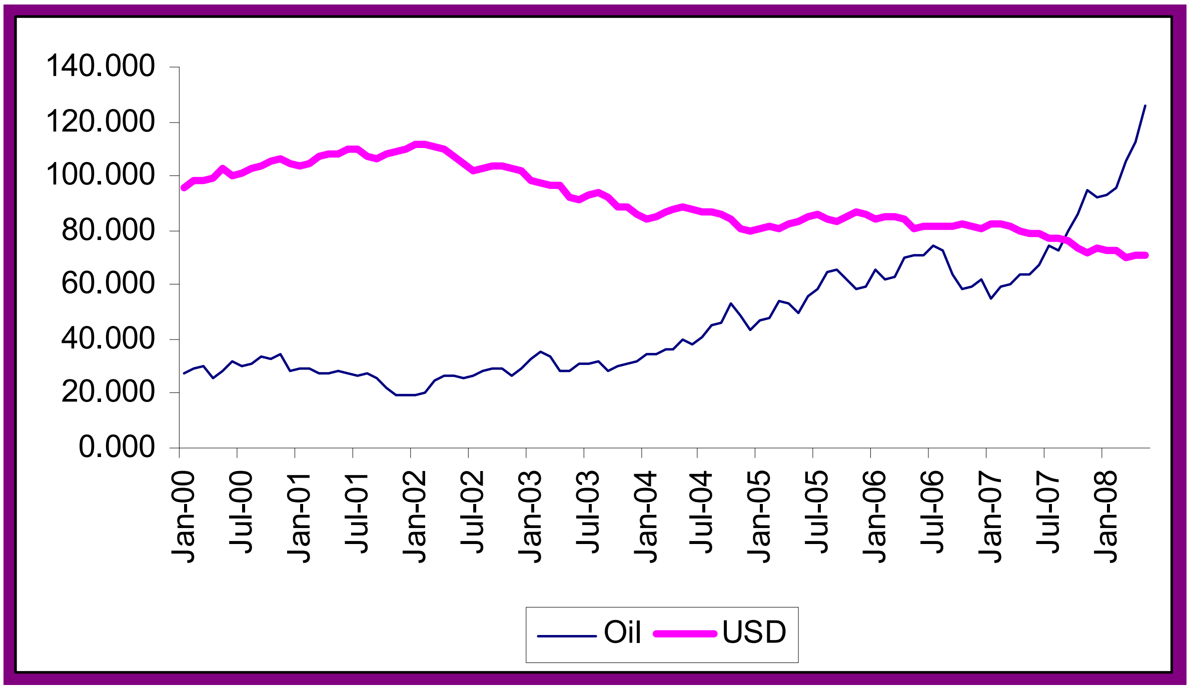


Figure 5.9
Relationship between oil price and the value of the US Dollar for the last 35 years



Note: Constructed by the author, using data from Energy Information Administration (EIA), downloaded from http://www.eia.doe.gov. and data from the Federal Reserve Bank of St.Louis, downloaded from http://www.frbstlouis.com.

Figure 5.10
Relationship between oil price and the value of the US Dollar for the last 8 years



Note: Constructed by the author, using data from Energy Information Administration (EIA), downloaded from http://www.eia.doe.gov. and data from the Federal Reserve Bank of St.Louis, downloaded from http://www.frbstlouis.com.

Table 5.1
Top World Oil Producers, 2007
(Million barrels per day)

Rank	Country	Production	Consumption	Net exports/(imports)
1	Saudi Arabia	10.23	2.31	7.92
2	Russia	9.88	2.86	7.02
3	United States	8.49	20.70	(12.21)
4	Iran	4.04	1.74	2.30
5	China	3.90	7.58	(3.68)
6	Mexico	3.51	2.05	1.46
7	Canada	3.36	2.35	1.01
8	United Arab Emirates	2.95	0.40	2.55
9	Venezuela	2.67	0.64	2.03
10	Norway	2.57	0.25	2.32
11	Kuwait	2.61	0.34	2.27
12	Nigeria	2.35	0.31	2.04
13	Brazil	2.28	2.31	(0.03)
14	Algeria	2.17	0.30	1.87
15	Iraq	2.09	0.61	1.48
16	Libya	1.84	0.29	1.55
17	United Kingdom	1.69	1.76	(0.07)

Source: Data gathered from EIA: http://tonto.eia.doe.gov/country/index.cfm

Table 5.2
Unit root test results

(1) Variable	(2) Trend?	(3) ADF	(4) DF-GLS	(5) KPSS	(6) Determination
Canada(1975:1-2007:12)					
s	Yes	-0.10(0)	-0.07(0)	0.69(4)***	$I(1)$
$(m - m^*)$	Yes	-1.47(5)	-1.15(6)	1.59(4)***	$I(1)$
$(y - y^*)$	Yes	-1.77(3)	-1.94(3)	0.59(4)***	$I(1)$
Denmark(1975:1-2007:12)					
s	Yes	-2.36(1)	-2.27(1)	0.52(4)***	$I(1)$
$(m - m^*)$	Yes	-2.61(12)	-2.46(12)	0.82(4)***	$I(1)$
$(y - y^*)$	Yes	-3.16(3)*	-2.80(3)*	0.11(4)***	$I(1)$
Euro Zone(1975:1-2007:12)					
s	Yes	-1.55(0)	-1.29(0)	0.40(4)***	$I(1)$
$(m - m^*)$	Yes	-1.60(6)	-1.58(6)	0.97(4)***	$I(1)$
$(y - y^*)$	Yes	-2.33(1)	-1.40(1)	0.70(4)***	$I(1)$
Japan(1980:1-2007:12)					
s	Yes	-1.60(0)	-1.43(0)	1.16(4)***	$I(1)$
$(m - m^*)$	Yes	-2.25(6)	-0.78(6)	1.64(4)***	$I(1)$
$(y - y^*)$	Yes	-1.60(3)	-0.96(4)	1.14(4)***	$I(1)$
Norway(1980:1-2007:12)					
s	Yes	-2.43(1)	-1.20(1)	0.35(4)***	$I(1)$
$(m - m^*)$	Yes	-1.94(13)	-1.98(13)	1.30(4)***	$I(1)$
$(y - y^*)$	Yes	-0.85(4)	-0.54(4)	1.54(4)*	$I(1)$
Mexico(1993:1-2007:12)					
s	Yes	-3.18(4)*	-0.49(0)	0.52(4)***	$I(1)$
$(m - m^*)$	Yes	-3.72(1)	-0.56(1)	0.76(4)***	$I(1)$
$(y - y^*)$	Yes	-3.07(1)	-2.20(1)	0.11(4)*	$I(1)$
Russia(1995:1-2007:12)					
s	Yes	-0.90(1)	-0.88(1)	0.67(4)***	$I(1)$
$(m - m^*)$	Yes	-0.40(1)	-1.43(1)	0.27(4)***	$I(1)$
$(y - y^*)$	Yes	-2.35(0)	-0.85(0)	0.55(4)***	$I(1)$
Seweden(1975:1-2007:12)					
s	Yes	-1.35(0)	-1.05(0)	0.57(4)***	$I(1)$
$(m - m^*)$	Yes	-2.21(12)	-2.22(12)	0.63(4)***	$I(1)$
$(y - y^*)$	Yes	-4.93(2)***	-0.93(2)	0.38(4)***	$I(1)$
U.K(1975:1-2007:12)					
s	Yes	-2.36(0)	-1.25(0)	0.63(4)***	$I(1)$
$(m - m^*)$	Yes	-0.62(4)	-0.59(4)	1.65(4)***	$I(1)$
$(y - y^*)$	Yes	-1.57(1)	-1.64(1)	1.48(4)***	$I(1)$
Canada(1975:1-2007:12)					
Δs	No	-19.60(0)***	-19.54(0)***	0.73(4)***	$I(0)$
$\Delta(m - m^*)$	No	-3.66(4)***	-1.02(5)	1.90(4)***	$I(0)$ or $I(1)$
$\Delta(y - y^*)$	No	-11.57(2)***	-0.69(7)	0.14(4)	$I(0)$
Denmark(1975:1-2007:12)					
Δs	No	-17.51(0)***	-16.23(0)***	0.05(4)	$I(0)$
$\Delta(m - m^*)$	No	-4.35(11)***	-4.35(11)***	0.07(4)	$I(0)$
$\Delta(y - y^*)$	No	-16.98(3)***	-1.14(10)	0.04(4)	$I(0)$
Euro Zone(1975:1-2007:12)					
Δs	No	-19.04(0)***	-2.35(8)**	0.18(4)	$I(0)$
$\Delta(m - m^*)$	No	-4.74(4)***	-3.36(5)***	0.46(4)*	$I(0)$
$\Delta(y - y^*)$	No	-26.62(0)***	-0.48(10)	0.11(4)	$I(0)$
Japan(1980:1-2007:12)					
Δs	No	-17.65(0)***	-1.40(8)	0.14(4)	$I(0)$
$\Delta(m - m^*)$	No	-1.97(5)	-0.60(5)	5.29(4)***	$I(1)$
$\Delta(y - y^*)$	No	-7.64(3)***	-0.67(8)	0.42(4)*	$I(0)$ or $I(1)$
Norway(1980:1-2007:12)					
Δs	No	-12.87(0)***	-12.53(0)***	0.34(4)	$I(0)$
$\Delta(m - m^*)$	No	-2.83(12)***	-0.32(12)	0.12(4)	$I(0)$
$\Delta(y - y^*)$	No	-14.78(3)***	-1.66(10)*	0.24(4)	$I(0)$
Mexico(1993:1-2007:12)					
Δs	No	-7.11(1)***	-1.93(9)*	0.55(4)**	$I(0)$
$\Delta(m - m^*)$	No	-8.60(0)***	-3.166(2)***	0.88(4)***	$I(0)$
$\Delta(y - y^*)$	No	-15.90(0)***	-0.97(4)	0.06(4)	$I(0)$
Russia(1995:1-2007:12)					
Δs	No	-8.99(0)***	-2.19(2)**	0.38(4)*	$I(0)$
$\Delta(m - m^*)$	No	-8.79(0)***	-8.73(0)***	0.18(4)	$I(0)$
$\Delta(y - y^*)$	No	-11.44(0)***	-11.39(0)***	0.48(4)**	$I(0)$
Seweden(1975:1-2007:12)					
Δs	No	-18.25(0)***	-2.17(8)**	0.23(4)	$I(0)$
$\Delta(m - m^*)$	No	-3.45(11)***	-0.38(12)	0.10(4)	$I(0)$
$\Delta(y - y^*)$	No	-22.74(1)***	-3.43(8)***	0.26(4)	$I(0)$
U.K(1975:1-2007:12)					
Δs	No	-18.53(0)***	-5.07(4)***	0.20(4)	$I(0)$
$\Delta(m - m^*)$	No	-4.11(7)***	-0.90(11)	0.91(4)***	$I(0)$ or $I(1)$
$\Delta(y - y^*)$	No	-25.64(0)***	-1.49(7)	0.11(4)	$I(1)$

Notes: Data are of monthly frequency. The symbol Δ refers to the first-difference of the original series. We include the deterministic trend only when testing in levels as suggested from graph inspection. ADF(k) refers to the Augmented Dickey-uller t-tests for unit roots, in which the null is that the series contains a unit root. The lag length (k) for ADF tests is chosen by the Schwartz Information Criterion. Next to the reported calculated t-alue, in parenthesis is the selected lag length. DF-GLS (k) refers to the modified ADF test proposed by Elliott et al. (1996), with the Schwarz Information Criterion used for lag-length selection. The KPSS test follows Kwiatkowski et al. (1992), in which the null is that the series is stationary and k=4 is the used lag truncation parameter. The symbols * [**] (***) attached to the figure indicate rejection of the null at the 10%, 5%, and 1% levels, respectively

Table 5.3
Cointegration test results

Basic Model

(1) Set of series	(2) Trace	(3) 0.05 Critical Value	(4) Max-Eigen	(5) 0.05 Critical Value
Canada(1975:1-2007:12) $s, (m - m^*), (y - y^*)$	44.31(2)***	29.80	38.41(2)***	21.13
Denmark(1975:1-2007:12) $s, (m - m^*), (y - y^*)$	42.04(2)***	29.80	28.59(2)***	21.13
Euro Zone(1975:1-2007:12) $s, (m - m^*), (y - y^*)$	33.48(2)**	29.80	25.45(2)***	21.13
Japan(1980:1-2007:12) $s, (m - m^*), (y - y^*)$	82.75(2)***	29.80	67.04(2)***	21.13
Norway(1980:1-2007:12) $s, (m - m^*), (y - y^*)$	12.97(3)	29.80	9.79(3)	21.13
Mexico(1993:1-2007:12) $s, (m - m^*), (y - y^*)$	47.22(2)***	29.80	21.59(2)*	21.13
Russia(1995:1-2007:12) $s, (m - m^*), (y - y^*)$	34.36(3)***	29.80	22.73(3)**	21.13
Seweden(1975:1-2007:12) $s, (m - m^*), (y - y^*)$	46.41(3)***	29.80	29.02(3)***	21.13
U.K(1975:1-2007:12) $s, (m - m^*), (y - y^*)$	33.76(2)**	29.80	29.85(2)***	21.13

Notes: The symbols * [**] (***) attached to the figure indicate rejection of the null of no cointegration at the 10%, 5%, and 1% levels, respectively. The lag length is chosen by the FPE, AIC, SC, or HQ Criterion.

Composite Model

(1) Set of series	(2) Trace	(3) 0.05 Critical Value	(4) Max-Eigen	(5) 0.05 Critical Value
Canada(1975:1-2007:12) $s, (m - m^*), (y - y^*), lroil$	62.58(2)***	47.86	37.72(2)***	27.58
Denmark(1975:1-2007:12) $s, (m - m^*), (y - y^*), lroil$	55.74(2)***	47.86	30.32(2)**	27.58
Euro Zone(1975:1-2007:12) $s, (m - m^*), (y - y^*), lroil$	64.41(2)***	47.86	27.70(2)**	27.58
Japan(1980:1-2007:12) $s, (m - m^*), (y - y^*), lroil$	108.66(2)***	47.86	63.33(2)***	27.58
Norway(1980:1-2007:12) $s, (m - m^*), (y - y^*), lroil$	36.95(3)	47.86	25.55(3)	27.58
Mexico(1993:1-2007:12) $s, (m - m^*), (y - y^*), lroil$	63.27(2)***	47.86	28.79(2)**	27.58
Russia(1995:1-2007:12) $s, (m - m^*), (y - y^*), lroil$	56.33(3)***	47.86	31.37(3)**	27.58
Sweden(1975:1-2007:12) $s, (m - m^*), (y - y^*), lroil$	53.78(3)**	47.86	31.55(3)**	27.58
U.K(1975:1-2007:12) $s, (m - m^*), (y - y^*), lroil$	50.76(2)**	47.86	33.18(2)***	27.58

Notes: The symbols * [**] (***) attached to the figure indicate rejection of the null of no cointegration at the 10%, 5%, and 1% levels, respectively. The lag length is chosen by the FPE, AIC, SC, or HQ Criterion.

Table 5.4

Cointegrating coefficient estimates, $s_t = \beta_0 + \beta_1(m_t - m_t^*) + \beta_2(y_t - y_t^*) + u_t$ and first differencing

(1) Country	(2) OLS estimates β1	(3) β2	(4) DOLS estimates[a] B1	(5) β2	(6) JOH-ML estimates β1	(7) β2	(8) OLS 1st Differencing β1	(9) β2
Canada	0.28***	-0.21	0.24***	-0.35***	0.18*	2.00***	0.07	-0.01
(1975:1-2007:12)	(0.07)	(0.34)	(0.03)	(0.13)	(0.11)	(0.49)	(0.16)	(0.08)
Denmark	-0.62***	0.58***	-0.65***	0.66***	-1.17***	2.59***	-0.05	0.04
(1975:1-2007:12)	(0.11)	(0.15)	(0.11)	(0.16)	(0.36)	(0.66)	(0.03)	(0.04)
Euro Zone	-0.63***	-0.62***	-0.59***	-0.48***	0.50	1.85***	-0.36	-0.24*
(1975:1-2007:12)	(0.14)	(0.18)	(0.14)	(0.18)	(0.46)	(0.60)	(0.31)	(0.13)
Japan	-1.06***	1.56***	-1.18***	2.01***	-2.53***	7.73***	-0.75*	-0.15
(1980:1-2007:12)	(0.22)	(0.25)	(0.22)	(0.33)	(0.63)	(0.78)	(0.41)	(0.13)
Mexico	0.81***	-3.50***	0.82***	-3.54***	0.32***	-5.40***	0.40*	-0.37
(1993:1-2007:12)	(0.05)	(0.70)	(0.05)	(0.75)	(0.12)	(1.47)	(0.21)	(0.26)
Russia	-0.01***	-0.01***	-0.01***	-0.01***	0.65***	-5.82***	-0.01	-0.01*
(1995:1-2007:12)	(0.00)	(0.00)	(0.00)	(0.00)	(0.10)	(1.02)	(0.01)	(0.00)
Sweden	-0.82***	-0.60	-0.83***	-0.44	-1.74	11.44***	0.01	0.01
(1975:1-2007:12)	(0.24)	(0.57)	(0.25)	(0.65)	(1.30)	(2.35)	(0.07)	(0.06)
United Kingdom	0.19***	0.25***	0.19***	0.30***	0.19**	0.77***	-0.22	0.03
(1975:1-2007:12)	(0.06)	(0.13)	(0.06)	(0.12)	(0.10)	(0.26)	(0.17)	(0.11)

The dependent variables are the US dollar exchange rates relative to the various currencies. All variables are in logs. Newey-West heteroskedasticity and autocorrelation consistent (HAC) standard errors are reported in parenthesis for both OLS and DOLS. The symbols * [**] (***) attached to the figure indicate rejection of the null of no cointegration at the 10%, 5%, and 1% levels, respectively.

[a]One lead and lag of the first-differenced relative money stock and relative industrial production are included in the DOLS regressions.

Table 5.5

Coefficient estimates of the composite model, $s_t = \beta_0 + \beta_1(m_t - m_t^*) + \beta_2(y_t - y_t^*) + \beta_3 lroil_t + u_t$

(1) Country	(2) OLS estimates β_1	(3) OLS estimates β_2	(4) OLS estimates β_3	(5) DOLS estimates β_1	(6) DOLS estimates β_2	(7) DOLS estimates β_3	(8) JOH-ML estimates β_1	(9) JOH-ML estimates β_2	(10) JOH-ML estimates β_3
Canada (1975:1-2007:12	0.04 (0.09)	-0.52* (0.27)	0.22*** (0.04)	0.05 (0.04)	0.03 (0.12)	0.18*** (0.02)	-0.47*** (0.10)	1.71*** (0.39)	0.25*** (0.06)
Denmark (1975:1-2007:12	-0.43*** (0.09)	0.62*** (0.15)	-0.14*** (0.02)	-0.44*** (0.10)	0.68*** (0.17)	-0.15*** (0.05)	-0.47 (0.34)	2.63*** (0.50)	-0.44*** (0.13)
Euro Zone (1975:1-2007:12	-0.84*** (0.16)	-0.64*** (0.15)	0.18*** (0.05)	-0.80*** (0.16)	-0.53*** (0.15)	0.18*** (0.06)	-1.16** (0.49)	1.63 (1.02)	0.46*** (0.11)
Japan (1980:1-2007:12)	-0.39* (0.23)	1.18*** (0.24)	-0.44*** (0.11)	-0.49** (0.22)	1.50*** (0.31)	-0.44*** (0.11)	-3.74*** (0.86)	8.47*** (0.96)	-0.90* (0.49)
Mexico (1993:1-2007:12)	0.97*** (0.04)	-3.47*** (0.54)	0.19*** (0.03)	0.98*** (0.05)	-3.56*** (0.56)	0.19*** (0.03)	0.21*** (0.04)	0.96*** (0.05)	3.36*** (0.45)
Russia (1995:1-2007:12)	-0.01*** (0.00)	-0.01*** (0.00)	0.01 (0.00)	-0.01*** (0.00)	-0.01*** (0.00)	0.02* (0.01)	1.02*** (0.12)	-3.63*** (0.83)	1.13*** (0.31)
Sweden (1975:1-2007:12)	-0.89*** (0.19)	-0.53 (0.49)	0.40*** (0.07)	-0.92*** (0.19)	-0.39 (0.55)	0.41*** (0.07)	-2.57*** (0.89)	14..40*** (3.01)	0.80*** (0.30)
United Kingdom (1975:1-2007:12	-0.02 (0.05)	-0.11** (0.06)	0.25*** (0.03)	-0.02 (0.06)	-0.08 (0.13)	0.25*** (0.06)	0.50 (0.32)	2.11*** (0.62)	0.72** (0.27)

The dependent variables are the US dollar exchange rates relative to the various currencies. All variables are in logs. Newey-West heteroskedasticity and autocorrelation consistent (HAC) standard errors are reported in parenthesis for both OLS and DOLS. The symbols * [**] (***) attached to the figure indicate rejection of the null of no cointegration at the 10%, 5%, and 1% levels, respectively.

[a]One lead and lag of the first-differenced relative money stock and relative industrial production are included in the DOLS regressions.

Table 5.6
Speed of adjustments (α)

(1) Country	(2) α	(3) S.E.	(4) t-stat
Canada (1975-2007)	-0.012	0.010	-0.605
Denmark (1975-2007)	0.005	0.008	0.649
Euro (1975-2007)	0.005	0.016	0.291
Japan (1975-2007)	-0.007***	0.003	-2.06
Mexico (1993-2007)	-0.176***	0.036	-4.797
Russia (1995-2007)	-0.055***	0.010	-5.510
Sweden (1975-2007)	-0.008***	0.003	-2.476
U.K (1975-2007)	-0.019***	0.006	-3.166

The speed of adjustment (α) measures the impact of lagged one period deviation from the long-run vector on exchange rate differences as dependent variable. *, **, *** indicates significant at the 10, 5, and 1 percent levels, respectively

Table 5.7. Basic Model and Composite Model
In-Sample Forecasting Performance Comparison

	Basic Model			Composite Model			
	RMSE[a]	MAE[b]	MAPE[c]	RMSE[a]	MAE[b]	MAPE[c]	U[d]
Canada	0.048	0.038	349.22	0.042	0.034	321.30	1.14
Denmark	0.046	0.037	3.49	0.043	0.036	3.44	1.07
Euro	0.067	0.054	111.65	0.063	0.050	103.06	1.06
Japan	0.102	0.087	4.00	0.093	0.080	3.72	1.10
Mexico	0.097	0.079	3.99	0.078	0.061	3.11	1.24
Russia	0.024	0.018	36.28	0.023	0.017	35.28	1.04
Sweden	0.102	0.086	11.16	0.089	0.077	9.85	1.15
U. K	0.057	0.043	23.81	0.053	0.039	22.29	1.08

[a]Root Mean Squared Error, [b]Mean Absolute Error, [c]Mean Absolute Percentage Error, [d]U is the ratio $RMSE_B/RMSE_C$

Table 5.8 Root Mean Square Errors (RMSEs) for the Basic and Composite Models for One-Step Ahead, Recursive Out-of-sample Forecast Comparisons.

(1) Dependent Variable	(2) $RMSE_B$	(3) $RMSE_C$	(4) U[a]	(5) DM[b]
Canada	0.0940	0.0750	1.25	5.15***
Denmark	0.0203	0.0200	1.02	1.56
Euro	0.0890	0.0522	1.71	9.37***
Japan	0.1221	0.1363	0.90	-1.32
Mexico	0.1637	0.0922	1.78	9.42***
Russia	0.0247	0.0239	1.03	0.83
Sweden	0.0305	0.0224	1.36	8.48***
United Kingdom	0.0827	0.0524	1.58	7.01***

[a]U is the ratio $RMSE_B/RMSE_C$ where $RMSE_B$ is the root mean square error for the basic model and $RMSE_C$ is the root mean square error for the composite model.

[b]Diebold-Mariano (1995) statistic obtained by regressing the loss differential series on an intercept and an MA(1) to correct for serial correlation. Negative statistics imply that the basic model forecast beats the composite model forecast. Positive statistics imply that the composite model forecast beats the basic model forecast.

*, **, *** indicate significant at the 10, 5, and 1 percent levels, respectively.

CHAPTER VI

CONCLUSION

The United States has been running an increasing current account deficit for more than fifteen years. In fact, the U.S. has a current account deficit with most countries of the world. The implication is that Americans have been enjoying an ever increasing standard of living by consuming way more than what they produce, not only in the area of manufactured goods, but also important commodities such as oil. These persistent deficits translate into additional indebtedness to the U.S. and an ever increasing amount of dollars reserves by countries such as China, Japan, South Korea, and others. Historically, studies concerning transmission of financial shocks have been unidirectional, going from the U.S. to other nations or regions of the world. However, conditions are now ripe to investigate how this remarkable level of financial flows reverting to the United States from these "surplus" countries impact U.S. financial markets. This dissertation explores the effects of reverting financial flows, using financial modeling and forecasting as a research design platform to shed light on three specific issues: (1) the impact of Chinese purchases of U.S. Treasury securities on the U.S. Treasury Yield Curve, (2) the impact of foreign purchases of U.S. corporations' stocks on the U.S. stock market, and (3) the impact of recent oil and other macroeconomic shocks on the U.S. dollar exchange rates.

This dissertation finds that China exerts considerable influence on the U.S. Treasury Yield Curve. An increase in the purchase of U.S. Treasuries by China leads to a significant reduction in the U.S. Treasury yields, specially in the mid-to-long term securities: as the amount of U.S. Treasury securities purchased by China goes up, the price of longer-term securities goes up, driving yields down, *ceteris paribus*.

Not only is the U.S. Treasury Yield Curve lowered by purchases of U.S. Treasuries by China, but also flattened: a hypothesized 1% increase in Treasury Constant Maturity Treasury Securities purchased by China significantly lowers and flattens the U.S Treasury Yield Curve. Using the metaphor by Friedman (2005) and reviewed by Leamer (2007), the flat world is observed in financial flows as well with a stronger effect on longer term securities than on shorter term securities. The explanatory power of purchases of U.S. Treasuries by Chinese investors on the behavior of the U.S. Treasury Yield Curve is corroborated by several forecasting techniques.

These findings have important policy implications. Even though the analyses support the notion that the amount of purchases of U.S. Treasuries by China has contributed to the lowering of the U.S. cost of debt, the price to pay for such benefit in the long-run may be too costly. First, even if at the moment a drastic action by China looks unlikely, the U.S. could become victim of a Chinese run against the dollar if such an action could serve China's imperialistic ambitions or if economic forces not foreseen at the moment dictate such an action. Such a move could be followed by other holders of U.S. Treasuries and would have devastating economic consequences. Second, the greater the influence a particular foreign power has on the interest rate of any other nation, the lesser the relevance of national monetary policy for the influenced country. A country gives up sovereignty when the government of that nation allows exogenous forces to significantly determine important monetary policy tools, such as the level of interest on debt securities. Therefore, it might be in the best interest of the United States to better control both the budget and the current account deficits and to try to live within its means.

With respect to the investigation of the impact of foreign purchases of U.S. corporations stocks (*FPUSC*) on the U.S. stock market performance, after controlling for several variables and conducting multiple analyses, the study finds that foreign purchases of U.S. corporation stocks significantly contribute to the explanation of variation in the S&P 500. In general, a 1% increase in *FPUSC* is associated with a 0.13% to 0.38% increase in the S&P 500 (*ceteris paribus*). This finding is consistent and statistically significant at conventional significance levels throughout specification. Based on this analysis, it can be inferred that there exists a long-run positive and significant relationship between the U.S. stock market and net purchases of U.S. stock by foreign investors. The study also shows that their relationship is time variant as indicated by rolling cointegration analysis. These results indicate that the U.S. market is affected not just by demand in the home market, but also foreign demand for domestic stock. Foreign investors might have different intentions than U.S investors in investing in the U.S. stock market, and their investing decisions may be motivated by more than just the domestic economic climate. But two driving factors are theoretically proposed. First, the concept of "safe-heaven" is considered. Second, the finance theory of diversification is also explored. It has been shown that diversification reduces risk (i.e. the standard deviation of returns) while providing average return performance. The principle applies to worldwide diversification as well: adding international stocks across world markets to a portfolio reduces volatility as long as the movements in international stock markets are not perfectly positively correlated. It can be argued that the observed decoupling of several economies from the influence of the United States has produced some market segmentation. Even a small reduction in the degree of international stock markets' positive correlation improves the benefit of international diversification. As stated by Solnik et al. (1996), diversifying across national markets with low correlation of returns allows investors to reduce their total portfolio risk, presumable without sacrificing returns. The findings support the argument that the U.S. stock market could now be more robust to negative domestic macroeconomic shocks.

With respect to the control variables, the results are in line with Chen et al. (1986) who found a negative relationship between the stock market and inflation and a negative relationship between the stock market and risk and interest rate as well. It is also found that that the inclusion of the foreign purchases in the vector comes together with a decrease in the absolute value of the domestic (inflation, interest rates, and the yield curve) forces in the U.S. stock market. The estimates show that, in a world with rapid and interconnecting financial flows, the demand side variable captured by the foreign appetite for U.S. stocks attenuates the negative effects of the domestic forces. Comparison of forecasting abilities of the basic model relative to the composite model (which include *FPUSC* as predictor) further supports the hypothesis that *FPUSC* has become a significant predictor of the U.S stock market performance.

This study also shows that the U.S Dollar (USD) has been continuously losing value against key currencies since 2001. In fact, from 2001 to 2007 the USD has lost 37% against the Canadian Dollar, 15% against the Japanese Yen, 65% against the Euro, 41% against the Pound, 23% against the Trade Weighted Broad Exchange Index, and 34%

against the Trade Weighted Major Currencies Exchange Index. Such a condition is of great concern to commodity currency countries such as the exporters of oil and other commodity rich countries. The reason for such a concern is that these natural resources are priced in USD in international markets and as the USD declines in value so does the purchasing power of these commodities.

Considering the importance of oil to the U.S. economy and the increased demand for oil by growing economies such as those of China and India, the study assesses how oil price shocks affect the value of the USD. Specifically, this study concentrates on assessing the magnitude of the impact that variation in oil prices has on the price of the USD relative to key currencies of net oil exporters and other widely traded currencies. Before evaluating the relationship between oil and the USD, tests were done for the existence of a stable long-run relationship among s_t, $(m_t - m_t^*)$, and $(y_t - y_t^*)$. Except for Norway, where the hypothesis of no cointegration cannot be rejected at any conventional level, the cointegrating relationship among s_t, $(m_t - m_t^*)$, and $(y_t - y_t^*)$ seems to be very strong for Canada, Denmark, the Euro Zone, Japan, Norway, Mexico, Russia, Sweden, and the United Kingdom. However, the cointegrating coefficient estimates are not all in line with theoretical expectations. These findings are in agreement with the surveys of the empirical exchange rate literature summarized by Frankel and Rose (1995), which presents the various difficulties in empirically relating exchange rate behavior to shocks in macroeconomic fundamentals.

It is found that when oil is added to the basic monetary model, in the long-run, oil price significantly contributes to the explanation of movements in the value of the USD in all of the included countries. In general, an increase in the real price of oil leads to a significant depreciation of the U.S. dollar relative to net oil exporter countries such as Canada, Mexico, and Russia. On the other hand, the currencies of importers of oil, such as Japan and Denmark, suffer a depreciation of their own currency relative to the U.S. dollar when the real price of oil goes up. In addition, the value of the U.S. dollar relative to currency of countries that are not net exporters or significant importers (such as the United Kingdom) tend to go down.

In the short-run, oil price shocks are associated with a decrease in the value of the USD relative to all of the currencies included in the analysis as well as relative to the trade weighted broad and trade weighted major indexes. This finding seems to support the hypothesis that oil is an important determinant of the price of the USD. This finding has serious implications for U.S. policy makers. The implication is that in order to stop the weakening of the U.S. dollar, the United States would need to do one or a combination of the following: (1) increase oil production at home, (2) reduce its dependency on oil and find alternative energy sources, (3) reduce its standard of living by decreasing the amount of energy consumption.

Since oil is such a pervasive commodity in the global economy and is denominated in U.S. dollars on the international markets, significant purchases of oil by the U.S. causes an increase in the supply of U.S. dollars on foreign exchange markets relative to the currencies of net exporter of oil. Assessing the impact of oil shocks on the U.S. dollar exchange rates should be an important element of our monetary policy framework, because the control of imports of oil mimics a direct intervention mechanism.

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BIOGRAPHICAL SKETCH

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In 1994 he went to the University of North Texas in Denton, Texas where he completed his Master of Science in accounting. After working in both academia and the industry for a few more years, he moved to Edinburg, Texas in 2005 to work on his PhD in Finance at the University of Texas Pan American. Mr. Lizardo is a member of several professional organizations including the American Institute of Certified Public Accountants (AICPA), the Financial Management Association (FMA), and the Eastern Finance Association (EFA). His paper "Exchange Rate Volatility in Latin American and the Caribbean Region: Evidence from 1985 to 2005" was recently accepted for publication in the *Journal of International Trade and Economic Development*. Mr. Lizardo is currently an associate business professor at Southwestern Adventist University, in Keene, Texas.