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FOREIGN EXCHANGE RATE RISK

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ABSTRACT

After the Credit Crisis, the foreign exchange market suffered a decline in its market from 2007 to 2010. After the crisis the government was constantly trying to make the foreign exchange market more transparent through regulations along with a shift in markets. Previous literature suggests that in prior crises, U.S. firms remained efficient hedgers during and after the crisis. Apart from other financial crises, the magnitude and globalized effects resulted in the change in the size of the foreign exchange market and government reform.

Assuming that firm’s had to alter their hedging techniques due to a turbulent economic environment, a hypothesis was conducted presuming that U.S. firms who were previously efficient hedgers were no longer efficient after the credit crisis. The purpose of this study is to examine foreign exchange risk before and after the crisis. It is assumed that this risk was not hedged appropriately after the thesis due to both government regulation attempts and that old hedging techniques no longer worked, causing U.S. firms to alter their hedging methods.
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INTRODUCTION

Due to the 2007-2009 credit crisis, the overall foreign exchange market in the over the counter (OTC) market increased from 2007-2010, but OTC trading declined. In 2010, the global foreign exchange turnover in the over the counter (OTC) market grew by 20 percent since 2007. The growth from 2004-2007 was 72 percent for foreign exchange turnover in the OTC market. In 2007, global foreign exchange turnover was $3.3 trillion which expanded to $4 trillion in 2010. The market share in the overall OTC foreign exchange market declined from 18 percent in 2007 to 13 percent in 2010. In 2004, total foreign exchange was trading $276 billion units daily and covered 14 percent of market share. In 2007, $593 billion was traded daily, with an increase of market share of 18 percent. In 2010, market share declined to 13 percent with $533 billion trading daily. (Bedell, 2010)

Figures 1 and 2 show that:

Categorizing the foreign exchange market into instruments used by non-financial customers, all have seen an increase in market share from 2004 to 2007, and a decrease from 2007 to 2010. The spot market increased slightly from a 17 percent market share in 2004 to 18 percent in 2007. In 2010, spot market share decreased to 15 percent. Foreign exchange swaps increased from a 9 percent market share in 2004 to 14 percent in 2007. In 2010, foreign exchange swaps decreased to a 10 percent market share. Currency swaps increased from a 14 percent market share in 2004 to 20 percent in 2007. In 2010, currency swaps declined to an 8 percent market share. Outright forwards, which have a locked-in exchange rate and delivery date, increased from a 27 percent market share in 2004 to 30 percent in 2007. In 2010, outright forwards fell to a 23 percent market share. Foreign exchange options and other products greatly increased from 18 percent
market share in 2004 to 28 percent in 2007. It fell drastically again in 2010 with only a 16 percent market share. (Bedell, 2010)

In addition to the decline of market share of the foreign exchange market after the credit crisis, the government interfered with the structure and regulations of the market. According to Miller (2009), the OTC derivatives market during the crisis created risk exposure and complicated potential failures of market participants even further. Since the OTC market is unregulated, conventional wisdom was that the OTC market was “robust” before the crisis. The crisis challenged the idea that OTC derivatives were meant to create financial stability and reduce risk to firms. Derivatives reform would allow the OTC market to migrate to a regulated exchange market. Exchange markets were able to deal with financial volatility in the crisis that OTC markets could not. This means that derivatives in an exchange market would have to be cleared by a central counterparty, which would monitor, record and confirm all trades in an exchange market. A derivatives clearinghouse would provide greater transparency. (Miller, 2009)

In 2010, Commissioner Michael V. Dunn expressed his opinions on why financial regulatory reform is needed.¹ He believes that congress needs to focus on providing transparency to the markets, reinstating some elements of the Glass-Steagall Act, and actively pursue antitrust laws to address “too big to fail.” (Dunn, 2010) Similarly Ben Bernanke expressed his aim for the derivatives market in 2011 at the Financial Markets Conference. Ben Bernanke describes the goal of a derivatives clearinghouse is to provide more transparency in the OTC derivatives market and to reduce systematic risk in the financial systems. (Bernanke, 2011)

¹ The National Futures Association CPO/CTA Regulatory Seminar
In a letter to the Office of Financial Policy, the ABA Securities Association (ABASA), the Institute of International Bankers (IIB), and the Financial Roundtable (the Roundtable) expressed their concern about transforming the derivatives market from OTC to an exchange market. If derivatives markets shift to exchanges, firms may not hedge their currency risk properly or as efficient as they would in the OTC market because of more restrictions. Inefficient hedging by firms could cause an increase in instability and inefficiency for emerging growth companies and could result in a damper in the job growth in the United States. (Walsh, Miller, & Whiting, 2010)

Due to the magnitude and globalized effects from the credit crisis resulted in the change in size of the foreign exchange market, along with government reform. This crisis differs from past crises, especially in the sense that U.S. firms are more directly affected. In prior crises, inefficient hedgers improved. I do not believe that this was the same case for the global credit crisis. According to Faff and Marshall, firm hedging resulted in limited foreign exchange risk before the crisis. (Faff & Marshall, 2005) Due to the changing environment and greatness of scale of the crisis, firms’ hedging techniques for foreign exchange risk would have to adjust to the new atmosphere. The foreign exchange market and its instruments used for hedging were restricted by the government may have caused previous efficient hedgers to become inefficient. The techniques that were working previously may not function as proficiently during and after the crisis, possibly due to increased risk aversion. Facts from the crisis on size of the foreign exchange market and government interference lead me to test the efficiency of U.S. firms’ hedging during the crisis.
The purpose of this study is to examine foreign exchange risk before and after the credit crisis. Literature suggests that U.S. multinational corporation’s foreign exchange risk was efficiently hedged using foreign exchange derivatives prior to the credit crisis. However, this risk may not be hedged effectively during or following the crisis for two reasons. First, the same techniques may no longer work, indicating that firms need to reevaluate their hedging methods. The crisis was global and presented a much more volatile environment than previous crises. Second, government attempts to regulate over the counter markets may interfere with firms’ ability to hedge as effectively as before.

The results indicate that there were 557 U.S. firms that became inefficient hedgers after the financial crisis. A firm’s total foreign sales, total sales, gains or losses on efficient hedges and their debt-to-equity ratio are leading accounting variables that drive foreign exchange risk.
LITERATURE REVIEW

Multinational firms must hedge their exchange rate risk. Operational hedging has been found to decrease a firm’s exchange rate exposure, along with increasing its stock return. According to Choi and Cao (2009), MNCs have smaller exchange rate risk exposure than non-MNCs, due to the fact that MNCs hedge their exchange rate risk. According to literature on Japanese MNCs by He and Ng (1998), there is smaller exchange rate exposure with highly levered firms (with low liquidity) rather than those with lower leverage. The study also found that Keiretsu MNCs (set of Japanese companies with interlocking business relations and shareholdings) are more exposed to exchange rate risk than non-Keiretsu firms. A study conducted by Reuer and Miller (1998) used a multi-currency model for U.S. firms, rather than a classical single-currency model. Their literature suggests that economic exposure for foreign exchange rate movements is significantly reduced by direct foreign investment.

Previous literature indicates that the direction of exchange rates varies over time due to the fact that firms adjust their behavior in response to changing exchange rate risks, according to (Dominguez and Tesear, 2006). Exchange rates determine if the direction of exchange rate risk is positively or negatively correlated. They find that exchange rate behavior is correlated with firm size, multi-national status of firms, foreign sales, international assets, competitiveness and trade at the industry level.

According to Faff and Marshall (2005), MNCs with greater foreign operations have a larger magnitude of foreign exchange exposure, suggesting that managers can focus on short term cash flows, rather than long term firm value. Their study not only demonstrates exposure, but also the magnitude of exposure. They find that the contribution of overseas business to total revenues
has: no association with the magnitude of foreign exchange exposures for U.S. MNCs. There is a positive association with U.K. MNCs and a negative association with Asia-Pacific MNCs. According to Nieh and Lee (2001), there is no long term relationship in any of the G7 countries in terms of exchange rate and stock prices. Their study states that there is a short term relationship for some of the countries in the former G7, but only for one day. In the German market, currency depreciation drives their stock return down. On the contrary in the Canadian and U.K. markets, currency depreciation stimulates their stock return the following day. In the Japanese and Italian markets, an increase in stock price often causes currency depreciation the following day. In both the long and short term, there is no relationship found when trying to predict the future of U.S. markets.

Use of Foreign Exchange Derivatives

Non-financial companies’ exchange rate exposure is reduced by the use of foreign exchange derivatives (FXDs). According to Anderson, Makar, and Huffman (2004), 1996-1998 was a time of inefficient hedging. Their studies indicated that from 1998-2000, there was a change in the type of derivatives used for hedging. Hedgers can modify their use of FXDs based on their past inefficiencies with FXDs. Past literature finds that past inefficient hedgers tend to increase their future use of FXDs.

Research by DeBruin and Huffman (1999) indicates that empirical evidence is scarce for large company’s use of derivatives. Large companies’ foreign exchange derivatives (FXDs) increase with the level of foreign currency exposure. The degree of geographic concentration is an indication of using less natural hedging. According to Shin and Soenen (1999), small multinational firms are also exposed to foreign exchange risk. Hedging is more common in large firms, however large MNCs hedging activities have been shown not so effective at eliminating
risk. Small MNCs benefit from a weakening in the international value of the U.S. dollar. According to Hagelin and Pramborg (2004), foreign exchange exposure is found to decrease with firm size. Along with size, the usage of foreign denominated debt and currency derivatives is found to reduce a firm’s foreign exchange exposure. The level of inherent exposure (foreign currency revenues minus foreign currency costs) causes foreign exchange exposure to increase. Economic exposure (future cash flows from operations in foreign subsidiaries) is reduced by the hedging of translation exposure.

The use of foreign currency derivatives is found to be associated with lower exchange rate exposure. According to a study done by Nguyen, Faff and Marshall (2007), the introduction of the Euro reduced the number of French firms that have significant exchange rate exposure. The introduction of the Euro reduced the absolutes size and magnitude of the exposure as well. This study finds that in the Euro Zone, firms in the Euro countries have less exchange rate risk with a common currency.

According to Allayannis, Ihrig, and Weston (2001), geographic dispersion of foreign subsidiaries does not reduce exchange rate exposure. Geographically disperse firms are more likely to use financial hedges to protect themselves from exchange rate risk. Allayannis, Ihrig, and Weston found that operational hedgers with foreign currency derivatives are found to increase firm value. Firm’s financial hedging strategies are related to lower exposures. Firms may not be able to maximize their shareholder value if the solely rely on operational hedges for their exchange rate risk management strategy. (Allayannis, Ihrig, & Weston, 2001) According to Pantzalis, Simkins, and Laux (2009), both breadth and depth of a firm’s foreign operations impact a firm’s exchange rate risk exposure. MNCs with greater breadth are less exposed to currency risk while MNCs with more depth (higher concentration in a country or region) are
more exposed to currency risk. Operational hedges create lower exposures for firms with both positive and negative exposure coefficients. (Pantzalis, Simkins, & Laux, 2009) According to Chowdhry and Howe (1999), the optimum financial hedging policy is with foreign currency call and put options and forward contracts. Operational hedging is less important for commodity-based firms along with managing short term exposures. MNCs use operational hedging when both exchange rates and demand are uncertain. (Chowdhry & Howe, 1999)

According to Barklou and Ong (2010), economic turmoil from the credit crisis spilled into the foreign exchange swap market in late 2007 and 2008. This challenged banks’ ability to manage their liquidity risk and roll over their funding requirements. The use of foreign exchange swaps for funding and hedging purposes is not unfailing, especially in times of a financial crisis and market stress. (Barklou & Ong, 2010)

Post Crisis Changes in Foreign Exchange Exposure

There has not been any literature found on foreign exchange hedging after the financial crisis of 2007-2008. Before the recent crisis, U.S. companies along with other foreign multinational corporations have had to adjust their hedging activities after other crises or political events. Literature found previous crises are indicators of how firms after the 2007-2008 financial crisis may react. Previous crises include the Asian Crisis, the Mexican Peso Crisis, and emerging market transitions which forced multinational firms to be more cautious after a crisis.

According to Chen and So (2002), a financial crisis has been shown to increase stock return volatility, which in turn leads to an increase in exchange rate variability. Their study measured how exchange rates fluctuated and how U.S. firms reacted to stock market risk during the Asian Crisis. All of the U.S. MNCs betas rose during this time. Other literature focused on the impact
of the Asian Crisis on the Philippine stock market before and after the crisis. According to Aquino (2005), stock returns in the Philippine market did not significantly react before the crisis. During the crisis, investors and firms demonstrated many different reactions to the exchange rate volatility. Post crisis, there was substantial exposure to exchange rate risk which caused investors to expect risk premiums on their investments. In relation to the Asian Crisis, literature shows that the market is inefficient and proof of inadequate hedging by investors and firms.

Safety first structures and optimization with bilateral U.S.-Mexican portfolios significantly shifted after the 1994 Mexican Peso Crisis. According to Varela and Hassan (2007) and using Markowitz’s mean-variance optimization, Mexico had higher safety-first weights pre-crisis, than it did post-crisis. After the crisis, safety-first optimizations require the U.S. to completely abort from Mexico, rather than attempt to minimize their variances.

Literature shows that firms pay more attention to their foreign exchange risk and hedging activities after a crisis, than they do without a crisis. Evidence from Kiymaz (2003) shows the difference in hedging in emerging market Turkey after a currency crisis. Being an emerging market, Turkish firms have high exposure to foreign exchange risk, especially in terms of importing and exporting. Foreign exchange exposure in Turkish firms after the crisis was much lower than it was before the crisis, proving that firms pay more attention to their activities after a crisis. Agreeing with this theory, Bin, Blenman and Chen (2004) studies suggest that most firms are better hedged against exchange rate risk during and after a crisis, than they were before. Their study examined American Depository Receipt (ADR) performance among currency crises in the past decade. During a currency crisis, ADRs acquire negatively significant abnormal

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2 ADR’s represent ownership in shares of non-U.S. companies that trade in U.S. financial markets.
returns. There is found to be an increase in exchange rate risk exposure when currency is switched from a “pegging” to a “floating” rate. ADRs that have greater firm size and U.S. market activity and more liquidity, tend to have less abnormal returns and less upward movements in currency exposure.

The Current Financial Crisis

Literature conducted on the most recent financial crisis in 2007-2008 allows us to visualize the environment firms were faced with and what led them to change their internal activities. Multinational firms with business abroad were faced with hedging alternatives based on the market conditions during this time.

Literature was conducted on the role of corporate governance in the 2007-2008 credit crisis. According the Erken, Hung, and Matos (2009), firms with more institutional ownership demonstrated more risk before the crisis. Firms with individual boards and institutional ownership experienced more loss in the height of the crisis. Evidence indicates that firms with CEO yearly bonus compensation tended to experience larger losses during the crisis. Corporate governance is positively associated with disciplining firm executives during the losses in the crisis (CEOs were being replaced in many firms that incurred losses). Corporate governance encouraged managers to focus on short term performance rather than firm value, which amplified the losses rather than preventing them. According to Melvin and Taylor (2009), a financial stress index (FSI) could have protected portfolios against the financial stress of the market during the Financial Crisis. Compared to past crises, the current crisis found evidence that a global FSI model could have minimized trade exposure. With specific market conditions, firms could have longed higher interest rate currency and shorted lower interest rate currencies to hedge their risk.
This study is an indication of inefficient hedging during the 2007-2008 financial crisis by U.S. multinational firms.

According to Swagel (2009), there are three constraints that U.S. Treasury officials had to deal with during the 2007-2008 financial crisis: a lack of authority for stabilizing financial measures, a congress unwillingly to grant that authority, and a necessary rapid response to the chaos involved in the crisis. Once the treasury saw the collapse of Bear Sterns and its repercussions, it saw a necessary movement to rescue Fannie Mae and Freddie Mac to calm the markets. Once Lehman Brothers failed, the Treasury was forced to buy illiquid securities from the despairing financial institutions. As the crisis worsened, the Treasury turned to capital injections.

According to Naude (2009), there was optimism in being a developing nation during the 2007-2008 global financial crisis. Some developing nations were affected by the crisis but most were barely affected or avoided a recession all together. The majority of the countries that were affected were able to recover quickly from any damage. Evidence suggests that a crisis amplifies the need and speed for financial development in developing nations.

According to Cecchetti (2009), the U.S. Federal Reserve’s financial instruments prior to the global financial crisis of 2008 were ineffective as a response to the crisis. Starting in December of 2007, the Fed started making changes to their instruments that they thought would add liquidity to financial institutions in need. The Fed was driven to manipulating the composition of their assets in the height of the crisis while lowering the Federal Funds Rate way below its target rate. Before the crisis, the Federal Funds Rate was constantly kept close to its target rate and the Fed was able to focus solely on their balance sheet. The Federal Reserve responded both
conventionally and unconventionally to the crisis, partly due to their inefficiencies in financial instruments prior to the crisis.

According to Jongwanich (2010), Asian countries took lessons from the Asian Crisis and moved more toward long-term capital during and after the current global financial crisis, while further developing their economies. His study stressed the reaction to the Asian Crisis in comparison to the Global crisis of 2008. Foreign direct investment is found to be less effected by a crisis opposed to portfolio investment and bank loans. After the current global crisis, short-term capital was reduced, since it was found to affect portfolio investments in bank loans during the Asian Crisis.
HYPOTHESES

Based on the findings of Faff and Marshall, this study seeks to answer the following research question. The purpose of this study is to examine foreign exchange risk before and after the credit crisis. Literature suggests that U.S. MNCs’ foreign exchange risk was efficiently hedged using foreign exchange derivatives prior to the credit crisis. Due to old techniques no longer working along with government attempts to regulate over-the-counter markets, exchange rate risk may not be hedged effectively during or following the crisis. The key hypotheses are:

Hypothesis #1: U.S. MNC foreign exchange risk is expected to increase following the credit crisis in 2007.

Hypothesis #2: The change in FX risk will be more pronounced for firms with (a) greater contribution of foreign sales to total sales, (b) larger size, and (c) greater reliance on financial hedges.
DATA AND METHODOLOGY

Data

The sample period begins January 2004, three years prior to the 2007 crisis, and ends December 2010, three years after the crisis. Any companies that had insufficient data, such as a stock price below $10 were deleted from the dataset from that year. If a firm had missing data in more than three fields, that firm was also deleted from the dataset for that specific year, suggesting that the firm was not truly active. All ADRs and non-U.S. based firms were eliminated from the sample. I downloaded the daily exchange rate of the Euro in terms of the U.S. dollar (EUR/USD) from January 2004 to December 2010. (Pacific Exchange Rate Service)

The final dataset is an unbalanced panel containing 5,820 firm-year observations. Each company differs from one another in terms of how many years it was present. Each year is assumed to be independent from another and that one year does not affect the next year. In Research Insight, the variables downloaded from January 1, 2004 to December 31, 2010 include the debt-to-equity ratio (DTEQ), total sales (SALE), total foreign sales (TFSALE), total assets (AT), gain/loss on inefficient hedges (HEDGEGL), and total debt (DT), and geographical data for each firm (GAREG). If the geographical data contained “98” then it was a firm with foreign sales. If this field was missing, then that individual firm has no foreign sales for that year.

Table 1 presents the simple summary statistics for the annual company data in relation to their daily stock prices, daily EUR/USD exchange rates, and the daily returns of the market, the New York Stock Exchange. The sample includes the debt-to-equity ratio, total sales, total foreign sales, total assets, gains/losses on efficient hedges, and total debt in 2007. Descriptive statistics present the number of observations, the mean, median, standard deviation, the minimum
observation, and the maximum observation. The mean debt-to-equity ratio for the firms in the sample is 143.79 with a standard deviation of 3060.51 and a minimum and maximum of -63384.12 and 172689.62, respectively. The mean total sales is 2933 with a standard deviation of 13221.14 and a minimum and maximum of -4234.47 and 375376, respectively. The mean total foreign sales is 1935.28 with a standard deviation of 9465.49 with a minimum and maximum of 0 and 269184, respectively. The mean total assets is 7880.45 with a standard deviation of 21.3185 and a minimum and maximum of 0 and 1715746, respectively. The mean hedge on a gain/loss is 0.24579 with a standard deviation of 21.31858 and a minimum and maximum of -300 and 360, respectfully. The mean total debt is 2669.08 with a standard deviation of 29177.97 and a minimum and maximum of 0 and 797168, respectfully.

Table 2 presents the correlation matrix of the panel variable and is used to establish the best cross sectional models to avoid collinearity. Total foreign sales and sales were very highly correlated (positively) with an 88.225 percent correlation. Sales and total foreign sales were also positively related to total assets, with a 46.097 percent correlation for sales and 43.272 percent correlation for total sales. Total assets and total debt have a high positive relationship, a correlation of 85.541 percent. Other raises for concerns were the relationship between total foreign sales and gains/losses on efficient hedges, which showed a negative relationship with -30.721 percent correlation. Total debt had a 33.764 percent correlation with sales and a 28.083 percent correlation with total foreign sales.

Due to the correlation, some of the variables are transformed before being utilized in the models. “PctFrgnSale” is a new variable representing the ration of SALE to TFSALE. This variable gives the percentage of each company’s foreign sales. Another new variable, “EffHedge” is a dummy variable explaining if a firm was efficient in hedging their international
exposure, for that specific year. If a firm was efficient at hedging their exchange rate risk for that year, EffHedge = 1. If they weren’t efficient at hedging, then EffHedge = 0.

Methodology

The first hypothesis is tested by capturing the estimates of foreign exchange risks for each firm using a time series analysis.

Following Faff and Marshall (2005), the first stage regression to estimate is:

\[
R_{it} = \alpha_{0i} + \alpha_{1i}R_{m_{it}} + \alpha_{2i}R_{fx_{it}} + \epsilon_{1i}t
\]

Where

\(R_{it}\) is the return for each of the multinational corporations

\(R_{m_{it}}\) is the return of the market index, the New York Stock Exchange

\(R_{fx_{it}}\) is the return on the EUR/USD exchange rate in period t

In the stage 1 formula, all \(\alpha\)’s are constants which are going to be estimates in the analysis.

The return for each of each of the multinational corporations is \(R_{it}\). This is where each company’s daily stock prices are converted to a return.

The second hypothesis is tested using panel regression with year fixed effects and firm random effects. The independent variables are possible variables that explain risk of international exposure. I am assuming that each year of the panel is independent from another and that one year does not affect the next year. The company name, or GVKEY, for each company has a random effect in the panel dataset. A random effect of a company name comes from a normal
distribution of possible effects. The variable “years” has a fixed effect is the panel dataset. A fixed effect for a variable makes a dummy variable for every value of that variable.

\begin{equation}
\alpha_{2i} = \beta_0 + \beta_{1i}DTEQ_{it} + \beta_{2i}SALE_{it} + \beta_{3i}TFSALE_{it} + \beta_{4i}AT_{it} + \beta_{5i}HEDGEGL_{it} + \beta_{6i}DT_{it} + \varepsilon_{1it}
\end{equation}

Where

DTEQ is the debt-to-equity ratio

SALE is total sales

TFSALE is total foreign sales

AT is total assets

HEDGE GL is the gain or a loss on an efficient hedge

DT is total debt

Another new variable, “EffHedge” is a dummy variable explaining if a firm was efficient in hedging their international exposure, for that specific year. If a firm was efficient at hedging their exchange rate risk for that year, EffHedge = 1. If they weren’t efficient at hedging, then EffHedge = 0.
RESULTS

The results of the time series analysis to test the first hypothesis are found in tables 4 and 5. Table 4 demonstrates the number of firms in each year who were either hedged (efficient hedgers) or unhedged (inefficient hedgers). Table 5 shows the shift in “estimate” of betas for firms from pre-crisis to post-crisis. The year 2007 was used for “pre” and the year 2009 was used for “post.” The table shows formerly hedged firms that remained hedged or became unhedged, and formerly unhedged firms that remained unhedged or became hedged.

According to Panel A in Table 5 in 2007, 557 firms were efficient hedgers pre crisis with an average beta of 80.89. In 2009, those same 577 firms became inefficient hedgers, with an average beta of -0.8710. Panel A is showing that the hypothesis is correct that previous efficient firms became inefficient after the financial crisis. The hypothesis is inclusive and we must look at the second regression with the betas from the first regression.

Table 3 presents the results of the second stage regression according to equation (2). For model 1, the coefficient of the PctFrgnSale variable is positive and is statistically significant at the 1 percent level, indicating that as a firm’s foreign sales increase, so does exchange rate risk. The coefficient for the EffHedge variable is negative and is statistically significant at the 0.1 percent level, indicating that as a firm’s ability to hedge efficiently increases, exchange rate risk decreases. The coefficient for DTEQ is positive and is significant at the 10 percent level, indicating that when the debt-to-equity ratio increases, exchange rate risk increases as well.

For model 2 the coefficient of the PctFrgnSale variable is positive and is statistically significant at the 1 percent level, indicating that exchange rate increases as a firm’s
The coefficient of EffHedge variable is negative and is statistically significant at the 0.1 percent level, indicating that as a firm’s ability to hedge efficiently increases, exchange rate risk decreases. The coefficient on the DTEQ variable is positive and is significant at the 5 percent level indicated that exchange rate increases when a firm’s debt-to-equity ratio does. The coefficient on the DT variable is negative and is not significant.

For model 3 the coefficient on the PctFrgnSale variable is positive and is significant at the 1 percent level indicating that exchange rate risk increases when a firm’s percentage of foreign sales do. The coefficient on the EffHedge variable is negative and is significant at the 0.1 percent level. This indicates that a firm’s exchange rate risk decreases as the firm’s ability to hedge efficiently increases. The coefficient on the DTEQ variable is positive and is significant at the 5 percent level which indicates that as a firm’s debt-to-equity ratio increases, so does their exchange rate risk. The coefficient on the AT variable is negative and is not significant in this model.

For model 4 the coefficient on the PctFrgnSale variable is positive and is significant at the 1 percent level indicating that exchange rate risk increases when a firm’s percentage of foreign sales increase. The coefficient on the DTEQ variable is positive and is not significant in this model. The coefficient on the AT variable is negative and is not significant in this model.

Taken together, these results indicate that there were firms who were previously efficient hedgers that became inefficient after the financial crisis. In all of the panel regression models, the variables PctFrgnSale and EffHedge were the main drivers of foreign exchange risk. The
debt-to-equity ratio was also slightly significant in most of the models. These findings indicate that a firm’s foreign sales, total sales, gains or losses on efficient hedges, and their debt-to-equity ratio are the accounting variables that lead to foreign exchange exposure.
SUMMARY AND CONCLUSION

It all started with a decrease of transactions in the foreign exchange market from 2007 to 2010 which raised suspicion on the hedging position of U.S. firms after the financial crisis in 2007. After the crash the government has and is continuously making attempts to transform foreign exchange into more transparent and regulated markets. Previous literature suggests that in prior crises, U.S. firms remained efficient hedgers during and after the crisis. Apart from other financial crises, the magnitude and globalized effects resulted in the change in the size of the foreign exchange market and government reform.

Assuming that firm’s had to alter their hedging techniques due to a turbulent economic environment, a hypothesis was conducted presuming that U.S. firms who were previously efficient hedgers were no longer efficient after the credit crisis. The purpose of this study was to examine foreign exchange risk before and after the crisis. It was assumed that this risk was not hedged appropriately after the thesis due to both government regulation attempts and that old hedging techniques no longer worked, causing U.S. firms to alter their hedging methods.

In the first regression, 577 U.S. firms that were efficient hedgers before the crisis were no longer efficient after the crisis. The second panel regression concluded that a firm’s total foreign sales, total sales, gains or losses on efficient hedges and their debt-to-equity ratio are the accounting variables that contribute to foreign exchange exposure.
WORKS CITED


APPENDIX

Table 1. Sample Descriptive Statistics

Summary statistics for all U.S. firms in 2007 are included in the event study analysis. Although my data set spans across seven years, from 2004-2010, 2007 was the year the financial crisis hit the markets. The debt-to-equity ratio, total sales, total foreign sales, total assets, gain/loss on efficient hedges, and total debt are all averages of U.S. firms from January to December, 2010.

Table 1. Sample Descriptive Statistics

<table>
<thead>
<tr>
<th>Variable</th>
<th>N</th>
<th>Mean</th>
<th>Median</th>
<th>Std Dev</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>DTEQ</td>
<td>3986</td>
<td>143.7893209</td>
<td>45.7175</td>
<td>3060.51</td>
<td>-63384.12</td>
<td>172689.62</td>
</tr>
<tr>
<td>SALE</td>
<td>3995</td>
<td>2933</td>
<td>334.198</td>
<td>13221.14</td>
<td>-4234.47</td>
<td>375376</td>
</tr>
<tr>
<td>TFSALE</td>
<td>1338</td>
<td>1935.28</td>
<td>231.04</td>
<td>9465.49</td>
<td>0</td>
<td>269184</td>
</tr>
<tr>
<td>AT</td>
<td>4001</td>
<td>7880.45</td>
<td>744.602</td>
<td>59514.86</td>
<td>0</td>
<td>1715746</td>
</tr>
<tr>
<td>HEDGEGL</td>
<td>719</td>
<td>0.24579</td>
<td>0</td>
<td>21.3185847</td>
<td>-300</td>
<td>360</td>
</tr>
<tr>
<td>DT</td>
<td>3989</td>
<td>2669.08</td>
<td>111.761</td>
<td>29177.97</td>
<td>0</td>
<td>797168</td>
</tr>
</tbody>
</table>

Table 2. Correlation Matrix
The correlation matrix presents the correlation, p-value, and the number of observations for each of the panel variables in 2007. SALE is total sales, TFSALE is total foreign sales, AT is total assets, HEDGEGL is hedged gains and losses, and DT is total debt.

<table>
<thead>
<tr>
<th></th>
<th>DTEQ</th>
<th>SALE</th>
<th>TFSALE</th>
<th>AT</th>
<th>HEDGEGL</th>
<th>DT</th>
</tr>
</thead>
<tbody>
<tr>
<td>DTEQ</td>
<td>1</td>
<td>25450</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SALE</td>
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<td>1</td>
<td>0.8621</td>
<td>25414</td>
<td>25519</td>
<td></td>
</tr>
<tr>
<td>TFSALE</td>
<td>-0.00114</td>
<td>0.88225</td>
<td>1</td>
<td>0.9167</td>
<td>&lt;.0001</td>
<td>8392</td>
</tr>
<tr>
<td>AT</td>
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<td>0.46097</td>
<td>0.43272</td>
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<td></td>
<td>25450</td>
</tr>
<tr>
<td>HEDGEGL</td>
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<td>-0.07509</td>
<td>-0.30721</td>
<td>-0.06593</td>
<td>1</td>
<td>4208</td>
</tr>
<tr>
<td>DT</td>
<td>0.00266</td>
<td>0.33764</td>
<td>0.28083</td>
<td>0.85541</td>
<td>-0.08009</td>
<td>1</td>
</tr>
</tbody>
</table>

The correlation matrix presents the correlation, p-value, and the number of observations for each of the panel variables in 2007. SALE is total sales, TFSALE is total foreign sales, AT is total assets, HEDGEGL is hedged gains and losses, and DT is total debt.
Table 3. Panel Regression Results

The following regression is estimated:

\[ \alpha_{2i} = \beta_0 + \beta_{1i}DTEQ_{it} + \beta_{2i}SALE_{it} + \beta_{3i}TFSALE_{it} + \beta_{4i}AT_{it} + \beta_{5i}HEDGEGL_{it} \]
\[ + \beta_{6i}DT_{it} + \varepsilon_{1it} \]

The dependent variable is a coefficient of foreign exchange risk, in which the independent variables explain. The dataset ranges from January 2004 to December 2010; however I am assuming that each year of the panel is independent from another and that one year does not affect the next year. PctFrngSale is TFSALE/SALE, demonstrating how much foreign sales a firm has. EffHedge is a dummy variable that takes a value of 1 if the firm was efficient at hedging against international exposure and 0 if inefficient. DTEQ is a firm’s debt-to-equity ratio. AT is a firm’s total assets. DT is a firm’s total debt. *, **, *** indicate statistical significant at the 10 percent, 5 percent, 1 percent, and 0.1 percent levels, respectively.
<table>
<thead>
<tr>
<th></th>
<th>Model 1</th>
<th>Model 2</th>
<th>Model 3</th>
<th>Model 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>3.714717</td>
<td>4.254554</td>
<td>4.618932</td>
<td>-186.143</td>
</tr>
<tr>
<td></td>
<td>(0.10)</td>
<td>(0.11)</td>
<td>(0.12)</td>
<td>(-3.62)****</td>
</tr>
<tr>
<td>PctFrngSale</td>
<td>235.5266</td>
<td>235.6398</td>
<td>235.8512</td>
<td>234.5061</td>
</tr>
<tr>
<td></td>
<td>(2.77)***</td>
<td>(2.77)***</td>
<td>(2.78)***</td>
<td>(2.77)***</td>
</tr>
<tr>
<td>EffHedge</td>
<td>-248.595</td>
<td>-248.901</td>
<td>-249.041</td>
<td>-249.041</td>
</tr>
<tr>
<td></td>
<td>(-3.95)****</td>
<td>(-3.95)****</td>
<td>(-3.96)****</td>
<td>(-3.96)****</td>
</tr>
<tr>
<td>DTEQ</td>
<td>0.00004</td>
<td>0.00004</td>
<td>0.00004</td>
<td>0.00003</td>
</tr>
<tr>
<td></td>
<td>(1.95)*</td>
<td>(1.99)**</td>
<td>(1.98)**</td>
<td>(1.64)</td>
</tr>
<tr>
<td>AT</td>
<td></td>
<td></td>
<td>-0.00007</td>
<td>-0.00000133</td>
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<tr>
<td></td>
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<td>(-0.01)</td>
</tr>
<tr>
<td>DT</td>
<td>-0.00013</td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td>(-0.48)</td>
<td></td>
<td></td>
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</tbody>
</table>
Table 4. Average “estimates” for Foreign Exchange Beta

The table presents the average “estimate” of foreign exchange betas by year, for hedged and unhedged firms. For each year, there are firms who demonstrated efficient hedging (hedged) and firms that illustrated inefficient hedging (unhedged). The table shows the number of firms in each year that were unhedged or hedged, along with its average mean beta, standard deviation, minimum, and maximum.

<table>
<thead>
<tr>
<th>Year</th>
<th>Firm Position</th>
<th>N</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>2004</td>
<td>Unhedged</td>
<td>347</td>
<td>314.88780</td>
<td>10506.37000</td>
<td>-52043.95000</td>
<td>186485.38000</td>
</tr>
<tr>
<td>2004</td>
<td>Hedged</td>
<td>5110</td>
<td>-4528.30000</td>
<td>205215.20000</td>
<td>-14273552.10000</td>
<td>89369.08000</td>
</tr>
<tr>
<td>2005</td>
<td>Unhedged</td>
<td>1259</td>
<td>3.37948</td>
<td>446.98915</td>
<td>-4420.36000</td>
<td>14431.41000</td>
</tr>
<tr>
<td>2006</td>
<td>Unhedged</td>
<td>1581</td>
<td>-28.65507</td>
<td>1494.60000</td>
<td>-5911.58000</td>
<td>12827.50000</td>
</tr>
<tr>
<td>2006</td>
<td>Hedged</td>
<td>4023</td>
<td>-5.30560</td>
<td>2390.84000</td>
<td>-84882.33000</td>
<td>78290.21000</td>
</tr>
<tr>
<td>2007</td>
<td>Unhedged</td>
<td>1718</td>
<td>51.77345</td>
<td>1996.28000</td>
<td>-384.78900</td>
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<tr>
<td>2007</td>
<td>Hedged</td>
<td>4084</td>
<td>188.08018</td>
<td>11755.92000</td>
<td>-36342.28000</td>
<td>742423.20000</td>
</tr>
<tr>
<td>2008</td>
<td>Unhedged</td>
<td>2329</td>
<td>22.40973</td>
<td>1080.43000</td>
<td>-108.91820</td>
<td>52104.92000</td>
</tr>
<tr>
<td>2008</td>
<td>Hedged</td>
<td>2838</td>
<td>-25.75908</td>
<td>7794.75000</td>
<td>-358451.29000</td>
<td>196925.54000</td>
</tr>
<tr>
<td>2009</td>
<td>Unhedged</td>
<td>1246</td>
<td>-7.08390</td>
<td>378.92423</td>
<td>-12293.65000</td>
<td>4476.89000</td>
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<tr>
<td>2009</td>
<td>Hedged</td>
<td>3092</td>
<td>-3.93704</td>
<td>413.24708</td>
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<td>12722.99000</td>
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<tr>
<td>2010</td>
<td>Unhedged</td>
<td>433</td>
<td>-18.17244</td>
<td>222.78669</td>
<td>-3610.03000</td>
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<td>2010</td>
<td>Hedged</td>
<td>4192</td>
<td>2.52674</td>
<td>562.74890</td>
<td>-29369.36000</td>
<td>16142.06000</td>
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</table>
Table 5. Formerly Hedged and Unhedged Firms

Panel A shows the shift in “estimate” for firms that were previous efficient hedgers (hedged) and who either remain efficient or became inefficient hedgers. Panel B shows the shift in “estimate” for firms that were formerly inefficient hedgers (unhedged) who became efficient or remained inefficient hedgers.

<table>
<thead>
<tr>
<th>Hedging Position</th>
<th>Period</th>
<th>N</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Minimum</th>
<th>Maximum</th>
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<tr>
<td>Panel A: Formerly HEDGED firms</td>
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<tr>
<td>Hedged</td>
<td>Pre</td>
<td>557</td>
<td>80.89118</td>
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<tr>
<td>Unhedged</td>
<td>Post</td>
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<tr>
<td>Hedged</td>
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<td>Hedged</td>
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<td>1950</td>
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<tr>
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<tr>
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<tr>
<td>Unhedged</td>
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<tr>
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<td>0.05799</td>
<td>0.51215</td>
<td>-5.69586</td>
<td>3.38772</td>
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Figure 1. Total Foreign Exchange Market

<table>
<thead>
<tr>
<th>Year</th>
<th>Total FX Market</th>
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<tbody>
<tr>
<td>2004</td>
<td>14%</td>
</tr>
<tr>
<td>2007</td>
<td>18%</td>
</tr>
<tr>
<td>2010</td>
<td>13%</td>
</tr>
</tbody>
</table>
Figure 2. Foreign Exchange Instruments

<table>
<thead>
<tr>
<th>Year</th>
<th>Spot Market</th>
<th>FX Swaps</th>
<th>Currency Swaps</th>
<th>Outright Forwards</th>
<th>FX Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>2004</td>
<td>17%</td>
<td>9%</td>
<td>14%</td>
<td>27%</td>
<td>18%</td>
</tr>
<tr>
<td>2007</td>
<td>18%</td>
<td>14%</td>
<td>20%</td>
<td>30%</td>
<td>28%</td>
</tr>
<tr>
<td>2010</td>
<td>15%</td>
<td>10%</td>
<td>8%</td>
<td>23%</td>
<td>16%</td>
</tr>
</tbody>
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