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Empirical essays on financial market linkages in macroeconomics

Ellis B. Heath
West Virginia University

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Empirical Essays on Financial Market Linkages in Macroeconomics

Ellis B. Heath

Dissertation submitted to the
College of Business and Economics
at West Virginia University
in partial fulfillment of the requirements
for degree of

Doctor of Philosophy
in
Economics

Arabinda Basistha, Ph.D, Chair
Alexei V. Egorov, Ph.D.
Alexander Kurov, Ph.D.
Hyungna Oh, Ph.D.
Santiago Pinto, Ph.D.

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Monetary Policy, Fiscal Policy, FOMC Announcements

Abstract

Three Empirical Essays on Financial Market Linkages in Macroeconomics

Ellis Heath

This dissertation highlights the effects of monetary and fiscal policy on financial markets both within and across borders. In the first essay I examine how credit affects both real GDP and inflation in the U.S. Without a well-functioning credit market, at least two principal components of GDP--consumer durables and investment--would suffer. Credit markets allow individuals and firms to match those with extra savings and those with more pressing spending and investing needs to mutually benefit each other. However, credit markets are diverse. Clearly, some credit variables would be expected to play a more important role in the macroeconomy than others. This paper examines the relationship between credit and the macroeconomy, specifically real GDP and inflation. I find that credit matters. Credit shocks affect real GDP and to a lesser extent inflation, but, not all credit measures do so. Real GDP reacts strongly to changes in credit-to-income ratios and certain interest rate spreads. Inflation, however, responds less so to credit shocks. That is not to say that credit shocks are not important for inflation. Particularly, certain credit aggregates and interest rate spreads that measure short-term and long-term rates appear to be influential for changes in inflation. In the second essay I use a dynamic panel data set to examine the effect of fiscal policy on real interest rates for a sample of 59 nations covering the time period from 1970 through 2006. Controlling for both country and time effects, I find that changes in the national budget affect real interest rates. A one-percent increase in a country's deficit-to-output ratio corresponds to an increase in that country's real interest rate. This increase is statistically and economically significant; it ranges in magnitude from approximately 12 to 15 basis points. A surprising secondary result also emerges: a country's financial openness does not appear to play an important role in the determination of their real interest rate. Finally, the third essay illustrates how the Mexican equity market reacts to US monetary policy surprises. In this essay I also document whether the Mexican equity market reaction is asymmetric. I use a popular measure for US monetary surprises and I control for comovements in the US and Mexican equity markets. I find that when cyclical variations are measured according to real GDP growth, the Mexican equity market responds more to US monetary policy shocks when the Mexican economy is experiencing a downturn. This is important as it shows that the credit channel works across international borders.

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Any errors are the sole responsibility of the author.

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CHAPTER 1. GENERAL OVERVIEW OF DISSERTATION

Financial markets play an important role in the economy. They facilitate the transfer of capital, the transfer of risk and international trade. The linkage of financial markets with other sectors of the economy is widely accepted. However, the manner in which this linkage takes place is debated. Theory sometimes helps. For example, Bernanke and Blinder (1988) show that monetary policy in the U.S. transmits to the real economy through the credit market. Jensen and Johnson (1995), Jensen et al (1996), Thorbecke (1997), Patelis (1997), Ehrmann and Fratzscher (2004), Rigobon and Sack (2004), Gurkaynak et al (2004) and Bernanke and Kuttner (2005) find that the unexpected component of U.S. monetary policy affects U.S. equity markets. Johnson and Jensen (1993), Ehrmann and Fratzscher (2002, 2006), Ehrmann et al (2005) and Wongswan (2005, 2006) find that this effect extends across border and can affect foreign equity markets. While Laubach (2003) and Engen and Hubbard (2004) disagree on the magnitude of the effect of fiscal policy changes on real interest rates, both of their results support the notion that fiscal policy and real interest rates are linked.

Most previous studies look only at the relationship between credit and the real economy. Few studies look at the relationship between credit and inflation. In Chapter 2, I examine the link between credit and the macro economy. I use several different measures of credit--interest rate spreads, credit aggregates and debt-to-income ratios--to this effect. I, then, attempt to quantify which measures of credit have the most explanatory power for real output and inflation in the U.S. I find that credit matters for real output, but much less so for inflation. More importantly, I come to the conclusion that the choice of credit variable is fundamental. Different credit variables give different results. Furthermore, for the macro

economy no one credit variable is uniquely important. Some matter more for real output and others, more for inflation.

According Keynesian IS/LM theory, fiscal policy via adjustments in the national budget can impact real interest rates. In a closed economy, government decisions concerning spending and taxation will have influence the level of a country's real interest rate. These effects are mitigated the more open the economy is. In Barro (1974) the term Ricardian equivalence is given. It states the Keynesian view may not hold. National budget decisions will not affect national savings and therefore, a country's real interest rate will remain unaffected as well.

Empirically, the literature supports the Keynesian view. However, the magnitude of this effect is disputed. In Chapter 3, I use a dynamic panel data set of 59 advanced, developed and transitional economies from 1970 through 2006 and find that fiscal policy affects real interest rates, but I find this effect to be small and temporary. I control for financial openness and surprisingly find that it does not appear to be important to the process. This is also occurs in the growth literature. There they have not had much success in capturing significant effects of financial openness on economic growth.

In Chapter 4, I look at the Mexican equity market and examine how it responds to U.S. monetary surprises. I also investigate whether this effect is dependent on the state of the Mexican economy. I find that the Mexican equity market drops by over six percent when there is an unexpected 100 basis-point increase in the federal funds target rate. I also find that the state of the Mexican economy matters. During economic downturns in Mexico, the Mexican equity market reaction to US monetary surprises is highly significant, both statistically and economically. Furthermore, this reaction is significantly different from the reaction of the equity

market when Mexico is growing economically. This result supports the credit channel theory across international borders.

CHAPTER 2. DO CREDIT VARIABLES AFFECT REAL OUTPUT AND INFLATION? IF SO, WHICH ONES?

2.1 INTRODUCTION

The importance of credit in the United States (U.S.) economy is well-documented. Bernanke and Blinder (1988) show in a theoretical framework how credit can affect real economic activity. In his empirical study of the Great Depression, Bernanke (1983) provides evidence of credit market failure as a catalyst that accelerated and worsened the effects of that recession. Friedman and Kuttner (1993) develop a sophisticated theoretical model and then empirically, using credit spreads show that credit markets matter for real economic activity. White (2006) argues that credit growth can have real effects on real output. In fact, both he and the Bank for International Settlements (BIS) express the view that credit growth is of such importance that it should be targeted by central banks just as prices are.¹ However, when discussing credit effects on real economic activity, it is not clear what the actual credit variables of interest should be. In the literature credit measures are varied. Credit aggregates, specific interest rates, interest rate spreads, credit ratios and lending standards are the most conventional ones. While examples of each may be found in the literature to represent credit in the economy, they do not provide the same results when looking at the impact of credit on real GDP and inflation. Using a variety of credit variables, the purpose of this paper is to examine the relationship between credit and real output. Additionally, I also look at the effect of credit on inflation.

Kaufmann and Valderrama (2007) use a credit aggregate — private credit — and find that for the U.S., credit shocks have a procyclical impact on real output. The effect of a private credit shock on prices is small. Also, using private credit, but for OECD countries, Claessens, Kose and Terrones (2008) observe that one out of every six recessions is accompanied by a credit crunch.

¹ See BIS 77th Annual Report.

Friedman and Kuttner (1992, 1998) look at the spread between six-month commercial paper and Treasury bills (paper-bill spread). They find that from the mid 1950s through the mid 1990s six-month paper-bill spreads averaged around 90 basis points six months before a recession and about 100 basis points during a recession. Otherwise, the average was closer to 50 basis points. In other words, the six-month paper-bill spread widened just before recessions. Increases in the spread are thought to be associated with all or some of the following: Tightening of monetary policy; increase in expectations of bankruptcies; and increase in cash requirements of firms. Lown and Morgan (2004) look at credit standards using survey results from the Federal Reserve's Senior Loan Officer Opinion Survey.² They conclude that credit standards can affect real activity through inventory investment. A tightening of credit standards during a recession is associated with a similar reduction in inventory investment. Swiston (2008) develops an index to measure financial conditions in the U.S. In addition to standards being important for real economic activity, he finds that corporate bond yields and high yield spreads are slightly significant as well. However, in his study some other measures, like the London Interbank Offered Rate (LIBOR) and credit aggregates in general, appear not to be. Bayoumi and Melander (2008) find that a bank's capital-to-asset ratio impacts real GDP in the US. This effect works through the credit market by changing credit availability in the economy. Murphy (1998) finds that past debt service burden ratios can explain consumption innovations; this relationship is negative. King (1994) proposes that countries with the largest debt ratio increases in the 1980s suffered the most during the 1990-91 recession.

Most studies look only at the link between credit and the real economy. Very few studies look at the relationship between credit and inflation. Kaufmann and Valderrama (2007) use private credit and find that reactions from inflation to credit shocks are minimal. Furthermore,

² This is a quarterly survey given by the Fed to loan officers at large banks in the U.S.

these credit shocks do not appear to have much importance in explaining the variability of inflations.

Thus, according to the literature, credit matters for real GDP, but much less so for inflation. The question, then, is not whether credit matters, but rather what credit variables matter for the real GDP and inflation. Here, I use a host of popular interest rate spreads, credit aggregates and debt-to-income ratios to examine which measures of credit have the most explanatory power for real output and inflation in the US. Using a vector autoregression (VAR) framework with generalized impulse response functions and generalized variance decompositions, I find that no credit variable significantly affects real output permanently. Interest-rate spreads and to a lesser extent debt-to-income ratios provide the most explanatory power of innovations in real GDP. Of the credit aggregates, only private credit is statistically important for describing changes in real GDP. Furthermore, most of the effects from the credit variables on real GDP dissipate by the end of the first year. At most, interest-rate spreads explain approximately 15 to 20 percent of the forecast error variance in real output after twenty quarters. For inflation, only shocks to certain credit aggregates and some interest-rate spreads seem to be important; shocks to debt-to-income ratios effects are never statistically different from zero. Variance decompositions of inflation show that some credit aggregates can account for over 20 percent of the forecast error variance in inflation at the five-year mark. Credit matters, but it depends on the measure used and at best, credit shocks are temporary as far as real output reactions and changes in inflation are concerned.

The contribution of this paper is not a theoretical one. This study is entirely empirical. What does emerge from these results is that certain types of credit variables feature more than others when changes occur to real GDP and inflation. This is useful first and foremost to

policymakers, but it could be useful to theoreticians, as good new theory concerning the behavior of real GDP and inflation to credit disturbances is needed in the literature. While other studies also examine different credit variables, I find that one overlooked category--credit-to-income ratios-is important. I also highlight interest rate spreads and provide a comparison of different types.

In section 2.2 I discuss the possible explanations of how different credit variables affect real GDP and inflation. Section 2.3 is a discussion of the methodology and data; here, I also outline the hypotheses that I test. In section 2.4, the results are discussed as well as their robustness. Finally, section 2.5 concludes.

2.2 THE TRANSMISSION OF CREDIT EFFECTS

Generally, credit is thought to be linked to the macro economy through its effect on consumption, specifically consumer durables. From the life-cycle model, as given by Ando and Modigliani (1963), credit serves the sole purpose of transferring consumption from high income periods to low income ones; the interest rate is the same for both borrowers and lenders. Allowing for higher interest rates for debt servicing as compared to lending adds a great deal of complexity to the analysis. Ludvigson (1999) proposes a model that recreates the empirical finding that consumer credit growth predicts consumption growth. Antzoulatos (1996) shows that models that do not account for credit growth tend to predict consumption levels that are smaller than the actual levels in times of strong income growth. Olney (1999) suggests that the large drop in consumption in 1930 at the beginning of the Great Depression could be associated with a credit shock. In Fisher (1933), a model is given that suggests that when high debt burdens are present, exogenous shocks have a greater impact than otherwise.

Both in the Keynes IS/LM and the Austrian business cycle models, a central problem for a monetary economy occurs when the rate of interest at which commercial banks are willing to lend (financial rate of interest) is different from the rate of interest determined by real factors (natural rate of interest).³ Assuming a starting point for the economy where real output equals potential real output, in the IS/LM model, when the financial rate of interest is higher than the natural rate of interest, real output will deviate away from the potential real output, resulting in an economic downturn. Also, if the natural rate of interest is higher than the financial rate of interest, an increase in real output away from potential real output will occur as will higher inflation.

In the Austrian model, the latter case above does not necessarily imply inflation as in the IS/LM model. Credit creation occurring from the financial rate of interest being less than the natural rate encourages investment in anticipation of future increases in the demand for goods and services. This increase in demand never happens and therefore, the investments undertaken never become profitable. Also, the byproduct of over-investment is a surplus of capital goods. Capital goods are durable, but not fungible, therefore, mistakes in investment are durable as well and corrections take time. Hence, inflation may not occur; instead, the economy may experience a speculative bubble.

The growth in credit aggregates, such as private credit, can be used as a proxy for credit. By comparing this type of variable to the growth in real GDP and inflation, credit market effects can be isolated. Changes in credit aggregates can be used as a proxy for credit cycles. Credit cycles are considered to be pro-cyclical.⁴ Therefore, negative growth of credit aggregates would be associated with downturns in the credit cycle and negative growth of real GDP. While

³ See Hicks (1967) essay on the Keynes-Hayek debate for a more thorough discussion of credit, real output and inflation in both the IS/LM and Austrian models.

⁴ See Borio et al (2001).

positive growth of the credit aggregates would happen in credit cycle booms and in the IS/LM case, increases in inflation would be the result. In the Austrian model, this would not necessarily be the case.

Another measure of credit is the ratio of credit-to-income. This variable captures incidents of when credit is growing at a different rate than income and hence can be used to proxy credit cycles as well. Analysis of this variable follows in the same light as with the growth in credit aggregates.

Finally, another variable of interest is the interest-rate spread. Here, comparisons of different prices for credit can be made. Changes in interest-rate spreads suggest changes in credit availability for different types of borrowers. The number of interest-rate spreads is wide and varied. Interpretations of each are different. For example, changes in the paper-bill spread are thought to be a leading indicator of the business cycle.⁵ When the difference between six-month commercial paper and Treasury bills grows, tightening of monetary policy is thought to occur.⁶ Tighter monetary policy forces borrowers to use direct financing methods instead of indirect ones. This increases the supply of commercial paper, lowering the price and raising the interest rate. This increase occurs at a rate that is greater than that from the tightening of monetary policy.

Another possible channel involving the paper-bill spread is one in which commercial paper and Treasury bills are not viewed as perfect substitutes by investors. Cook (1981) points out this imperfect substitutability and suggests that it may stem from the fact that state-tax laws vary in their treatment of interest earned on commercial paper, while all states treat interest earned from Treasury bills as exempt, and commercial paper is less liquid than Treasury bills

⁵ See Friedman and Kuttner (1998).

⁶ See Bernanke (1990).

are. In this framework, the paper-bill may be related to the business cycle if monetary policy becomes restrictive and forces borrowers to use direct financing or low aggregate demand forces firms to raise funds through direct financing since they are not able to do so through the goods and services market. However, this framework also allows for movement in the paper-bill spread that is unrelated to the business cycle. State, local and foreign governments buy up the Treasury bills independent of business cycle factors. This forces borrowers to raise cash through the issuance of commercial paper and thereby increasing the paper-bill spread.

In a counter argument, Kashyap et al. (1993) and Thoma and Gray (1994) suggest that over time the substitutability of commercial paper and Treasury bills is greater due to more evolved financial markets. This increases substitutability implying that the systematic relationship of this spread with business cycles has become noise rather than determinant.

Finally, interest rate spreads are also thought to represent distress in the credit market. For example, the LIBOR-Federal Funds effective rate spread is less studied in academic literature but quite popular in the financial press.⁷ The LIBOR is a market-based short term interest rate at which banks can borrow funds from each other. It is very similar to the Federal Funds rate, except that the LIBOR is determined by the market. It is determined daily by 16 large banks. The LIBOR is important given that it is used as a benchmark in the U.S. for pricing both consumer and business loans, especially mortgages. In contrast, the Federal Funds rate is determined by the US monetary authorities. Normally, the spread between the LIBOR and the Federal Funds rate is stable and small. A widening of the spread is thought to be an indicator of a credit bottleneck. Credit is easier among larger institutions, but not outside of this circle. Therefore, banks can obtain cash easily, but they are not willing to lend it out, as reflected by the

⁷ For examples of this, see the following articles online in *The Wall Street Journal* both here <http://online.wsj.com/article/SB120489585652819527.html> by Gaffen and here by Ip <http://blogs.wsj.com/marketbeat/2008/03/06/credit-crunch-iii-mortgage-backed-drift/> (accessed March 12, 2008).

higher LIBOR rate relative to the Fed Funds effective rate. It is also possible that this spread widens due to private investment demand growing relative to stable monetary policy. This would have the opposite effect on the real economy. An extension of this is to look at the spread between higher risk instruments and lower risk ones (such as Baa yields and the LIBOR). An increase in these types of spread would suggest that more credit worthy institutions are not having as much relative difficulty in raising credit as are those that are less credit worthy. In other words, the risk premium increases. This would follow along the lines of the credit channel theory in which high risk firms suffer not only from conditions in the credit market, but additionally, due to their inability to raise funds internally.

Of these theories, only the Keynes IS/LM model predicts for inflationary effects from the credit market. Austrian theory allows for them, but does not guarantee them. Most studies involving inflation and credit look at how inflation effects credit, rather than how credit affects inflation.⁸ For real output this is not the case.

2.3 TESTABLE HYPOTHESES, METHODOLOGY AND DATA

In this paper, I set out to test the following hypotheses: 1) Credit matters for real US GDP; 2) Credit matters for inflation in the US; 3) For the US, different measures of credit give different results. I assume that credit is an endogenous variable in an endogenous system of macro and monetary variables.

I employ a VAR framework to examine the effect of different credit variables on both real output and inflation in the US. Given that monetary policy must be controlled for, I use a VAR model based on previous monetary policy studies.⁹ The traditional variables in these studies include real output, inflation, the Federal Funds rate, and commodity prices. The

⁸ See Debelle (2004) for example.

⁹ For example, see Bernanke and Blinder (1992), Leeper and Gordon (1994), Christiano, Eichenbaum and Evans (1996) and Bernanke and Mihov (1998).

commodity price variable, due to Sims (1992) and now typical in the literature, is included to control for the "price puzzle." The price puzzle refers to the fact that in VAR estimations inflation initially responds positively to restrictive monetary policy. Including the commodity price index is considered to provide forward-looking information about inflation that is unique to the Fed.

Bernanke, Gertler and Watson (1997) add oil prices to the VAR model given above in order to examine the role oil shocks play in the US economy. Lown and Morgan (2004) add credit standards in the same manner to see the importance they have in the US economy and conclude that a reduction in credit standards during a recession is associated with a similar reduction in inventory investment.¹⁰ Kaufmann and Valderrama (2007) add private credit and asset prices to see how real output and inflation are affected.¹¹ Following their lead, I do the same by adding a credit variable to the traditional monetary policy VAR model. I rotate among different categories of credit variables from 1986 through 2008 to see which variable is the most indicative of changes in real output and/or inflation.

The reduced form VAR model is given by:

$$Y_t = \sum_{i=1}^n \beta_i Y_{t-i} + \varepsilon_t \quad (1)$$

where Y_t and Y_{t-i} are vectors that include real output, inflation, commodity prices, the Federal Funds rate and a credit variable. The following assumptions are made:

$$E(\varepsilon_t) = 0 \text{ and } E(\varepsilon_t \varepsilon_t') = \Sigma \text{ for all } t.$$

In a traditional VAR model, impulse response functions are obtained in the manner below:

¹⁰ The time period for their study is from 1967 through 2003 with a gap from 1984 to 1990 when standards were not reported. This gap and the fact that this study goes from 1986 through most of 2008 make comparison of standards with other credit variables not conducive for this paper.

¹¹ Kaufmann and Valderrama (2007) do not include the commodity price index in their paper, therefore their model is a five-variable VAR as well.

$$\xi_j(i) = \theta_i P e_j \quad (2)$$

where ξ_j represents the impulse response function, θ_i is the infinite moving average matrix obtained from the Wold decomposition of Equation 1, P is a lower Choleski decomposition of Σ and finally, e_j is a selection vector in which the impulse j is one and the other elements are zero.

Here, following Pesaran and Shin (1998), a generalized impulse response function (GIRF) is used.¹² It is given below:

$$\xi_j^G(i) = \frac{\theta_i \Sigma e_j}{\sqrt{\sigma_{jj}}} \quad (3)$$

where σ_{jj} is the element from the j th row and j th column of the variance-covariance matrix Σ .

For variance decompositions, the generalized version is calculated as follows:

$$\phi_{ij}^G(i) = \frac{\sum_{h=0}^n (e'_i \theta_h \Sigma e_j)^2}{\sigma_{jj} \sum_{h=0}^n (e'_i \theta_h \Sigma \theta'_h e_j)} \quad (4)$$

compared to the usual variance decomposition:

$$\phi_{ij}(i) = \frac{\sum_{h=0}^n (e'_i \theta_h P e_j)^2}{\sum_{h=0}^n (e'_i \theta_h \Sigma \theta'_h e_j)} \quad (5)$$

The benefit from using GIRFs and generalized variance decompositions is that the ordering of the variables in the VAR does not matter. If Σ is non-diagonal, then, the order of the variables matters in VAR analysis, but in generalized analysis it does not.¹³

The data is quarterly with 92 observations and spans from the first quarter of 1986 through the fourth quarter of 2008.¹⁴ The sources and the transformations of the data are given in

¹² Pesaran and Shin (1998) give the theoretical framework for GIRFs and generalized variance decompositions. For empirical studies that employ this framework, see Wang (2005) and Kaufmann and Valderrama (2007).

¹³ In Section 2.4.5 I report the Choleski Decomposition results that differ from the generalized ones.

Table 2 - 1. Also, as determined by the Akaike Information Criterion (AIC), the lag selection is four quarters.

2.4 EMPIRICAL RESULTS

First, I report the generalized impulse response functions of real GDP and inflation to a one-standard deviation credit shock. I do this for each credit variable. This shows how real GDP and inflation react to disturbances in the credit variable and how the variables interact with each other. To determine how important the credit shocks are in explaining changes in real GDP and inflation, I examine the generalized variance decompositions of real GDP and inflation.

Since I use generalized impulse response functions and generalized variance decompositions, the results do not depend on the ordering of the variables and therefore they are independent of any preconceived notion of how these variables might interact in both the short term and long term. Because of this, no restrictions are necessary.

2.4.1 Generalized Impulse Response Functions for real GDP

In Figure 2 - 1, the generalized impulse response functions of real GDP for the VAR models using credit aggregates are given. These variables are Private Credit, Domestic, non-financial Credit Market Debt Outstanding, Household, non-financial Credit Market Debt Outstanding, Total Consumer Credit Outstanding, Commercial Bank Consumer Credit Outstanding, Finance Companies Consumer Credit Outstanding, Credit Unions Consumer Credit Outstanding, Savings Institutions Consumer Credit Outstanding and Non-financial Business Consumer Credit Outstanding. The size of the shocks is equal one standard deviation of the credit variable. Of the aggregates only Private Credit and Savings Institutions Consumer Credit Outstanding are

¹⁴ Before 1986, usage of LIBOR rates for the US was not considered to be truly market-oriented.

statistically significant. Both are statistically significant in the third and second quarters, respectively, after the initial shock, but not before nor after.

Private Credit is the most commonly used credit aggregate in the literature. It is reported by the IMF and consists of the claims on the private sector both for banking institutions and nonbank financial institutions. Kaufmann and Valderrama (2007) find that shocks to private credit have a slightly positive effect on real US GDP during recessionary periods and no effect otherwise. Not accounting for state-dependence, the effect I find is similar to theirs in both magnitude and longevity.

The Savings Institutions Consumer Credit Outstanding variable is not commonly looked at in general monetary models. It is reported regularly by the Federal Reserve. In a case study of US recessions from 1960 through 1990, Bernanke and Lown (1991) look at a similar variable and find that mortgages held by savings institutions behaved irregularly. In most of the six recessions that they investigate, this credit aggregate grew, but in the 1990 recession it shrank by 20 percent. Both here and in their study the level of importance of this variable on real output appears to be minimal.

The fact that the other credit aggregates are not statistically significant is not surprising. Swiston (2008) looks at some of the same credit aggregates in a VAR framework but with Cholesky decomposed shocks and finds that credit aggregates are not important for innovations in real GDP.¹⁵

Figure 2 - 2 shows the generalized impulse response functions from a shock to various credit-to-income ratios on real GDP. The credit-to-income ratios used are Household Debt Service Ratio, Financial Obligations Ratio, Total Homeowner Financial Obligations Ratio,

¹⁵ The common credit aggregates in his study and mine are banks loans, household credit, and non-financial business credit.

Homeowner Financial Mortgage Obligations Ratio and Homeowner Financial Consumer Obligations Ratio. All of the ratios impact real GDP. Increases in the ratios are followed by negative responses in real GDP. These shock are statistically significant in all cases, except for Homeowner Financial Consumer Obligations Ratio, which is marginal so.

The Household Debt Service Ratio is the ratio of debt payments to disposable personal income. The debt payments are the estimated required payments on outstanding mortgages and consumer debt. The Financial Obligations Ratios are a wider measure than the Household Debt Service Ratio. They include automobile lease payments, rental payments on tenant-occupied property, homeowners' insurance, and property tax payments. Maki (2000) looks at the effect of the Household Debt Service Ratio on consumption and does not find a strong statistical link. However, he does not look at real GDP. He also does not assume an endogenous system. The Financial Obligations Ratios are used as a measure of the credit markets in general, but are often overlooked when measuring credit market impacts on real GDP.¹⁶

Figure 2 - 3 provides the generalized impulse response functions for the response of the annualized quarterly growth rate of real GDP to one standard deviation shocks to various interest rate spreads. The interest rate spreads are expressed in terms of quarterly averages. The interest rate spreads are the Aaa-Federal Funds spread, the Aaa-LIBOR spread, the Aaa-10-year Treasury rate spread, the Aaa-3-month Treasury bill spread, the Baa-Federal Funds rate spread, the Baa-LIBOR spread, the Baa-10-year Treasury rate spread, the Baa-3-month Treasury bill spread, the Credit Card-LIBOR spread, the LIBOR-Federal Funds rate spread and the 24-month Personal Credit-LIBOR spread.

Numerous spreads exhibit a statistically significant impact on real GDP, some more so than others however. All spreads comparing Aaa and Baa rates with the long-term 10-year

¹⁶ See Dynan et al (2003) and Johnson (2005) for example.

Treasury rate are important for real GDP. The spread between the Baa rates and the 10-year Treasury ones is commonly known as the "Default" spread. Widening of this spread indicates an increase in the liquidity premium; short-term borrowers are more credit constrained relative to those who have locked in longer term rates. It also measures the risk premium since the Baa rate is the rate offered on corporate bonds by the riskier firms and the 10-year Treasury rate is considered risk-free. The result here is much more significant than that obtained by Swiston (2008). The surprising result is that the spreads with the Aaa and Baa rates and Federal Funds rate does not appear to be important. The difference between either the Aaa or Baa rates and the LIBOR is marginally so; in the second quarter after an initial shock to either spread, real GDP exhibits a statistically significant negative response. Both the Credit Card-LIBOR spread and the 24-month Personal Credit-LIBOR spread are initially important for innovations in real GDP. Here, two extremes of credit risk are being captured. Another surprising result is the reaction of real GDP to the LIBOR-FF rate spread. Here, I find a positive response from real GDP to shocks to this spread. While in the literature not much work has been done with the LIBOR-FF spread as it relates to the macro economy, a recent report from Citigroup Global Markets, Inc. found a similar result.¹⁷ Swiston (2008) also finds that shocks to the LIBOR by itself cause an increase in real GDP. As mentioned earlier, this could be due to the demand for private investment increasing relative to the Federal Funds rate.

2.4.2 Generalized Impulse Response Functions for Inflation

In Figure 2 - 4, the generalized impulse response functions of inflation as measured by the annualized quarterly growth rate of the GDP deflator for the VAR models using credit aggregates are provided. Here, some of the credit aggregates do appear to have an important role.

¹⁷ See Diclemente and Schoenholtz (2008).

Shocks to Consumer Credit Outstanding and its sub-series for Commercial Banks and Credit Unions appear to play an important role for one quarter in the inflation series. The other series Domestic Non-financial Credit Market Debt Outstanding does as well. It is not clear what the theoretical explanation might be for this. The best description would come from the Austrian business cycle theory that would suggest a growth in credit aggregates could indicate a speculative bubble forming in the economy which in turn would be followed by a correction, or contraction in real GDP. Empirically, Kaufmann and Valderrama (2007) find that the Private Credit aggregate provides no information about inflation. Shocks to this variable are statistically insignificant for the real US GDP series.

In Figure 2 - 5 the generalized impulse response functions for the response of the annualized quarterly growth rate of the GDP deflator to one standard deviation shocks to various credit ratio-to-income variables is given. The credit ratios are expressed in terms of quarterly averages. The credit variables are the following: Household Debt Service Ratio, Financial Obligations Ratio, Total Homeowner Financial Obligations Ratio, Homeowner Financial Obligations Ratio: Mortgage and Homeowner Financial Obligations Ratio: Consumer.

All of the ratios have no statistically significant effect on inflation with the possible exception of the Homeowner Financial Consumer Obligations Ratio. This ratio appears to have a slight effect that is statistically significant in the second quarter after the initial shock.

Figure 2 - 6 shows the generalized impulse response functions for the response of the annualized quarterly growth rate of the GDP deflator to one standard deviation shocks to various interest rate spreads. As before, the interest rate spreads are expressed in terms of quarterly averages and include the Aaa-Federal Funds spread, the Aaa-LIBOR spread, the Aaa-10-year Treasury rate spread, the Aaa-3-month Treasury bill spread, the Baa-Federal Funds rate spread,

the Baa-LIBOR spread, the Baa-10-year Treasury rate spread, the Baa-3-month Treasury bill spread, the Credit Card-LIBOR spread, the LIBOR-Federal Funds rate spread and the 24-month Personal Credit-LIBOR spread.

Here, with the exception of the Aaa-10-year Treasury rate, there is no statistical effect from shocks to these variables on inflation. In the first quarter shocks to the Aaa-10-year Treasury rate spread have a negative impact on inflation. This would follow Keynesian IS/LM theory would predict since an increase in this spread is associated with economic downturns and hence, lower inflation.

2.4.3 Generalized Variance Decompositions for real GDP

Table 2 - 2 gives the generalized variance decomposition of the annualized quarterly growth rate of real GDP under various VAR frameworks with different credit aggregates variables. As with the generalized impulse response functions, the most important credit aggregates for changes in real GDP are Private Credit and Savings Institutions Consumer Credit Outstanding. Both explain approximately ten percent of the error variance in real GDP from two quarters to twelve quarters out. The two non-financial credit market variables (domestic and household) and Commercial Bank Consumer Credit Outstanding explain about six percent of the forecast error variance at the four-year mark.

From Table 2 - 3 the generalized variance decomposition of real GDP with different credit-to-income ratio variables is provided. Clearly, all of the credit ratios in general account for a similar magnitude of the forecast error variance as the best credit aggregates. Furthermore, the explanatory power of the credit ratios is high even in the first quarter.

In Table 2 - 4 the generalized variance decomposition of real GDP with different interest rate spreads is given. Again, as with the generalized impulse response functions in Figure 2 - 3,

the same interest rate spreads that were important in Figure 2 - 3 are the ones that account for the most error variance in real GDP. Here, over fifteen percent of the forecast error variance in real GDP can be accounted for by some interest rate spreads.

2.4.4 Generalized Variance Decompositions for Inflation

The generalized variance decomposition of inflation with various credit aggregates variables can be found in Table 2 - 5. The two non-financial credit market variables (domestic and household) account for approximately one-fifth of the error variance in inflation through twelve quarters. Of the credit aggregates, for inflation these are by far the most important. Private Credit seems to have the least explanatory power, accounting for only five percent of the forecast errors in inflation at the four-year mark.

For inflation, Table 2 - 6 shows that credit-to-income ratio variables do not account for much of the error variance in inflation. At best, the Homeowner Financial Consumer Obligations Ratio explains a little over seven percent of the forecast errors in inflation within the first year.

In Table 2 - 7 the generalized variance decomposition of inflations under various VAR frameworks with different interest rate spreads is given. At just under twenty percent, the Baa-10-year Treasury rate spread explains the forecast errors in inflation the best. In general, with the exception of the Baa-10-year Treasury rate spread the other interest rate spreads only account for just over five percent of the error variance in inflation.

2.4.5 Robustness of Results

Changing the lag lengths to two instead of four did not change the results significantly, nor did using a lag length of eight. These results were also robust to using monthly data and substituting Industrial Production and the Consumer Price Index for GDP and the GDP deflator. I also

differenced real GDP, the GDP deflator, the Commodity Index and the credit variables. Again, the results were robust to these changes.

I also looked at the system of equations using Choleski decompositions instead of the generalized framework.¹⁸ In general, the results were similar with some exceptions. The Aaa-10-year Treasury rate spread, the Credit Card-LIBOR spread, the LIBOR-Federal Funds rate spread and the 24-month Personal Credit-LIBOR spread no longer have a significant impact on real GDP. For inflation, only the Aaa-10-year Treasury rate spread loses explanatory power.

To test whether the year 2008 is driving the results, I re-ran the VAR system through 2007 only. There were no significant changes except for the Aaa-10-year Treasury rate spread's impact on inflation. Again, as with the Choleski decomposition framework, this spread became less important for innovations in inflation.

2.5 CONCLUDING REMARKS

In any field certain components of a variable may or may not play a larger role in the relationship that variable has with other variables. For example, in determining cycles in real GDP, the role each component of real GDP plays is varied. Some, such as the consumer durables component, are extremely important for real GDP cycles. Changes in the subcategory--consumer durables--match well with changes in the overall category--real GDP. Others, such as government spending, however, do not. Here, I argue that the same applies to credit and how it affects the macro economy. Certain types of credit variables are more important than others. Certainly, for policymakers, as well as agents in the economy, knowing what type of credit disturbances have the most impact on real GDP and inflation is essential to better understand perturbations in macro economy.

¹⁸ In all variations, the credit variable was in the last position which is the weakest position. This is the general method as given by the literature.

Credit shocks affect real GDP and to a lesser extent inflation, but, not just any credit measures does so. Real GDP reacts strongly to changes in credit-to-income ratios and certain interest rate spreads. The spreads that are the most important are those that measure the highest risk rates against the lowest risk rates, specifically rates that individuals pay for risky loans versus those that large banks pay on loans to each other. Also, important are the corporate bond spreads that measure the short-term rates versus the safest long-term rate (10-year Treasury rates). When the importance of these credit shocks to real GDP is examined, clearly the interest rate spreads of the type described above feature prominently. So too do the credit-to-income ratios, but to a lesser extent. Shocks to one credit aggregate, private credit, also are important in describing the variability in real GDP, even though the reaction of real GDP to private credit shocks is barely significant statistically.

Inflation, however, responds less so to credit shocks. That is not to say that credit shocks are not important for inflation. Particularly, certain credit aggregates and interest rate spreads that measure short-term and long-term rates appear to be influential for innovations in inflation. Shocks to consumer credit outstanding and some subcategories of this series move inflation. Uniquely among the interest rate spreads, only shocks to the Aaa-10-year Treasury spread appear to cause variations in inflation. Inflation does not seem to respond to shocks to credit-to-income ratios.

Of all the credit variables, one variable stands out. The Baa-10-year Treasury rate spread stands out for the important role it has in explaining innovations in both real GDP and inflation. This seems to be the most important single credit variable in this study.

This paper contributes to the literature by highlighting some important empirical findings. I find that credit matters for real GDP and inflation, but not in the same way. For innovations in

real GDP and inflation, the source of the credit disturbance is important. The literature lacks a good theoretical explanation of the issue of why certain credit variables would be important for real GDP and inflation and others would not. Most explanations are anecdotal. Ideally, the empirical results here and in other studies could be used to help form a strong theoretical framework that might illustrate the channels through which credit disturbances impact real output and inflation.

2.6 APPENDIX

Figure 2 - 1

In Figure 2 - 1 the generalized impulse response functions for the response of the annualized quarterly growth rate of real GDP to one standard deviation shocks to various credit aggregates variables. The credit aggregates are also expressed in terms of annualized quarterly growth rate. The credit variables are the following: Private credit, Domestic, non-financial Credit Market Debt Outstanding, Household, non-financial Credit Market Debt Outstanding, Total Consumer Credit Outstanding, Commercial Bank Consumer Credit Outstanding, Finance Companies Consumer Credit Outstanding, Credit Unions Consumer Credit Outstanding, Savings Institutions Consumer Credit Outstanding and Non-financial Business Consumer Credit Outstanding.

Figure 2 - 2

In Figure 2 - 2 the generalized impulse response functions for the response of the annualized quarterly growth rate of real GDP to one standard deviation shocks to various credit ratio-to-income variables is given. The credit ratios are expressed in terms of quarterly averages. The credit variables are the following: Household Debt Service Ratio, Financial Obligations Ratio, Total Homeowner Financial Obligations Ratio, Homeowner Financial Obligations Ratio: Mortgage and Homeowner Financial Obligations Ratio: Consumer.

Figure 2 - 3

In Figure 2 - 3 the generalized impulse response functions for the response of the annualized quarterly growth rate of GDP to one standard deviation shocks to various interest rate spreads are given. The interest rate spreads are expressed in terms of quarterly averages. The credit variables are the following spreads: Aaa-Federal Funds rate; Aaa-LIBOR; Aaa-10-year Treasury rate; Aaa-3-month Treasury bill rate; Baa-Federal Funds rate; Baa-LIBOR; Baa-10-year Treasury rate; Baa-3-month Treasury bill rate; Credit Card-LIBOR; LIBOR-Federal Funds rate; and 24-month Personal Credit-LIBOR.

Figure 2 - 4

In Figure 2 - 4 the generalized impulse response functions for the response of the annualized quarterly growth rate of the GDP deflator to one standard deviation shocks to various credit aggregates variables. The credit aggregates are also expressed in terms of annualized quarterly growth rate. The credit variables are the following: Private credit, Domestic, non-financial Credit Market Debt Outstanding, Household, non-financial Credit Market Debt Outstanding, Total Consumer Credit Outstanding, Commercial Bank Consumer Credit Outstanding, Finance Companies Consumer Credit Outstanding, Credit Unions Consumer Credit Outstanding, Savings Institutions Consumer Credit Outstanding and Non-financial Business Consumer Credit Outstanding.

Figure 2 - 5

In Figure 2 - 5 the generalized impulse response functions for the response of the annualized quarterly growth rate of the GDP deflator to one standard deviation shocks to various credit ratio-to-income variables is given. The credit ratios are expressed in terms of quarterly averages. The credit variables are the following: Household Debt Service Ratio, Financial Obligations Ratio, Total Homeowner Financial Obligations Ratio, Homeowner Financial Obligations Ratio: Mortgage and Homeowner Financial Obligations Ratio: Consumer.

Figure 2 - 6

In Figure 2 - 6 the generalized impulse response functions for the response of the annualized quarterly growth rate of the GDP deflator to one standard deviation shocks to various interest rate spreads are given. The interest rate spreads are expressed in terms of quarterly averages. The credit variables are the following spreads: Aaa-Federal Funds rate; Aaa-LIBOR; Aaa-10-year Treasury rate; Aaa-3-month Treasury bill rate; Baa-Federal Funds rate; Baa-LIBOR; Baa-10-year Treasury rate; Baa-3-month Treasury bill rate; Credit Card-LIBOR; LIBOR-Federal Funds rate; and 24-month Personal Credit-LIBOR.

Table 2 - 1

Name	Definition	Summary Statistics					Source(s)
		Mean	Median	Maximum	Minimum	Standard Deviation	
Commodity Price Index	Annualized quarterly growth rate	3.05	2.54	18.12	-12.08	5.46	Federal Reserve Bank of St. Louis; PPIACO - Producer Price Index: All Commodities
Real GDP	Annualized quarterly growth rate	2.85	2.92	8.92	-8.16	2.80	Federal Reserve Bank of St. Louis; GDPC1 - Real Gross Domestic Product, 1 Decimal
GDP deflator	Annualized quarterly growth rate	3.25	2.57	10.93	0.64	2.11	Federal Reserve Bank of St. Louis; GDPDEF - Gross Domestic Product: Implicit Price Deflator
Federal Funds effective rate	Quarterly average	6.56	5.68	17.78	1.00	3.69	Federal Reserve Bank of St. Louis; FEDFUNDS - Effective Federal Funds Rate
BAA	Quarterly average	8.29	8.06	11.38	5.97	1.48	Federal Reserve Statistics: Selected Interest Rates
AAA	Quarterly average	7.35	7.28	10.21	5.09	1.43	Federal Reserve Statistics: Selected Interest Rates
LIBOR	Quarterly average	5.10	5.41	9.81	1.12	2.14	British Bankers' Association
3-month Treasury Bill	Quarterly average	4.43	4.86	8.54	0.30	1.95	Federal Reserve Statistics: Selected Interest Rates
10-year Treasury Constant Maturity Rate	Quarterly average	6.15	5.95	9.21	3.25	1.63	Federal Reserve Statistics: Selected Interest Rates
Commercial Bank Interest Rates: Terms of Credit	Quarterly average	15.55	15.75	18.51	11.87	2.11	Federal Reserve Statistics: Consumer Credit
Commercial Bank Interest Rates: 24-month Personal Credit	Quarterly average	13.51	13.58	15.69	11.14	1.17	Federal Reserve Statistics: Consumer Credit

Name	Definition	Summary Statistics					Source(s)
		Mean	Median	Maximum	Minimum	Standard Deviation	
Private Credit	Annualized quarterly growth rate	5.65	6.43	45.89	-17.35	9.99	International Monetary Fund; Series Codes: 11122D.ZF & 11142D.ZF
Credit Market Debt Outstanding: Domestic, nonfinancial	Annualized quarterly growth rate	4.29	4.20	11.22	-2.51	2.21	Economagic webpage
Credit Market Debt Outstanding: Household, nonfinancial	Annualized quarterly growth rate	5.40	6.04	12.03	-3.13	3.63	Economagic webpage
Consumer Credit Outstanding: Total	Annualized quarterly growth rate	3.93	3.58	13.90	-6.79	4.41	Federal Reserve Statistics: Consumer Credit
Commercial Bank Consumer Credit Outstanding	Annualized quarterly growth rate	2.28	2.59	17.01	-12.51	6.60	Federal Reserve Statistics: Consumer Credit
Finance Companies Consumer Credit Outstanding	Annualized quarterly growth rate	4.73	5.34	44.87	-26.86	12.17	Federal Reserve Statistics: Consumer Credit
Credit Unions Consumer Credit Outstanding	Annualized quarterly growth rate	2.66	2.61	22.31	-15.22	6.74	Federal Reserve Statistics: Consumer Credit
Savings Institutions Consumer Credit Outstanding	Annualized quarterly growth rate	-0.70	1.61	39.42	-42.38	14.27	Federal Reserve Statistics: Consumer Credit
Nonfinancial Business Consumer Credit Outstanding	Annualized quarterly growth rate	-2.93	-3.56	33.29	-68.84	15.11	Federal Reserve Statistics: Consumer Credit
Household Debt Service Ratio	Quarterly average	12.49	12.07	14.29	10.79	1.04	Economagic webpage
Financial Obligations Ratio	Quarterly average	17.81	17.62	19.39	16.16	0.89	Economagic webpage
Total Homeowner Financial Obligations Ratio	Quarterly average	26.50	26.24	31.26	23.41	1.91	Economagic webpage
Homeowner Financial Obligations Ratio: Mortgage	Quarterly average	9.98	9.71	11.71	9.04	0.74	Economagic webpage
Homeowner Financial Obligations Ratio: Consumer	Quarterly average	5.87	6.00	6.84	4.55	0.68	Economagic webpage

Table 2 - 2

Variance Decomposition of real GDP					
Forecast Horizon	Commodity	real GDP	Inflation	Fed Funds Rate	Private Credit
1	2.69	100.00	0.28	8.03	3.75
2	3.24	90.63	0.40	11.18	9.20
3	6.68	81.99	0.35	11.34	12.85
4	21.33	66.67	4.37	9.42	12.62
8	22.02	60.78	6.46	11.70	12.57
12	21.28	59.82	8.31	11.64	12.47
Forecast Horizon	Commodity	real GDP	Inflation	Fed Funds Rate	Consumer Credit Outstanding
1	2.56	100.00	0.39	9.00	1.11
2	3.61	95.22	0.36	10.00	1.22
3	6.91	84.25	0.33	12.61	2.09
4	22.52	67.10	4.95	10.32	1.66
8	22.41	62.68	6.27	13.68	1.66
12	21.55	61.45	7.32	13.18	2.57
Forecast Horizon	Commodity	real GDP	Inflation	Fed Funds Rate	Consumer Credit Outstanding (Commercial Banks)
1	4.80	100.00	0.16	10.36	0.00
2	4.79	90.95	0.14	9.71	4.78
3	7.92	82.76	0.14	12.47	4.40
4	23.70	67.11	3.66	10.18	3.51
8	23.76	59.90	5.36	13.41	5.45
12	23.08	59.53	5.86	13.33	5.63
Forecast Horizon	Commodity	real GDP	Inflation	Fed Funds Rate	Consumer Credit Outstanding (Finance Companies)
1	4.70	100.00	0.00	8.80	0.59
2	5.83	95.78	0.04	9.17	0.58
3	8.85	85.53	0.03	11.88	2.36
4	23.24	69.95	3.44	9.86	1.90
8	22.27	63.22	5.17	12.34	3.48
12	21.74	62.57	5.84	12.25	3.77
Forecast Horizon	Commodity	real GDP	Inflation	Fed Funds Rate	Consumer Credit Outstanding (Savings Institutions)
1	3.63	100.00	1.06	9.34	0.07
2	4.04	86.42	1.01	9.27	10.29
3	8.51	76.16	0.86	10.09	10.04
4	25.56	61.31	4.24	8.06	8.04
8	27.08	54.82	5.14	11.59	7.55
12	26.43	52.81	7.11	11.27	7.74
Forecast Horizon	Commodity	real GDP	Inflation	Fed Funds Rate	Consumer Credit Outstanding (Nonfinancial Businesses)
1	1.45	100.00	0.50	9.07	1.55
2	2.58	93.83	0.46	9.68	2.64
3	6.60	84.84	0.44	13.49	2.28
4	22.28	68.55	4.50	11.31	2.19
8	23.26	61.66	6.31	14.76	2.36
12	22.58	60.93	7.21	14.49	2.57

Variance Decomposition of real GDP					
Forecast Horizon	Commodity	real GDP	Inflation	Fed Funds Rate	Domestic, Non-financial Credit Market Debt
1	2.32	100.00	0.45	9.04	0.73
2	4.40	95.55	0.98	9.18	0.89
3	9.27	85.11	0.85	11.48	3.06
4	24.25	68.81	5.18	9.61	4.71
8	24.68	63.41	6.28	12.40	6.32
12	23.96	62.44	6.60	12.38	6.57
Forecast Horizon	Commodity	real GDP	Inflation	Fed Funds Rate	Non-financial Household Credit Market Debt
1	3.94	100.00	0.01	10.17	4.69
2	4.78	96.28	0.06	10.30	4.67
3	8.44	86.50	0.19	12.86	4.75
4	22.51	70.82	3.98	10.82	4.08
8	22.75	64.89	4.43	13.50	5.18
12	22.52	63.27	4.49	13.22	6.45
Forecast Horizon	Commodity	real GDP	Inflation	Fed Funds Rate	Consumer Credit Outstanding (Credit Unions)
1	1.45	100.00	0.50	9.07	1.55
2	2.58	93.83	0.46	9.68	2.64
3	6.60	84.84	0.44	13.49	2.28
4	22.28	68.55	4.50	11.31	2.19
8	23.26	61.66	6.31	14.76	2.36
12	22.58	60.93	7.21	14.49	2.57

In Table 2 - 2 the generalized variance decomposition of the annualized quarterly growth rate of real GDP under various VAR frameworks with different credit aggregates variables is given. The credit aggregates are also expressed in terms of annualized quarterly growth rate. The credit variables are the following: Private credit, Domestic, non-financial Credit Market Debt Outstanding, Household, non-financial Credit Market Debt Outstanding, Total Consumer Credit Outstanding, Commercial Bank Consumer Credit Outstanding, Finance Companies Consumer Credit Outstanding, Credit Unions Consumer Credit Outstanding, Savings Institutions Consumer Credit Outstanding and Non-financial Business Consumer Credit Outstanding.

Table 2 - 3

Variance Decomposition of real GDP					
Forecast Horizon	Commodity	real GDP	Inflation	Fed Funds Rate	Household Debt Service Ratio
1	3.49	100.00	1.29	7.27	6.03
2	3.98	86.66	1.18	6.95	14.28
3	7.26	79.24	1.08	9.72	12.71
4	18.62	67.40	5.11	8.50	11.17
8	21.41	60.41	6.09	11.24	11.07
12	20.86	59.55	6.79	10.98	10.74
Forecast Horizon	Commodity	real GDP	Inflation	Fed Funds Rate	Financial Obligations Ratio
1	3.18	100.00	1.28	7.36	5.88
2	3.89	87.83	1.26	7.24	12.82
3	7.29	80.35	1.15	9.84	11.39
4	19.38	68.03	5.39	8.50	10.52
8	21.77	60.98	6.46	11.27	10.43
12	21.20	59.88	7.27	11.06	10.28
Forecast Horizon	Commodity	real GDP	Inflation	Fed Funds Rate	Homeowner Financial Obligations Ratio
1	3.18	100.00	1.28	7.36	5.88
2	3.89	87.83	1.26	7.24	12.82
3	7.29	80.35	1.15	9.84	11.39
4	19.38	68.03	5.39	8.50	10.52
8	21.77	60.98	6.46	11.27	10.43
12	21.20	59.88	7.27	11.06	10.28
Forecast Horizon	Commodity	real GDP	Inflation	Fed Funds Rate	Homeowner Financial Obligations Ratio: Mortgage
1	3.09	100.00	1.44	7.38	4.66
2	3.90	89.15	1.38	7.18	11.06
3	7.17	81.82	1.37	9.82	9.75
4	18.97	69.53	5.30	8.60	8.40
8	21.30	62.73	6.19	10.75	9.85
12	20.74	61.61	7.77	10.37	9.59
Forecast Horizon	Commodity	real GDP	Inflation	Fed Funds Rate	Homeowner Financial Obligations Ratio: Consumer
1	3.14	100.00	1.51	7.75	4.49
2	4.06	90.17	1.48	7.73	9.30
3	8.24	81.17	1.30	10.04	8.22
4	22.10	67.18	5.52	8.43	7.84
8	23.20	61.66	6.74	11.32	7.32
12	22.66	60.94	7.36	11.21	7.13

In Table 2 - 3 the generalized variance decomposition of the annualized quarterly growth rate of real GDP under various VAR frameworks with different credit-to-income ratio variables is given. The credit ratios are expressed in terms of quarterly averages. The credit variables are the following: Household Debt Service Ratio, Financial Obligations Ratio, Total Homeowner Financial Obligations Ratio, Homeowner Financial Obligations Ratio: Mortgage and Homeowner Financial Obligations Ratio: Consumer.

Table 2 - 4

Variance Decomposition of real GDP					
Forecast Horizon	Commodity	real GDP	Inflation	Fed Funds Rate	Aaa-FF spread
1	3.68	100.00	0.30	11.07	0.48
2	4.10	96.53	0.33	11.68	1.40
3	7.72	88.65	0.55	13.31	2.36
4	21.52	72.41	6.15	10.86	4.21
8	21.54	66.44	7.86	13.12	6.00
12	20.75	65.10	9.18	13.46	6.18
Forecast Horizon	Commodity	real GDP	Inflation	Fed Funds Rate	Aaa-LIBOR spread
1	3.03	100.00	0.11	10.09	1.06
2	3.75	95.59	0.74	10.67	2.31
3	6.54	86.13	0.98	12.47	9.20
4	21.02	70.08	6.85	10.29	10.92
8	20.60	64.19	7.97	13.59	13.70
12	20.33	63.52	9.27	13.22	13.11
Forecast Horizon	Commodity	real GDP	Inflation	Fed Funds Rate	Aaa-10 year Treasury spread
1	3.76	100.00	0.00	8.25	13.91
2	3.92	89.19	0.01	10.82	14.39
3	8.27	80.22	0.02	11.33	17.03
4	28.21	62.14	5.41	8.69	13.02
8	30.59	53.29	6.85	11.86	13.53
12	29.93	52.85	7.75	11.75	13.44
Forecast Horizon	Commodity	real GDP	Inflation	Fed Funds Rate	Aaa-3 month T-bill spread
1	3.45	100.00	0.68	8.93	0.90
2	3.54	96.12	0.67	9.62	0.90
3	7.83	88.72	1.16	10.61	1.14
4	24.02	70.84	6.99	8.56	2.86
8	25.37	62.68	8.74	11.17	5.39
12	24.26	61.66	9.56	11.04	5.56
Forecast Horizon	Commodity	real GDP	Inflation	Fed Funds Rate	Baa-FF spread
1	3.19	100.00	0.60	12.32	0.07
2	3.08	96.54	0.57	12.26	0.07
3	6.38	89.96	0.92	13.37	0.81
4	21.66	71.64	6.29	10.59	1.68
8	22.08	64.78	9.03	12.35	4.07
12	20.80	62.53	9.58	13.75	5.02
Forecast Horizon	Commodity	real GDP	Inflation	Fed Funds Rate	Baa-LIBOR spread
1	3.04	100.00	0.29	12.65	6.05
2	3.59	96.57	0.77	13.17	5.98
3	5.22	88.04	1.01	14.74	12.35
4	20.03	71.09	7.23	11.89	11.44
8	19.98	65.37	9.04	13.66	13.49
12	19.36	64.35	10.01	13.82	13.29

Variance Decomposition of real GDP					
Forecast Horizon	Commodity	real GDP	Inflation	Fed Funds Rate	Baa-10 year Treasury spread
1	4.48	100.00	0.01	8.68	15.22
2	4.15	82.54	0.84	9.23	23.12
3	4.98	76.86	0.75	8.54	25.86
4	32.79	54.80	4.63	6.34	19.07
8	36.32	44.60	5.37	10.39	19.58
12	35.97	43.73	5.59	10.56	20.04
Forecast Horizon	Commodity	real GDP	Inflation	Fed Funds Rate	Baa-3 month T-bill spread
1	3.28	100.00	0.99	8.46	0.00
2	3.02	94.45	0.91	8.77	0.54
3	7.38	87.95	1.75	9.13	0.63
4	27.13	67.47	7.58	6.94	0.79
8	28.52	58.53	9.76	10.11	4.64
12	27.78	56.64	9.92	10.56	5.46
Forecast Horizon	Commodity	real GDP	Inflation	Fed Funds Rate	Credit Card-LIBOR spread
1	3.25	100.00	0.20	11.08	14.56
2	3.36	94.57	0.19	10.13	14.51
3	6.57	88.47	0.39	10.86	15.91
4	25.26	68.83	4.51	8.41	12.49
8	26.30	58.96	6.86	13.76	14.34
12	25.85	57.98	7.80	13.57	15.18
Forecast Horizon	Commodity	real GDP	Inflation	Fed Funds Rate	LIBOR-FF spread
1	2.49	100.00	0.13	13.52	3.81
2	2.75	94.29	0.16	11.86	5.72
3	6.74	87.28	0.15	12.62	7.25
4	24.70	67.24	2.24	9.83	5.63
8	26.52	57.31	5.14	12.24	8.62
12	26.43	49.94	6.02	13.48	8.53
Forecast Horizon	Commodity	real GDP	Inflation	Fed Funds Rate	24-month Personal Credit-LIBOR spread
1	1.22	100.00	0.83	10.09	11.92
2	1.25	96.39	0.97	10.65	11.06
3	5.38	84.92	1.04	11.81	18.18
4	18.26	69.08	3.52	11.26	14.82
8	20.53	59.54	4.88	15.24	16.97
12	19.82	56.92	5.29	15.93	17.65

In Table 2 - 4 the generalized variance decomposition of the annualized quarterly growth rate of real GDP under various VAR frameworks with different interest rate spreads is given. The interest rate spreads are expressed in terms of quarterly averages. The credit variables are the following spreads: Aaa-Federal Funds rate; Aaa-LIBOR; Aaa-10-year Treasury rate; Aaa-3-month Treasury bill rate; Baa-Federal Funds rate; Baa-LIBOR; Baa-10-year Treasury rate; Baa-3-month Treasury bill rate; Credit Card-LIBOR; LIBOR-Federal Funds rate; and 24-month Personal Credit-LIBOR.

Table 2 - 5

Variance Decomposition of Inflation					
Forecast Horizon	Commodity	real GDP	Inflation	Fed Funds Rate	Private Credit
1	12.35	0.28	100.00	1.57	0.00
2	21.06	5.88	87.57	7.77	0.00
3	18.80	5.35	77.67	10.25	2.40
4	18.71	6.87	78.06	9.52	2.23
8	12.60	16.80	66.66	10.36	5.56
12	11.64	20.12	63.73	9.39	5.18
Forecast Horizon	Commodity	real GDP	Inflation	Fed Funds Rate	Consumer Credit Outstanding
1	10.94	0.39	100.00	0.88	14.52
2	18.32	3.85	91.61	1.59	12.75
3	17.56	4.41	85.06	4.62	13.25
4	18.89	6.32	83.06	4.35	13.53
8	14.60	13.10	70.43	5.08	10.44
12	12.84	15.47	67.05	4.64	9.81
Forecast Horizon	Commodity	real GDP	Inflation	Fed Funds Rate	Consumer Credit Outstanding (Commercial Banks)
1	9.64	0.16	100.00	2.47	10.10
2	15.79	5.15	82.98	3.61	12.24
3	15.16	5.50	77.03	5.95	11.63
4	17.52	8.58	75.56	6.64	10.29
8	13.25	16.09	68.97	8.43	7.70
12	12.03	18.40	66.76	7.79	7.20
Forecast Horizon	Commodity	real GDP	Inflation	Fed Funds Rate	Consumer Credit Outstanding (Finance Companies)
1	7.29	0.00	100.00	2.55	1.37
2	16.11	6.12	88.39	4.85	1.41
3	15.15	6.74	78.50	7.22	5.40
4	16.72	9.47	76.01	6.65	5.40
8	13.53	15.88	64.46	8.84	4.06
12	12.02	18.98	61.35	8.25	3.93
Forecast Horizon	Commodity	real GDP	Inflation	Fed Funds Rate	Consumer Credit Outstanding (Savings Institutions)
1	10.93	1.06	100.00	1.14	0.03
2	19.07	1.94	92.62	1.92	0.91
3	17.67	1.85	85.35	4.81	5.04
4	16.98	3.92	81.34	4.51	7.36
8	13.01	8.25	68.85	5.36	8.78
12	12.33	9.36	63.64	5.20	10.13
Forecast Horizon	Commodity	real GDP	Inflation	Fed Funds Rate	Consumer Credit Outstanding (Nonfinancial Businesses)
1	11.63	0.50	100.00	2.44	4.92
2	17.09	2.66	93.82	2.66	4.50
3	16.44	3.52	86.10	5.28	5.68
4	18.02	5.40	83.09	5.19	5.37
8	13.49	12.91	70.26	6.78	4.85
12	12.15	15.08	67.34	6.14	5.01

Variance Decomposition of Inflation					
Forecast Horizon	Commodity	real GDP	Inflation	Fed Funds Rate	Domestic, Non-financial Credit Market Debt
1	10.78	0.45	100.00	3.43	24.38
2	15.94	3.16	89.61	3.78	21.55
3	15.02	3.09	84.59	7.33	20.27
4	15.35	4.73	81.76	7.46	18.18
8	14.04	9.27	68.35	9.20	15.58
12	13.55	9.51	63.95	8.66	15.70

Forecast Horizon	Commodity	real GDP	Inflation	Fed Funds Rate	Non-financial Household Credit Market Debt
1	7.45	0.01	100.00	2.18	14.12
2	20.37	5.93	81.37	3.33	12.55
3	18.72	5.98	69.10	10.64	12.33
4	15.73	7.43	64.20	8.83	13.30
8	14.73	15.35	42.79	10.59	19.05
12	17.75	16.11	33.96	9.23	24.36

Forecast Horizon	Commodity	real GDP	Inflation	Fed Funds Rate	Consumer Credit Outstanding (Credit Unions)
1	11.63	0.50	100.00	2.44	4.92
2	17.09	2.66	93.82	2.66	4.50
3	16.44	3.52	86.09	5.28	5.68
4	18.02	5.40	83.09	5.19	5.37
8	13.49	12.91	70.26	6.78	4.85
12	12.15	15.08	67.34	6.14	5.01

In Table 2 - 5 the generalized variance decomposition of the annualized quarterly growth rate of the GDP deflator with various credit aggregates variables is given. The credit aggregates are also expressed in terms of annualized quarterly growth rate. The credit variables are the following: Private credit, Domestic, non-financial Credit Market Debt Outstanding, Household, non-financial Credit Market Debt Outstanding, Total Consumer Credit Outstanding, Commercial Bank Consumer Credit Outstanding, Finance Companies Consumer Credit Outstanding, Credit Unions Consumer Credit Outstanding, Savings Institutions Consumer Credit Outstanding and Non-financial Business Consumer Credit Outstanding.

Table 2 - 6

Variance Decomposition of Inflation					
Forecast Horizon	Commodity	real GDP	Inflation	Fed Funds Rate	Household Debt Service Ratio
1	9.14	1.29	100.00	0.53	0.96
2	15.69	6.79	89.04	1.78	5.26
3	14.25	7.85	78.92	5.25	5.12
4	15.76	9.95	75.60	4.71	4.48
8	14.13	16.11	62.96	5.05	3.41
12	12.31	18.45	59.80	4.72	3.21
Forecast Horizon	Commodity	real GDP	Inflation	Fed Funds Rate	Financial Obligations Ratio
1	9.61	1.28	100.00	0.77	0.62
2	15.72	5.75	90.52	1.93	4.10
3	14.45	6.55	81.55	5.13	4.26
4	16.48	8.72	78.41	4.75	3.77
8	14.10	14.69	66.21	5.16	3.10
12	12.55	16.83	63.20	4.81	3.15
Forecast Horizon	Commodity	real GDP	Inflation	Fed Funds Rate	Homeowner Financial Obligations Ratio
1	9.61	1.28	100.00	0.77	0.62
2	15.72	5.75	90.52	1.93	4.10
3	14.45	6.55	81.55	5.13	4.26
4	16.48	8.72	78.41	4.75	3.77
8	14.10	14.69	66.21	5.16	3.10
12	12.55	16.83	63.20	4.81	3.15
Forecast Horizon	Commodity	real GDP	Inflation	Fed Funds Rate	Homeowner Financial Obligations Ratio: Mortgage
1	11.31	1.44	100.00	0.63	0.02
2	20.64	6.76	86.97	1.86	2.87
3	19.38	7.84	74.24	6.55	3.59
4	21.04	9.54	70.37	5.65	3.77
8	17.71	16.33	61.91	4.85	2.98
12	16.39	18.81	57.65	4.70	3.69
Forecast Horizon	Commodity	real GDP	Inflation	Fed Funds Rate	Homeowner Financial Obligations Ratio: Consumer
1	10.46	1.51	100.00	1.27	1.56
2	15.50	5.22	89.83	2.71	7.73
3	14.41	5.54	82.85	5.35	7.54
4	16.77	7.76	79.88	5.07	7.01
8	14.03	12.79	66.45	5.94	5.18
12	12.21	14.86	63.00	5.52	4.54

In Table 2 - 6 the generalized variance decomposition of the annualized quarterly growth rate of the GDP deflator under various VAR frameworks with different credit-to-income ratio variables is given. The credit ratios are expressed in terms of quarterly averages. The credit variables are the following: Household Debt Service Ratio, Financial Obligations Ratio, Total Homeowner Financial Obligations Ratio, Homeowner Financial Obligations Ratio: Mortgage and Homeowner Financial Obligations Ratio: Consumer.

Table 2 - 7

Variance Decomposition of Inflation					
Forecast Horizon	Commodity	real GDP	Inflation	Fed Funds Rate	Aaa-FF spread
1	11.45	0.30	100.00	1.45	0.41
2	22.76	4.49	86.79	2.86	0.91
3	21.94	4.83	79.37	6.47	4.50
4	21.84	6.08	78.88	6.48	4.55
8	17.11	13.43	69.43	7.29	3.56
12	16.12	15.31	66.11	6.80	5.89
Forecast Horizon	Commodity	real GDP	Inflation	Fed Funds Rate	Aaa-LIBOR spread
1	13.37	0.11	100.00	1.50	2.37
2	22.59	2.86	89.22	2.54	2.44
3	21.55	3.16	81.64	6.13	8.89
4	23.52	4.75	80.54	6.34	8.16
8	18.06	13.63	71.77	6.58	6.11
12	17.04	15.67	67.77	6.00	8.39
Forecast Horizon	Commodity	real GDP	Inflation	Fed Funds Rate	Aaa-10 year Treasury spread
1	12.01	0.00	100.00	3.46	9.60
2	20.79	4.95	88.86	5.99	9.03
3	20.42	6.06	82.20	7.72	8.22
4	21.26	8.83	79.21	8.39	7.46
8	15.28	18.30	68.24	10.49	10.62
12	13.94	22.54	62.62	10.12	9.53
Forecast Horizon	Commodity	real GDP	Inflation	Fed Funds Rate	Aaa-3 month T-bill spread
1	11.35	0.68	100.00	0.34	0.05
2	22.08	4.45	86.50	1.59	0.96
3	21.64	5.46	80.28	4.22	2.93
4	20.46	6.33	77.80	4.29	4.70
8	16.42	13.66	67.78	5.32	3.98
12	18.12	15.23	62.34	5.47	5.78
Forecast Horizon	Commodity	real GDP	Inflation	Fed Funds Rate	Baa-FF spread
1	11.36	0.60	100.00	1.18	0.45
2	22.67	4.52	86.92	2.46	2.31
3	21.57	4.53	79.80	6.53	4.92
4	21.27	5.22	79.60	6.67	4.55
8	15.74	12.71	70.49	8.09	4.28
12	15.67	14.25	66.28	7.84	5.79
Forecast Horizon	Commodity	real GDP	Inflation	Fed Funds Rate	Baa-LIBOR spread
1	12.71	0.29	100.00	1.11	0.18
2	22.03	3.06	89.52	2.45	1.97
3	20.53	2.90	82.25	6.64	7.69
4	22.53	4.09	81.19	7.14	7.20
8	17.12	12.69	72.29	7.97	7.29
12	16.76	14.26	68.19	7.56	8.30

Variance Decomposition of Inflation					
Forecast Horizon	Commodity	real GDP	Inflation	Fed Funds Rate	Baa-10 year Treasury spread
1	10.30	0.00	100.00	3.30	16.68
2	15.63	3.34	91.56	6.81	16.62
3	14.90	3.52	86.76	8.76	15.72
4	18.58	6.24	82.76	10.90	16.23
8	15.39	15.33	72.06	12.12	19.33
12	14.62	16.32	65.02	11.05	19.22
Forecast Horizon	Commodity	real GDP	Inflation	Fed Funds Rate	Baa-3 month T-bill spread
1	11.33	0.99	100.00	0.39	1.39
2	22.11	4.68	86.73	1.51	3.72
3	21.36	5.36	80.43	4.75	4.65
4	20.01	5.57	78.39	4.69	5.30
8	16.63	13.10	66.54	6.07	6.24
12	21.18	14.55	58.04	7.02	7.51
Forecast Horizon	Commodity	real GDP	Inflation	Fed Funds Rate	Credit Card-LIBOR spread
1	11.99	0.20	100.00	1.48	0.01
2	19.18	2.34	93.27	2.54	0.62
3	19.73	3.11	86.11	4.78	2.29
4	21.91	5.66	83.30	4.97	2.97
8	17.24	11.65	74.17	6.23	2.55
12	15.52	12.75	70.96	5.63	3.22
Forecast Horizon	Commodity	real GDP	Inflation	Fed Funds Rate	LIBOR-FF spread
1	10.69	0.13	100.00	2.67	4.14
2	17.24	2.24	93.19	5.32	4.20
3	19.63	3.60	82.51	5.56	9.49
4	23.01	6.06	78.98	6.01	10.42
8	14.09	11.24	54.01	11.32	9.43
12	14.08	12.97	47.17	12.23	7.58
Forecast Horizon	Commodity	real GDP	Inflation	Fed Funds Rate	24-month Personal Credit-LIBOR spread
1	12.01	0.83	100.00	1.64	0.33
2	18.38	2.53	91.94	2.65	2.70
3	18.74	2.79	84.96	5.52	2.81
4	21.87	4.33	81.93	5.86	4.29
8	17.25	12.11	71.75	8.56	6.03
12	14.76	14.15	66.31	8.88	5.32

In Table 2 - 7 the generalized variance decomposition of the annualized quarterly growth rate of the GDP deflator under various VAR frameworks with different interest rate spreads is given. The interest rate spreads are expressed in terms of quarterly averages. The credit variables are the following spreads: Aaa-Federal Funds rate; Aaa-LIBOR; Aaa-10-year Treasury rate; Aaa-3-month Treasury bill rate; Baa-Federal Funds rate; Baa-LIBOR; Baa-10-year Treasury rate; Baa-3-month Treasury bill rate; Credit Card-LIBOR; LIBOR-Federal Funds rate; and 24-month Personal Credit-LIBOR.

CHAPTER 3. REAL INTEREST RATES AND FISCAL POLICY: A GLOBAL STUDY

3.1 INTRODUCTION

In the forefront of every nation's fiscal policy debate exists the issue of whether to run a budget deficit or a budget surplus. Given that the latter is rarely attained by most countries, the debate then reduces to one that concerns the size of the budget deficit. One of the arguments given against increasing the magnitude of a budget deficit is the cost that will be incurred by the economy from a resulting increase in the real interest rate. When government spending grows more than government receipts, the private sector pays the price through an increase in real interest rates in response to the lower pool of loanable funds available to the economy. Recently, this debate has garnered more attention given that the U.S. has gone from having a rare budget surplus to the more typical budget deficit. Other nations have seen similar fluctuations.

Gale and Orszag (2004) give a thorough overview of the different economic effects of budget deficits on real interest rates. They present two theoretical views: a Ricardian equivalence explanation and a Keynesian IS-LM explanation. Barro (1974) shows that if Ricardian equivalence prevails, national savings will always be constant, regardless of national deficits. If a government is operating under a national deficit, private savings will increase in anticipation of future tax increases or lower government spending. The change in the national budget will then be offset by an equal change in private savings. Since national savings provide the pool of loanable funds to the economy, there will be no change in the real interest rate. The Keynesian IS-LM view, however, implies that Ricardian equivalence might fail. Under this explanation, private savings does not completely offset changes in the national budget. In a closed economy, the real interest rate responds sharply to changes in the national budget, since national savings cannot expand through capital inflows. If the economy is an open one, it is possible that national

savings can expand through capital inflows or shrink if domestic capital goes abroad. If fiscal policy is expansionary, the real interest rate will increase. The new higher real interest rate will attract foreign capital. This new source of capital will expand the pool of loanable funds and drive down the real interest rate. Whether the real interest rate returns to its original level or not will depend on the degree of financial openness that exists in the economy in question. In the Keynesian IS-LM view, exchange rate regimes are important as well. While they will not change the type of response in the real interest rate, a floating or fixed currency will affect the magnitude of their response. A fixed currency will dampen this effect since the central bank will have to adjust the money supply in order to offset the change in the real interest rate and maintain their currency at a constant value.

Empirically, most findings support the Keynesian view. Changes in the national budget affect real interest rates. Using a measure of projected deficits to control for business cycle effects, Laubach (2003) finds that an increase in the deficit-GDP ratio by one percent raises the ten-year Treasury note by at least 24 basis points. Engen and Hubbard (2004) duplicate the Laubach study, but with more control variables; at 18 basis points, they find the same directional effect but of a much smaller magnitude. In an international study Ardagna, Caselli and Lane (2004) find that for OECD countries a one-percent increase in the national deficit-GDP ratio results in a cumulative change of 150 basis points for the real interest rate, while the one-time, initial increase is approximately 10 basis points.

I use a dynamic panel data set of 59 nations from 1970 through 2006. I control for both exchange rate regimes and financial openness. As in the previous literature, I find that fiscal policy affects real interest rates, but not as much as previous studies would suggest. A one-percent increase in the national deficit to national output ratio in real terms increases that

nation's real interest rate. The effect is statistically and economically significant. The benchmark result ranges in magnitude from around 12 to 15 basis points, depending on which measure of financial openness is used. This study is unique in that it covers a range of very different nations. It is not limited to nations with similar economies, rather it encompasses both advanced, developed and transitional economies.

A second finding is the apparent unimportance of financial openness. At no stage is the financial openness variable statistically significant in the determination of the real interest rate. This result does not change when using a *de jure* measure of financial openness instead of a *de facto* one. While this appears to be a puzzling result, it is not entirely so. In economic growth literature Fratzscher and Bussière (2004) document the failed efforts in the literature to quantify financial openness effects on economic growth.

The section that follows goes over the methodology and data set used in this study. Section 3.3 provides a discussion of the results. Section 3.4 provides some robustness checks and the final section of this chapter concludes.

3.2 METHODOLOGY AND DATA

In an effort to analyze the behavior of real interest rates when faced with changes in national budgets among a variety of nations, I make adjustments to an empirical model given by Giavazzi et al. (2000) and Kamps (2006). I assume that the real interest rate depends on the growth rate of per capita income and the ratio of the budget surplus to GDP. The model is dynamic due to the fact that I also assume that there is persistence in the real interest rate, so lagged values of the real interest rate are included.¹⁹ I also control for financial openness and exchange rate regimes.

¹⁹ For example, see Rapach and Wohar (2004) concerning real interest rate persistence.

3.2.1 Pooled OLS

The general specification of the model assumes n lags of the dependent variable and is given as follows:

$$r_{it} = \beta_0 + \beta_1 y_{it} + \beta_2 s_{it} + \beta_3 (s_{it} * fo_{it}) + \beta_4 xch_{it} + \sum_{n=1}^p \alpha_n r_{it-n} + \varepsilon_{it} \quad (1)$$

Here, r stands for the real interest rate, y is the growth in per capita income, s is the national budget-to-GDP ratio. Positive values of s indicate a budget surplus, while negative ones imply a national deficit. The variable fo is a measure of financial openness and xch is a binary variable that captures whether the i th country's exchange rate regime is floating or fixed by assigning a value of 1 for the former and 0 for the latter. Of course, t is a time subscript, i is the country subscript and n is the lag length. Also, as given by Equation 1, I assume that financial openness interacts with the national budget to affect the real interest rate.

3.2.2 Fixed Effects

Given the range of countries being examined and the time period being covered, certain specific effects would be expected. These may be sensitive to either country factors and/or time factors. If the individual country effects are due to variables being omitted, then, it is possible that there could be correlation issues with the other independent variables. Additionally, since the sample of countries used in this study is not truly random, controlling for fixed effects would seem more appropriate.²⁰ To account for this, the above model will be estimated again, but in the following manner:

$$r_{it} = \beta_0 + \delta_i + \eta_t + \beta_1 y_{it} + \beta_2 s_{it} + \beta_3 (s_{it} * fo_{it}) + \beta_4 xch_{it} + \sum_{n=1}^p \alpha_n r_{it-n} + \varepsilon_{it} \quad (2)$$

²⁰ The Hausman test confirms this.

Country fixed effects and time fixed effects are controlled for using dummy variables (not shown here for convenience) and are represented by the additional vectors δ and η , respectively.

3.2.3 Arellano-Bond Estimator

Since the dependent variable r depends on past values of r , dynamic effects need to be accounted for. However, allowing for a lags of the dependent variable on the right-hand side of the equation potentially could lead to an endogeneity problem. With this in mind and in order to obtain consistent parameters for this model and address the potential endogeneity issue, following Arellano and Bond (1991) a generalized method-of-moments (GMM) approach is used to estimate the parameters. First-differencing Equation 2 above gives the following:

$$\Delta r_t = \beta_0 + \beta_1 \Delta y_t + \beta_2 \Delta s_t + \beta_3 \Delta(s_t * fo_t) + \beta_4 \Delta xch_t + \sum_{n=1}^p \alpha_n \Delta r_{t-n} + \Delta \varepsilon_t \quad (3)$$

The individual country and time effects are now eliminated and estimation can be done using GMM procedures. For the dependent variable, the Arellano-Bond estimator calls for using the lagged variable r_{t-2} as an instrument and for the independent variables, their own differences are used as in Equation 3. So, following Arellano-Bond, the equation to be estimated is:

$$r_{t-2} = \beta_0 + \beta_1 \Delta y_t + \beta_2 \Delta s_t + \beta_3 \Delta(s_t * fo_t) + \beta_4 \Delta xch_t + \sum_{n=1}^p \alpha_n \Delta r_{t-n} + \Delta \varepsilon_t \quad (4)$$

Given the assumption that there tends to be some degree of persistence in the real interest rate, one would expect past values of r to be positively correlated with current values; therefore, α_p should be positive and statistically significant. Also, if β_1 is statistically significant, it should be positive, given that theory would suggest that increases in per capita income drive the real interest rate up through higher demand for money. The sign of β_2 should be negative if it is significant; this would confirm Keynesian IS-LM behavior of real interest rates in response to changes in the national budget. However, if this parameter is not statistically different from zero,

then Ricardian equivalence would appear to prevail. The parameter β_3 for the interaction variable ($s*fo$) should be positive if financial openness is important, since financial openness will offset the national budget effect on real interest rates by providing capital when shortages in the loanable funds market occur and vice versa. At first glance, it is not clear what the expected sign of the coefficient β_5 should be. Since central banks in countries with fixed exchange rates use monetary policy to offset changes in the interest rate, it could be either sign. Fortunately, this will not matter since the purpose of including it here is simply to control for different currency regimes.

3.2.4 Data

The data for this study is annual and covers the period from 1970 through 2006.²¹ The lag used for the real interest rate independent variable is one.²² The real interest rate is calculated by subtracting the inflation rate from the national treasury bill rate. The inflation rate is calculated using the consumer price index of each country. The real per capita GDP growth rate is obtained from each country's GDP series, population series and consumer price index. The national budget ratio is calculated using each country's surplus/deficit series and GDP series. Following Edison et al. (2002), the *de facto* financial openness series is a ratio of the country's capital inflows and outflows to GDP. All of the above series are taken from the International Monetary Fund's *International Financial Statistics* database. The *de jure* financial openness index is taken from the Chinn-Ito index.²³ The exchange rate information was taken from the IMF *De Facto Exchange Rate Arrangements and Anchors of Monetary Policy*.

²¹ See Table 3 - 12 for a list of the countries included in this paper and see Table 3 - 13 for the summary statistics for the data.

²² Running the regressions with two or more lags does not change the results significantly and furthermore the second lag is insignificant statistically.

²³ The latest version of this index can be found at <http://www.ssc.wisc.edu/~mchinn>.

3.3 DISCUSSION OF RESULTS

3.3.1 Fiscal Policy, Real Interest Rates and de jure Financial Openness

The first column of Table 3 - 1 shows the results from the pooled OLS estimation using the *de jure* financial openness variable. At first glance, these benchmark results would appear to support Ricardian equivalence; that is, fiscal policy is not important in the determination of real interest rates. But, if this were the case, the financial openness variable should not matter either. Here, it does. However, while the financial openness variable is statistically significant, economically its effect on real interest rates is small. It does have the expected sign, since the coefficient's positive sign would indicate that financial openness improves the real interest rate impact, but economically, this is very small at 2 basis points. The coefficients for the other regressors are significant and as expected.

In all likelihood, the pooled OLS estimation is not adequate. Given the wide sample and broad time period, one would expect some sort of fixed effects to occur. In the second column of Table 3 - 1 the results from estimating Equation 2 are given. Controlling for both time and country fixed effects suggests that fiscal policy does matter both statistically and economically. A one-percent change in the national budget to GDP ratio corresponds to a 12 basis point change in the real interest rate, regardless of country or time period. If a country increases its national deficit by one percent relative to its GDP, an increase of 12 basis points in the real interest rate would be expected. This estimate is higher than the estimate given by Ardagna, Caselli and Lane (2004), but a bit less than Laubach's (2003) and Engen and Hubbard's (2004).

While the short-run effect found by Ardagna, Caselli and Lane (2004) was not of great magnitude, they did find that the long-run effect was prominent at 150 basis points after 10 years. Assuming that the financial openness coefficient is not statistically different from zero as the results indicate, based on the results from column two of Table 3 - 1, the long-run effect of a

change in the national budget would approach approximately 16 basis points. This is illustrated in Figure 3 - 1. This effect would be permanent, but small compared to the 150 basis point effect in Ardagna, Caselli and Lane (2004).

Due to the fact that a lag of the dependent variable appears as an independent variable, controlling just for fixed effects may not be sufficient. Instrumenting and using the GMM technique as given by Arellano and Bond (1991), fiscal policy appears to matter a bit more. Statistically, the coefficient for the budget surplus variable is stronger. Economically, the basis point impact on the real interest rate is slightly more at 15 basis points. Looking at Figure 3 - 2, the long-run effect is also greater at just under 20 basis points after 10 years. This effect is permanent and asymptotically approaches 20 basis points.

In both the fixed effects and the GMM regressions, what stands out is that the coefficient for financial openness is never statistically significant. In all cases the control variables are important and they have the signs that are expected.

3.3.2 Fiscal Policy, Real Interest Rates and *de facto* Financial Openness

In Table 3 - 2 the results from the pooled OLS estimation using the *de facto* financial openness variable are given. As in the *de jure* case, fiscal policy does not seem to matter, however, neither does financial openness. Of the control variables only the currency regime and the one-year lag of the real interest rate appear important statistically.

As stated earlier, the pooled OLS estimation does not seem appropriate. Using two-way fixed effects for country and time, results similar to those in the *de jure* fixed effects regression are obtained. Financial openness is the only variable that does not appear to matter statistically. The other coefficients are all of similar magnitudes and statistical significance levels as those results using the *de jure* financial openness variable. The one-time basis point effect of an

increase in the national deficit on the real interest rate is approximately 15 basis points. The long-term effect is around 16.25 basis points as given in Figure 3 - 3.

Under the Arellano-Bond estimation, the statistical significance and economic magnitude are similar. In other words, fiscal policy appears to matter, but financial openness does not. Here, the basis point increase in the real interest rate from a one-percentage increase in the deficit-to-GDP ratio is approximately 13 basis points. The long-term effect approaches 20 basis points as shown in Figure 3 - 4.

3.4 SENSITIVITY ANALYSIS

The results above are not sensitive to lag selection. A lag length of one seems to be the most appropriate, but additionally lags of the dependent variable have no effect on the results that the budget surplus variable is negatively correlated to the real interest rate and that the financial openness variable has no effect.

Excluding the exchange rate variable does not change the results for either financial openness variable and for either estimation technique.

Also, sub-sample data sets also support the finding that financial openness does not appear to be important in the determination of real interest rates. The first two rows of Table 3 - 3 and Table 3 - 4 show the results for sub-sample analysis based on whether a country is industrial or not. The results in the third row are from examining countries that are members of the OECD.²⁴ However, only in the sub-sample for non-industrial countries is the national budget variable important.

In the previous analysis, correlation between the lagged dependent variable and the error term is not taken into consideration. When this is accounted for by using the Arellano-Bond

²⁴ Not all countries of the OECD are in the original sample. Here, only the countries from this sample that are in the OECD are looked at.

estimator, the two original results are both supported: the national budget is statistically important in the determination of real interest rates and financial openness does not appear to matter for real interest rates. This is shown in Table 3 - 5 and Table 3 - 6.

Next, I drop all sub-Saharan nations, except for South Africa. The results are given in the fourth rows of Table 3 - 3 through Table 3 - 6. Again, the results are robust. The magnitude and sign of the effect of budget surplus variable on the real interest rate is approximately the same. Additionally, the coefficient for financial openness in all specifications is insignificant statistically.

In Table 3 - 7 and Table 3 - 8 I use different GMM estimators with different specifications. Again, the results are robust. The budget surplus coefficient is statistically and economically significant, while the financial openness variable remains statistically insignificant.

Finally, in Table 3 - 9 and Table 3 - 10 I conduct the Sargan test using the Arellano-Bond estimator. For both financial openness variables the Sargan test provides a p-value greater than the significance level of 0.05. Therefore, I do not reject the null hypothesis of instrument exogeneity and I conclude that the instruments are not correlated with the error term. I also conduct the Sargan test for lags of the dependent variable greater than one. With the exception of a lag of two, all higher order lags do not allow for rejection of the null hypothesis of overidentifying restrictions being valid. The instruments appear to be exogenous. Additionally, in Table 3 - 11, I report the Arellano-Bond test for autocorrelation in the first-differenced errors. I reject the null hypothesis of serial correlation in the first-differenced error terms at an order higher than one; this implies that the moment conditions used by the Arellano-Bond estimator are valid.

3.5 CONCLUDING REMARKS

While Ricardian equivalence suggests that fiscal policy has no effect in the determination of the real interest rate, most empirical evidence suggests otherwise. However, even though the literature appears to support the Keynesian IS-LM hypothesis that fiscal policy matters for real interest rates, there is often much disagreement over the degree of economic importance. Most of the focus on this issue is centered on the U.S. economy. The one study that has looked beyond the U.S. was limited to OECD countries that are similar to the U.S.

Here, I test the link between fiscal policy and real interest rates on a much broader sample. I look at developed, developing and transitional economies. Controlling for exchange rate regimes and financial openness, I find evidence that supports the Keynesian IS-LM hypothesis, but only slightly. While fiscal policy is statistically and economically important in the determination of real interest rates, in this study I find the effect to be smaller than estimated in previous studies, both in the short run and in the long run. Increases in the national deficit to GDP ratio are linked positively with changes in the real interest rate. I find that the strongest effect is in the short-run. This effect ranges from 12 to 15 basis points. However, after approximately 5 years, the effect approaches its maximum level of around 16 to 20 basis points. Therefore, the long-run effect is not as important.

Additionally, I find a surprising result: financial openness does not appear to play an important role in the determination of real interest rates. This result is robust to country selection and two different measures of financial openness. This result is truly puzzling. Possible explanations are that current measures of financial openness suffer from measurement error and/or the degree of financial openness in the world is close among different economies and therefore due to a lack of variation it does not appear to have much explanatory power for the determination of real interest rates. Also, it may be the case that trade openness better captures

financial openness than conventional measures of financial openness do. Another possible explanation is that institutional quality is not captured. If institutions are weak, then the degree of financial openness in a country will not matter since it will lack proper institutions to allow for this mechanism of capital flows to function properly.

3.6 APPENDIX

Table 3 - 1

De jure financial openness

	Default	With Time and Country Effects	GMM
Lagged real interest rate	0.71*** (0.02)	0.20*** (0.03)	0.35*** (0.03)
Per Capita GDP	0.03** (0.02)	0.25*** (0.03)	0.19*** (0.03)
National Budget to GDP ratio	-0.01 (0.02)	-0.12** (0.05)	-0.13** (0.06)
Financial Openness	-0.02** (0.01)	-0.04 (0.02)	-0.02 (0.03)
Currency Regime	0.41** (0.18)	1.88*** (0.62)	3.96*** (0.79)

Standard errors are given in parenthesis. Bold face indicates coefficients have -value less than or equal to 0.10 (***) ≤ 0.01 ; ** ≤ 0.05 ; * ≤ 0.10). There are 52 observations for the first two columns and 680 for the last one.

Table 3 - 2

De facto financial openness

	Default	With Time and Country Effects	GMM
Lagged real interest rate	0.72*** (0.02)	0.20*** (0.03)	0.35*** (0.03)
Per Capita GDP	0.02 (0.02)	0.25*** (0.03)	0.19*** (0.03)
National Budget to GDP ratio	-0.03 (0.02)	-0.15*** (0.05)	-0.15*** (0.05)
Financial Openness	0.0001 (0.0002)	0.00003 (0.0003)	0.0002 (0.0004)
Currency Regime	0.44** (0.18)	1.87*** (0.62)	3.96*** (0.79)

Standard errors are given in parenthesis. Bold face indicates coefficients have -value less than or equal to 0.10 (***) ≤ 0.01 ; ** ≤ 0.05 ; * ≤ 0.10). There are 752 observations for the first two columns and 680 for the last one.

Table 3 - 3*De jure* Sensitivity Analysis (FE)

	National Budget	Financial Openness
Industrial Countries	-0.04 (0.05)	0.004 (0.02)
No Industrial Countries	-0.13** (0.07)	-0.05 (0.04)
OECD Countries in sample	-0.01 (0.05)	0.002 (0.02)
No Sub-Saharan Countries	-0.10** (0.05)	-0.04 (0.03)

Standard errors are given in parenthesis. Bold face indicates coefficients have p-value less than or equal to 0.10 (** ≤ 0.01 ; ** ≤ 0.05 ; * ≤ 0.10). There are 316 observations for the first row, 436 for the second, 306 for the third row and 757 for the last row.

Table 3 - 4*De facto* Sensitivity Analysis (FE)

	National Budget	Financial Openness
Industrial Countries	-0.04 (0.05)	0.0000 (0.0004)
No Industrial Countries	-0.18*** (0.07)	0.0001 (0.0004)
OECD Countries in sample	-0.03 (0.05)	0.002 (0.002)
No Sub-Saharan Countries	-0.13*** (0.04)	0.000 (0.000)

Standard errors are given in parenthesis. Bold face indicates coefficients have p-value less than or equal to 0.10 (** ≤ 0.01 ; ** ≤ 0.05 ; * ≤ 0.10). There are 316 observations for the first row, 436 for the second, 306 for the third row and 757 for the last row.

Table 3 - 5*De jure* Sensitivity Analysis (GMM)

	National Budget	Financial Openness
Industrial Countries	-0.11** (0.05)	0.02 (0.02)
No Industrial Countries	-0.15** (0.07)	-0.02 (0.04)
OECD Countries in sample	-0.08** (0.05)	0.009 (0.02)
No Sub-Saharan Countries	-0.13** (0.06)	-0.02 (0.03)

Standard errors are given in parenthesis. Bold face indicates coefficients have p-value less than or equal to 0.10 (***) ≤ 0.01 ; ** ≤ 0.05 ; * ≤ 0.10). There are 295 observations for the first row, 385 for the second, 283 for the third row and 682 for the last row.

Table 3 - 6*De facto* Sensitivity Analysis (GMM)

	National Budget	Financial Openness
Industrial Countries	-0.10** (0.04)	0.0001 (0.0004)
No Industrial Countries	-0.19*** (0.07)	0.0003 (0.0005)
OECD Countries in sample	-0.10** (0.05)	0.003 (0.002)
No Sub-Saharan Countries	-0.14*** (0.05)	-0.000 (0.000)

Standard errors are given in parenthesis. Bold face indicates coefficients have p-value less than or equal to 0.10 (***) ≤ 0.01 ; ** ≤ 0.05 ; * ≤ 0.10). There are 295 observations for the first row, 385 for the second, 283 for the third row and 682 for the last row.

Table 3 - 7*De jure* Sensitivity Analysis (Other Estimators)

	National Budget	Financial Openness
Blundell-Bond Estimator	-0.14***	-0.01
	(0.05)	(0.03)
Arellano-Bond with strictly exogenous covariates	-0.11**	-0.01
	(0.05)	(0.03)
Arellano-Bover/Blundell-Bond Estimator with strictly exogenous covariates	-0.14***	-0.01
	(0.05)	(0.03)

Standard errors are given in parenthesis. Bold face indicates coefficients have p-value less than or equal to 0.10 (***) $\leq$ 0.01; ** $\leq$ 0.05; * $\leq$ 0.10). There are 752 observations for each row.

Table 3 - 8*De facto* Sensitivity Analysis (Other Estimators)

	National Budget	Financial Openness
Blundell-Bond Estimator	-0.14***	0.000
	(0.05)	(0.000)
Arellano-Bond with strictly exogenous covariates	-0.12**	-0.000
	(0.05)	(0.000)
Arellano-Bover/Blundell-Bond Estimator with strictly exogenous covariates	-0.14***	0.000
	(0.05)	(0.000)

Standard errors are given in parenthesis. Bold face indicates coefficients have p-value less than or equal to 0.10 (***) $\leq$ 0.01; ** $\leq$ 0.05; * $\leq$ 0.10). There are 752 observations for each row.

Table 3 - 9

Sargan Test (*de jure*)

	National Budget to GDP ratio	Financial Openness	P-value
One lag	-0.13**	-0.02	0.05
	(0.06)	(0.03)	
Two lags	-0.13**	-0.01	0.00
	(0.06)	(0.03)	
Three lags	-0.15**	0.01	0.12
	(0.06)	(0.03)	

Table 3 - 10

Sargan Test (*de facto*)

	National Budget to GDP ratio	Financial Openness	P-value
One lag	-0.15***	0.0002	0.05
	(0.05)	(0.0004)	
Two lags	-0.14***	-0.00004	0.00
	(0.05)	(0.0004)	
Three lags	-0.14***	-0.00001	0.13
	(0.05)	(0.0004)	

Table 3 - 11

Autocorrelation Tests

	P-value	
	Order 1	Order 2
<i>De jure</i> Financial Openness	0.0007	0.9641
<i>De facto</i> Financial Openness	0.0007	0.9793

Table 3 - 12

Countries in sample

Australia		Iceland		Philippines
Bahamas		Israel		Poland
Bahrain		Italy		Seychelles
Barbados		Jamaica		Singapore
Belgium		Kenya		Slovenia
Belize		Kuwait		South Africa
Bolivia		Kyrgyz Rep.		Spain
Brazil		Latvia		Sri Lanka
Canada		Lesotho		St. Kitts & Nevis
Cyprus		Lithuania		St. Lucia
Czech Rep.		Malawi		Swaziland
Egypt		Malaysia		Sweden
Ethiopia		Malta		Switzerland
Fiji		Mexico		Thailand
France		Moldova		Trinidad & Tobago
Germany		Morocco		Uganda
Greece		Nepal		United Kingdom
Grenada		Netherlands		United States
Haiti		New Zealand		Zambia
Hungary		Papua N. Guinea		

Table 3 - 13

Name	Definition	Summary Statistics for Data				Standard Deviation	Source(s)
		Mean	Median	Maximum	Minimum		
<i>r</i>	Difference between nominal short-term interest rate and the annual rate of change of the private consumption deflator	1.47	2.17	33.21	-81.10	6.36	Treasury Bill Rate (60C.ZF) and CPI (64.XZF) from IMF's <i>International Financial Statistics</i> database
<i>y</i>	Annual growth rate of real per capita GDP	1.18	1.74	30.17	-37.91	5.82	GDP (99B.CZF), Population (99Z.ZF) and CPI (64.XZF) from IMF's <i>International Financial Statistics</i> database
<i>s</i>	Ratio of the national budget to GDP	-2.94	-2.83	16.11	-31.63	4.33	Government Cash Surplus/Deficit (cCSD.CG) and GDP (99B.CZF) from IMF's <i>International Financial Statistics</i> database
<i>fo (de jure)</i>	Financial Openness measure	0.64	0.18	2.60	-1.77	1.52	Chinn-Ito Index from http://www.ssc.wisc.edu/~mchinn
<i>fo (de facto)</i>	Financial Openness measure	25.72	5.10	1321.54	0.00	88.34	Flows of capital (78BDD+78BED+78BFD+78BGD) and GDP (99B.CZF) from IMF's <i>International Financial Statistics</i> database
<i>xch</i>	Binary variable that takes on value of 0 if currency regime is managed and 1, otherwise	0.53	-	-	-	0.50	<i>Exchange Rate Arrangements and Anchors of Monetary Policy</i>

Observations: 833

Figure 3 - 1

The above graph shows the outcome of a one-percentage point increase in the deficit-to-GDP ratio on the real interest rate using results from *de jure* fixed effect estimation.

Figure 3 - 2

The above graph shows the outcome of a one-percentage point increase in the deficit-to-GDP ratio on the real interest rate using results from *de jure* GMM estimation.

Figure 3 - 3

The above graph shows the outcome of a one-percentage point increase in the deficit-to-GDP ratio on the real interest rate using results from *de facto* fixed effect estimation.

Figure 3 - 4

The above graph shows the outcome of a one-percentage point increase in the deficit-to-GDP ratio on the real interest rate using results from *de facto* GMM estimation.

CHAPTER 4. MEXICAN STOCK EXCHANGE REACTION TO US MONETARY SURPRISES

4.1 INTRODUCTION

The Federal Reserve announcement concerning the federal funds target rate is one of the most important news items concerning monetary policy in the world. For U.S. equity markets, numerous studies have shown that the U.S. stock market is responsive to changes in U.S. monetary policy.²⁵ For foreign markets, U.S. monetary policy impact on foreign exchange rates and foreign interest rates has been examined in the literature as well.²⁶ The impact of Federal Open Market Committee (FOMC) announcements on foreign equity indices is looked at by Johnson and Jensen (1993), Ehrmann and Fratzscher (2002, 2006), Ehrmann et al (2005) and Wongswan (2005, 2006). In this literature it is shown that some of the reaction from foreign equity indices to US monetary policy is both direct and indirect; in addition to reacting to US monetary policy, foreign equity indices react through the U.S. equity market as well.

However, one issue that has received less attention is the importance of business cycles in determining the magnitude of the equity market reaction to monetary policy. Basistha and Kurov (2008) look at U.S. equity market reactions to the surprise component from FOMC announcements. They find that U.S. equity market reactions are more pronounced when the U.S. economy is in a recession. Using Granger causality statistics, Rodriguez and Rowe (2007) find that U.S. monetary policy can impact Hong Kong GDP and they suggest that if Hong Kong were in a recession, given that Fed policy is exogenous to the Hong Kong GDP, FOMC

²⁵ See Jensen and Johnson (1995), Jensen et al (1996), Thorbecke (1997), Patelis (1997), Ehrmann and Fratzscher (2004), Rigobon and Sack (2004), Gurkaynak et al (2004), and Bernanke and Kuttner (2005).

²⁶ Husted and Kitchen (1985), Roley (1987), Tandon and Urich (1987), Arora and Cerisola (2001, Durham (2001), Ehrmann and Fratzscher (2002), Andersen et al (2003, 2005), Miniane and Rogers (2004) and Robitaille and Roush (2004).

announcements could be detrimental to the Hong Kong economy. Specifically, they blame the fixed exchange rate of Hong Kong and point to the interest rates as the transmission mechanism.

Here, I look at a foreign equity market (*Indice de Precios y Cotizaciones*, or IPC) of a country (Mexico) that does not have a fixed exchange rate. I examine the response of the IPC to unexpected changes in federal funds target rate. Additionally, I examine whether the state of the Mexican economy is important for the IPC reaction to U.S. monetary policy. Wongswan (2005) and Hausman and Wongswan (2006) find that a surprise increase in the federal funds target rate of 100 basis points would provoke a decline in the Mexican equity market of approximately six percent. However, neither study considers the effects that the U.S. equity market might have that are independent of U.S. monetary shocks. The authors argue that since Mexico is in the same time zone as the U.S., these effects are negligible. However, Ehrmann and Fratzscher (2006) hold that even though Mexico is in the same hemisphere as the U.S., U.S. equity markets must be controlled for when looking at the Mexican equity market's reaction to FOMC announcements. They find that the reaction of the Mexican equity market to surprise changes in the federal funds target rate is statistically insignificant. They do find, however, that the future direction of U.S. monetary policy is statistically significant.

Controlling for the U.S. stock market, I find that the IPC drops by 6.66 percent when the federal funds target rate is increased unexpectedly by 100 basis points and vice versa. This result supports that found by Wongswan (2005) and Hausman and Wongswan (2006). I also find that the state of the Mexican economy matters. Furthermore, during periods where Mexico has witnessed at least two consecutive quarters of negative growth in real GDP, the IPC reacts by over 60 percent to an unexpected 100 basis-point change in the federal funds target rate. When this is not the case, the IPC reaction is significantly weaker. When using industrial production

instead, the magnitude is smaller, but it is still much more significant both economically and statistically than when Mexican industrial production is not declining for two consecutive quarters. This result is important in that it suggests that the exogenous event of a U.S. monetary surprise can cause significant damage to the Mexican stock exchange, especially if the Mexican economy is experiencing negative real growth.

Furthermore, these results suggest that the credit channel theory can be applied across the border. The Mexican equity market, like the U.S. equity market, suffers more during cyclical downturns when faced with U.S. monetary surprises. These results add to the literature in that previous work has ignored this aspect when looking at the surprise component of the FOMC announcements and their effect on foreign equity markets.

Additionally, these results make an empirical case for international monetary policy coordination, at least from Mexico's point of view. Theoretical models are mixed on whether international monetary policy coordination can bring gains. In their model, Obstfeld and Rogoff (2002) find that welfare gains from international monetary policy coordination are small and that un-coordinating policymakers can actually maximize global welfare if they are acting in an optimizing fashion individually. Canzoneri et al (2005) incorporate optimizing households, monopolistic competition and price stickiness into a similar theoretical framework as given by Obstfeld and Rogoff (2002) and find that coordination may matter. Here, my results suggest that from Mexico's point of view, monetary policy coordination with the US would be in their interests.

The rest of the paper is organized as follows. The next section offers an explanation of why the Mexican equity markets might react to surprises in U.S. monetary policy and then outlines the specific hypotheses I wish to test. Section 4.3 describes the estimation approach I

use and the data. In Section 4.4 the results are discussed. In section 4.5 different specifications are made to see how sensitive these results are. Finally, Section 4.6 gives a summary of the findings and draws some conclusions.

4.2 TRANSMISSION CHANNELS AND TESTABLE HYPOTHESES

4.2.1 Monetary Policy and Equity Markets

From the finance literature, the discounted cash flow reasoning can be used to calculate the price of a financial asset by using future cash flows of the asset and determining their present value. If there is a monetary surprise, this will raise the rate at which these assets are discounted and hence, lower their price. Empirical evidence overwhelmingly supports this assertion. Ehrmann and Fratzscher (2004), Rigobon and Sack (2004) and Bernanke and Kuttner (2005) all conclude that a 100 basis-point surprise in the federal funds target rate would provoke a change in the U.S. equity market in the range of approximately four to six percent; this correlation is negative.

4.2.2 Transmission Channels to Foreign Equity Markets

Just as U.S. equity markets react to U.S. monetary policy, foreign equity markets might as well. The link depends on whether the federal funds target rate affects foreign interest rates, too. If so, then, the same logic as given by the discounted cash flow reasoning would apply to foreign equity markets. A surprise tightening in the federal funds target rate would increase the foreign discount rate through its effect on the global interest rate and hence, foreign equity prices would fall. Monticini and Vaciago (2005) find that Euro bond rates do react to FOMC surprises, but British rates do not.²⁷

²⁷ They conclude that the BoE's focus on longer term rates may have something to do this, in addition to the less convincing argument that the BoE is older and therefore better at controlling its domestic rates than the ECB is.

However, stock market co-movements must also be considered. For example, in their study of the Japanese and U.S. equity markets, Lin, Engle and Ito (1994) find that there is significant co-movement between these two markets with the causality going in both directions.

4.2.3 Credit Channel Theory

Bernanke and Gertler (1989) show that the state of the economy can play an important role when investigating the effects of changes in monetary policy. Specifically, when an economy is in a recession, changes in credit conditions brought on by monetary surprises have a bigger impact than when the economy is experiencing positive real GDP growth. This happens through two channels. Borrowers that are dependent on external financing suffer when the supply of bank credit is reduced. Also, firms become less credit worthy due to deterioration in the quality of their balance sheets from the cyclical downturn in the economy. Both of these channels together have a multiplier-type effect on real output. Because of this, the economy becomes more sensitive to macroeconomic changes during economic downturns than during economic booms.

The link between the domestic economy and domestic equity markets is well-documented for many different economies. Andritzky et al (2007) show that the bond market in emerging economies reacts to U.S. macroeconomic news. For Mexico, Lustig (2001) highlights how the U.S. economy can affect Mexico.

Empirically, when investigating stock market reactions to monetary surprises, most work looks at domestic monetary changes and the domestic equity market reaction. Using newspaper announcements and daily stock returns in the U.S. during the early 1990s, Warner and Georges (2001) find little evidence that supports the credit channel theory. Basistha and Kurov (2008), however, find support for the credit channel theory. They look at a longer time period and use a more sophisticated method for measuring monetary surprises and they show that the U.S. stock

market responds approximately twofold more to unexpected changes in the federal funds target rate during tight credit conditions than when credit is easier.

4.2.4 Hypotheses

In this paper I set forth to test two hypotheses. The first is that U.S. monetary shocks cause reactions by the Mexican equity market. The second is that this effect on the Mexican equity market is asymmetric; the Mexican equity market responds more when the Mexican economy is experiencing negative real growth.

While foreign equity market response to U.S. monetary surprises has been examined in the literature, the importance of cyclical variations for this response has not. As cited earlier, previous studies that account for cyclical variations use the U.S. equity markets as their focus, not foreign equity markets. This paper contributes to the literature in that both of these points are examined.

4.3 ESTIMATION FRAMEWORK

4.3.1 Event-study Approach

In this paper an event-study approach is used. The events of interest are the surprise components from FOMC announcements concerning changes to the federal funds target rate. These include decisions to change as well as decisions not to change the federal funds target rate. Given that these policy decisions are anticipated by the market, all or some of the effect should already be incorporated into the foreign equity prices in the IPC. The degree to which the market correctly anticipates these policy changes will determine the degree of the impact. Complete anticipation by markets would suggest that IPC prices completely adjusted before the FOMC announcement. However, if the markets were surprised, or rather did not anticipate the event with complete accuracy, some reaction in IPC prices would be expected.

After each event, I look at the daily movement of IPC prices. These events can be considered exogenous since the event window is short and the Fed is unlikely to react to Mexican equity markets. I also control for U.S. equity prices since some of the change in IPC prices could be due to the reaction of U.S. equity prices to U.S. monetary policy announcements rather than the announcements themselves. Two FOMC announcements are excluded from the sample. One announcement on February 4, 1994 occurred the same day as an employment release. Given that there is a strong positive correlation between the unexpected components of employment releases and FOMC announcements, U.S. monetary policy could be reacting to employment news and therefore, the FOMC announcements would not be exogenous.²⁸ The other announcement was the one from September 17, 2001 which was in response to the events that took place on September 11, 2001.²⁹ All other FOMC announcements from November 1993 through September 2008 are included.³⁰ FOMC announcements after September 2008 are not included due to the fact that the federal funds target rate and the federal funds effective rate were not in line after this date.³¹ The entire sample includes 127 observations.

4.3.2 Target Rate Surprises

To identify the effect of the FOMC announcements, the unanticipated component of the change in the federal funds target rate is inferred from changes in the current-month fed funds futures rate for the day of the announcement.³² This technique due to Kuttner (2001) is quite popular in the literature. It is calculated by the following formula:

$$\Delta i_t^u = \frac{D}{D-d} (f_t^0 - f_{t-1}^0) \quad (1)$$

²⁸ See Basistha and Kurov (2008).

²⁹ See Bernanke and Kuttner (2005)

³⁰ The beginning date of the sample is determined by the earliest available data for the IPC stock exchange.

³¹ In Gurkaynak (2005), he points out that when the federal funds target rate is different from the federal funds effective rate, the general calculation as given by Kuttner (2001) for monetary surprises cannot be used.

³² I thank Alex Kurov for providing me with this data.

where Δi_t^u is the surprise component of the target rate change; f_t^0 is the fed funds rate inferred from the settlement price of the current-month fed funds futures contract; d represents the day on which the current FOMC meeting takes place and D is the number of days in the month. The subscript t represents the FOMC announcement. Also, the term $D/(D-d)$ is a scaling factor that corrects for the number of remaining days in the month in which the rate change occurs.³³ The average fed funds rate during the contract's month is used to calculate the settlement price of the fed funds futures.

4.3.3 Mexican and U.S. Equity Data

For Mexican equity prices, I use the *Indice de Precios y Cotizaciones* (IPC). The IPC is a collection of 35 stocks that are traded on the *Bolsa Mexicana de Valores* (BMV). This data is available at Yahoo! Finance. Since the BMV is open at the same time as the U.S. equity markets are, the data is the daily close-to-close percentage return of the IPC index on days of FOMC announcements.

Despite the fact that both the U.S. equity and Mexican equity markets have similar trading hours, it is still possible that changes in the IPC are being caused by the U.S. equity market itself, rather than the surprise component of the FOMC announcement. For U.S. equity prices I use the daily close-to-close percentage return of the *Standard & Poor's 500 Index* (S&P). This data is available at Yahoo! Finance as well. To isolate the effect that the S&P has on the IPC that is not related to U.S. monetary policy, I follow Basistha and Kurov (2008) and estimate the following equation:

$$R_t^{US} = \alpha + \beta \Delta i_t^u + \varepsilon_t^{US} \quad (2)$$

³³ See Kuttner (2001) for more details on the scaling factor as well as the calculations of this component.

Here, R_t^{US} is daily return of the S&P on the day of the FOMC announcement (t). Again, the surprise component ($\Delta i_t''$) is as before. The residuals (ε_t^{US}) from this estimation are kept and later used to proxy for the portion of the daily return in the S&P on the day of an FOMC announcement that cannot be attributed to the unexpected component of this announcement.

4.3.4 Business Cycle Data

In order to test whether cyclical variation matters for IPC reactions to the surprise component of FOMC announcements, I need a proxy for Mexican business cycles. In the U.S. business cycles are determined by the *National Bureau of Economic Research* (NBER). A similar measure for Mexico does not exist. The NBER defines a recession as follows:

A recession is a significant decline in economic activity spread across the economy, lasting more than a few months, normally visible in production, employment, real income, and other indicators. A recession begins when the economy reaches a peak of activity and ends when the economy reaches its trough. Between trough and peak, the economy is in an expansion.³⁴

With this in mind, I attempt to proxy for Mexican business cycles. Therefore, I look at real output data, employment data and credit conditions for Mexico.

4.3.5 Production Data

To proxy cyclical variation, I use the standard "newspaper" definition of at least two quarters of negative real Mexican GDP growth. One of the major criticisms of this method of measuring business cycles is that since the frequency of the GDP series is quarterly, it gives a very general, if not vague, notion of when a change in the business cycle actually occurred. Since my goal is not to determine exact dates for the Mexican business cycle, but rather to determine general

³⁴ Source: NBER announcement on December 1, 2008 <<<http://www.nber.org/cycles/dec2008.html>>>.

periods of cyclical variation, this measure should be marginally sufficient. Using this metric, for Mexico there is one recession that occurs for the first 3 quarters of 1995.

Moreover, I also look at the Mexican Industrial Production (IP) index series obtained from the *International Financial Statistics* (IFS) from the *International Monetary Fund* (IMF). Here, I use a minimum of 6 months of negative growth to indicate periods of economic downturn in the Mexican economy. This generates one recession from the third quarter of 1994 through the third quarter of 1995.

Additionally, I also use a minimum of 4 months of negative growth as well, since this would correspond to negative growth crossing over a two-quarter span. This method generates the same recession as with the previous measure and an additional one for the first 2 quarters of 2008.

Finally, given that a recent report by the IMF suggests that the entire year of 2008 will be considered a recession for Mexico once the data revisions have been made, I have also generated a series for both real GDP and the Industrial Production index that reflexes this forecast.³⁵ These add one recession for the entire year of 2008 to the real GDP measure and the 6-month IP measure.

All business cycle variables mentioned above are binary variables which take on a value of one if the period is marked by negative real growth and a value of zero otherwise.

4.3.6 Unemployment Data

Given that employment is also a possible indicator of cyclical variation, I also use unemployment numbers for Mexico from the IFS. As with the real GDP business cycle indicators, I use a binary variable coded in the same manner. One limitation of the employment

³⁵ Source: Haver analytics, cited in the March 20, 2009 Economic Health Check report by the IMF.

series is that for the unemployment times series the availability of the data is limited to the time period from the first quarter of 2000 until the present. Using this measure there are two recessions: one from the third quarter of 2001 through the first quarter of 2002 and a second one for the entire year of 2008.

4.3.7 Credit Market Data

Finally, I use private credit data for Mexico from the IFS to proxy for credit cycles. This series is also shortened due to data availability; it starts from quarter one of 1997. As with the other cyclical variables, it is coded as a binary variable if two or more consecutive quarters exhibit negative growth. This measure generates three recessions: 1) The third quarter of 1998 through the first quarter of 1999; 2) The fourth quarter of 2000 through the first quarter of 2001; 3) The second and third quarters of 2005.

4.4 EMPIRICAL RESULTS

4.4.1 Benchmark results

For the benchmark result, cyclical variations in the Mexican economy are ignored. Equation 3 is estimated:

$$R_t^{MEX} = \alpha + \beta_1 \Delta i_t^u + \beta_2 \varepsilon_t^{US} + \mu_t \quad (3)$$

Here, the only new term relative to Equation 2 is R_t^{MEX} which is the daily return of the IPC on the day of the FOMC announcement. I estimate this equation using OLS and to account for the effect of outliers, a robust regression is run as well. The estimation procedure that I use is the MM-estimation. It is a type of weighted least squares given by Yohai (1987) that allows for robustness when outliers are thought to be present.

In Table 4 - 1 the results from both estimations of Equation 3 are provided. For the OLS estimation, the β_1 coefficient is approximately -6.66. This indicates that a 100 basis-point

surprise increase in the federal funds target rate will cause a drop of nearly seven percent in the IPC. This effect is apart from any IPC comovements associated with the S&P not related to the U.S. monetary surprise. In the second column the β_1 coefficient decreases significantly in magnitude suggesting the presence of outliers. However, approaching minus three percent, the coefficient is both economically and statistically significant. The interpretation here is that a positive shock of a 100 basis points to the federal funds target rate would invoke a fall of 2.83 percent in the IPC. Wongswan (2005) estimates this coefficient to be -6.13 and -2.82; the latter excludes non-scheduled FOMC meetings. In his paper, however, U.S. equity returns are assumed not to affect the Mexican equity market because both operate during the same time zone. Hausman and Wongswan (2006) include the overall U.S. equity returns and find no statistically significant effect of FOMC announcements on the Mexican stock market. In this same paper, when they exclude the U.S. equity returns, the coefficient estimate then becomes approximately negative seven percent. In this last estimation, they control for the future expected direction of monetary policy, often referred to as the "path" surprise. Ehrmann et al (2005) control for sector and country fixed effects and find that the surprise component of the FOMC announcement is insignificant statistically concerning movements in the Mexican stock exchange. The non-US monetary effect from the S&P on the IPC in my regression is statistically significant with a magnitude of around 0.90. This is slightly greater than the estimate from Ehrmann et al (2005).

4.4.2 Business Cycle indicator using real GDP

Next, I allow for business cycles as measured by real Mexican GDP. I estimate Equation 4 below:

$$R_t^{MEX} = \alpha + \beta_1 \Delta i_t^u (1 - C_t^{MEX}) + \beta_2 \Delta i_t^u C_t^{MEX} + \beta_3 \varepsilon_t^{US} + \mu_t \quad (4)$$

The new term relative to Equation 3 is the cyclical variation variable (C_t^{MEX}); it interacts with the U.S. monetary surprise variable and takes on a value of one when the Mexican economy is in an economic downturn and zero, otherwise. From Table 4 - 2, in both the OLS estimation and the MM estimation, U.S. monetary shocks have a statistically significant and economic effect on the IPC. However, the magnitude of this effect is much greater when the Mexican economy is experiencing a contraction. Conducting a Wald test ($H_0: \beta_1 = \beta_2$) confirms that the reaction of the Mexican stock market to an FOMC surprise when Mexico is suffering a recession is statistically different from the same reaction when the Mexican economy is not in a recession.

In the previous regression, the year 2008 is treated as an expansionary period. This will probably not be the case once the final revised data is announced. Given that forecasts for the Mexican real GDP are expected to be negative for the entire year of 2008, I allow the year 2008 to be treated as a recession; the results change in magnitude, but the asymmetry is still present. Table 4 - 3 gives the results of the estimation of Equation 4 when the time series for the variable C_t^{MEX} reflects a contraction in the Mexican economy for the year 2008.

Compared to a value of approximately -60.00 to -70.00, the magnitude of the coefficient β_2 is much smaller. The coefficient β_1 is as well, but more importantly it is statistically insignificant in both estimations. Again, the difference in coefficients β_1 and β_2 is statistically significant. Also, this indicates that the recession of 1995 was much more of a driving force for the Mexican economy than the recession 2008 appears to be.

4.4.3 Business Cycle indicator using the Industrial Production index

Here, I change the business cycle indicator so that it is determined by the Mexican Industrial Production index. Specifically, I code 6 or more periods of negative IP growth in the Mexican

economy as a recessionary period (i.e. $C_t^{MEX} = 1$). All other periods are treated as expansionary ($C_t^{MEX} = 0$). I estimate Equation 4 again. Table 4 - 4 provides the results.

In the OLS estimation, the IPC appears to react equally to U.S. monetary shocks regardless of the state of the economy. The coefficients are not statistically different. Moreover, only the coefficient β_1 is statistically significant. Controlling for outliers, however, yields a different result. Now, both coefficients are statistically significant and the magnitude of β_2 at negative 13.88 appears to be greater than the negative 2.66 for β_1 . The null of these two coefficients being equal is not rejected at the 10% significance level.

Again, using revised data which reflects 2008 as being a contractionary period I estimate Equation 4 and get the following results as given in Table 4 - 5.

The coefficient β_2 is statistically significant in both estimations, while the coefficient β_1 is not. In magnitude β_2 is statistically different from β_1 in the OLS estimation, but in the MM estimation it cannot be said that they are not different from each.

4.4.4 Employment

Another common gauge of business activity is employment. Here, I use employment data as my cyclical variation variable. In Table 4 - 6, I use at least two consecutive quarters of positive growth in unemployment as a proxy of business downturns.

In the OLS estimation, the cyclical variation matters, but in the MM estimation it does not. None of the cyclical variable coefficients are significant, except for the business downturn coefficient in the OLS estimation.

4.4.5 Credit Markets

Finally, I look at cyclical variation in the private credit market.

In the OLS estimation, tightening of private credit markets matters slightly, but it is when outliers are controlled for that it matters the most. When private credit is shrinking, a 100-basis point surprise in the federal funds target rate is greeted with a negative 15.61 percent change in the IPC. This is statistically different from the β_1 coefficient.

4.5 OTHER FACTORS

4.5.1 Do U.S. business cycles matter?

It might be that the IPC is reacting to U.S. business cycles and not cyclical variations in the Mexican economy. Using NBER recession dates, I estimate Equation 5 below:³⁶

$$R_t^{MEX} = \alpha + \beta_1 \Delta i_t^u (1 - C_t^{US}) + \beta_2 \Delta i_t^u C_t^{US} + \beta_3 \varepsilon_t^{US} + \mu_t \quad (5)$$

where the cyclical variable (C_t^{US}) corresponds to U.S. business cycles and interacts with the U.S. monetary shock variable (i) and takes on a value of one when the U.S. economy is in an economic downturn and zero, otherwise.. The other variables are the same as in Equation 4.

From Table 4 - 8, in both the OLS estimation and the MM estimation, the U.S. business cycle monetary shocks have a statistically significant and economic effect on the IPC. However, in neither estimation is $\beta_1 - \beta_2$ statistically different from zero. The IPC clearly does not react differently to the FOMC announcements when the U.S. economy is in an NBER recession.

4.5.2 US returns as Independent Variable

In Hausman and Wongsan (2006), they estimate Equation 6 and Equation 7:

$$R_t^{MEX} = \alpha + \beta_1 \Delta i_t^u + \beta_2 R_t^{US} + \mu_t \quad (6)$$

where R_t^{US} represents the return of the U.S. equity market on the day of FOMC announcements.³⁷

³⁶ See <http://www.nber.org/cycles.html> for NBER US business cycle dates.

$$R_t^{MEX} = \alpha + \beta_1 \Delta i_t^u + \beta_2 \lambda R_t^{US} + \mu_t \quad (7)$$

Here, λ represents the degree of comovement between the IPC and the S&P. It is obtained from the following time series regression:

$$R_t^{MEX} = \lambda_0 + \lambda_1 R_t^{US} + \nu_t \quad (8)$$

in which the daily returns from the IPC are regressed on the daily returns from the S&P over the entire time period of this study (November 1993 through September 2008). Here, the value of λ is approximately 0.79.

I estimate variations of Equation 6 and Equation 7, incorporating the cyclical variables for the Mexican economy.

$$R_t^{MEX} = \alpha + \beta_1 \Delta i_t^u (1 - C_t^{MEX}) + \beta_2 \Delta i_t^u C_t^{MEX} + \beta_3 R_t^{US} + \mu_t \quad (9)$$

$$R_t^{MEX} = \alpha + \beta_1 \Delta i_t^u (1 - C_t^{MEX}) + \beta_2 \Delta i_t^u C_t^{MEX} + \beta_3 \lambda R_t^{US} + \mu_t \quad (10)$$

In both the OLS and MM estimation, the IPC responds in a statistically significant manner when the Mexican economy is in a downturn. At approximately -16.00, this response is economically significant. Furthermore, the coefficient β_1 is small and statistically insignificant in both estimations. Additionally, β_1 minus β_2 is statistically different from zero at the one percent significance level.

4.6 CONCLUDING REMARKS

Here I document the reaction of the IPC to U.S. monetary shocks. I control for the comovement of the IPC with the S&P. I find that the IPC is responsive to U.S. monetary shocks. I also examine whether the IPC's response depends on cyclical variations in the Mexican economy. Given that there are no official business cycle dates, I use several proxies. I find that for the

³⁷ If it is believed that there is comovement between the BMV and the S&P, it can be shown that the value of the coefficient for the US monetary shock is understated.

popular recession measure of two or more consecutive contractions in real GDP the IPC reaction is asymmetric. That is, when the Mexican economy is experiencing negative real GDP growth, the Mexican equity market reaction to surprises in the FOMC announcements is greater than when the Mexican economy is not contracting.

This finding is robust to using other techniques for measuring U.S. monetary shock spillover effects to foreign equity markets, but it is not robust to every measure of Mexican cyclical variations. Specifically, it does not do well with the unemployment proxy.

These findings contribute to the literature in two ways. One, they support the idea that the credit channel applies across international borders and is certainly present in the case of the Mexican-U.S. border. Credit constrained firms in Mexico suffer the effects of U.S. monetary surprises when the Mexican economy is in a recession more than when the Mexican economy is growing. The state of the Mexican economy is important. Secondly, these results support the need for international monetary policy coordination, at least from Mexico's point of view.

4.7 APPENDIX

Table 4 - 1

Mexico Stock Return		
	OLS	Robust
	-6.66***	-2.83**
Monetary Surprise	(1.44)	(1.34)
Residuals from US Stock Return on US	0.83***	0.92***
Monetary Surprise	(0.10)	(0.09)
Intercept	0.39***	0.35***
	(0.12)	(0.11)
Number of observations	127	126

In this table the coefficients for the regression $[R_t^{MEX} = \alpha + \beta_1 \Delta i_t^u + \beta_2 \varepsilon_t^{US} + \mu_t]$ are given. The dependent variable is the close-to-close daily return of the BMV on the day of an FOMC announcement. The term Δi_t^u is the unexpected component from the FOMC announcement and ε_t^{US} are the residuals from a regression of the close-to-close daily return of the S&P on the day of an FOMC announcement on the same Δi_t^u mentioned above. The first column gives the OLS estimation and the second column gives the MM estimation. The standard errors are in parenthesis and statistically significant coefficients are in bold (***, **, * represent one, five and ten percent levels of statistical significance).

Table 4 - 2

Mexico Stock Return		
	OLS	Robust
Monetary Surprise during Mexican Boom (real GDP)	-6.29***	-2.45*
	(1.39)	(1.30)
Monetary Surprise during Mexican Recession (real GDP)	-68.99***	-63.01***
	(20.24)	(17.13)
Residuals from US Stock Return on US	0.82***	0.92***
Monetary Surprise	(0.09)	(0.08)
Intercept	0.43***	0.38***
	(0.12)	(0.10)
$\beta_1 - \beta_2$	0.003	0.001
Number of observations	127	126

In Table 4 - 2 the coefficients for the regression $[R_t^{MEX} = \alpha + \beta_1 \Delta i_t^u (1 - C_t^{MEX}) + \beta_2 \Delta i_t^u C_t^{MEX} + \beta_3 \varepsilon_t^{US} + \mu_t]$ are given. The dependent variable is the close-to-close daily return of the BMV on the day of an FOMC announcement. The term Δi_t^u is the unexpected component from the FOMC announcement and ε_t^{US} are the residuals from a regression of the close-to-close daily return of the S&P on the day of an FOMC announcement on the same Δi_t^u mentioned above. The interaction term C_t^{MEX} is a binary variable that proxies cyclical variations in the Mexican economy; here, this term is based on real Mexican GDP. It takes on a value of 1 if FOMC announcement occurs during a contraction in the Mexican economy and 0, otherwise. As before, the first column gives the OLS estimation and the second column gives the MM estimation. The standard errors are in parenthesis and statistically significant coefficients are in bold (***, **, * represent one, five and ten percent levels of statistical significance). The fifth row gives the p-value that the null hypothesis of $\beta_1 - \beta_2 = 0$ is rejected.

Table 4 - 3

Mexico Stock Return		
	OLS	Robust
Monetary Surprise during Mexican Boom (real GDP - 2008 recession)	-2.16 (1.54)	-1.87 (1.45)
Monetary Surprise during Mexican Recession (real GDP - 2008 recession)	-19.47*** (2.69)	-19.42*** (2.54)
Residuals from US Stock Return on US Monetary Surprise	1.03*** (0.10)	0.98*** (0.09)
Intercept	0.42*** (0.11)	0.37*** (0.11)
$\beta_1 - \beta_2$	0.000	0.000
Number of observations	127	127

In Table 4 - 3 the coefficients for the regression $[R_t^{MEX} = \alpha + \beta_1 \Delta i_t^u (1 - C_t^{MEX}) + \beta_2 \Delta i_t^u C_t^{MEX} + \beta_3 \varepsilon_t^{US} + \mu_t]$ are given. The dependent variable is the close-to-close daily return of the BMV on the day of an FOMC announcement. The term Δi_t^u is the unexpected component from the FOMC announcement and ε_t^{US} are the residuals from a regression of the close-to-close daily return of the S&P on the day of an FOMC announcement on the same Δi_t^u mentioned above. The interaction term C_t^{MEX} is a binary variable that proxies cyclical variations in the Mexican economy; here, this term is based on real Mexican GDP. It takes on a value of 1 if FOMC announcement occurs during a contraction in the Mexican economy and 0, otherwise. As before, the first column gives the OLS estimation and the second column gives the MM estimation. The standard errors are in parenthesis and statistically significant coefficients are in bold (***, **, * represent one, five and ten percent levels of statistical significance). The fifth row gives the p-value that the null hypothesis of $\beta_1 - \beta_2 = 0$ is rejected.

Table 4 - 4

Mexico Stock Return

	OLS	Robust
Monetary Surprise during Mexican Boom (IP index - 6 months)	-6.66*** (1.48)	-2.66* (1.40)
Monetary Surprise during Mexican Recession (IP index - 6 months)	-6.53 (6.17)	-13.88* (7.91)
Residuals from US Stock Return on US Monetary Surprise	0.83*** (0.10)	0.91*** (0.09)
Intercept	0.39*** (0.12)	0.37*** (0.11)
$\beta_1 - \beta_2$	0.983	0.166
Number of observations	127	125

In Table 4 - 4 the coefficients for the regression $[R_t^{MEX} = \alpha + \beta_1 \Delta i_t^u (1 - C_t^{MEX}) + \beta_2 \Delta i_t^u C_t^{MEX} + \beta_3 \varepsilon_t^{US} + \mu_t]$ are given. The dependent variable is the close-to-close daily return of the BMV on the day of an FOMC announcement. The term Δi_t^u is the unexpected component from the FOMC announcement and ε_t^{US} are the residuals from a regression of the close-to-close daily return of the S&P on the day of an FOMC announcement on the same Δi_t^u mentioned above. The interaction term C_t^{MEX} is a binary variable that proxies cyclical variations in the Mexican economy; here, this term is based on 6 or more consecutive months of negative growth in the Mexican IP index. It takes on a value of 1 if FOMC announcement occurs during a contraction in the Mexican economy and 0, otherwise. As before, the first column gives the OLS estimation and the second column gives the MM estimation. The standard errors are in parenthesis and statistically significant coefficients are in bold (***, **, * represent one, five and ten percent levels of statistical significance). The fifth row gives the p-value that the null hypothesis of $\beta_1 - \beta_2 = 0$ is rejected.

Table 4 - 5

Mexico Stock Return

	OLS	Robust
Monetary Surprise during Mexican Boom (IP index - 2008 recession)	-2.33 (1.65)	-1.95 (1.51)
Monetary Surprise during Mexican Recession (IP index - 2008 recession)	-16.36*** (2.55)	-7.64** (3.57)
Residuals from US Stock Return on US Monetary Surprise	1.00*** (0.10)	0.94*** (0.09)
Intercept	0.42*** (0.12)	0.35*** (0.11)
$\beta_1 - \beta_2$	0.000	0.155
Number of observations	127	126

In Table 45 the coefficients for the regression $[R_t^{MEX} = \alpha + \beta_1 \Delta i_t^u (1 - C_t^{MEX}) + \beta_2 \Delta i_t^u C_t^{MEX} + \beta_3 \varepsilon_t^{US} + \mu_t]$ are given. The dependent variable is the close-to-close daily return of the BMV on the day of an FOMC announcement. The term Δi_t^u is the unexpected component from the FOMC announcement and ε_t^{US} are the residuals from a regression of the close-to-close daily return of the S&P on the day of an FOMC announcement on the same Δi_t^u mentioned above. The interaction term C_t^{MEX} is a binary variable that proxies cyclical variations in the Mexican economy; here, this term is based on 6 or more consecutive months of negative growth in the Mexican IP index. It takes on a value of 1 if FOMC announcement occurs during a contraction in the Mexican economy and 0, otherwise. As before, the first column gives the OLS estimation and the second column gives the MM estimation. The standard errors are in parenthesis and statistically significant coefficients are in bold (***, **, * represent one, five and ten percent levels of statistical significance). The fifth row gives the p-value that the null hypothesis of $\beta_1 - \beta_2 = 0$ is rejected.

Table 4 - 6

Mexico Stock Return

	OLS	Robust
Monetary Surprise during Mexican Boom (Unemployment)	-1.15 (1.69)	-1.19 (1.61)
Monetary Surprise during Mexican Recession (Unemployment)	-15.93*** (2.35)	-4.49 (3.77)
Residuals from US Stock Return on US Monetary Surprise	0.90*** (0.10)	0.84*** (0.09)
Intercept	0.25** (0.13)	0.25** (0.12)
$\beta_1 - \beta_2$	0.000	0.437
Number of observations	76	75

In Table 4 - 6 the coefficients for the regression $[R_t^{MEX} = \alpha + \beta_1 \Delta i_t^u (1 - C_t^{MEX}) + \beta_2 \Delta i_t^u C_t^{MEX} + \beta_3 \varepsilon_t^{US} + \mu_t]$ are given. The dependent variable is the close-to-close daily return of the BMV on the day of an FOMC announcement. The term Δi_t^u is the unexpected component from the FOMC announcement and ε_t^{US} are the residuals from a regression of the close-to-close daily return of the S&P on the day of an FOMC announcement on the same Δi_t^u mentioned above. The interaction term C_t^{MEX} is a binary variable that proxies cyclical variations in the Mexican economy; here, this term is based on 2 or more consecutive quarters of positive growth in the Mexican unemployed. It takes on a value of 1 if FOMC announcement occurs during a contraction in the Mexican economy and 0, otherwise. As before, the first column gives the OLS estimation and the second column gives the MM estimation. The standard errors are in parenthesis and statistically significant coefficients are in bold (***, **, * represent one, five and ten percent levels of statistical significance). The fifth row gives the p-value that the null hypothesis of $\beta_1 - \beta_2 = 0$ is rejected.

Table 4 - 7

Mexico Stock Return

	OLS	Robust
Monetary Surprise during Mexican Boom (Private Credit)	-6.36*** (1.68)	-2.06 (2.20)
Monetary Surprise during Mexican Recession (Private Credit)	-9.71*** (3.01)	-15.61*** (4.73)
Residuals from US Stock Return on US Monetary Surprise	0.76*** (0.10)	0.84*** (0.09)
Intercept	0.33** (0.13)	0.36*** (0.11)
$\beta_1 - \beta_2$	0.344	0.013
Number of observations	101	98

In Table 4 - 7 the coefficients for the regression $[R_t^{MEX} = \alpha + \beta_1 \Delta i_t^u (1 - C_t^{MEX}) + \beta_2 \Delta i_t^u C_t^{MEX} + \beta_3 \varepsilon_t^{US} + \mu_t]$ are given. The dependent variable is the close-to-close daily return of the BMV on the day of an FOMC announcement. The term Δi_t^u is the unexpected component from the FOMC announcement and ε_t^{US} are the residuals from a regression of the close-to-close daily return of the S&P on the day of an FOMC announcement on the same Δi_t^u mentioned above. The interaction term C_t^{MEX} is a binary variable that proxies cyclical variations in the Mexican economy; here, this term is based on 2 or more consecutive quarters of negative growth in Mexican private credit. It takes on a value of 1 if FOMC announcement occurs during a contraction in the Mexican economy and 0, otherwise. As before, the first column gives the OLS estimation and the second column gives the MM estimation. The standard errors are in parenthesis and statistically significant coefficients are in bold (***, **, * represent one, five and ten percent levels of statistical significance). The fifth row gives the p-value that the null hypothesis of $\beta_1 - \beta_2 = 0$ is rejected.

Table 4 - 8

Mexico Stock Return

	OLS	Robust
Monetary Surprise during US Boom (NBER)	-6.10*** (2.35)	-4.24** (1.98)
Monetary Surprise during US Recession (NBER)	-6.99*** (1.81)	-3.94* (2.38)
Residuals from US Stock Return on US Monetary Surprise	0.83*** (0.10)	0.94*** (0.09)
Intercept	0.39*** (0.12)	0.36*** (0.11)
$\beta_1 - \beta_2$	0.766	0.922
Number of observations	127	125

In Table 4 - 8 the coefficients for the regression $[R_t^{MEX} = \alpha + \beta_1 \Delta i_t^u (1 - C_t^{US}) + \beta_2 \Delta i_t^u C_t^{US} + \beta_3 \varepsilon_t^{US} + \mu_t]$ are given. The dependent variable is the close-to-close daily return of the BMV on the day of an FOMC announcement. The term Δi_t^u is the unexpected component from the FOMC announcement and ε_t^{US} are the residuals from a regression of the close-to-close daily return of the S&P on the day of an FOMC announcement on the same Δi_t^u mentioned above. The interaction term C_t^{US} is a binary variable that proxies cyclical variations in the U.S. economy; here, this term is based on the NBER dating of recessions. It takes on a value of 1 if FOMC announcement occurs during a contraction in the U.S. economy and 0, otherwise. As before, the first column gives the OLS estimation and the second column gives the MM estimation. The standard errors are in parenthesis and statistically significant coefficients are in bold (***, **, * represent one, five and ten percent levels of statistical significance). The fifth row gives the p-value that the null hypothesis of $\beta_1 - \beta_2 = 0$ is rejected.

Table 4 - 9

Mexico Stock Return

	OLS	Robust
Monetary Surprise during Mexican Boom (real GDP - 2008 recession)	1.42 (1.64)	1.55 (1.54)
Monetary Surprise during Mexican Recession (real GDP - 2008 recession)	-15.89*** (2.60)	-16.00*** (2.45)
	1.03***	0.98***
US Stock Return	(0.10)	(0.09)
Intercept	0.12 (0.12)	0.08 (0.11)
$\beta_1 - \beta_2$	0.000	0.000
Number of observations	127	127

In Table 4 - 9 the coefficients for the regression $[R_t^{MEX} = \alpha + \beta_1 \Delta i_t^u (1 - C_t^{MEX}) + \beta_2 \Delta i_t^u C_t^{MEX} + \beta_3 R_t^{US} + \mu_t]$ are given. The dependent variable is the close-to-close daily return of the BMV on the day of an FOMC announcement. The term Δi_t^u is the unexpected component from the FOMC announcement and ε_t^{US} are the residuals from a regression of the close-to-close daily return of the S&P on the day of an FOMC announcement on the same Δi_t^u mentioned above. The interaction term C_t^{MEX} is a binary variable that proxies cyclical variations in the Mexican economy; here, this term is based on real Mexican GDP. It takes on a value of 1 if FOMC announcement occurs during a contraction in the Mexican economy and 0, otherwise. As before, the first column gives the OLS estimation and the second column gives the MM estimation. The standard errors are in parenthesis and statistically significant coefficients are in bold (***, **, * represent one, five and ten percent levels of statistical significance). The fifth row gives the p-value that the null hypothesis of $\beta_1 - \beta_2 = 0$ is rejected.

Table 4 - 10

Mexico Stock Return

	OLS	Robust
Monetary Surprise during Mexican Boom (real GDP - 2008 recession)	1.42 (1.64)	1.55 (1.54)
Monetary Surprise during Mexican Recession (real GDP - 2008 recession)	-15.89*** (2.60)	-16.00*** (2.45)
US Stock Return times Comovement factor	1.30*** (0.12)	1.24*** (0.11)
Intercept	0.12 (0.12)	0.08 (0.11)
$\beta_1 - \beta_2$	0.000	0.000
Number of observations	127	127

In Table 4 - 10 the coefficients for the regression $[R_t^{MEX} = \alpha + \beta_1 \Delta i_t^u (1 - C_t^{MEX}) + \beta_2 \Delta i_t^u C_t^{MEX} + \beta_3 \lambda R_t^{US} + \mu_t]$ are given. The dependent variable is the close-to-close daily return of the BMV on the day of an FOMC announcement. The term Δi_t^u is the unexpected component from the FOMC announcement and ε_t^{US} are the residuals from a regression of the close-to-close daily return of the S&P on the day of an FOMC announcement on the same Δi_t^u mentioned above. The interaction term C_t^{MEX} is a binary variable that proxies cyclical variations in the Mexican economy; here, this term is based on real Mexican GDP. It takes on a value of 1 if FOMC announcement occurs during a contraction in the Mexican economy and 0, otherwise. As before, the first column gives the OLS estimation and the second column gives the MM estimation. The standard errors are in parenthesis and statistically significant coefficients are in bold (***, **, * represent one, five and ten percent levels of statistical significance). The fifth row gives the p-value that the null hypothesis of $\beta_1 - \beta_2 = 0$ is rejected.

Table 4 - 11

	Mean	Median	Maximum	Minimum	Standard Deviation
U.S. Monetary Surprises	-1.1804	0.0000	19.0800	-42.5000	8.6090
S&P Returns	0.3403	0.2526	5.0099	-4.7141	1.2969
IPC Returns	0.4660	0.3689	6.5528	-4.7173	1.8210

In Table 4 - 11 U.S. Monetary Surprises are given in basis points. The equity returns are given in percentage returns.

CHAPTER 5. SUMMARY AND CONCLUSIONS

This dissertation attempts to answer several question concerning financial market linkages to the macro economy. Chapter 2 asks whether credit matters for real U.S. GDP, whether credit matters for inflation in the U.S. and whether different measures of credit give different results. I find that credit surprises can impact real GDP. Their impact on inflation, however, is less. Also, the choice of credit variable matters for both. Real GDP is affected by changes in credit-to-income ratios and certain interest rate spreads. Spreads that measure the highest risk rates against the lowest risk rates tend to be the most important ones. Credit-to-income ratios also are important for innovations to real GDP. Inflation is not as responsive to credit shocks. Only a few credit aggregates and interest rate spreads appear to be influential for innovations in inflation. Inflation does not seem to respond to shocks to credit-to-income ratios.

In Chapter 3, I test two hypotheses: 1) Fiscal policy matters for real interest rates; and 2) Financial openness affects the impact of fiscal policy on real interest rates. I find evidence that supports the first hypothesis, but not the second one. The first result supports the Keynesian IS-LM view. The second result appears to be surprising, but it echoes the results found in the economic growth literature which show that financial openness is very difficult to capture. Furthermore, while I accept the first hypothesis, the results do not find this channel to be lasting or pronounced. Fiscal policy seems to matter for real interest rates, but this effect is small and temporary.

Chapter 4 explores two hypotheses. First, the Mexican equity market reacts to U.S. monetary shocks. Second, this effect is asymmetric and the Mexican equity market's response is greater when the Mexican economy is experiencing a recession. I find evidence to support both

hypotheses. I find that the Mexican equity market reacts to surprises in the FOMC announcements. Additionally, using several proxies for Mexican recessions, I find that when the Mexican economy is in a recession, the Mexican equity market reaction is greater than when the Mexican economy is not contracting. These findings support the notion that the credit channel applies across international borders, at least for the case of the Mexican-U.S. border. Credit constrained firms in Mexico suffer the effects of U.S. monetary surprises when the Mexican economy is in a recession more than when the Mexican economy is growing. The state of the Mexican economy is important.

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