Credit Market Innovations and Gross Domestic Income

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ABSTRACT

In this paper I compare the effects of different credit variables on real output in the US. However, instead of using real Gross Domestic Product as a proxy for real output, I use real Gross Domestic Income. I use a VAR framework with generalized impulse response functions and generalized variance decompositions. I look at a credit aggregate and different credit spreads. I find that shocks to some credit variables can have significant effects on real output; the reaction, however, is a temporary one. Specifically, measures of the risk premium and the term premium have the most importance in explaining innovations to real Gross Domestic Income. However, in all cases the effect is a temporary one.

Keyword: Credit, GDI, real output, VAR, credit spreads

I. INTRODUCTION

The important part that credit has in the United States (US) economy is well documented. Credit is considered to be linked to the macroeconomy through the effect it has on consumption, specifically consumer durables. The life-cycle model, as given by Ando and Modigliani (1963), shows that credit serves the sole purpose of transferring consumption from high-income periods to low-income ones with the interest rate being the same for both borrowers and lenders. Allowing for interest rates for debt servicing to be higher as compared to lending brings complexity to the analysis. In Olney (1999), the fall in consumption at the beginning of the Great Depression in 1930 is associated with a credit shock. In the Keynes IS/LM business cycle model, as well as the Austrian business cycle model, a core problem for monetary economies occurs when the rate of interest that commercial banks are willing to lend at differs from the rate of interest as determined by real factors. Assuming a starting point for the economy where real output equals potential real output and an IS/LM model, when the financial rate of interest is lower than the natural rate of interest, real output will deviate away from the potential real output, resulting in higher inflation. If the natural rate of interest is lower than the financial rate of interest, a decrease in real output away from potential real output will occur as will an economic downturn. In the Austrian business cycle model, the former case above does not necessarily imply inflation as it does in the IS/LM model. Credit creation occurring from the financial rate of interest being lower than the natural rate incentivizes investment in expectation of future increases in the demand for goods and services. The increase in demand never happens and therefore, the investments that are undertaken never become profitable. Also, the byproduct of over-investment is a surplus of capital goods. Capital goods are durable, but not fungible, therefore, corrections take time since mistakes in investment are durable as well. Furthermore, inflation may not happen; instead, the economy might 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 output (e.g., Gross Domestic Product (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. Another group of credit measure consists of ratios of different credit aggregates to income. This variable captures incidents when certain credit aggregates are 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 category of credit variables is the group made up of varying interest-rate spreads. 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. When the difference between the yields of the six-month commercial paper and Treasury bills grows, tightening of monetary policy is thought to occur. 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. Also, 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. 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. However, while the Federal Funds rate is determined through the market process, its outcome is targeted beforehand by the Federal Reserve and the determination of this target is not market-driven even though it is determined using the market. The LIBOR, on the other hand, is entirely determined by the market. The LIBOR is important given that it is used as a benchmark in the US 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. In a study of the Great Depression, Bernanke (1983) provides empirical evidence that credit market failures acted as a catalyst that accelerated and worsened the effects of that event. Bernanke with Blinder (Bernanke and Blinder 1988) follows this up with theoretical investigation of how credit affects real economic activity. Friedman and Kuttner (1993) use both theory and empirics to show that credit market innovations are important for real economic activity. Even White (2006) from the Austrian School of Economics puts forth that credit growth can have an effect on real output. In a joint report with the Bank for International Settlements (BIS) he expresses the view that credit growth is so important that it should be used as a target by central banks similar to the way prices are in inflation-targeting regimes. Kaufmann and Valderrama (2007) find that for the US, private credit shocks impact real output in procyclical manner. In countries that are part of the OECD, Claessens et al (2008) show that for every six recessions one is accompanied by a private credit crunch. Friedman and Kuttner (1998) look at the spread between six-month commercial paper and Treasury bills (paper-bill spread); they show that from the mid-1950s through the mid- 1990s this risk premium spread hovered around 90 basis points six months before a recession and around 100 basis points while a recession was occurring with the norm average being 50 basis points post recession. Hence, the risk premium grew before recessions. These increases are thought to be associated with most, if not all, of the following events: contractionary monetary policy; increased expectation of bankruptcies; and increased cash requirements for firms. Using results from the Federal Reserve's Senior Loan Officer Opinion Survey Lown and Morgan (2004) examine standards of credit; they come to the conclusion that credit standards channel through inventory investment to affect real activity. Swiston (2008) develops and uses an index to measure financial conditions in the US. In addition to credit standards, he shows that corporate bond yields and high yield spreads are modestly important for real output while other measures that include the London Interbank Offered Rate (LIBOR) and credit aggregates in general are not. Bayoumi and Melander (2008) find that a bank's capital-to-asset ratio affects real GDP in the US working through the credit market by changing credit availability in the economy. Murphy (1998) finds that past debt service burden ratios indirectly affect consumption innovations. While the majority of 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) using private credit find that reactions from inflation to credit shocks are minimal and that these credit shocks do not appear to have an important role in explaining the variability in inflation. Heath (2011) adds to this literature by looking at which credit variables have the most impact on real output and prices. Specifically, he asks which credit variables matter. He uses 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 (GIRF) and generalized variance decompositions, he shows 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 in his study. The Baa-10-year Treasury rate spread stands out for its importance in explaining changes in both real GDP and inflation. This appears to be the single most important credit variable in this study. Of the credit aggregates, only private credit is statistically important for describing changes in real GDP. 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; the effect from shocks to debt-to-income ratios 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. Thus, 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. Certain types of credit variables feature more prominently than others when changes occur to real GDP and inflation.

In all of the above studies, real GDP is used as a proxy for real economic growth in the US economy. Recently however, Gross Domestic Income (GDI) has become a popular variable to gauge economic growth, especially among Wall Street economists. Nalewaik (2010, 2012) suggests that it is a more reliable indicator than Gross Domestic Product. GDI measures what an economy takes in versus GDP, which measures what an economy produces. Ideally, these two statistics would be the same, but they are not even though they do trend together. Measurement error is the most likely culprit of this difference. Here, I do not try to make a claim for one statistic being better than the other; rather, at minimum both should be considered. With this in mind, I examine the relationship between credit and real economic activity as measured by GDI and using a variety of credit variables. Several papers, such as Lown and Morgan (2004), Kaufmann and Valderrama (2007), and Heath (2011), looked at credit and real output.using real GDP. This study follows this line of research using GDI as a proxy for real output. Following Heath (2011) particular focus is made on which categories of credit matter—ratios to income, spreads, or aggregates--for GDI. Another point of interest is the duration of the effects of credit on GDI (i.e., whether they are permanent or temporary). In this framework I find that shocks to the yield curve and the paper-bill spread can have significant effects on real output as measured by GDI; the reaction, however, is a temporary one.

In the next section, hypotheses, methodology and data sources will be discussed. A section on the empirical results follows. Section IV gives a discussion of the results and concluding remarks are given in Section V.

II. Testable Hypotheses, Methodology and Data

In this paper, I test whether credit variables matter for real GDI and if so, which ones. I also look at whether the effects are temporary or permanent. Following the literature an underlying assumption of this study is that credit is an endogenous variable in an endogenous system of macro and monetary variables. A VAR framework is used to examine the effect of different credit variables on real GDI. Given that monetary policy must be controlled for, a VAR model based on previous monetary policy studies, such as Bernanke and Blinder (1992) is used. In this literature the traditional variables used include real output, inflation, the Federal Funds rate, and commodity prices. For real output I use real GDI. Following Sims (1992), the commodity price variable is included to control for the "price puzzle." This puzzle refers to the initial positive response of inflation to restrictive monetary policy in most VAR studies. By including the commodity price index forward-looking information about inflation that is unique to the Fed is obtained. I also add a credit variable to augment the traditional monetary policy VAR model. I rotate among different categories of credit variables from 1986 through 2017 to see which variable is the most indicative of changes in real GDI. This approach is not new to the literature. Bernanke et al (1997) do the same with oil prices and real GDP in order to examine the role oil shocks play in the US economy. Lown and Morgan (2004) and Kaufmann and Valderrama (2007) also employ a similar augmented version with other variables of interest.

The reduced form VAR model is given by:

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

where Yt is a vector that includes real GDI, inflation, commodity prices, the Federal Funds rate and a credit variable. The covariance matrix is defined as follows:

In a recursive VAR model, impulse response functions (IRF) are obtained in the manner below:

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

where ξj 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, ej is a selection vector in which the impulse j is one and the other elements are zero.

Here, following Pesaran and Shin (1998), GIRFs are used. It is given below:

$$\xi_j^G(i) = \theta_i \Sigma e_j \Big/ \sqrt{\sigma_{jj}} \tag{3}$$

where σjj is the element from the jth row and jth column of the variance-covariance matrix Σ. For variance decompositions, the generalized version is calculated as follows:

$$\phi_{lj}^G(i) = -\sum_{h=0}^{n}\left(e_l'\theta_i \Sigma e_j\right)^2 \Big/ \sigma_{jj}\sum_{h=0}^{n}\left(e_l'\theta_i \Sigma \theta_i' e_j\right) \tag{4}$$

compared to the usual variance decomposition:

$$\phi_{lj}(i) = \sum_{h=0}^{n}\left(e_l'\theta_i P e_j\right)^2 \Big/ \sum_{h=0}^{n}\left(e_l'\theta_i \Sigma \theta_i' e_j\right) \tag{5}$$

If Σ is non-diagonal, then, GIRFs and generalized variance decompositions are unique in that they represent the only method of producing order-invariant impulse responses and variance decompositions. In a recursive VAR framework the ordering of the variables is important. There are many ways to set up orthogonalized impulse responses and variance decompositions. Each produces a different result. This can be seen from equations (2) through (5). Clearly, in the recursive VAR framework illustrated by equations (2) and (5) for ordinary IRFs and variance decompositions, respectively, the lower Choleski matrix of the variance covariance matrix appears. The determination of this matrix is directly linked to the ordering of the variables in the VAR model. In the generalized VAR framework, as seen in equations (3) and (4), P is replace by the variance-covariance matrix divided by the standard deviation of the source of the disturbance. Thus, the ordering of the variables does not matter. In addition to being unique, the benefit from using GIRFs and generalized variance decompositions is that the ordering of the variables in the VAR does not matter.

The data is summarized and described in Table 1; sources are also given. The data is quarterly with 139 observations. The credit variables represented are: consumer credit, both total and revolving[1]; the spread between 3-month commercial paper and 3-month Treasury rate; the

[1] Heath (2020) suggests that revolving credit is more cyclical than total credit and might be more forward-looking for business cycles.

spread between the 3-month LIBOR and 3-month Treasury rate; and, the spread between the 10-year and the 3-month Treasury rates[2]. Before 1986, LIBOR rates for the US were not considered to be truly market-oriented, therefore the range of this study spans from the first quarter of 1986 through the third quarter of 2020. Also, as determined by the Akaike Information Criterion (AIC), the lag selection is 2 quarters.

III. Empirical Results

From Figure 1, a one-standard deviation shock to the paper-bill spread has a temporary effect on real GDI. This initial increase in the risk premium associated with holding corporate paper over Treasury bills is negatively-correlated with real GDI in the first period. So, when the risk premium increases, GDI drops temporarily. This quickly reverses itself in the second and third periods as the effect of the paper-bill shock now dissipates. After the first quarter, the effect is not significantly different from zero.

Figure 2 shows the result of a one-standard deviation shock to the Libor-Treasury spread. The effect is temporary. In the first quarter there is a negative reaction in real GDI growth. While in academic literature the Libor-FF spread and its relationship to real output and inflation has not been given a lot of attention, in the financial press it has. This spread is thought to represent a risk premium and is used as a measure of credit disallocation. Increases in the spread indicate that loanable funds can be obtained from the central bank more easily than they can be by the public; in other words, the general economy cannot obtain credit easily even though the central bank is attempting to supply easy credit. Increases in the Libor-FF spread are believed to be negatively correlated with real output. The results here would support that view, but none of the effects from the shock are statistically significant. The effect also appears to be a temporary one.

Looking at Figure 3, a one-standard deviation shock to the yield curve has a statistically positive effect on real GDI in a direct manner, but only after the second quarter. This effect appears to last for about one year. Numerous studies find that the yield curve is a leading indicator of real output. A flat, or inverted, yield curve is considered one of the most accurate

[2] Also, commonly known as the yield curve.

leading indicators of an economic downturn in the US.[34] This follows what we would expect in the literature since the way a shock is structured here would be the opposite of the flat, or inverted, yield curve. Here, the yield curve is structured so that a positive shock would mean an upward-sloping yield curve which would follow what the literature would predict.

From Figures 4 and 5, the reaction of real GDI growth to a one-standard deviation shock to growth of the two consumer credit series are shown. Revolving consumer credit represents open arrangements like credit cards and total consumer credit includes those as well as closed arrangements like car loans, boat loans, and education loans. They are separated here as some literature suggests that the revolving series is more important for real output than the nonrevolving which dominates the total credit series.[5] In this study, these aggregate credit variables do not appear to have permanent effects on real output. Nor do the effects appear to be statistically significant at any time horizon.

Table 2 shows the generalized variance decompositions for the VAR model with the different credit variables and GDI. Real GDI movements are mostly explained by its own shocks. Shocks to the commercial paper-bill spread explain approximately four percent of the variations in real GDI throughout the 2-year time horizon with remarkably little variance at any given quarter.

The variances in real GDI are also given with the Libor-Treasury spread as the credit variable. The credit variable here, however, becomes increasingly more important. It starts out explaining nearly 8 percent of variations in real GDI and by the two-year mark the explanatory power it near 9 percent.

The explanatory power of movements to the yield curve on real GDI are minimal to start, but by the end of the first year, the yield curve describes around 10 percent of the movements in real GDI and by the end of the second year the explanatory power goes up to over 20 percent.

Both revolving consumer credit and total consumer credit exhibit similar results. Their explanatory power ranges from 4 to 8 percent for revolving consumer credit and 5 to 9 percent for total consumer credit.

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[3] A flat yield curve would mean that the 10-year Treasury rate equals the 3-month Treasury rate; an inverted yield curve would meant that the 10-year Treasury rate is less than the 3-month Treasury rate.
[4] See Estrella (2005), Estrella and Hardouvelis (1991), Stojanovic and Vaughan (1997), Estrella and Mishkin (1997, 1998), Dotsey (1998), Wright (2006), Erdogan et al. (2013), and Heath (2014).
[5] See Heath (2020).

IV. DISCUSSION OF RESULTS

GDI appears to respond most to the yield curve and the paper-bill spread. This should not be surprising since the yield curve measures the term premium and is considered one of the most accurate leading indicators of economic activity in the US. [6] The paper-bill spread measures the risk premium which is considered a strong indicator of US economic activity as well.[7] The significance of both series is seen in the impulse response functions and the variance decompositions. Both explain high percentages of changes to GDI based on the variance decompositions. With the impulse response functions, the risk premium indicator appears to have a short temporary effect, almost concurrent, on GDI as the literature would suggest. The yield curve on the other hand has a delayed longer effect; again, the literature supports this given that the yield curve is a leading indicator of real US output.

The other credit series do seem to play a prominent role in explaining variations of GDI, but not to the degree that the yield curve and the paper-bill do. As far as impulse response functions are concerned, the two aggregate credit series—revolving and total consumer credit—and the Libor-Treasury spread do not have a statistically significant effect on GDI. Libor-Treasury spread is thought to be an indicator of inefficient, or dysfunctional, monetary policy. That is, when the Libor-Treasury spread increases, monetary policy is less likely to work.[8] It is considered a measure of the risk premium like the paper-bill spread, but it is more of an extreme case risk premium since it is capturing the extra risk financial institutions face compared to the risk-free rate. Since this event does not occur often, this effect of this spread cannot be captured as easily. Aggregate credit variables tend to have less information about real output so the results here are not surprising.[9]

V. Concluding Remarks

In this paper I address several issues concerning credit effects on real output as measured by GDI. I show that some explanatory credit variables can have a significant, but temporary, effect

[6] See footnote 4 in this paper for more, but Estrella (2005) gives a good overview of the importance of the yield curve on economic activity in the US.
[7] See Di Tella and Hall (2020) and Schumacher and Ẑochowski (2017).
[8] See Thornton (2009) for a nice overview.
[9] See Heath (2011).

on real output. Credit shocks from aggregates, such as consumer credit, do not appear to be statistically significant and their explanatory power of changes in GDI is below 10 percent in the first two years. However, the term premium, as measured by the yield curve, and the risk premium, as measured by the paper-bill spread, explain a large portion of the innovations to GDI. Shocks to these variables are also statistically significant, but temporary. The other credit spread used in this study is the Libor-Treasury spread. Surprisingly, this did not have the explanatory power that the other credit spreads had. This may be because the Libor-Treasury spread rarely fluctuates and when it does it is during unusual and drastic events, such as the Financial Crisis of 2007-2009. Given that these events are few and far between, there are probably not enough observations for this spread's effect to register in a study such as this one.

Thus, credit matters for GDI, but not all credit does. It is not the credit variable alone that matter rather it is the interest rate relative to others that does. Interest rate spreads are important for GDI. This follows what many previous studies have found for GDP.

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VII. APPENDIX

Table 1

Data Definitions, Summary Statistics, and Sources*

Name	Definition	Mean	Standard Deviation	Minimum	Maximum	Source(s)
COMM	Annualized quarterly growth rate of Producer Prices	0.0213	0.0754	-0.378	0.29	Federal Reserve Bank of St. Louis
GDI	Annualized quarterly growth rate of real GDI	0.0254	0.0448	-0.3258	0.2579	Federal Reserve Bank of St. Louis
GDP	Annualized quarterly growth rate of real GDP	0.0254	0.0456	-0.3138	0.3344	Federal Reserve Bank of St. Louis
INFL	Annualized quarterly growth rate of GDP deflator	0.0212	0.0104	-0.0209	0.0487	Federal Reserve Bank of St. Louis
FF	Quarterly average of the effective Federal Funds rate	3.3879	2.7228	0.06	9.73	Federal Reserve Bank of St. Louis
PB	Quarterly average of 3-month AA commercial paper rate minus 3-month Treasury rate	0.4018	0.3472	0.04	2.27	Federal Reserve Bank of St. Louis
LITR	Quarterly average of 3-month LIBOR rate minus 3-month Treasury rate	0.5599	0.4008	0.14	2.46	Federal Reserve Bank of St. Louis
YC	Quarterly average of 10-year Treasury rate minus 3-month Treasury rate	1.6776	1.1124	-0.63	3.61	Federal Reserve Bank of St. Louis
RCR	Annualized quarterly growth rate of real revolvingconsumer credit outstanding	0.0426	0.0745	-0.2629	0.2811	Federal Reserve Bank of St. Louis
TCR	Annualized quarterly growth rate of real total consumer credit outstanding	0.0366	0.0446	-0.058	0.1457	Federal Reserve Bank of St. Louis

*139 observations covering the period from 1986q1 through 2020q3

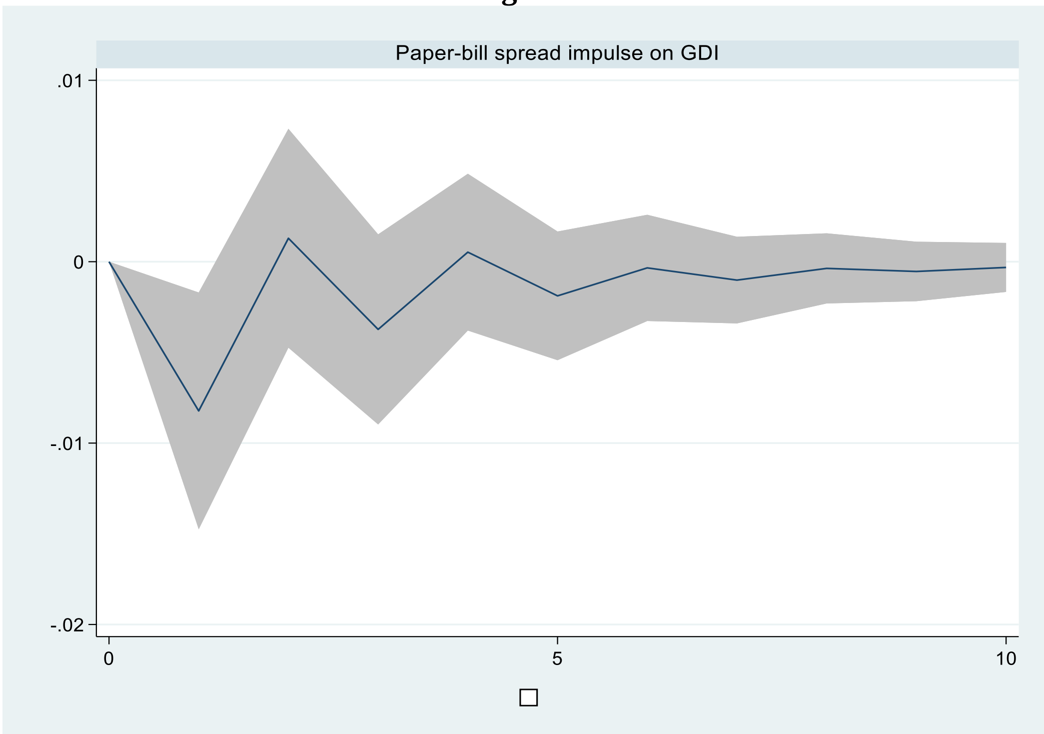
Table 2

GDI Variance Decomposition

	Paper-Bill spread		LIBOR-Treasury spread	
Quarter	FEVD	S.E.	FEVD	S.E.
1	0.0000	0.0000	0.0000	0.0000
2	0.3430	0.0271	0.0770	0.0133
3	0.3190	0.0266	0.0730	0.0112
4	0.3740	0.0322	0.0810	0.0134
5	0.3700	0.0321	0.0800	0.0131
6	0.3850	0.0336	0.0830	0.0139
7	0.3850	0.0335	0.0840	0.0140
8	0.3890	0.0339	0.0860	0.0144
	Yield Curve		Revolving Credit	
Quarter	FEVD	S.E.	FEVD	S.E.
1	0.0000	0.0000	0.0000	0.0000
2	0.0050	0.0034	0.0441	0.0103
3	0.0680	0.0053	0.0570	0.0126
4	0.1040	0.0080	0.0730	0.0151
5	0.1530	0.0107	0.0760	0.0157
6	0.1830	0.0127	0.0760	0.0158
7	0.2090	0.0143	0.0780	0.0159
8	0.2240	0.0154	0.0780	0.0159
	Total Credit			
Quarter	FEVD	S.E.		
1	0.0000	0.0000		
2	0.0550	0.0116		
3	0.0770	0.0146		
4	0.0860	0.0162		
5	0.0900	0.0170		
6	0.0890	0.0171		
7	0.0930	0.0177		
8	0.0930	0.0176		

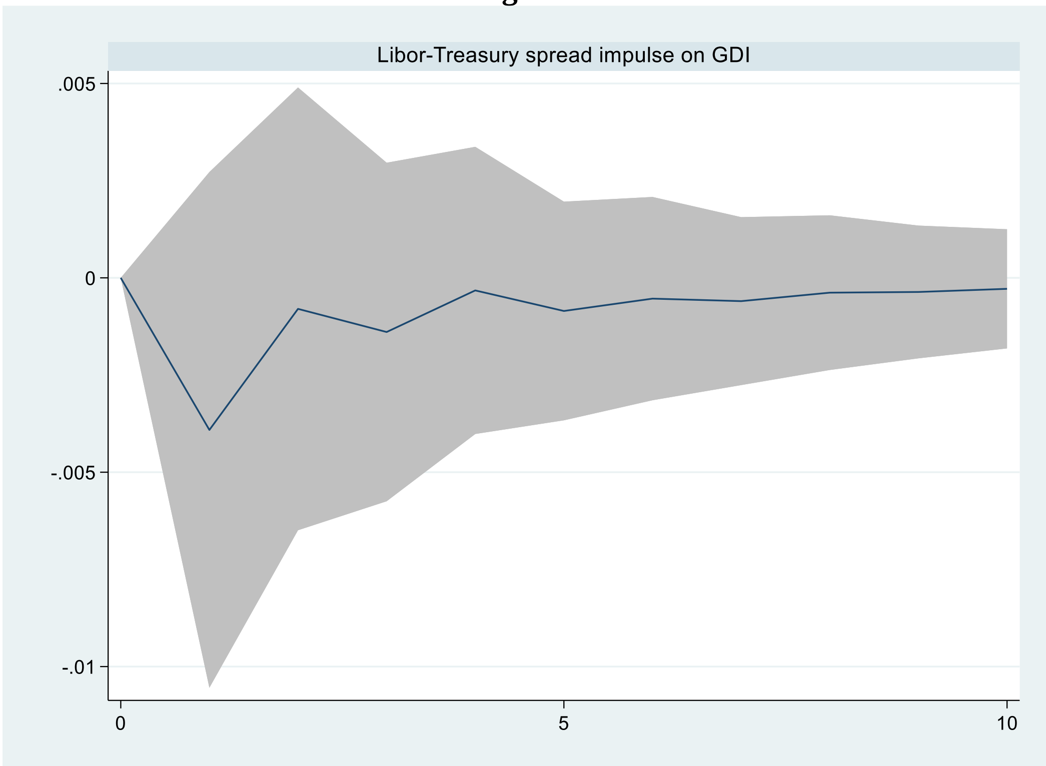
Note: Above are the generalized variance decompositions for GDI. The numbers given represent the percent of the forecast error of the decomposed variable explained by the variable in the column heading at the quarter given by the forecast horizon. Forecast errors for each quarter are given as well.

Figure 1



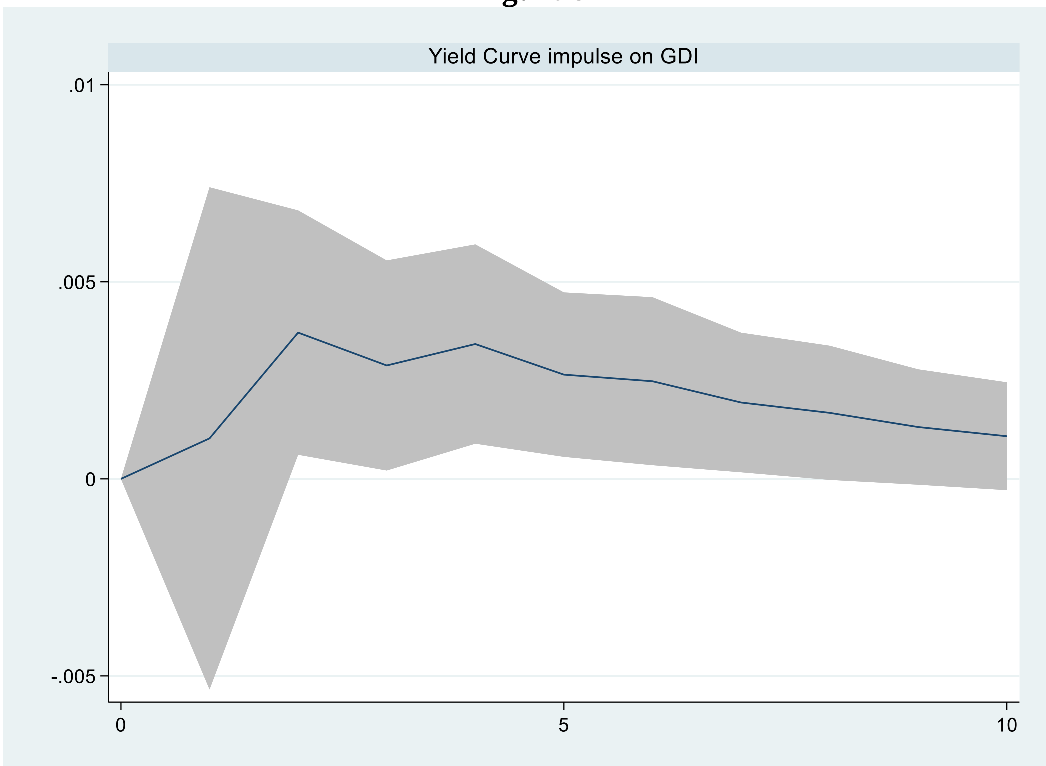
Note: Above are the responses of GDI to a one standard-deviation generalized impulse on the commercial paper-bill spread. The commercial paper-bill spread represents the difference between the 3-month AA corporate paper rate and the 3-month Treasury bill rate. The effects are traced out for 10 quarters. The confidence interval is two standard errors.

Figure 2



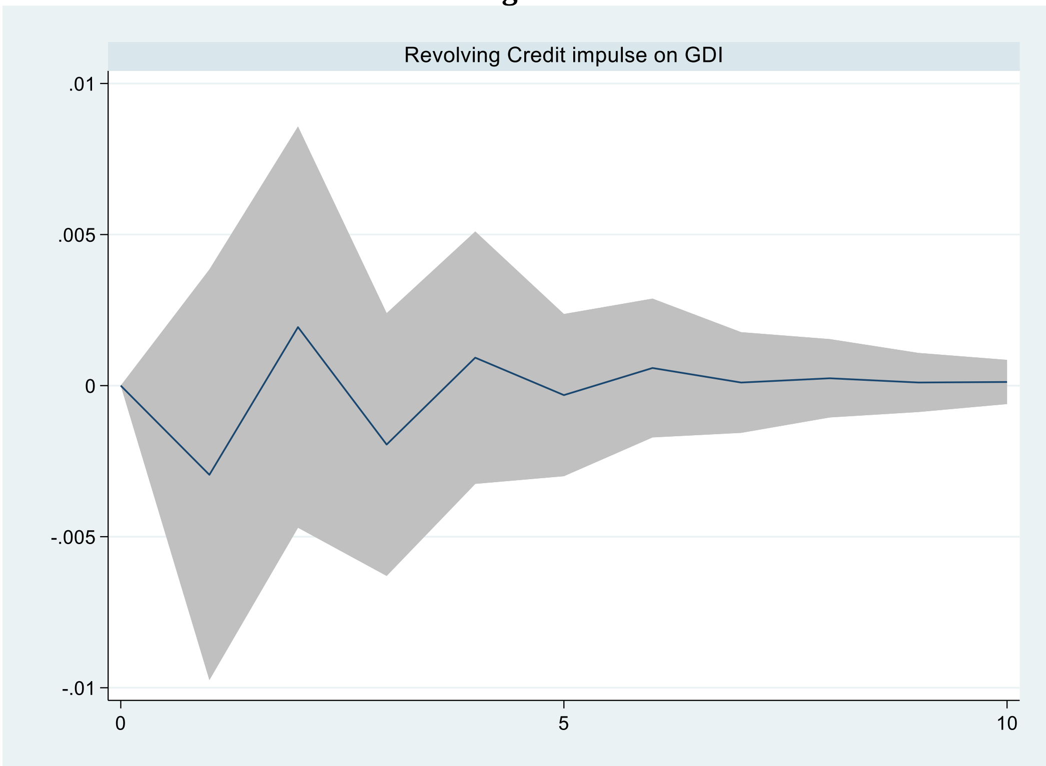
Note: Above are the responses of GDI to a one standard-deviation generalized impulse on the LIBOR-FF spread. The LIBOR-FF spread represents the difference between the 3-month LIBOR rate and the effective FF rate. The effects are traced out for 10 quarters. The confidence interval is two standard errors.

Figure 3



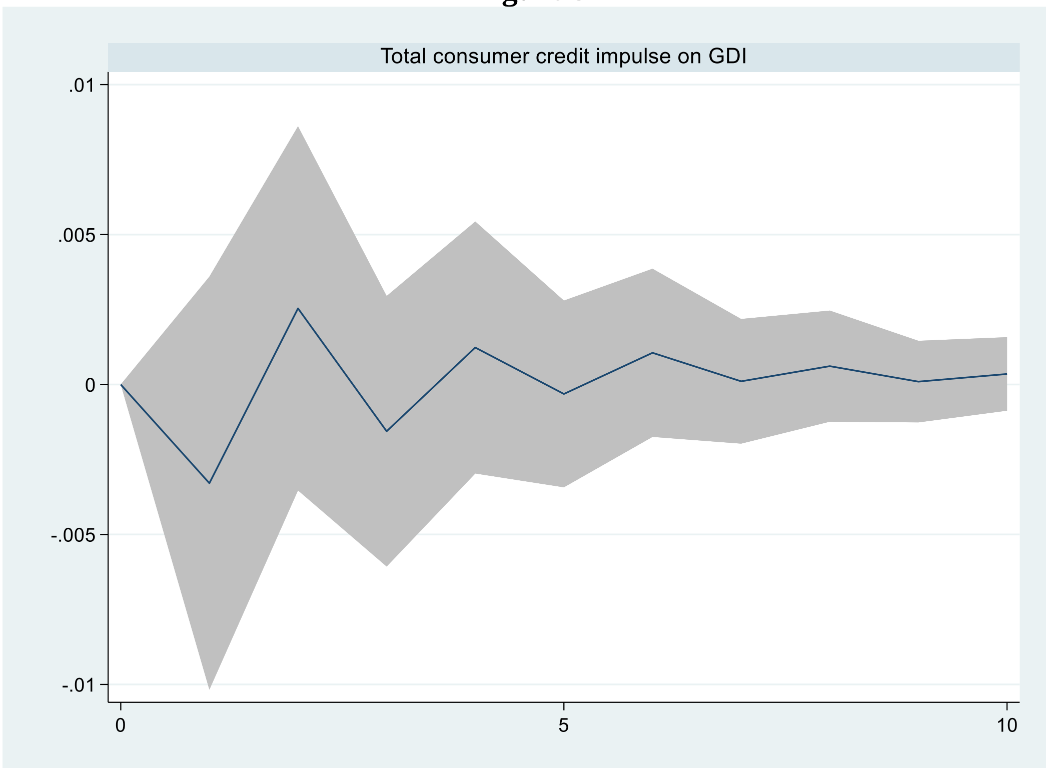
Note: Above are the responses of GDI to a one standard-deviation generalized impulse on the YIELD CURVE. The YIELD CURVE is the spread between the 10-year Treasury rate and the 3-month Treasury rate. The effects are traced out for 10 quarters. The confidence interval is two standard errors.

Figure 4



Note: Above are the responses of GDI to a one standard-deviation generalized impulse on the revolving credit. Revolving credit represents open-arrangements, like credit cards. The effects are traced out for 10 quarters. The confidence interval is two standard errors.

Figure 5



Note: Above are the responses of GDI to a one standard-deviation generalized impulse on the total consumer credit. Total consumer credit includes both credit cards and closed arrangements, like boat, car, and education loans. The effects are traced out for 10 quarters. The confidence interval is two standard errors.