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Do Credit Shocks Matter? A Global Perspective

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Abstract

This paper examines the importance of credit market shocks in driving global business cycles over the period 1988:1-2009:4. We first estimate common components in various macroeconomic and financial variables of the G-7 countries. We then evaluate the role played by credit market shocks using a series of VAR models. Our findings suggest that these shocks have been influential in driving global activity during the latest global recession. Credit shocks originating in the United States also have a significant impact on the evolution of world growth during global recessions.

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Contents Page

I. INTRODUCTION

The global financial crisis of 2007–09 that originated in U.S. credit markets rapidly spread across borders and led to recessions in almost all advanced economies. The global reach and depth of the crisis, which are without precedent in the post-World War II period, have renewed interest in the linkages between the real economy and credit markets, and have triggered an intensive debate about the importance of shocks originating in financial markets for business cycles. Our objective in this paper is to answer one of the central questions of this debate: Do credit shocks matter in driving the global economic activity?

We study this question by analyzing the importance of credit and productivity shocks in explaining business cycles in G-7 countries. Given that there is already a sizeable literature about the importance of productivity shocks, they serve as a natural benchmark against which we assess the influence of shocks originating in credit markets. We first estimate common components in various macroeconomic and financial variables. We then examine the roles played by credit shocks in explaining global business cycles by employing a set of VAR models. In addition, we study the transmission of credit shocks originating in the U.S. to the global economy using a factor-augmented VAR (FAVAR). Our results suggest that credit shocks play an important role in driving economic activity especially during global recessions.

Our study contributes to a large body of research focusing on the interactions between financial markets and the real economy. In section II, we briefly summarize the relevant research. As the summary shows, empirical evidence on the linkages between credit market dynamics and global economic activity is surprisingly limited. Our study addresses this major gap in the literature. To our knowledge, it is the first one to analyze the global implications of shocks originating in credit markets. Another novel aspect of the study is that we derive credit shocks that are not just based on traditional credit spread measures, but also on fluctuations in the volume of credit. Finally, our study extends beyond the general analysis of impulse responses and variance decompositions, and evaluates the role played by credit shocks during recent global recessions. This is particularly important given that the 2007–09 global recession is associated with widespread dislocations in credit markets.

In section III, we introduce our database and econometric approach. The database comprises quarterly series of credit, credit spread, default rate, GDP, labor productivity, inflation, and the interest rates of the G-7 countries over the period 1988:1–2009:4. In order to study the global dimensions of credit shocks, we construct a global factor for each variable. We then employ a set of VAR models to analyze the importance of credit and productivity shocks. Our approach to the identification of these shocks is an agnostic one based on intuitively appealing sign restrictions.

In section IV, we estimate a VAR model of the global factors together with U.S. credit spreads and U.S. default rates. We then analyze how global credit shocks affect world business cycles using impulse responses and variance decompositions. We also study how these shocks affect world GDP during global recessions through counterfactual simulations. In Section V, we focus on the role of credit shocks originating in the U.S. using a FAVAR model that includes U.S. variables along with the global GDP factor. We conclude in Section VI with a brief summary of our main results and directions for future research.

II. Credit Markets and the Business Cycle: A Brief Survey

A short review of the literature on credit markets and business cycles highlights the importance of the question we are studying. The role of credit markets in driving business cycles varies substantially across different classes of models. Some models imply that these markets are only peripherally important for the dynamics of business cycles while others assign a significant role to shocks originating in the financial sector. [1]

Basic economic theory suggests that, in a frictionless world under complete markets, macroeconomic and financial variables can interact closely through wealth and substitution effects. Developments in credit markets, which are simply reflected by movements in asset prices, can influence consumption through their impact on household wealth, and can affect investment by altering a firm's net worth and the market value of the capital stock relative to its replacement value (see Campbell, 2003; Cochrane, 2006). However, in models with complete markets, the financial sector is a "veil" in the sense that there is no role for financial intermediaries or credit market disturbances, since these models do not account for financial imperfections/frictions. The models, hence, imply that shocks originating in credit markets play only a minor role, if any, in explaining business cycles.

In theory, however, interactions between financial variables and the real economy can be amplified when financial imperfections are present.[2] This amplification largely occurs through the financial accelerator and related mechanisms operating through firms, households and countries' balance sheets. According to these mechanisms, an increase (decrease) in asset prices improves an entity's net worth, enhancing (reducing) its capacity to borrow, invest, and consume. This process, in turn, can lead to further increases (decreases) in asset prices and produce general equilibrium effects (e.g., Bernanke and Gertler, 1989; Bernanke, Gertler, and Gilchrist, 1999; Kiyotaki and Moore, 1997; and numerous other studies on the role of financial imperfections). In other words, disturbances in credit markets can translate into much larger cyclical fluctuations in the real economy in these models.[3]

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[1] While the early literature did recognize that financial markets play an important role in the real economy, this emphasis later faded. For example, Fisher (1933) and Keynes were among the first to emphasize the importance of financial markets in shaping macroeconomic outcomes during the Great Depression. Subsequent research, however, focused largely on the role of money as the most relevant financial variable. The famous Modigliani and Miller (1958) "capital structure irrelevance" hypothesis and the general focus on efficient financial markets, however, inadvertently drew attention away from the relevance of financial markets for macroeconomic performance.

[2] Surveys of this literature can be found in Gertler (1988), Claessens, Kose, and Terrones (2010), and Gilchrist and Zakrajšek (2010).

[3] Some recent studies have focused on the role of asset prices in transmitting financial cycles (Adrian and Shin, 2009; and Geanakoplos, 2009). Recent studies also consider how the state of the financial system can affect business cycles (Gertler and Kyotaki, 2010; Brunnermeier and Sannikov, 2010).

Other studies apply models of frictions in credit markets to open economies and consider how the dynamics of exchange rates relate to business cycles (see Céspedes, Chang and Velasco, 2004). This line of research also studies how fluctuations in asset prices can affect the value of collateral required for international funding (see Mendoza, 2010). Caballero and Krishnamurthy (1998) and Schneider and Tornell (2004) model how, because of balance sheet constraints, fluctuations in credit and asset markets translate into boom-bust cycles in emerging market economies.[4]

Many empirical studies provide evidence regarding the linkages between the dynamics of business cycles and disturbances in credit markets (e.g., Bernanke and Gertler, 1989; Borio, Furfine, and Lowe, 2001). These examine the procyclical nature of credit cycles and business fluctuations, albeit mostly for single country cases. For example, Bordo and Haubrich (2010) analyze cycles in money, credit and output between 1875 and 2007 in the United States. They show that episodes of financial stress exacerbate cyclical downturns. While most studies use aggregate data, some others also utilize micro data (see Kashyap and Stein (2000); and Kannan (2010)).

Our paper is closely related to some recent studies analyzing the importance of credit shocks using VAR models. Meeks (2009) examines the role of credit shocks in explaining U.S. business cycles. He documents that credit shocks do play an important role during financial crises, but they have a lesser role during "normal" business cycles. Gilchrist, Yankov and Zakrajšek (2009) and Gilchrist and Zakrajšek (2010) report that credit market spreads have a significant impact on business cycles in the U.S. during the period 1990-2008. Using a DSGE model, Perri and Quadrini (2010) find that the latest recession and its global reach can be explained by credit market shocks.

III. Database and Methodology

Database

Our dataset includes quarterly series of credit, credit spread, default rate, GDP, labor productivity, inflation, and the interest rates of the G-7 countries for the period 1988:1–2009:4. We concentrate on this period for the following reasons. First, it is a common denominator for the cross-country data we need to analyze the interaction between credit shocks and business cycle dynamics in the G-7 countries. Second, this period covers a substantial portion of the "Great Moderation" era as well as the latest global financial crisis (see Blanchard and Simon (2001) and Stock and Watson (2005)). Third, this period also coincides with a rapid increase in trade and financial linkages among the G-7 countries and a broader converge of their business cycles (see Kose, Otrok, and Whiteman, 2008).

[4] There is also a rich set of studies analyzing the implications of various types of financial crises for the real economy (see Gorton, 2009; Reinhart and Rogoff, 2009; Laeaven and Valencia, 2008).

Our measure of credit is aggregate claims on the private sector by deposit money banks. This measure is also used in earlier cross-country studies on credit dynamics (see Mendoza and Terrones, 2008; and Claessens, Kose, and Terrones, 2009 and 2010). The use of credit volume differentiates our study from most others on the impact of credit shocks and allows us to construct a global credit factor since this variable is available for all of the G-7 countries at the quarterly frequency.[5] We deflate the nominal credit series using the CPI to obtain real credit. Inflation corresponds to the changes in each country's CPI.

Unlike the other variables, credit spread and default rates series are available for only the U.S. In order to measure credit spreads, we use corporate bond spreads. In particular, these spreads are the yield differences between Moody's Seasoned Aaa and Baa corporate bonds for the U.S. The Aaa bonds are "judged to be the highest quality with minimal credit" risk while the Baa bonds are "subject to moderate credit risk and possess certain speculative characteristics."

There is no single accepted measure of credit spreads as the recent literature on the importance of credit shocks employs various alternative ones. For instance, Meeks (2009) uses a measure of credit spreads defined in terms of a risky bond portfolio that belongs to Moody's B1/B2 category. Such a portfolio is described by Moody's as being subject to "high credit risk." Gilchrist, Yankov and Zakrajšek (2009) take a panel of credit spreads and estimate a common factor of these spreads as their measure.

The default rate series corresponds to the monthly rates for Moody's rated U.S. speculative-grade corporate bonds from the Moody's Investor Service. As in the case of credit spreads, we take the observation of the last month of each quarter as our quarterly default rates. Meeks (2009) uses a similar default rate series to identify credit shocks.

We track aggregate business cycles with real GDP. Our GDP data are chained volume series from the OECD. The interest rates correspond to nominal short term government bill rates, generally Treasury Bill Rates, and are from the IFS. Labor productivity is defined as real GDP per hours worked and is obtained from the OECD. We provide a detailed list of the data series and their sources in Appendix I. Before constructing our factors and estimating the VAR models, we make appropriate transformations in each data series. In particular, we take four-quarter growth rates of GDP, labor productivity, and credit. Interest rates are first differenced. Credit spreads and default rates are in levels. All variables are seasonally adjusted and expressed in percentages.

[5] Only a few others include credit volume to study the impact of credit market shocks on the real economy (see Balke, 2000). It would be useful to employ a variable that accounts for a broader measure of credit than the one we use here, but such series are not available on a consistent basis across countries.

Methodology

Since our objective is to analyze the global dimensions of credit shocks, we undertake our exercise in two steps. First, we estimate the common component in each variable to obtain a global factor. Although our data sample includes only G-7 countries, this country group accounts for slightly more than half of global GDP over the 1988–2009 period (in PPP exchange rates). Second, we use VAR models to analyze the importance of credit and productivity shocks in explaining business cycles. We also consider how shocks originating in the U.S. transmit to the global economy using a FAVAR (Factor Augmented VAR) model. We now briefly explain each step in turn.

Estimation of Global Factors. To estimate the global factors, we extract the first principal component of each variable using the series of G-7 countries. There are, of course, alternative approaches to construct global equivalents of these variables. For example, we could employ a full-fledged dynamic factor model, as in Kose, Otrok, and Whiteman (2003). Their method is especially useful to estimate different common factors simultaneously, such as global, regional, and country-specific factors. However, the global factor obtained with a dynamic factor model is quite similar to the first principal component.[6] We use the simpler approach since we are only interested in the global component of each variable.

Figure 1a presents the estimated global factors. The estimated factors are broadly consistent with a number of well-known cyclical episodes in the global economy. For instance, the downturns in the estimated global GDP factor coincide with the recessions of the early 1990s, early 2000s, and the latest episode of 2007–09. The downturn during the latest episode is particularly striking because of its highly synchronous nature and its unprecedented depth. The estimated factors of the other variables also reveal interesting patterns. For example, the global credit factor indicates that the episodes we discuss above were also associated with declines in credit. The global inflation factor shows a steady decline beginning in the early 1990s until the recent global recession, consistent with the literature on the "conquest of inflation" in advanced economies. The global interest rate factor also follows familiar patterns: it rises rapidly in the late 1980s and early 1990s and then declines thereafter.

Figure 1b presents the evolution of the U.S. credit spread and default rates. Although there are small elevations in both variables during the early 1990s and 2000s, the increases recorded

[6] In fact, we did estimate the dynamic factor models for some of the variables and arrived at almost identical factors to those from the principal component models. It is also possible to employ simple world aggregates for our exercise. However, such aggregates are dominated by movements of variables of large countries since these are often size weighted averages. In contrast, the first principal component does not automatically give a large weight to countries like the U.S. Moreover, the first principal components we estimate often account for a sizeable fraction of variation in each aggregate we consider. For example, the first principal component on average explains 70 percent of output variation of the G-7 countries.

during the global financial crisis are clearly in a different league. For instance, the spread climbs to 3 percent in 2008–09, which is more than twice its previous highest value over the 1988–2007 period. The default rates also follow a similar pattern and reach a new high during the recent crisis.

We are able to estimate global factors for all variables except the credit spread and default rates, since these series are available for only the U.S. We assume that credit spread and default rates for the U.S. are good representations for their global counterparts since the U.S. economy has been the dominant force in world markets. For example, over the period of 1988–2009, the U.S. economy constitutes roughly half of the G-7 output while it accounts for almost one-fourth of global output. Moreover, the U.S. financial markets are the largest, reflecting not only the size of the economy but also their depth. For example, capitalization of the U.S. equity markets accounts for around 40 percent of total capitalization of world equity markets. Changes in U.S. credit markets and asset prices have strong signaling effects worldwide, and spillovers from U.S. financial markets have been important, especially during periods of market stress.

VAR Models. We estimate two VAR models. The first one includes the estimated global factor of each variable, the U.S. credit spread and default rates. The second model is a FAVAR as it uses the U.S. specific variables along with the global GDP factor.[7] The models we have can be represented by:

$$y_t = a_{(0)} + A_{(1)}y_{(t-1)} + A_{(2)}y_{t-2} + \ldots . + A_{(l)}y_{t-l} + u_t \,; t = 1, \ldots, T,$$

where y_t is an m×1 vector of variables at date t, A_i is an m×m coefficient matrix for each lag of the variable vector with $a_{(0)}$ being the constant term. u_t is the vector of one-step ahead prediction error. The two models differ only in terms of the set of variables in the y_t vector. For the first VAR, y_t includes the estimated global factors, and U.S. credit (i.e., corporate bond) spread and default rates.[8] In the case of the U.S. FAVAR, the vector consists of the set of U.S. variables and the global GDP factor. In our estimation, the lag length, *l*, is kept at four.

We use these models to examine the roles of credit and productivity shocks in explaining the global and U.S. business cycles. Since there is already a large literature about the importance of productivity shocks as a source of business cycle fluctuations, it constitutes a natural benchmark against which we evaluate the role of credit shocks. We use global and the U.S. specific versions of these shocks in our respective models for the global economy and the U.S.

[7] Our second model follows the work of Bernanke, Bovin, and Eliasz (2005) who developed the factor-augmented VAR (FAVAR) to study the effects of monetary policy in a closed economy framework.
[8] Bernanke, Bovin, and Eliasz (2005) compare FAVARs that treat estimated factors as data as is done here, with more sophisticated Bayesian estimates that account for uncertainty in the estimated factors. They find that there is no real gain from the more computationally intensive Bayesian methods for this type of problem.

We identify the shocks using a set of sign restrictions imposed on impulse responses following Uhlig (2005).[9] Instead of relying on restrictions on the variance-covariance matrix of the structural residuals' orderings based on the presumed exogeneity or predetermination of variables, this identification approach allows us to produce impulse responses that are qualitatively consistent with standard theoretical predictions. The sign restrictions algorithm we use, however, differs from Uhlig (2005) in that we simultaneously identify two orthogonal shocks.[10] An alternative approach would be to identify each shock, credit or productivity, one at a time. However, this does not guarantee the orthogonality of the two shocks, making it difficult to argue that the identified shocks are truly "structural".

The sign restrictions we impose are intuitively appealing. For example, we identify adverse credit market shocks by assuming that they lead to a decrease in credit and a simultaneous increase in the price of credit, i.e., the credit spreads. In addition, we assume that productivity does not fall and default rates do not rise. [11] The restrictions on credit and credit spreads describe the natural responses of volume and price of credit to such disturbances. Given the forward looking nature of credit markets, the restrictions on productivity and default rates ensure that we identify a credit supply shock rather than an endogenous credit response to expected fluctuations in future activity.

It is important to note we do not require that a contractionary credit shock brings "good times" with higher productivity or lower default rates. We merely require that the decline in credit not be associated with expected declines in productivity or increases in default rates. In other words, our adverse credit shock reflects a credit supply contraction as opposed to an endogenous decline in credit due to lenders reducing credit in response to expectations of an increase in future default rates and/or a decline in future productivity. Our identification scheme does not impose any restriction on the response of GDP.

The restrictions on default rates and credit spreads can be formally derived from a costly state verification model (see Appendix II in Meeks (2010) for full derivation). Levin, Natalucci and Zakrajšek (2004) estimate a closely related model using micro-level data and provide evidence that the default cost parameter does vary over time. This empirically motivates the sign restrictions on financial variables as the varying costs yield contractions in credit markets following the derived sign restrictions. The restrictions on productivity and inflation are not

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[9] Uhlig (2005) considers the importance of monetary policy shocks by imposing sign restrictions on the impulse responses of prices, nonborrowed reserves, and the federal funds rate.

[10] Our simultaneous identification scheme implies that the second shock is identified by drawing an impulse vector that is orthogonal to the first impulse vector and at the same time obeys the sign restrictions we impose. This is a more restrictive requirement than a sequential identification scheme where the orthogonality condition is relaxed. We limit ourselves to identifying only two shocks (credit and productivity) at a time, since identifying multiple shocks is computationally burdensome. We also consider credit-policy and credit-demand pairs. However, we did not get sufficient number of correct draws of the impulse vectors for these pairs from a total of 100,000 draws.

[11] Meeks (2009) shows that such restrictions on default rates are required to identify credit shocks originating in the financial sector.

needed in this identification scheme and in fact our results are even stronger without this additional restriction. We add the restriction on productivity and inflation to ensure that we have not commingled two shocks in the VAR identification scheme. The restrictions on productivity simply serve to clarify that the credit contraction is one that originates on the credit side of the economy and is not a contraction related to lowered productivity. We are not implying that there is a shock that contracts the credit market and raises productivity, rather we are ensuring that the credit shock is not commingled with a productivity shock.

A second motivation for this restriction is from the DSGE model in Gilchrist et. al. (2009). In that model, any shock that affects the net-worth of borrowers (firms) is a credit demand shock. Thus, this further justifies our restrictions on the productivity shock which affects the net-worth to ensure that we are identifying a credit supply shock. Moreover, the responses of inflation are consistent with our sign restrictions on inflation in their structural model.

We identify the positive productivity shocks by assuming that they are associated with a simultaneous increase in labor productivity and in GDP, and a fall in inflation for four quarters following the shock. The latter restriction on inflation can be formally derived from a New Keynesian DSGE model, where inflation is driven by marginal cost, and positive productivity shocks lower marginal cost.

We keep the horizon for sign restrictions for both productivity and credit shocks at four quarters to maintain symmetry across the two shocks. The selection of four quarters also captures the idea that the impact of each shock lasts for at least a year.[12] We have conducted sensitivity exercises to check the robustness of our results to alternative identification restrictions and horizon assumptions. All of our main results are robust to these variations.

IV. Credit Shocks and Global Business Cycles

In this section, we place the global factors in credit, GDP, inflation, interest rates, and labor productivity in our VAR model, together with U.S. credit spreads and default rates. With this model, we estimate the autoregressive dynamics among the variables we are interested in, and identify global credit and productivity shocks. We analyze the role of worldwide credit shocks in explaining global business cycles in three steps. First, we consider the impulse responses of the variables in our VARs to these shocks. Next, we study the variance of global GDP attributed to credit and productivity shocks. Third, we conduct a series of counterfactual simulations to evaluate the role of credit shocks during global recessions.

[12] The selection of horizon length closely follows Peersman and Straub (2009) who also use the same length to identify productivity shocks for the Euro area. There are some studies that keep the sign restriction horizon shorter than the one we use. For instance, Uhlig (2005) identifies monetary shocks by keeping the sign restrictions horizon at 2 quarters. In the context of credit market shocks for the U.S., Meeks (2009) identifies this shock by imposing sign restrictions on spreads for 2 quarters and those on defaults for 12 quarters.

Impulse Responses

Figure 2 shows the median impulse response functions to an adverse global credit shock, together with the 14 and 86 percentile responses (based on 500 draws). The shapes of these impulse response functions are broadly consistent with our expectations. A temporary adverse credit shock, by assumption, raises corporate bond spreads and reduces total credit at impact. Global productivity increases at impact, but declines gradually over time. Although global activity rises in tandem with the temporary increase in productivity, it starts contracting after the third quarter possibly because of the adverse impact of the limited availability and higher price of credit on aggregate demand. In particular, the global GDP factor declines steadily over the 12-quarter horizon suggesting that credit shocks can have long lasting effects on activity. However, the response of global GDP factor to credit market shocks is not statistically significant.

Short-term interest rates increase on impact but fall subsequently, presumably reflecting monetary easing in response to the eventual decline in economic activity following the unexpected tightening in credit markets. Since real GDP and inflation increase on impact, we are not capturing monetary policy-induced credit supply shocks with our identification assumption. While we expect the contraction and higher price of credit to put downward pressure on prices, the impulse response of inflation to our credit "supply" shock suggests otherwise, probably because of the initial increase in productivity and global activity. A credit shock that is identified without restrictions on productivity implies a decline in global GDP and inflation, but such a credit shock likely combines both demand and supply elements. [13]

As in the case of credit shocks, the impulses to productivity shocks that have not been restricted for identification purposes generally have the expected patterns.[14] However, they are not statistically significant except for the initial four quarters imposed for identification. The credit channel appears to play the expected role in the transmission of productivity shocks. Specifically, credit volume increases while the costs of credit (spreads) and defaults decrease, as one would expect given that firms net worth and investment rise with productivity improvements. We also analyze the robustness of our results with respect to different identification schemes. Specifically, we identify credit shocks by selecting only impulse responses with either a positive credit spread response or a negative credit growth response. In addition, we consider versions where we eliminate the joint restrictions on default rates, productivity and orthogonality. The results are qualitatively similar to those obtained with our baseline identification scheme.

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[13] We present these findings in Figure A1 in Appendix II.

[14] We present the responses to the global productivity shocks in Figure A2 in Appendix II. The results of additional sensitivity exercises are available from the authors upon request.

Variance Decompositions

The insignificance of responses of global real variables to credit shocks does not necessarily imply that these shocks are not important. In fact, our variance decompositions suggest that measured by their contribution to fluctuations to the global GDP factor, credit shocks are as important as productivity shocks. We report our findings in panel A of Table 1. Although the reported variance decompositions are based on a set of orthogonal shocks, they will not necessarily add up to 100 percent since there are other potential unidentified shocks that will make up the rest of the variance.

The credit shock, for example, accounts for roughly 11 percent of the 12-quarter ahead forecast error variance of the global GDP factor. Productivity shocks, on the other hand, account for approximately 12 percent of the total forecast error variance of the global GDP factor. Thus, our decompositions suggest that credit shocks account for about as large a share of fluctuations on their own as the standard productivity shocks.[15]

In addition to global GDP, credit shocks play an important role in explaining the variance of other variables. For example, they explain almost 10 percent of the variance of global productivity and around 11 percent of the variations in inflation and interest rates. These shares are close to those obtained for the productivity shocks. We have so far focused on the importance of credit shocks over the period 1988-2009. We now turn to a different question and consider the role of these shocks in explaining the path of global GDP during global recessions.

Credit Shocks during Global Recessions

How important are global credit shocks during episodes of global recessions? This is an obvious question to ask given that the latest episode is a global event associated with disruptions in international credit markets. We also consider the roles played by credit shocks during the global recession of 1990–91. These two episodes of global recessions correspond to declines in world real GDP per capita.[16] While the Great Recession of 2007–09 is associated mainly with financial sector problems, the previous global recession reflects a host of issues in various corners of the world: difficulties in the U.S. saving and loan industry, banking crises in several Scandinavian economies, adverse effects of an exchange rate crisis on a large number of European countries, and challenges faced by the east European transition economies.

To gauge the role of credit shocks during these episodes, we perform a number of counterfactual exercises. Each of these exercises represents simulations where the structural shock of interest is set to zero over the relevant period. In the case of the latest episode, for example, the

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[15] In Figure A5 of Appendix II, we provide the posterior coverage intervals for the variance decompositions. The estimates we report here are fairly precise and support our headline conclusion about the importance of productivity and credit market shocks.

[16] Our definition of global recessions follows Kose, Loungani, and Terrones (2010). In particular, they identify four troughs in global economic activity over the past 50 years—1975, 1982, 1991, and 2009.

counterfactual credit shock simulation shows how the global GDP factor would have evolved without the adverse “credit supply event” that has been the hallmark of the Great Recession. It is important to recognize that while the credit supply shock is set to zero in this exercise, the volume of credit can still contract in response to other shocks. So, the credit channel is still in operation, but credit supply shocks, per se, are not the source of the downturn in the counterfactual simulation.

The left graph of panel A in Figure 3 compares the results of counterfactual simulation for the global GDP factor during the Great Recession episode. Specifically, it shows the differences between the actual cumulative change in the demeaned global GDP factor and the cumulative changes in the simulated values in the absence of the global credit shock during 2007:3–2009:4. The impact of the global credit shock has obviously intensified as the recession turned into a global event, spreading from the U.S. to other advanced countries. For example, without the credit shock, the global recession would have been about 10 percent milder, given the difference between actual and simulated cumulative growth in 2009:3.

The estimated impact of credit shocks in this counterfactual exercise is clearly significant while they did not appear to matter in the IRFs of Figure 2. The two results can be reconciled by noting that the IRFs in Figure 2 are the estimated impact of credit shocks over the whole sample and hence are unconditional moments. The counterfactual exercise is conditional on one subsample of the data. This highlights a main message of our paper: credit shocks do not matter in general but in certain extreme periods they can matter a lot.

The left graph of panel B in Figure 3 compares the contributions of credit and productivity shocks to the cumulative global GDP growth based on the counterfactual simulations. Credit shocks on their own accounted for a larger share of the cumulative decline in the global GDP factor than productivity shocks. We interpret this result as evidence for the important role of global credit shocks in the latest episode.[17]

Counterfactual simulations for the 1990–91 global recession suggests, however, that credit shocks played a less important role than they did in the 2007-2009 period (the right graphs of panels A and B in Figure 3). This finding is intuitively appealing. Unlike the 2007–09 episode, where difficulties in international credit markets were a critical driving force, the 1990–91 global recession had a number of different sources. As we show in the next section, the impact of a U.S. credit shock on U.S. activity is quite sizeable during the 1990–91 recession, which is not surprising given that U.S. credit markets went through a prolonged period of contraction.

[17] The results of counterfactual exercises above are qualitatively robust to alternative definitions of credit shocks. In particular, when we drop the joint restrictions on default rates, productivity and orthogonality in various combinations, the importance of credit shocks during the Great Recession holds in general and sometimes becomes a bit stronger. These results are available from the authors upon request.

Moreover, the extent of real sector synchronization is also much greater in the most recent episode.[18]

The conclusions we draw from the analysis in this section is that credit shocks matter for the global economy, albeit to varying degrees. Their effects may not generally be large, but global credit shocks have played an important role in some episodes, notably in the latest global recession. Such ambiguities in the effects of credit shocks are not new. Other studies analyzing the relationship between financial conditions and future economic activity and inflation at the country level also often report weak and unstable predictive power.[19] One notable exception is that of Gilchrist, Yankov and Zakrajšek (2009) who argue that the predictive power of credit spreads for economic activity increases substantially, especially at longer horizons, when the measure of credit spreads is derived from securities issued by intermediate-risk rather than high-risk firms.

V. The Global Transmission of U.S. Credit Shocks

We have so far considered the role played by global credit shocks in explaining global GDP. There is much to be said about rapidly increasing international financial linkages, which have led to the speedy transmission of domestic credit shocks to other economies. National and global credit shocks may thus have partly become indistinguishable. Nevertheless, in view of the key role of the U.S. financial system in global financial markets and the large size of the U.S. economy, a key question is whether credit shocks that originate in the U.S. have international repercussions. In this section, we examine this question by analyzing a set of FAVAR models with U.S. variables along with the global GDP factor estimated earlier. As in the previous section, we consider the role of U.S. credit shocks by first studying impulse responses, then variance decompositions, and finally global recession episodes.

The impulse response functions to a U.S. credit shock are shown in Figure 4. The shapes of the median responses are broadly similar to those from the VAR in the previous section. However, the impact effects of a 1 standard deviation credit shock on several of the variables are more modest in the US FAVAR model. A major feature of the effects of a U.S. credit shock is that it has noticeable international repercussions. In fact, while the impact response on U.S. GDP is positive, not surprising given our identifying restrictions on productivity, the global GDP factor

[18] Imbs (2010), using monthly data on industrial production, concludes that the degree of cross-country business cycle correlations during the latest crisis was the highest in three decades.

[19] There is a large literature analyzing the predictive power of financial variables for future activity. However, the predictive value of these financial variables, including asset prices, generally is limited (see Stock and Watson (2003)). A number of studies discuss the predictive value of interest rates for output fluctuations and the timing of recessions and recoveries (see Wheelock and Wohar, 2009).

declines on impact. That said, these transmission effects generally are not statistically significant.[20]

Table 1 (panel B) presents the variance decompositions. U.S. credit shocks play an important role in explaining the variance of domestic macroeconomic aggregates. For example, they account for 9 percent of fluctuations in the U.S. GDP (based on the 12-quarter ahead forecast error variance). Our estimate of the fraction of variance of the U.S. GDP due to a credit shock is consistent with the findings by Meeks (2009).[21] More interestingly, the U.S. credit shocks account for 11 percent of the variance of global GDP, confirming the important role played by disturbances in the U.S. credit markets in explaining global business cycles. Productivity shocks account for roughly 12 percent of the variation in both the U.S. GDP and the global GDP factor. This corroborates our earlier finding that credit shocks are as important as standard productivity shocks in driving business cycles.

How important are U.S. credit shocks during global recessions? To answer this question, we conduct a set of counterfactual simulations, as in the previous section. The results are summarized in Panels A of Figures 5 and 6, which show the differences between the actual cumulative change in the demeaned U.S. GDP (global GDP factor) and the cumulative changes in the simulated values of the same variables in the absence of the U.S. credit shock during the two global recession episodes. Panel B in Figures 5 and 6 display the differences between the actual and counterfactual simulations for the two shocks.

Two findings stand out. First, credit shocks originating in the U.S. account for a larger difference in the cumulative change for the global GDP factor under the counterfactual simulations than U.S. productivity shocks. In the case of the U.S. GDP, domestic credit shocks are about as important as productivity shocks in the early stages of the latest global recession. Nevertheless, U.S. credit shocks appear to play a sizeable role in the 1990–91 recession. As in the case of the counterfactual exercise for global credit shocks, these results are stronger especially when restrictions on default rates are relaxed.

Second, the 1991 downturn in the U.S. clearly is associated with adverse disturbances in the U.S. credit markets and to a lesser extent abroad.[22] Our results suggest that the U.S.-specific credit disturbances transmit to global activity as evidenced by the largest difference accounted by the U.S. credit market shocks in driving global GDP, especially in the later stages of the 1991 global recession. In contrast, our earlier counterfactual simulations with the VAR suggest that global

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[20] As in the case of the earlier VAR, we also identify an alternative credit shock and U.S. productivity shocks using the schemes described in section II. The impulse responses to these shocks are presented in Figures A3 and A4 in Appendix II. The findings are broadly consistent with the ones from the VAR estimated with global factors.

[21] Since the variance decompositions based on shocks, which are identified with sign restrictions, are generally different from those based on the standard recursive decompositions, we restrict the comparison of our results against those studies utilizing sign restrictions only (see Meeks (2009) for a similar point).

[22] For a discussion about disruptions in U.S. credit markets in the late 1980s and early 1990s, see Reinhart and Rogoff (2009) and Salido and Nelson (2010).

credit shocks generally do not account for the largest differences between actual and counterfactual global GDP in the 1991 episode. Together, these findings suggest that the main credit shock during this episode was a disturbance in the U.S. credit markets and that the strong global repercussions do not necessarily arise primarily because of transmission through financial channels.

The important role played by credit market disturbances in explaining the severity of certain recessions is also reported by some recent studies. For example, Perri and Quadrini (2010) argue that credit shocks are more relevant than productivity shocks in explaining the Great Recession, especially its global dimension. Using a DSGE model, they show that in a financially integrated world, credit shocks originating in one country (the U.S. in our case) can result in highly synchronized global business cycles— a distinctive feature of the latest episode. On the other hand, productivity shocks must be highly synchronized across countries to produce globally synchronized cycles. Mian and Sufi (2010), using detailed microeconomic data, document that the dramatic expansion and collapse of mortgage lending that is at the heart of the Great Recession align well with a credit supply explanation rather than one based on productivity driven credit demand. In related research, Claessens, Kose, and Terrones (2009, 2010) analyze the interactions between recessions and disruptions in credit and asset markets using a large cross-country sample of business and financial cycles. Their findings also suggest that when recessions coincide with substantial declines in credit, they tend to become deeper.

VI. Conclusion

The latest financial crisis has been a bitter reminder of the important role of credit markets in macroeconomic fluctuations. Although there has been a large research program analyzing how gyrations in credit markets translate into fluctuations in the real sector at the country level, the global dimensions of credit market shocks have not yet been studied. Our paper aims to provide a perspective about the linkages between credit markets and global business cycles using a simple framework. In particular, we analyze the importance of credit market shocks for the G-7 countries using a series of VAR models.

We start with a set of impulse responses to get a grasp of the dynamic reactions to disturbances in credit markets. We find that these disturbances do have an impact on output, but their effects on other variables are not always significant. We then conduct variance decompositions to analyze the importance of credit market shocks in driving business fluctuations. The results of this exercise suggest that these shocks are as important as productivity shocks.

We then assess the role of credit shocks during global recessions. In particular, we undertake a series of counterfactual simulations to examine the evolution of global GDP during the 1991 and 2009 global recessions. We find that credit shocks have played an important role during the latest global recession. Our simulations indicate that the impact of credit shocks during the 1991 global recession is smaller, but this is mostly due to the U.S. specific nature of the credit shock and the confluence of other factors during this episode.

We also study the global implications of credit shocks that originate in the U.S. by employing a set of FAVAR models. Our results with respect to the impulse responses and variance decompositions of these models are mostly consistent with those from the VAR models with global factors. During the latest episode, U.S. credit shocks have been influential in driving global growth dynamics. Moreover, they have played an important role in shaping the evolution of U.S. business cycles during the 1991 recession.

We plan to study the potential importance of cross-country spillovers through various financial market linkages in our future research. In addition to credit markets, it would be interesting to analyze how asset (equity and real estate) market linkages can transmit business cycles across countries. It would also be useful to examine the importance of credit market shocks originating in advanced countries for emerging market economies.

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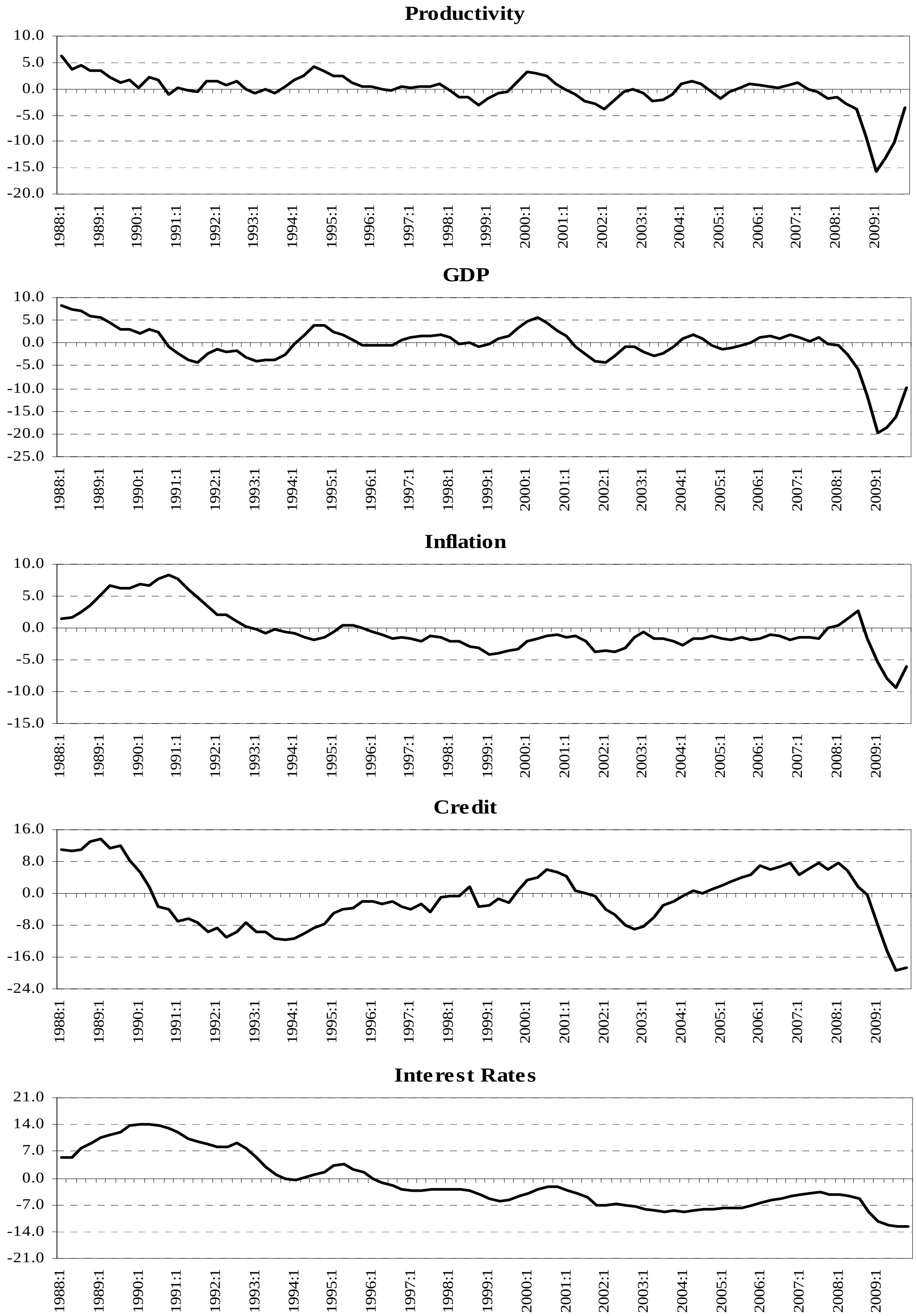
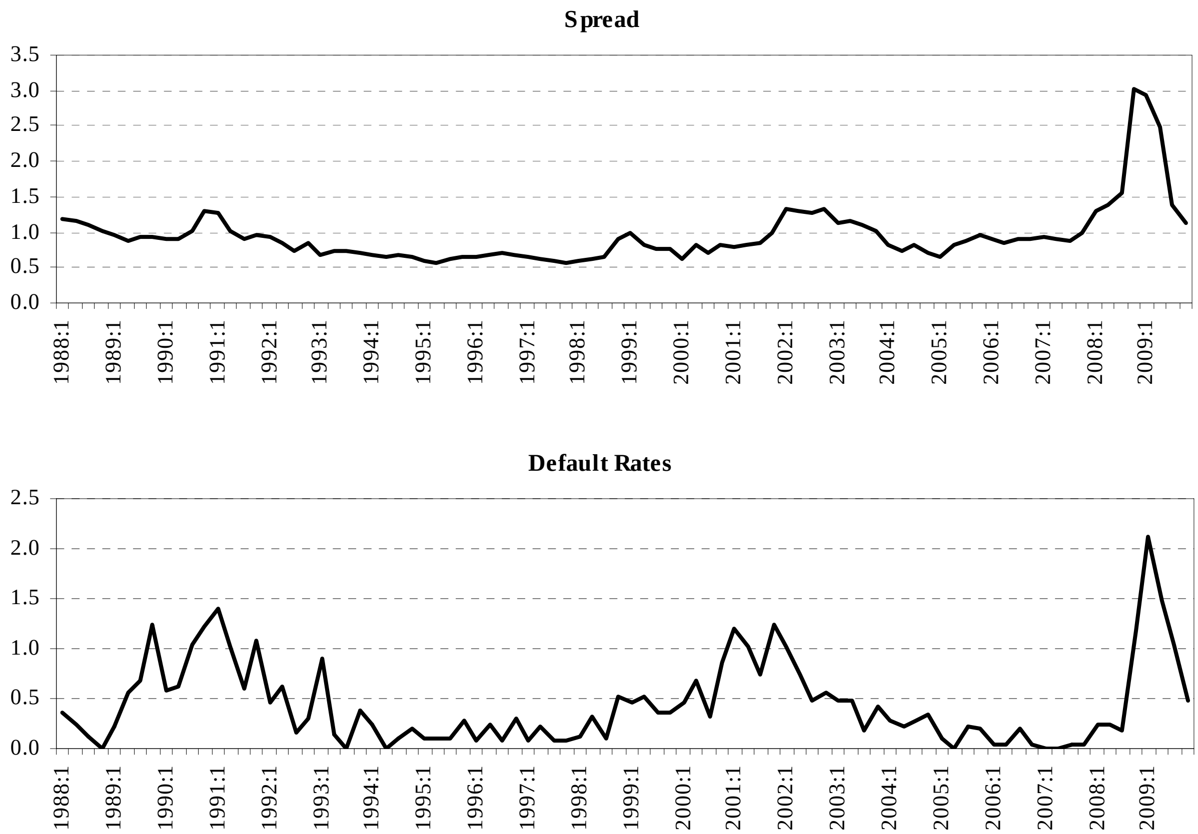
Figure 1a
G-7 Common Factors



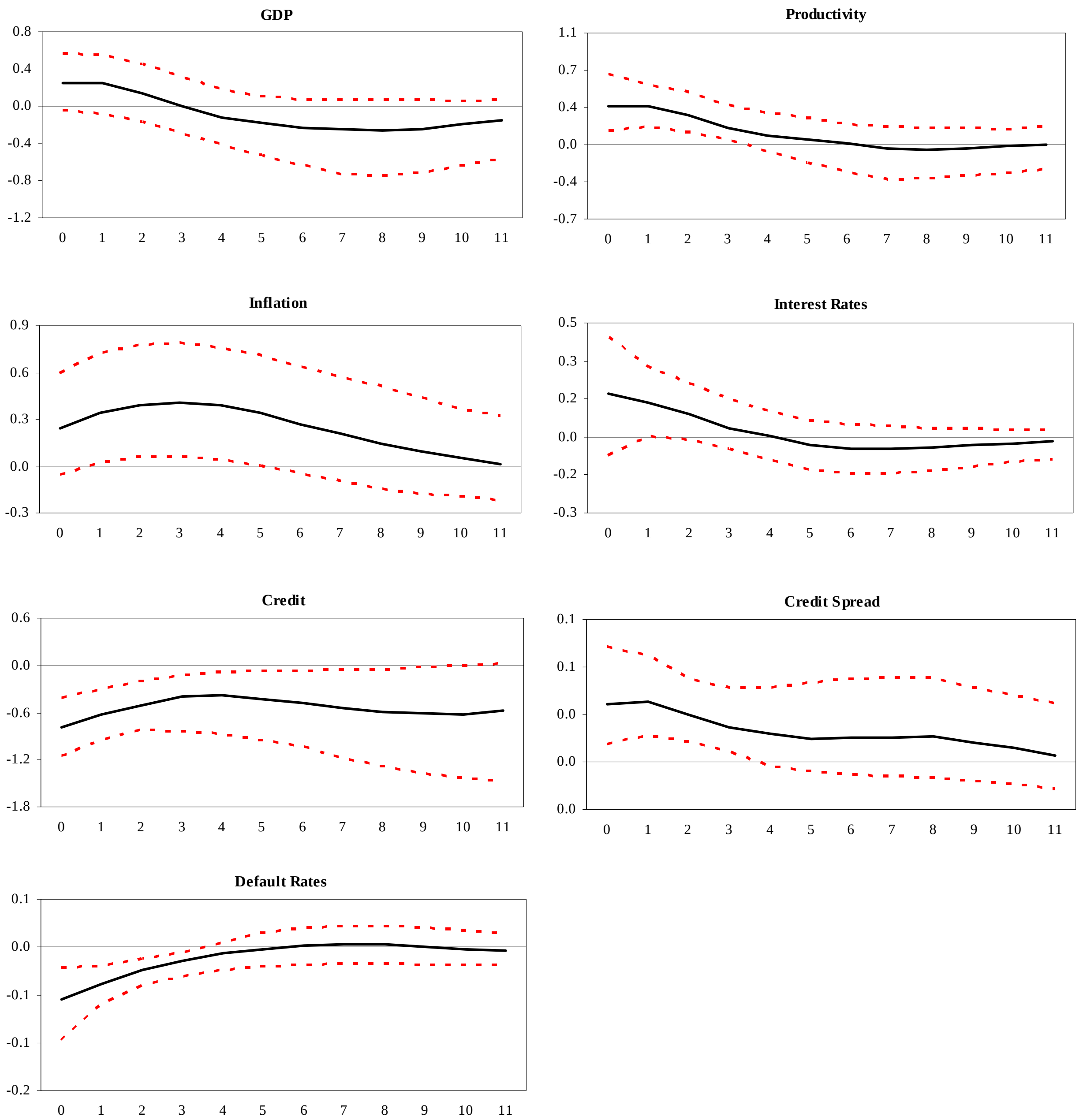
Note: The graphs show the common factors for the G-7 countries estimated using the principal component method.

Figure 1b
US Specific Credit Market Variables



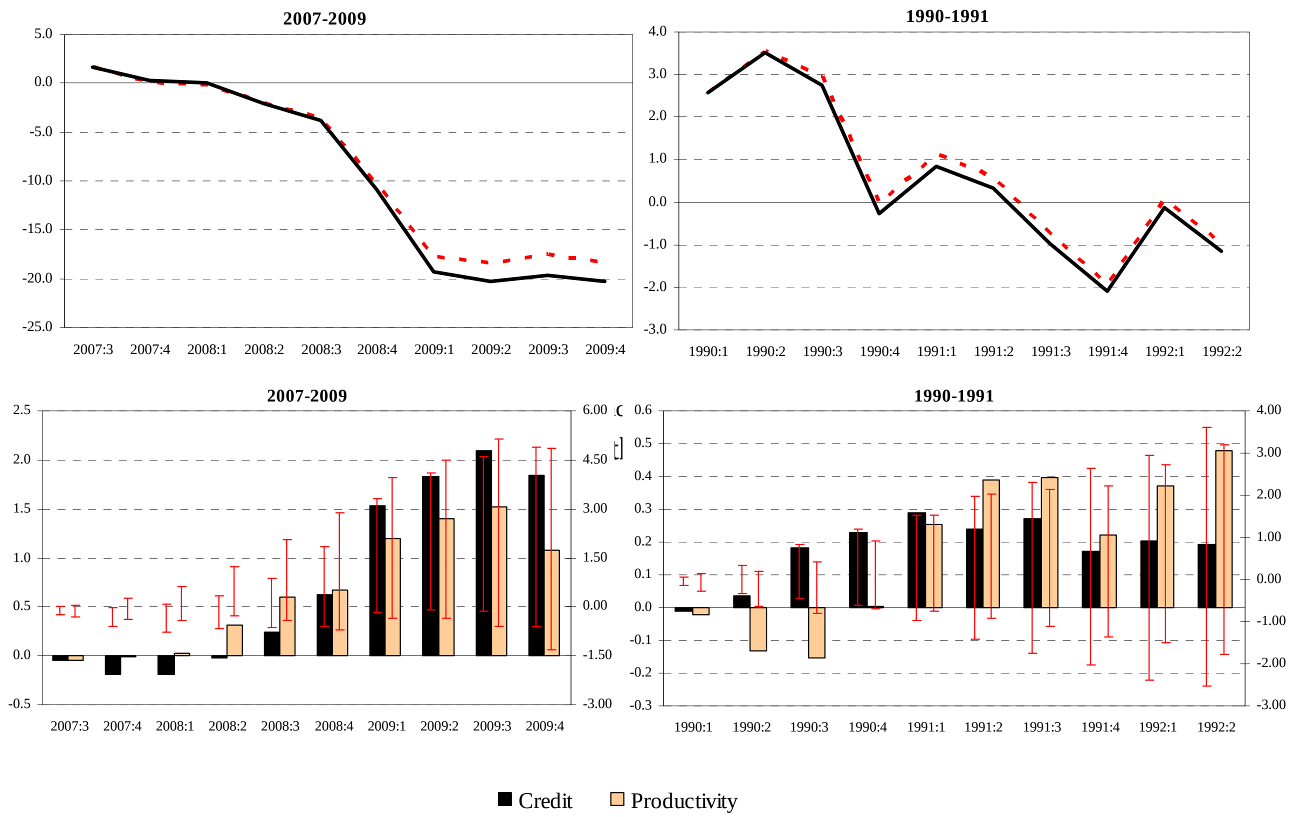
Note: The graphs show the US corporate bond spread and the US default rates.

Figure 2
Impulse Responses due to a Credit Shock: VAR with Global Factors



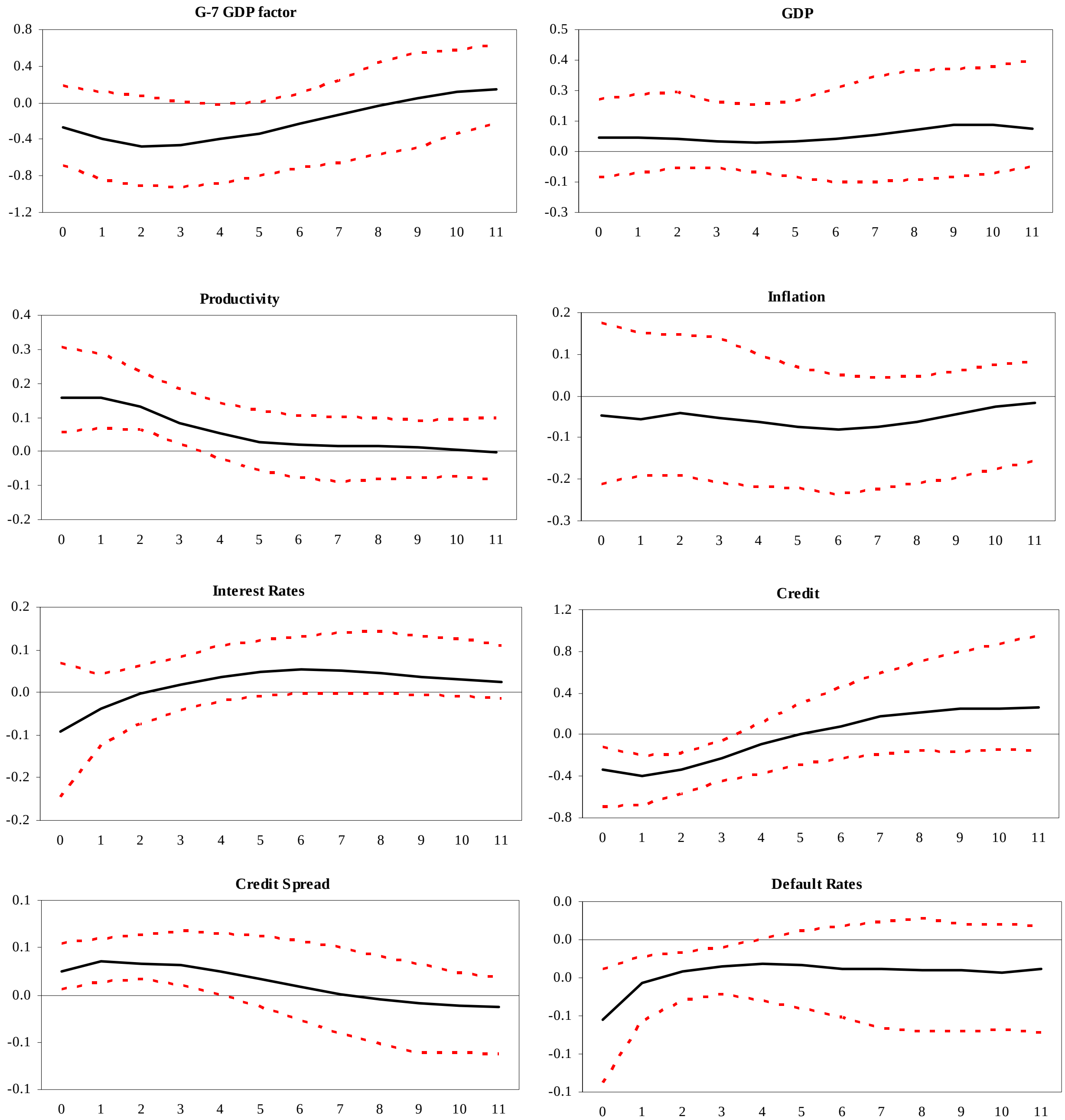
Note: The graphs show the impulse responses of the G-7 factors, the US credit spread and the US default rates due to a 1 standard deviation global credit shock in the G-7 VAR model. The solid line represents the median and the dotted lines represent the 16th and the 84th percentiles based on 500 draws.

Figure 3
A. Dynamics of Global GDP: Credit Shock



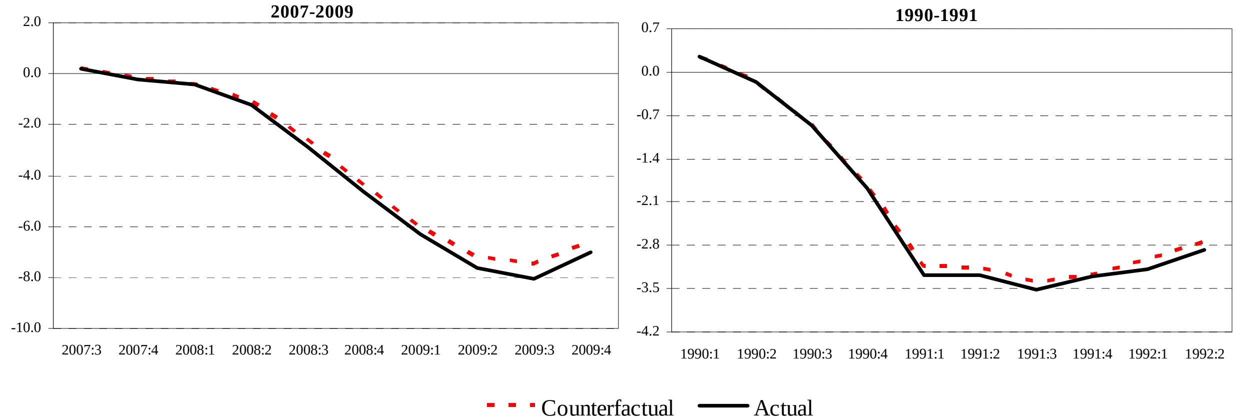
Note: Panel A shows the dynamics of cumulative four quarterly growth rates of the global GDP factor during the recessions of 2007–09 and 1990–91 respectively. The solid line represents the actual global GDP factor and the dotted line represents the counterfactual when the global credit shock is set to zero during the period considered. We perform a similar exercise for the global productivity shock. Panel B, then, shows the difference between the counterfactual and the actual global GDP factor when the respective shock is shut down during the two recessions. The bars shown on the left axis are the median differences. A positive (negative) bar at each period then captures how the decrease in the global GDP factor would have been lesser (greater) in the absence of the respective shock. The confidence bands shown on the right axis correspond to the 16th and the 84th percentiles.

Figure 4
Impulse Responses due to a Credit Shock: US FAVAR

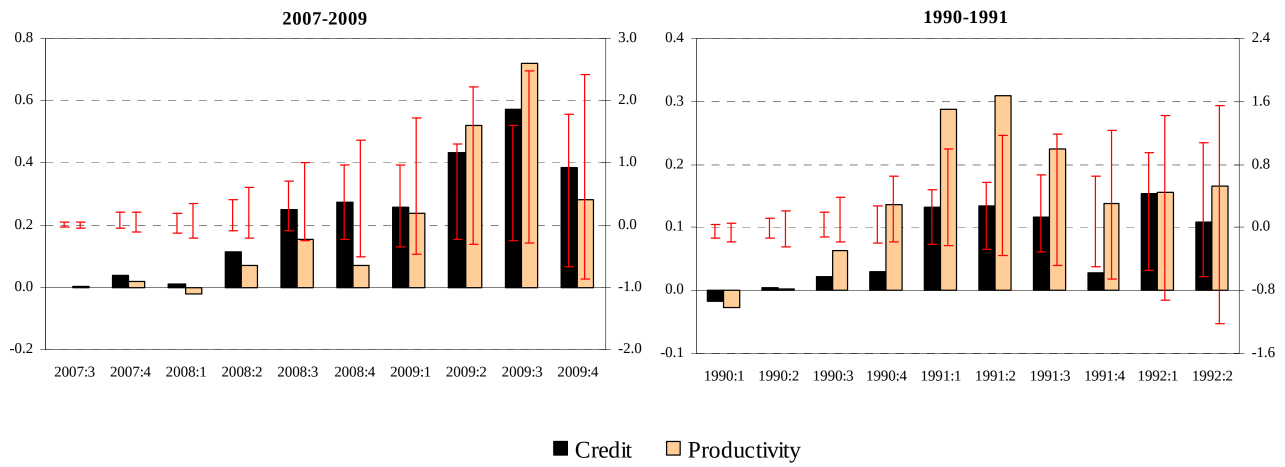


Note: The graphs show the impulse responses of the US variables and the global GDP factor due to a 1 standard deviation U.S. credit shock in the US FAVAR model. The solid line represents the median and the dotted lines represent the 16th and the 84th percentiles based on 500 draws.

Figure 5
A. Dynamics of US GDP: Credit Shock

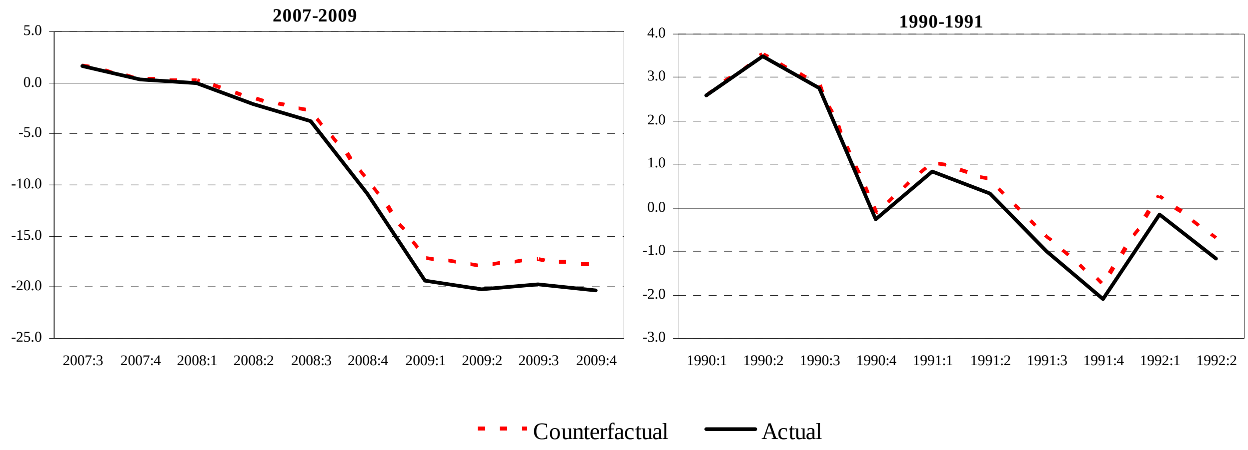


B. Cumulative Growth Gap of US GDP

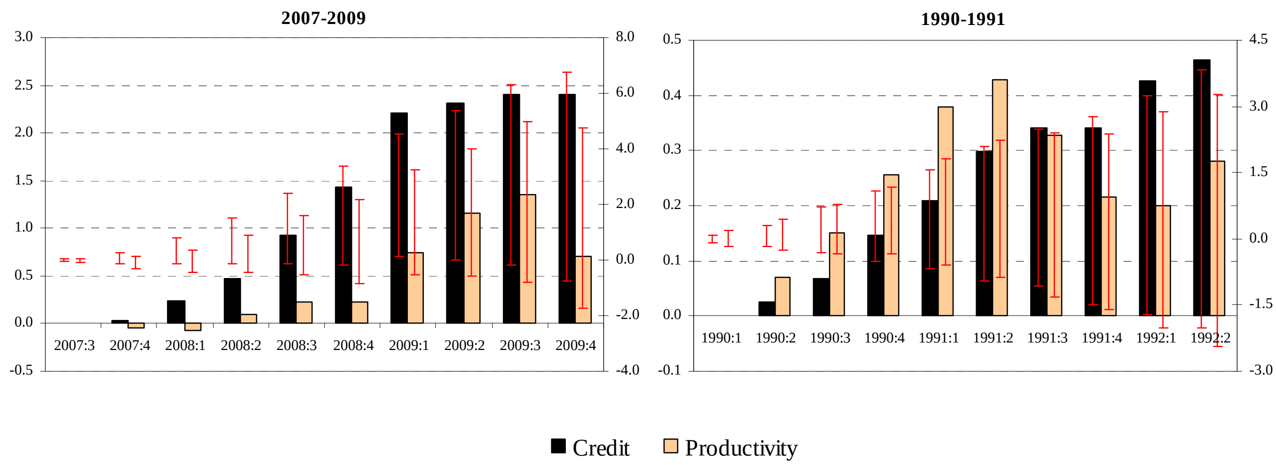


Note: Panel A shows the dynamics of cumulative four quarterly growth rates of the U.S. GDP factor during the recessions of 2007–09 and 1990–91 respectively. The solid line represents the actual U.S. GDP and the dotted line represents the counterfactual when the U.S. credit shock is set to zero during the period considered. We perform a similar exercise for the U.S. productivity shock. Panel B, then, shows the difference between the counterfactual and the actual U.S. GDP factor when the respective shock is shut down during the two recessions. The bars shown on the left axis are the median differences. A positive (negative) bar at each period then captures how the decrease in the global GDP factor would have been lesser (greater) in the absence of the respective shock. The confidence bands shown on the right axis correspond to the 16th and the 84th percentiles.

Figure 6
A. Dynamics of Global GDP: Credit Shock



B. Cumulative Growth Gap of Global GDP



Note: Panel A shows the dynamics of cumulative four quarterly growth rates of the global GDP factor during the recessions of 2007–09 and 1990–91 respectively. The solid line represents the actual global GDP factor and the dotted line represents the counterfactual when the U.S. credit shock is set to zero during the period considered. We perform a similar exercise for the U.S. productivity shock. Panel B, then, shows the difference between the counterfactual and the actual global GDP factor when the respective shock is shut down during the two recessions. The bars shown on the left axis are the median differences. A positive (negative) bar at each period then captures how the decrease in the global GDP factor would have been lesser (greater) in the absence of the respective shock. The confidence bands shown on the right axis correspond to the 16^{th} and the 84^{th} percentiles.

Table 1

A. Variance Decompositions: VAR with Global Factors

Shocks	Forecast horizon (in quarters)	GDP	Productivity	Inflation	Interest Rates	Credit	Credit Spread	Default Rates
Credit	1	8.9	6.5	6.8	9.9	14.6	9.2	15.7
	4	9.7	8.8	9.2	10.1	13.9	9.5	14.9
	8	10.6	10.3	10.6	10.5	12.5	10.9	14.2
	12	10.8	10.4	10.9	10.8	12.1	11.1	13.9
Productivity	1	9.3	7.1	23.5	9.1	9.1	8.5	10.7
	4	10.5	9.4	19.6	10.3	11.4	9.9	12.2
	8	12.1	11.0	16.6	11.8	13.3	11.4	12.5
	12	12.3	11.4	16.3	12.3	14.5	11.8	12.5

B. Variance Decompositions: US FAVAR

Shocks	Forecast horizon (in quarters)	Global GDP	GDP	Productivity	Inflation	Interest Rates	Credit	Credit Spread	Default Rates
Credit	1	9.2	8.3	4.7	4.3	7.3	10.1	4.9	18.9
	4	10.7	8.0	6.0	6.9	9.4	10.9	8.0	14.4
	8	11.1	8.4	7.3	8.9	10.5	10.8	9.1	13.2
	12	11.0	9.3	7.8	9.5	10.9	10.7	9.5	13.0
Productivity	1	7.8	11.3	11.9	14.2	8.0	14.4	8.2	8.9
	4	10.8	12.2	13.1	13.7	10.1	13.5	10.7	10.1
	8	12.1	13.2	13.6	13.6	11.1	13.6	11.8	11.5
	12	12.3	12.9	13.6	13.6	11.7	13.6	12.3	11.7

Note: Panel A shows the proportion of forecast error variance of the global factors and the U.S. credit spread and default rates explained by the global credit and productivity shocks for different forecast horizons, in the VAR with global factors model. Panel B shows the variance decompositions for the U.S. variables and the global GDP factor due to U.S. credit and productivity shocks in the U.S. FAVAR model. Figures are the median variance decompositions and are in percentages. As noted in the text, though both shocks are identified simultaneously, the variance decompositions need not add up to 100.

APPENDIX I: DATABASE

Inflation*

Country	Source	Source Base	Database	Code	Description
Canada	IFS	EDSS	IFTSTSUB	15664...ZF...	CPI:ALL CITIES POP OVR.30,000
France	IFS	EDSS	IFTSTSUB	13264...ZF...	CPI: 108 CITIES
Germany	IFS	EDSS	IFTSTSUB	13464...ZF...	CPI Unified Germany
Italy	IFS	EDSS	IFTSTSUB	13664...ZF...	CPI:ALL ITALY
Japan	IFS	EDSS	IFTSTSUB	15864...ZF...	CPI:ALL JAPAN-485 ITEMS
United Kingdom	IFS	EDSS	IFTSTSUB	11264...ZF...	CPI: ALL ITEMS
United States	IFS	EDSS	IFTSTSUB	11164...ZF...	CPI All ITEMS CITY AVERAGE

*Inflation is calculated as the year over year change in CPI.

Nominal Short Term Interest Rate

Country	Source	Source Base	Database	Code	Description
Canada	IFS	EDSS	IFTSTSUB	15660C..ZF...	TREASURY BILL RATE
France	IFS	EDSS	IFTSTSUB	13260C..ZF...	TREASURY BILLS:3 MONTHS
Germany	IFS	EDSS	IFTSTSUB	13460C..ZF...	TREASURY BILL RATE
Italy	IFS	EDSS	IFTSTSUB	13660C..ZF...	TREASURY BILL RATE
Japan	IFS	EDSS	IFTSTSUB	15860C..ZF...	FINANCING BILL RATE
United Kingdom	IFS	EDSS	IFTSTSUB	11260C..ZF...	TREASURY BILL RATE
United States	IFS	EDSS	IFTSTSUB	11160C..ZF...	TREASURY BILL RATE

Labour Productivity

Country	Source	Source Base	Database	Code	Description
Canada	OECD	EDSS	OETSADB	156.PDTY	Labour productivity of the total economy
France	OECD	EDSS	OETSADB	132.PDTY	Labour productivity of the total economy
Germany	OECD	EDSS	OETSADB	134.PDTY	Labour productivity of the total economy
West Germany	OECD	EDSS	OETSADB	WGR.PDTY	Labour productivity of the total economy
Italy	OECD	EDSS	OETSADB	136.PDTY	Labour productivity of the total economy
Japan	OECD	EDSS	OETSADB	158.PDTY	Labour productivity of the total economy
United Kingdom	OECD	EDSS	OETSADB	112.PDTY	Labour productivity of the total economy
United States	OECD	EDSS	OETSADB	111.PDTY	Labour productivity of the total economy

Gross Domestic Product

Country	Source	Source Base	Database	Code	Description
Canada	Statistics Canada	Haver	G10+	S156NGPC@G10	Gross Domestic Product (SAAR, Mil.Chn.2002.C$)
France	Institut National de la Statistique et des Etudes Economiques	Haver	G10+	S132NGPC@G10	Gross Domestic Product (SA/WDA, Mil.Chn.2000.Euros)
Germany	Deutsche Bundesbank	Haver	G10+	S134NGPC@G10	Gross Domestic Product (SA/WDA, Bil.Chn.2000.Euros)
Italy	Istituto Nazionale di Statistica	Haver	G10+	S136NGPC@G10	Gross Domestic Product (SA/WDA, Mil.Chn.2000.Euros)
Japan	Cabinet Office	Haver	G10+	S158NGPC@G10	Gross Domestic Product (SAAR, Bil.Chn.2000.Yen)
United Kingdom	Office for National Statistics	Haver	G10+	S112NGPC@G10	Gross Domestic Product (SA, Mil.Chained.2005.Pounds)
United States	Bureau of Economic Analysis	Haver	G10+	S111NGPC@G10	Gross Domestic Product (SAAR, Bil.Chn.2005$)

Credit

Country	Source	Source Base	Database	Code	Description
Canada	IFS	EDSS	IFTSTSUB	15622D..ZF...	CLAIMS ON PRIVATE SECTOR
France	IFS	EDSS	IFTSTSUB	13222D..ZF...	CREDIT TO PRIVATE SECTOR
Germany	IFS	EDSS	IFTSTSUB	13422D..ZF...	CLAIMS ON OTH RESSID SECTOR
Italy	IFS	EDSS	IFTSTSUB	13622D..ZF...	CLAIMS ON OTHER RESIDENT SECTORS
Japan	IFS	EDSS	IFTSTSUB	15822D..ZF...	CLAIMS ON PRIVATE SECTOR
United Kingdom	IFS	EDSS	IFTSTSUB	11222D..ZF...	CLAIMS ON PRIVATE SECTOR
United States	IFS	EDSS	IFTSTSUB	11122D..ZF...	CLAIMS ON PRIVATE SECTOR

Spread

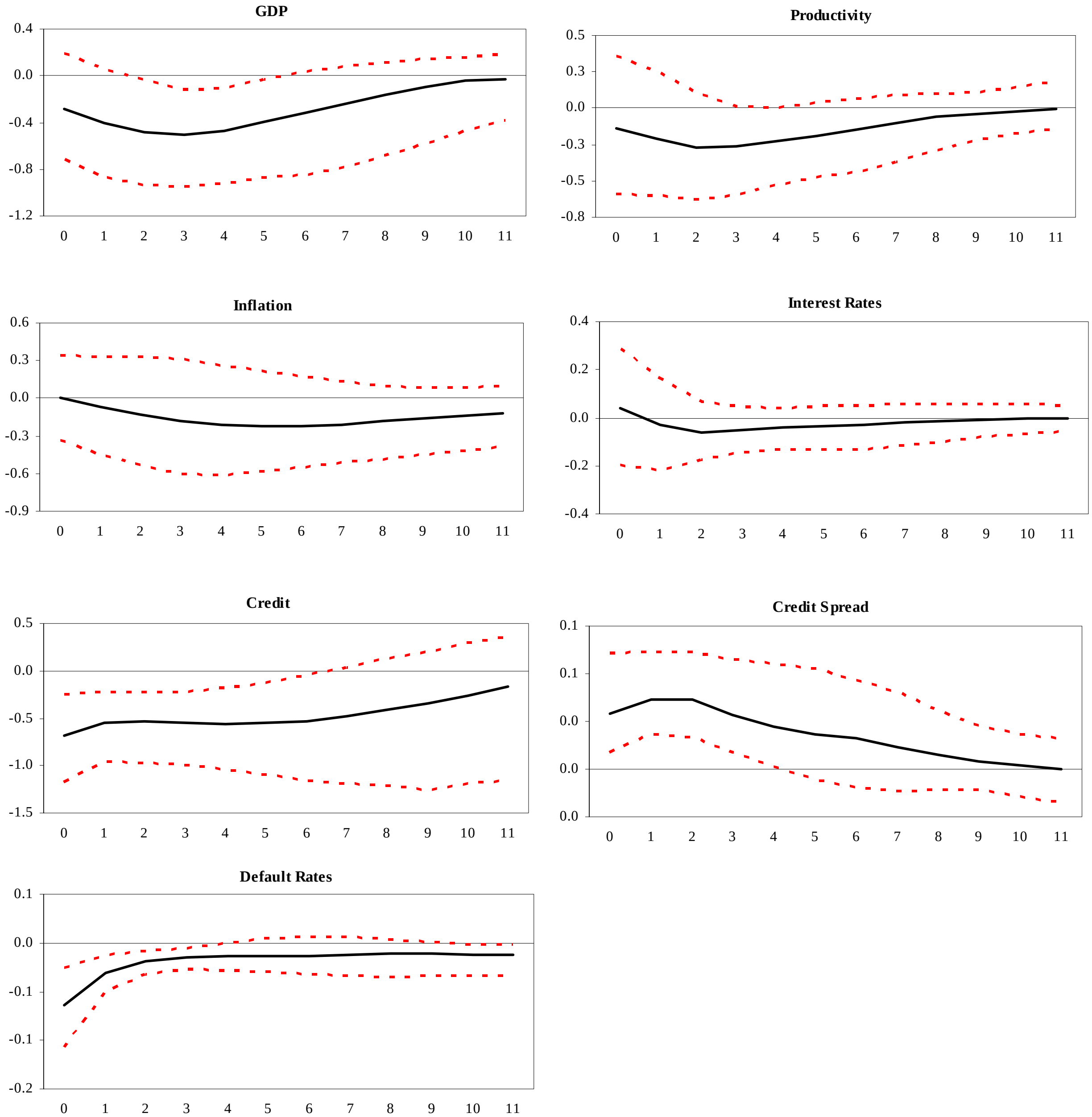
Country	Source	Source Base	Code	Description
Spread**	Calculated			(Baa Interest Rate- Aaa Interest Rate)
Baa	Moody's Investor Services.	Board of Governors of the	BAA	Moody's Seasoned Baa Corporate Bond Yield
Aaa	Moody's Investor Services.	Board of Governors of the	AAA	Moody's Seasoned Aaa Corporate Bond Yield
Default Rates**	Moody's Investor Services.	Moody's Investor Services.	-	Moody's Corporate Default Rates

**Both series are in monthly frequency. We take the data at the end month of each quarter to be the quarterly data.

Note: To complete the data for some series we also use other databases. Details of this are available form the authors on request.

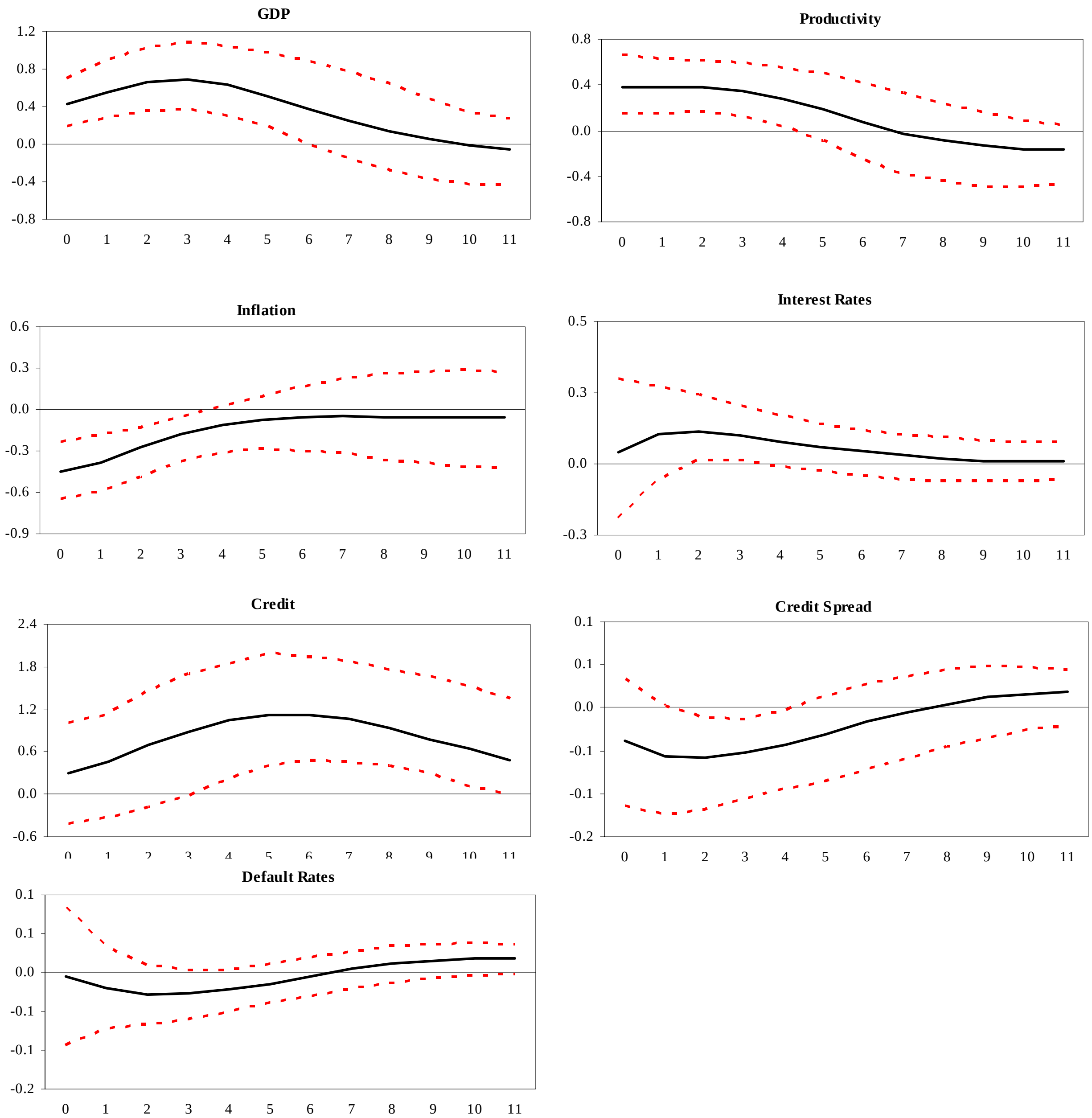
APPENDIX II: SENSITIVITY EXPERIMENTS

Figure A1
Impulse Responses due to an Alternative Credit Shock: VAR with Global Factors



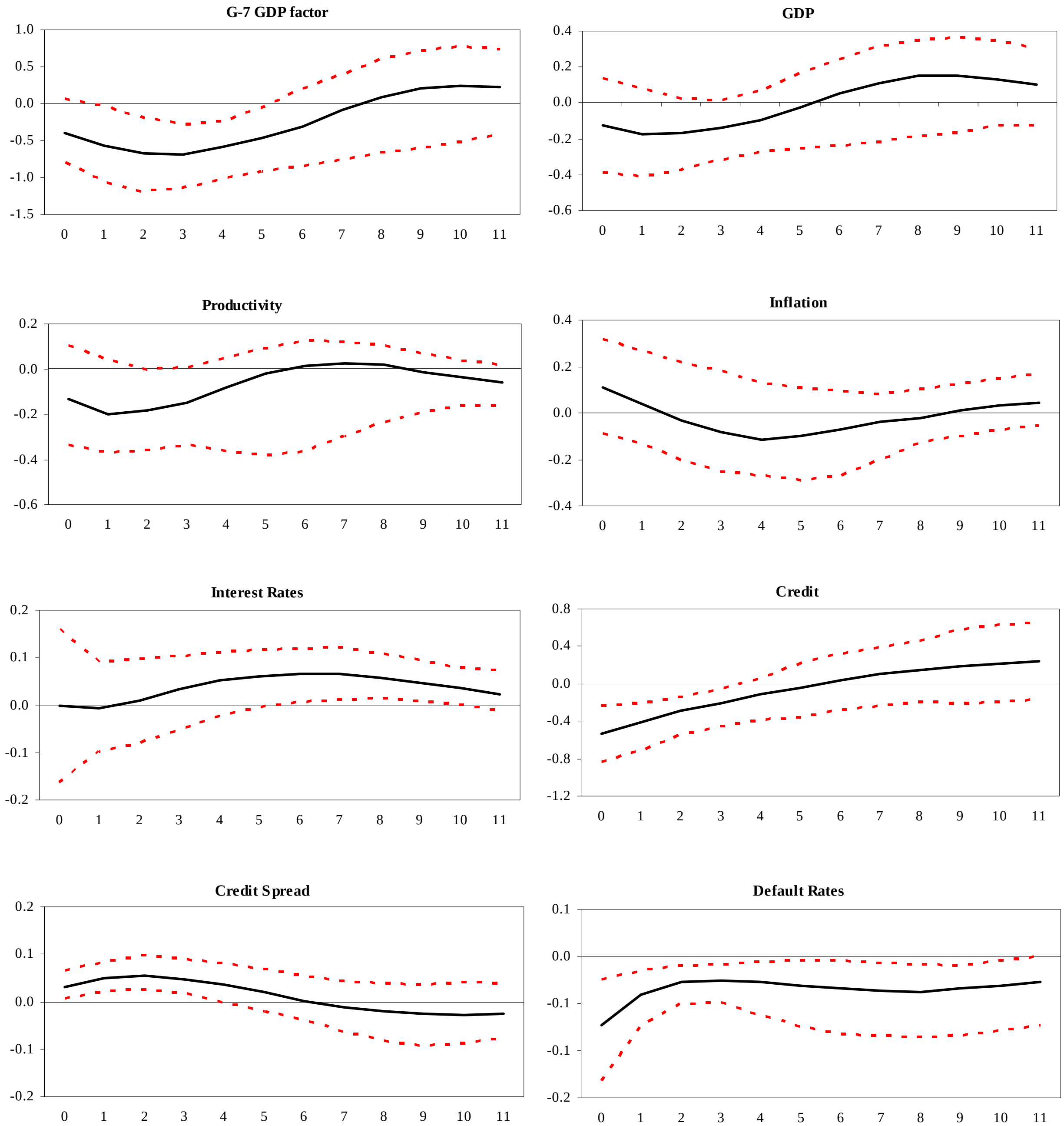
Note: The graphs show the impulse responses of the global factors, the US credit spread and the US default rates due to a 1 standard deviation global credit shock in the VAR with global factors model. Here, credit shocks are alternatively defined by relaxing the restrictions on productivity as in the main text. The solid line represents the median and the dotted lines represent the 16th and the 84th percentiles based on 500 draws.

Figure A2
Impulse Responses due to a Productivity Shock: VAR with Global Factors



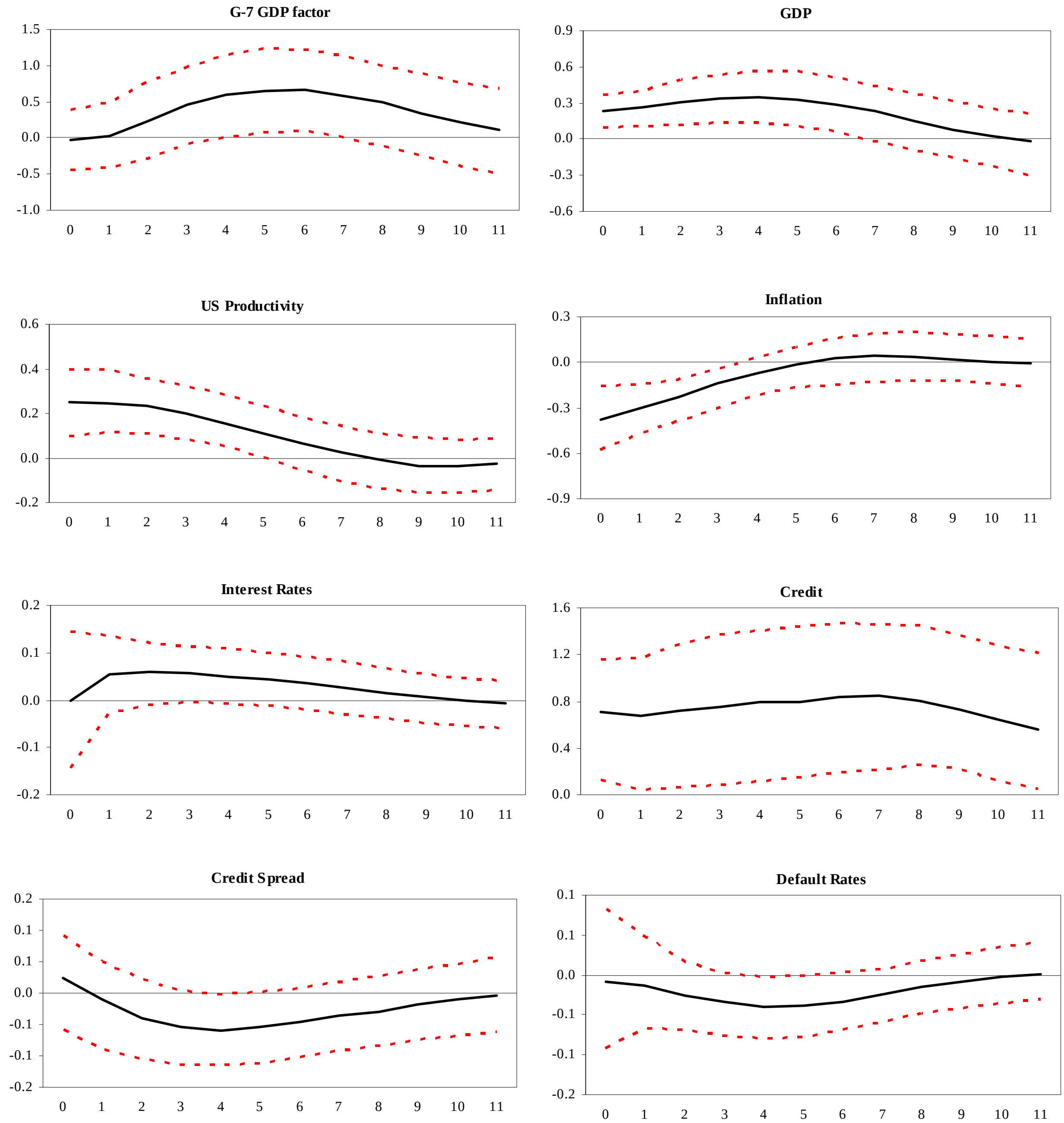
Note: The graphs show the impulse responses of the global factors, the US credit spread and the US default rates due to a 1 standard deviation global productivity shock in the VAR with global factors model. The solid line represents the median and the dotted lines represent the 16th and the 84th percentiles based on 500 draws.

Figure A3
Impulse Responses due to an Alternative Credit Shock: US FAVAR



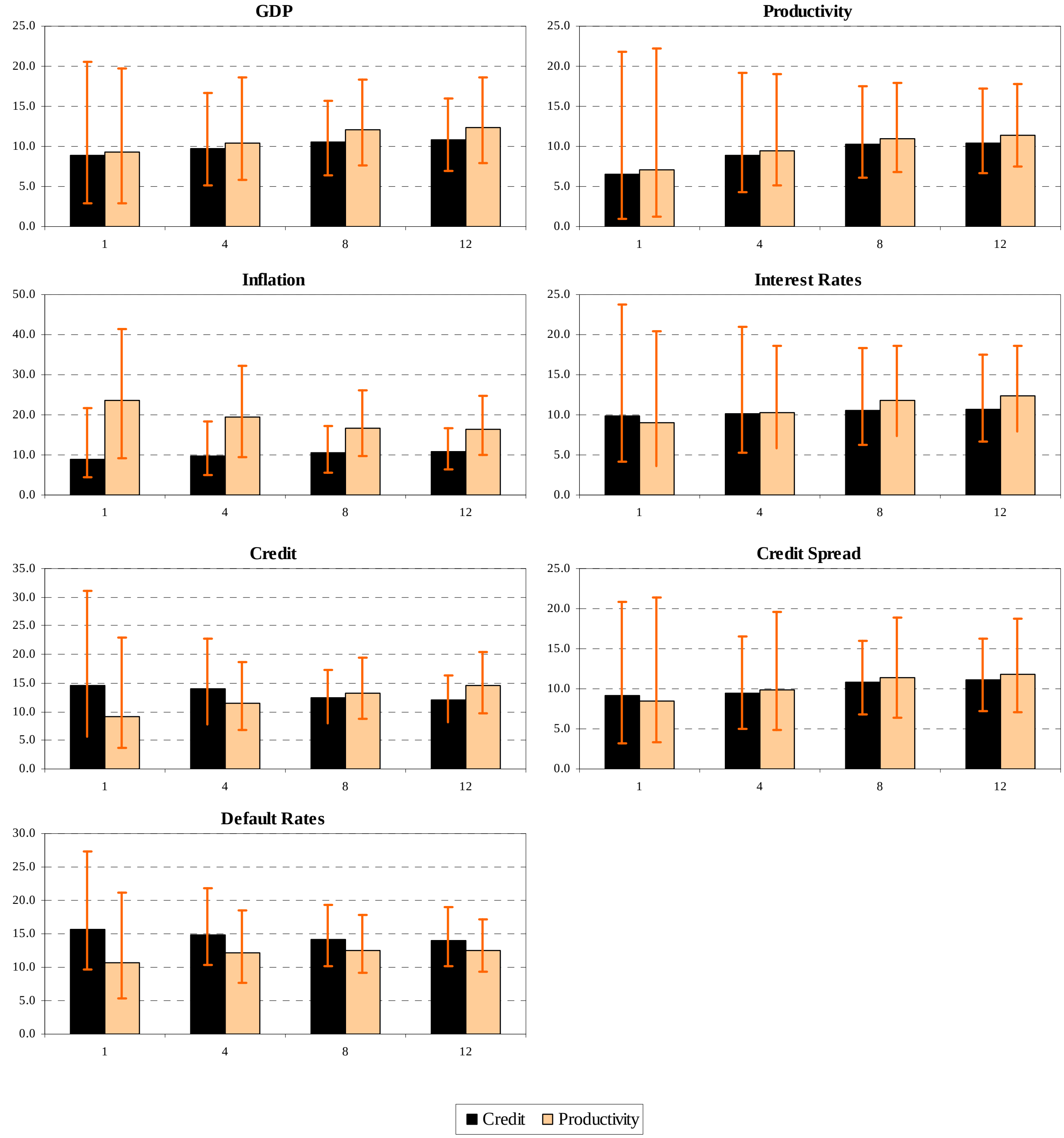
Note: The graphs show the impulse responses of the U.S. variables and the global GDP factor due to a 1 standard deviation U.S. credit shock in the US FAVAR model. Here, credit shocks are alternatively defined by relaxing the restrictions on productivity as in the main text. The solid line represents the median and the dotted lines represent the 16^{th} and the 84^{th} percentiles based on 500 draws.

Figure A4
Impulse Responses due to a Productivity Shock: US FAVAR



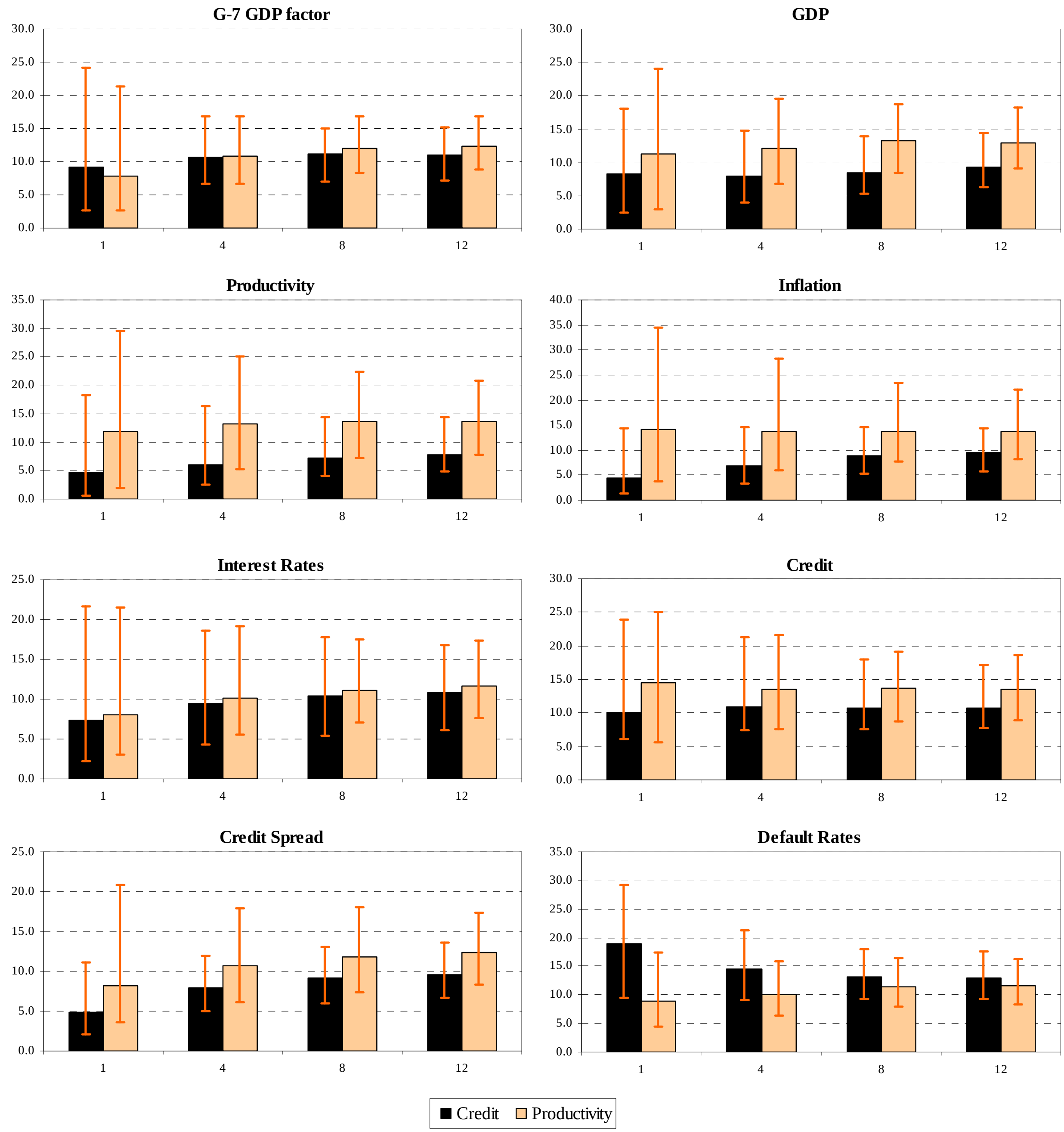
Note: The graphs show the impulse responses of the US variables and the global GDP factor due to a 1 standard deviation U.S. productivity shock in the US FAVAR model. The solid line represents the median and the dotted lines represent the 16th and the 84th percentiles based on 500 draws.

Figure A5
Variance Decomposition: VAR with Global factors



Note: This chart shows the proportion of forecast error variance of the global factors and the U.S. spread and default rates explained by the global credit and productivity shocks for different forecast horizons, in the VAR with global factors model. The bars are the medians and confidence bands correspond to the 18th and 84th percentiles.

Figure A6
Variance Decomposition: U.S. FAVAR



Note: This chart shows the proportion of forecast error variance of the U.S. variables and the G-7 GDP factor explained by the U.S. credit and productivity shocks for different forecast horizons, in the U.S. FAVAR model. The bars are the medians and confidence bands correspond to the 18th and 84th percentiles.