DYNAMIC EFFECTS OF FINANCIAL INTERMEDIATION OVER THE BUSINESS CYCLE

CAROL SCOTESE LEHR and PING WANG*

This paper provides a empirical evidence that the financial intermediation disturbances can generate business cycles. We examine three countries whose financial sectors are fully developed but quite distinct in their institutional and regulatory circumstances; thus, we can infer whether financial intermediation disturbances differ across dissimilar financial environments. We find that the dynamic responses of output to financial intermediation shocks exhibit similar patterns in all cases studied. However, the various institutional and regulatory circumstances have generated different propagation mechanisms transmitting the financial disturbance to output in ways that lead the magnitudes of the responses to deviate across economies. (*JEL* E32, E44)

I. INTRODUCTION

Does the financial sector veil the real economy? Although some economists, such as Lucas [1988] argue that financial factors are "over-stressed," there is a growing literature that theoretically cultivates the channels through which financial intermediation can influence economic fluctuations and long-run growth. Rather than focus on the traditional monetary transmission mechanism, this literature plants itself in the microfoundations of asymmetric information and contract theory.

The new financial intermediation literature stems from seminal works by Diamond [1984], Townsend [1983a, 1983b] and Boyd and Prescott [1986] that demonstrate that, in the presence of private information and costly state verification, it is optimal for borrowing and lending to be conducted under financial intermediary arrangements. These ideas were then extended by Williamson [1987] to show how disturbances in the financial intermediation sector can generate business cycle fluctuations. Essentially, when investment projects become more risky or difficult to evaluate, loan supply falls and business cycle movements emerge.[1] Moreover, other financial intermediation impulses are likely to be important as well. These include changes to the institutional framework or the regulatory environment, and any other event that enhances (or hinders) the intermediaries capacity to allocate capital efficiently among competing alternative uses (e.g., financial innovation).

Yet, despite the theoretical rhetoric on the importance of financial intermediation to output fluctuations, the empirical relevance of financial intermediation remains an unsettled question. This paper brings us one step closer to the solution by econometrically identifying structural financial intermediation disturbances and estimating their effect on output movements in three major industrialized countries: Germany, the United Kingdom, and the United States. We choose these three advanced economies not only because their financial sectors are fully de-

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1. Financial factors can also amplify business cycle fluctuations. See, for example, Bernanke, Gertler, and Gilchrist [1994] and the references contained therein. However, the focus of this article will be on impulses that originate in the financial intermediation sector rather than on the manner that financial factors may alter the propogation mechanism. Also, Greenwood and Jovanovic [1990], Bencivenga and Smith [1991] and Chen, Chiang, and Wang [1996] show how financial intermediation can alter long-run growth rates.

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veloped but also because their distinct banking structures and regulatory environments are capable of generating and transmitting financial intermediation disturbances in different ways. That is, the "depth" of financial intermediation is relatively similar across countries. Therefore, the cross-country analysis allows us to focus on the ability of financial intermediation to generate short-run cycles and to draw some suggestive insights regarding the role of regulatory and institutional factors across countries.

The existing empirical evidence linking financial factors to real economic activity has involved noticing statistical correlations between some financial variables and some real variables. Goldsmith [1969], using data from 1860 to 1963, showed that there is a positive relationship between economic development and the size of the financial sector. Kuznets [1971], in a cross-section study of 57 developed and developing economies, found that the share of banking, insurance and real estate in gross domestic product rises as income increases. McKinnon [1973] showed that the ratios of private credit to national income and a broad monetary aggregate to national income are positively related to per capita income. Recently, King and Levine [1993] reconfirmed the correlation between growth rates and four financial development measures in a cross-section of more than 80 countries.

Although these studies have made important contributions in documenting the link between financial intermediation and real economic activity, they are subject to two major shortcomings. First, they are reduced-form systems and, therefore, are not well suited for making inferences regarding economic causality. Within the context of the existing empirical evidence, we cannot be sure whether intermediation shocks drive output or output shocks influence financial intermediation.[2] Second, they do not estimate the dynamic effects of financial intermediation shocks and, thus, lend little insight into the understanding of financial intermediation's impact on business cycle activity.[3]

By emphasizing the economic fluctuations induced by financial intermediation, we believe that this paper has four important contributions. First, we examine the time-series effects of financial intermediation in three economies with large and well-developed financial sectors and dissimilar institutional and regulatory settings. This enables us to compare the initiation and propagation of financial intermediation shocks across different environments and allows us to draw some inferences regarding the interaction of institutional settings and financial-intermediation-generated business cycles. Second, our econometric methodology enables us to identify financial intermediation disturbances separate from policy (fiscal and monetary) and real (technological) shocks. Thus, we are able to clearly judge whether financial intermediation shocks cause business cycles or simply follow business cycles. Third, we examine the dynamic short- and longer-run responses of output growth, as opposed to contemporaneous cross-section correlations.

Fourth, as part of this study, we estimate the historical contribution of financial intermediation disturbances to output fluctuations in the three countries studied. This permits us to remark on the quantitative importance of financial intermediation disturbances to output movements over the past three decades. Also, the historical decompositions can be used as a diagnostic tool that enables us to compare the estimated response of output to financial intermediation disturbances with the actual regulatory changes over time and across countries. That is, while the impulse response functions trace out the path of output to a "representative" disturbance, the historical decompositions show the path of output over the sample in response to the estimated financial intermediation disturbances. By checking the estimated output path against realized events, we can judge the ability of our empirical model to pick up the actual disturbances.

2. King and Levine [1993] touched on the issue of causality versus correlation by examining whether finance leads output or vice versa. The issue of causality has also been addressed by Demetriades and Hussein [1996] and Rajan and Zingales [1998]. However, these studies are looking for causation between long-run growth rates and financial intermediation rather than causation at business cycle frequencies. Moreover, the former two studies are reduced-form investigations, whereas this article uses a structural model.

3. For a study similar in spirit to this paper, see Lehr [1998], who examined the effect of financial innovation on output growth and interest rate differentials in the United States.

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The remainder of the paper is organized as follows. In Section II, we discuss how financial intermediation disturbances can cause business cycle fluctuations and compare the institutional backdrop across countries. Section III elaborates on the interactions between the real and the financial activities and details our econometric implementation which utilizes a structural vector autoregression (VAR) approach developed by Blanchard and Quah [1989] to identify the exogenous shocks. In so doing, no conditions need to be placed on the contemporaneous relationships, and the data alone will determine the empirical short-run dynamics. Since our interest is in estimating short-run fluctuations, it is crucial that we place no a priori restrictions on the short-run dynamics. We also recognize that measuring financial intermediation presents risks of its own. Therefore, we use three alternative financial intermediation proxies to bolster the robustness of our results. In Section IV, we describe the data and present the empirical results. Our findings support the hypothesis that financial intermediation shocks can have significant business-cycle implications. While the dynamic patterns of such effects do not differ much across countries, there are some variations in the quantitative contributions of financial intermediation disturbances to output fluctuations. We attribute these differences primarily to dissimilarities in the underlying institutional and regulatory environments. Section V examines the sensitivity of the results to alternative identification schemes, and Section VI concludes the paper.

II. AN OVERVIEW OF FINANCIAL INTERMEDIATION AND BANKING STRUCTURES

The new financial intermediation literature formalizes analytically the ideas first presented by Goldsmith [1969], McKinnon [1973], and Shaw [1973]. Specifically, financial intermediation can have real effects for any combination of the following reasons: (i) in the face of uncertain liquidity needs, intermediaries can increase the amount of savings that goes towards capital accumulation; (ii) when project returns are private information and can be obtained only at a cost, intermediaries can economize on monitoring expenses and increase the number of funded projects; and, (iii) intermediaries can specialize in project evaluation and allocate funds in the most efficient manner. To the extent that intermediaries become better or worse at doing these things, financial intermediation will thus continue to have real effects.[4]

For example, Bernanke [1983] attributes the prolongation of the Great Depression to the worldwide financial panics beginning in 1929. Moreover, in the past 15–20 years, financial innovation has proliferated the ways in which intermediaries channel funds and allocate savings. The introduction of new products on the liability side were aimed at increasing the number of depositors, and the theory would imply that the more funds are intermediated, the more effective will be the allocation of capital. Also, innovations on the asset side have created new borrowers or secondary markets, allowing for the more efficient allocation of financial assets across individuals. Furthermore, other innovations were designed to reduce the intermediaries' costs in providing intermediated services. The change in costs can also generate fluctuations in real activity, since this is directly related to the amount of loans that can be made for any level of deposits.

We next turn to the comparison of the institutional backdrop across the three economies: the United States, Germany, and the United Kingdom. In the United States, financial innovation was driven in part by the constraints established by regulation. On the other hand, German regulation has been quite loose, and, therefore, banks were not subject to the same pressures. As a result, the German system did not experience the same onslaught of financial innovation as did the U.S. system. Meanwhile, the United Kingdom served as an international financial center, attracting banking institutions from all over the world. That situation led to a different set of concerns for the British authorities, whose previous reliance on moral suasion as a regulatory tool was gradually

4. The above channels should not be confused with the credit channel of the monetary policy transmission. In this article, financial intermediation shocks originate from the intermediaries themselves whereas in the credit channel literature the shocks originate from the monetary authorities and the focus is on how intermediaries propagate the disturbance.

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undermined. Since institutional and regulatory environments have the potential to be a crucial factor in the generation and propagation of financial intermediation disturbances, we analyze the econometric evidence from each of these three countries. The empirical implementation relies on measures of financial intermediation drawn from the banking sector, therefore; the remainder of this section will outline the difference in banking structures in the three countries.

The industrial organization of the German banking system is quite distinct from that of the United States or the United Kingdom in that "universal" banking is the practice. That is, German banks participate in investment banking activities and have an active and powerful presence on corporate boards. Some argue that the German banks' presence in the boardroom affords them a superior role in evaluating the riskiness of loans and enables more efficient monitoring.[5] On the other hand, this structure has undermined the development of securities exchanges in Germany, since most corporate lending is done through the banking system.[6] Moreover, there is considerable public ownership of banks. For example, in 1988 only about 30% of bank assets were in privately owned banks, another 30% of assets were held by cooperatives, and the remaining 40% were in publicly owned banks. Finally, the regulatory environment in Germany has been quite liberal without the distorting interest rate ceilings that engendered a rush of financial innovation in the United States.[7]

The United States' and the United Kingdom's banking structures are similar in that both have traditionally segmented the industry into specialized units (e.g., commercial banks, thrifts or building societies, investment banks, etc.). Moreover, both systems have seen this specialization greatly diminished, and the distinction between the different types of institutions has become blurred. In the case of the United Kingdom, the breakdown was driven mostly by competitive pressures because the separation was not legally regulated. In the United States, competition and deregulation have allowed traditionally specialized firms to diversify into other financial activities. Both the United Kingdom and the United States have experienced more regulatory oversight than have German banks. For example, the Competition and Credit Control policy in the United Kingdom and Regulation Q in the United States established interest-rate ceilings for their respective jurisdictions. However, regulatory trends in the United States and the United Kingdom began to diverge in the 1980s when the former undertook a dramatic deregulation course, while the Banking Act of 1979 in the United Kingdom tightened supervision. Notably, one factor that sets the United Kingdom apart from both Germany and the United States is the predominance of foreign banks.[8] In 1989, 59% of all authorized banks were either foreign or United Kingdom incorporated subsidiaries of foreign banks and 59% of all assets were denominated in foreign currency.

We will see that these features (universal banking in Germany, foreign banking in the United Kingdom, and regulation and deregulation in the United States) help to explain differences in both the size of financial intermediation shocks and the magnitude of financial-intermediation-induced output fluctuations across countries.

III. EMPIRICAL METHODOLOGY

General Approach

In the section below, we use a structural VAR model to estimate both the short- and long-run responses of output to the structural financial intermediation disturbance. In contrast to the simultaneous equation method, this structural VAR approach focuses on the responses of the included variables to unobservable structural disturbances (in lieu of observed independent variables). Also, unlike single equation models which capture the correlation between output growth and financial variables, our method can recover the structural shocks given some plausible long-run causal relations.[9]

5. See Pozdena and Alexander [1992].

6. German banks provide 60% of external corporate finance and 45% of venture capital as compared to 30% and 10%, respectively, in the United States.

7. The power to regulate loan and deposit rates was abolished in 1967.

8. See Llewellyn [1992].

9. Alternative VAR models include the Sims [1980] method (which imposes ad hoc causal orderings) and the Bernanke [1986] method, which imposes restrictions on the contemporaneous responses.

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More specifically, under the empirical methodology employed below, the retrieving process of the structural shocks is unique only up to the signs of the diagonal elements of the long-run moving average matrix. These signs are fixed a priori by the theoretical predictions. Moreover, to ensure that the structural VAR is economically meaningful, we also check that the empirical long-run responses (of the off-diagonal elements) are consistent with the theoretical arguments. This latter effort is another facet that differentiates the structural VAR methodology from atheoretical VAR studies.

Theoretical Arguments

In this subsection, we give a brief overview of the literature on financial intermediation and real economic activity to motivate our empirical investigation. We also hope that the discussion will help in forming the backdrop for the discussion of the econometric identification.

Recent theoretical work of financial development and macroeconomic performance has examined various roles played by the financial sector. When the underlying economy is frictionless, it is obvious that intermediation is inessential to real activity. To ensure an active role for financial intermediaries, one needs to consider either incentive frictions (due to asymmetric information and incompleteness of financial contracts) or technological frictions (such as asset indivisibility and imperfect risk diversification).[10] For instance, Townsend [1983b], Diamond [1984], and Boyd and Prescott [1986] argue that, under private information and costly state verification, financial intermediary coalitions are optimal incentive-compatible arrangements. Diamond and Dybvig [1983] and Bencivenga and Smith [1991] stress the liquidity management role of banks in the sense that financial intermediation can convert liquid funds into longer term investments to improve the performance of the real sector. Williamson [1987] and Greenwood and Jovanovic [1990] highlight the risk pooling and effective monitoring functions of financial intermediaries, both leading to higher expected rates of returns. Becsi, Wang, and Wynne [1997] emphasize that the financial sector provides access to the benefits of pooled funds and economies of scale, thus ensuring the emergence of financial intermediation.[11] Finally, Chen, Chiang, and Wang [1996] formalize the Schumpeterian view on how financial deepening can be associated with capital accumulation and economic development via a loan-service production technology.

Following Townsend [1983b], Diamond [1984], Boyd and Prescott [1986] and Bencivenga and Smith [1991], we adopt the notion that improvements to financial intermediation as independent of shifts to the output production parameter in the long run. Note that this does not imply that the level of financial development is independent of the level of income. This long-run relationship will allow us to place a zero restriction in the long-run covariance matrix and aid in identifying the structural financial intermediation disturbance. However, our sensitivity analysis section will present results from a model that allows output disturbances to influence the long-run path of financial intermediation as in Greenwood and Jovanovic [1990], Chen, Chiang, and Wang [1996] and Becsi, Wang and Wynne [1997; 1999]. The nature of the results is unchanged.

As the above discussion indicates, the literature has enumerated many channels through which financial intermediation may interact with goods production. It is our belief that the true financial intermediation process contains elements from the many models discussed above. Since our goal is an empirical investigation of the dynamic effects of changes to the financial intermediation process, we do not intend to run a "horse race" between the different microfoundations models. Indeed, the existence of one does not preclude the relevance of others.

On the other hand, we are concerned with estimating the dynamic short-run effects of financial intermediation disturbances and should indicate that there have been some theoretical commentary on that matter.

10. See Becsi and Wang [1997] for a critical survey of the functions of financial intermediation and the interrelationships between the real and the financial sectors.

11. See also Greenwald and Stiglitz [1993], who point out the literature has overlooked that markets with economies of scale can be imperfectly competitive.

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Williamson [1987] showed that in a real business cycle model when investment projects become more risky, credit-rationing worsens and the change in loan supply contributes to the cycle. Cooper and Ejarque [1994] calibrate a real business cycle model with financial intermediation shocks. They find that the model with financial intermediation fit that data best when financial intermediation shocks are relatively unimportant or when the returns to financial intermediation are part of a sunspot equilibrium. Using the latter specification, Cooper and Ejarque [1995] conclude that the real effects of financial improvements can be large in the presence of "thick-market externality" and that a substantial portion of the variation in the interwar period can be explained by financial disturbances.

The present paper will confront the data directly, identify the structural financial intermediation disturbance, and estimate its importance in generating macroeconomic fluctuations. To ensure that we avoid crucial misspecification issues, we will include the sources of other major aggregate disturbances: policy (monetary and fiscal) and technological. Specifically, the four macroeconomic aggregates of our focus are fiscal, financial, real, and monetary, and their corresponding structural disturbances are fiscal expansion, financial improvement, output enhancement (or real supply), and monetary growth shocks. For presentation purposes, these shocks are denoted by $\xi^g, \xi^\theta, \xi^\nu$, and ξ^μ, respectively. The inclusion of a fiscal shock in the model allows us to separate a significant portion of the persistent aggregate demand shock from the technology-based aggregate supply shock. This circumvents the possible misspecification of the output disturbances. Meanwhile, the inclusion of a nominal monetary shock precludes the possibility that our financial intermediation disturbance will be contaminated by monetary policy actions. The subsection below elaborates on the role of each of these shocks in the econometric specification.

What are the theoretical predictions about the long-run effects of fiscal, financial, real supply and monetary shocks on output growth and financial advancement? First, because of the detrimental effect of distortionary taxes, we expect that a permanent fiscal shock that enlarges government size has a negative effect on output growth, though its effect on the financial sector is unclear. Second, based on the arguments in previous paragraphs, a positive financial shock that enhances the financial activity can raise output growth via fast and more effective capital accumulation. Third, it is standard in the optimal growth literature to have a positive effect of a technological improvement on output growth. However, technological improvement's impact on financial activity is ambiguous as a result of the opposing effects derived from induced demand and intersectoral substitution.[12] Finally, it is now common in the endogenous monetary growth literature to predict the near-superneutrality of money in the sense that a permanent shock to money growth has very little real growth effects. Thus, output growth and financial advancement are essentially unaffected by the rate of money supply expansion. In the remainder of the section, we will elaborate on the nature of the shocks and their role in identifying the structural disturbances.

Econometric Implementation

Our econometric implementation identifies four structural shocks: a fiscal shock, a financial intermediation shock, a real supply shock, and a monetary shock, as denoted by $\{\xi^g, \xi^\theta, \xi^\nu, \xi^\mu\}$. In the VAR exercises, we employ variables including a measure of government size (the ratio of real government spending [RG] to real gross domestic product [$RGDP$]), one of three proxies for financial intermediation (FI), real gross domestic product and an $M1$ measure of money ($M1$) Table I shows the relationship between the macroeconomic aggregates in theoretical considerations, the empirical measures, and their respective shocks.

Since the financial activity is central to our study, we estimate our system using three different measures for financial intermediation derived from banking aggregates. In choosing our measures, we have followed the tradition begun with Goldsmith, McKinnon and Shaw and followed by King and Levine

12. See Chen, Chiang, and Wang [1996] for a complete theoretical analysis.

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TABLE I
Representation of Measures and Shocks

Macroeconomic Aggregate	Empirical Measure	Structural Shock
Fiscal Expansion	$\Delta \ln\left(\frac{RG}{RGDP}\right)$	ξ^{g}
Financial Improvement	$\Delta \ln(FI)$	ξ^{fi}
Output Enhancement	$\Delta \ln(RGDP)$	ξ^{y}
Monetary Growth	$\Delta \ln(M1)$	ξ^{m}

[1993]. Namely, we use three proxies that represent either the degree to which funds are intermediated or their allocation by intermediaries. The rationale is as follows: as an intermediary's efficiency improves (due to innovation, regulatory changes, improved project evaluation, etc.), it will supply more loans and/or receive more deposits. The measures are scaled (by output or total credit, as explained below) to avoid the normal increase (decrease) of loans or deposits that follow the business cycle expansions (contractions) and to normalize for scale effects.

Specifically, the three financial intermediation measures adopted are (i) the ratio of claims on the nonfinancial private sector to output, (ii) the ratio of money plus quasi-money to output, and (iii) the ratio of claims on the nonfinancial private sector to total credit. The estimations for the different proxies will be referred to as Models I, II and III, respectively. Model I captures most directly the production of credit by the banking sector and was also used by Goldsmith [1969]. Model II represents funds allocated to the banking sector by the public, and is a traditional measure of "financial depth" as discussed by Shaw [1969] and McKinnon [1973]. Model III is a rough assessment of credit allocation as discussed by King and Levine [1993].

Of course, none of the above proxies captures perfectly the unobservable path of financial intermediation. However, theories of financial intermediation do predict a positive correlation between the size of the financial intermediary sector and its benefits. Model I measures the size of the banking sector in terms of its output (credit), whereas Model II measures the size in terms of its inputs (deposits). One disadvantage of the liability-based proxy used in Model II is that it simply accounts for the magnitude of the intermediaries inputs rather than what it does with them. To the extent that financial innovation and deregulation influence the intermediaries ability to allocate those deposits more efficiently, that measure will misrepresent the true course of financial intermediation fluctuations. On the other hand, if the liability measure is driven mostly by depositors reactions to a more or less efficient intermediary, the trouble of the Model II proxy will be mitigated.

The Model III variable for financial intermediation is intended to represent, to some degree, the intermediary's portfolio choice and credit allocation. The larger is the ratio of nonfinancial credit to total credit issued the greater is the extent to which banks are lending to private firms rather than governments. Since the private sector tends to use borrowed funds more for investment purchases than does the government, this measure helps to measure more precisely the benefits of bank lending. In less repressed economies, the Model III measure aids in capturing the bank's portfolio choice between private sector loans and risk-free government securities. That is, as private loans become more difficult to evaluate, the bank could choose to substitute into the risk-free asset. However, neither this measure nor the measure used in Model I can accurately measure the more subtle changes in capital allocation that improvements to the financial intermediation process may engender.

In summary, all of the above proxies include some element of the financial intermediation process, although none of them perfectly incorporates all aspects. Therefore, we estimate the model using all three alternative measures and investigate the robustness of our results under the various models.

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Identification of the VAR

We begin with the VAR representation of the structural form:

$$A(L)\mathbf{X}_t = \boldsymbol{\xi}_t, \tag{1}$$

where $\mathbf{X}$ is a (4×1) vector of the stationary forms of the variables:

$$\mathbf{X} = \left[\Delta \ln \frac{RG}{RGDP} \quad \Delta \ln(FI) \quad \times \Delta \ln(RGDP) \quad \Delta \ln(M1)\right].$$

The (4×1) vector $\boldsymbol{\xi}$ contains the correspondent structural shocks:

$$\boldsymbol{\xi} = [\xi^g \quad \xi^{fi} \quad \xi^y \quad \xi^m].$$

Finally, L is the lag operator and $A(L)$ is a nonsingular lag matrix polynomial.

Assume that the moving average representation is fundamental (Lippi and Reichlin [1993]). That is, all structural disturbances can be recovered as one-sided convergent distributed lags in the observable variables. This assumption, as pointed out by Blanchard and Quah [1989], is required in standard macroeconometric methods and is made implicitly in most empirical macroeconomic studies. When $A(1)$ is lower triangular, as our restrictions will imply, and $\boldsymbol{\xi}$ is orthogonal, we can follow the procedure described in Blanchard and Quah [1989] and Ahmed, Ickes, Wang, and Yoo [1993] to estimate the reduced form and retrieve the moving average representation of the structural form:[13]

$$\mathbf{X}_t = C(L)\boldsymbol{\xi}_t, \tag{2}$$

where $C(L) = A^{-1}(L)$. The estimated $C(1)$, which is also lower triangular, contains the estimated long-run multipliers of the structural shocks on the variables contained in $\mathbf{X}_t$. Thus, the identifying restrictions on $A(1)$ are (i) that the growth rate of government size is exogenous in the long run, (ii) that financial intermediation is insensitive to output shocks in the long run, and (iii) that money is superneutral in the long run.

The first restriction does not imply that government spending as a ratio of output would not respond to movements in the business cycle frequency.[14] On the contrary, the short-run dynamic paths of all variables are not restricted in any way. The conditions for identification merely state that the long-run path of government size depends on elements outside of the system such as public and political pressures to increase (or decrease) the size of government. These include factors such as the drive to privatize (or nationalize), the trend of government sponsored health-care costs, movements to advance (or retard) social spending, desires to build (or diminish) the military, etc. This restriction is generally consistent with the fiscal trend concept as in Ahmed and Yoo [1995] and the cross-country evidence as in Barro [1990].

Similarly, the second restriction states that the long-run trend of financial intermediation depends on factors such as regulation, changes in the institutional setting, and trends in the financial marketplace. Although this restriction may be arguable, it is only a natural starting point, especially since the theoretical arguments indicate a clear-cut positive effect from financial improvements to real growth, whereas the influence of goods productivity on the financial activity is ambiguous in sign. In Section V below, we

13. Using the method developed in Ahmed, Ickes, Wang, and Yoo [1993], we rewrite equation (1) as: $[A(L) - A(1)L](1 - L)X_t = -A(1)X_{t-1} + \xi_t$, whose corresponding reduced from is: $\Phi(L)DX_t = \Gamma X_{t-1} + e_t$. Denote $Var(e_t) = \Sigma$ and let H be the inverse of the Cholesky decomposition of $\Gamma^{-1}\Sigma\Gamma^{-1}$. Then the above reduced form becomes: $H\Gamma^{-1}DX_t = HX_{t-1} + H\Gamma^{-1}e_t$. Thus, $H = -A(1)$, which is lower triangular, and $Var(H\Gamma^{-1}e_t)$ is diagonal.

14. For example, we would expect that, during supply-driven expansions, output may increase faster than government spending and g/y will decrease, whereas the reverse would transpire during contractions.

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will check the robustness of the results with respect to this specification.[15]

The last restriction that requires money to be superneutral in the long run is not only based on the endogenous monetary growth theory but widely accepted in the empirical macroeconomic literature (see Shapiro and Watson [1988] for another example of this restriction and the more detailed discussion in Ahmed, Ickes, Wang, and Yoo [1993]). Furthermore, the fact that the long-run path of nominal money is unrestricted allows the money supply to respond endogenously to all economic disturbances and is consistent with the notion that central banks' reaction functions depend on the macroeconomic environment.

It should also be pointed out that estimation process includes lagged values of all of the variables in each equation. Therefore, we are not restricting in any way, the movement of any of the variables over the business cycle nor do we restrict short-run comovements of monetary, financial or other real variables considered in our system.

Thus, the long-run causal ordering of the benchmark system is government size, financial intermediation, output, and money supply. While the ordering of government size, output, and money supply is natural and plausible based on identifying restrictions consistent with theoretical models, we are open to the suggestion that there may be alternative theoretical orderings in regard to financial intermediation versus the other two real variables. Specifically, we have two alternative scenarios in mind. First, one may argue against our relative ordering of government size and financial intermediation. In particular, it is possible that financial market development may have long-run implications for government size. For example, an economy with a universal banking system may enable better risk management and thus require less government regulation, which lowers the demand for a big public sector. Therefore, we also estimate the model reversing the ordering of those two variables: financial intermediation, government size, output, and money supply. Second, there is some reason to believe that the long-run path of financial intermediation might be influenced by technological advances in communications and information processing. This would argue for the following long-run ordering: government size, output, financial intermediation, and money supply. The disadvantage to this specification is that financial intermediation shocks are restricted from influencing long-run path of output.

In sum, the strength of this analysis lies in the use of the structural VAR technology that allows us to econometrically identify the structural financial intermediation disturbance. On the other hand, there are two major dangers associated with attempting to recover unobserved structural disturbances. First, the omission of other disturbances may damage the identification. Second, the shock identified may be an aggregate of several shocks, as discussed in Blanchard and Quah [1989]. Therefore, to avoid the first problem, we have included fiscal, monetary, and real shocks, in addition to financial intermediation disturbances. Since the real shock may contain supply, persistent demand, and oil price disturbances, there is no obvious omission of any structural shock independent of those considered.

To circumvent the second problem, we impose a plausible set of identification assumptions that is consistent with most theoretical analyses and empirical evidence as cited above. We recognize, however, that it is possible to place the financial intermediation variable in any three positions before money supply. Therefore, we estimated the model

15. To implement this structural VAR, either financial intermediation shocks must be restricted from influencing long-run output movements or supply shocks must be unimportant for explaining long-run financial intermediation. We have chosen the latter specification for the benchmark model, since the financial intermediation variable is scaled and, therefore, the impact of supply shocks on the measure should not be important. Essentially, by looking at ratios, the common trend between the numerator and the denominator is eliminated. However, for the sake of robustness, we also estimate the model allowing supply shocks to impact the long-run trend of intermediation. This may be the case if supply shocks (such as technological progress) have a differential impact on the intermediation sector relative to the rest of the economy. The disadvantage of the latter specification is that by so doing, we also prevent financial intermediation disturbances from having a long-run impact on output. Although we prefer the first specification, the results for the business cycle frequency (the focus of this article) are unchanged across specifications. In other words, the short-run relationships between output cycles and financial intermediation disturbances is unaffected by the assumptions on the long-run dynamics.

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under all three alternative sets of identifying restrictions.[16] While there are some quantitative differences, our main conclusions remain unchanged. Thus, it seems unlikely the identification scheme results in the comingling of the true disturbances within one of our estimated disturbances.[17] Furthermore, we present the results using three different proxies for financial intermediation. Thus, we also address concerns that may arise as to the sensitivity of the identification to proxy choice. In particular, recall that the financial intermediation disturbances are real, rather than nominal events. Therefore, one may worry that the proxy in Model II may be picking up some nominal disturbances. However, our results are robust to alternative (credit) proxies, which are unlikely to include effects arising from nominal shocks. The use of the various proxies also helps in alleviating concerns that the estimated financial intermediation disturbance is picking up technological supply shocks. This is so because two of the three proxies are deflated by output, which implies that the proxy does not reflect movements generated by a common trend between the financial variables and output.

Finally, we also conduct an in-sample historical diagnostic to infer the reasonableness of the identification. Specifically, we plot the estimated portion of output movements attributed to the financial intermediation disturbance to see whether they are accurately and consistently picking up easily identifiable country-specific regulatory and institutional changes. We find that the estimated historical diagnostics behave as one would expect when confronted with the country-specific financial environments. The success of this exercise also upholds our belief that the use of banking aggregates as proxies for the financial intermediation process is sufficient to recover the intended financial intermediation disturbance.

In the section below, we report the results from the benchmark model and the sensitivity of those results to the alternative restrictions is discussed in the following section.

IV. EMPIRICAL EVIDENCE

The Data and Time Series Properties

The empirical investigation covers three countries: Germany, the United Kingdom and the United States, with quarterly observations ranging from 1960:1 to 1993:2, using the data described in Section III.[18] To implement the structural VAR, all variables must be in their stationary forms and augmented Dickey-Fuller (ADF) tests were performed on all data. The results indicated that logged values of all of the variables were integrated of order one [I(1)]. (See Table II.) All data were obtained from the International Financial Statistics CD-Rom published by the International Monetary Fund.[19]

Estimation

Based on the Akaike information criterion (AIC), the estimation was conducted using two lags of data for the United States' and German models, and three lags were used for all United Kingdom models. The impulse response functions generated by the VAR display both the short-and longer-run reactions of the variables to the various shocks. Variance decomposition analysis breaks down the variance of the forecast error into components arising from each of the disturbances. Finally, historical decompositions show the movements in output that

16. As argued by Faust and Leeper [1994], our methodology imposes infinite-order (long-run) restrictions on a reduced-form VAR. The estimation results are valid only if the estimated reduced-form (finite-horizon) VAR is the correct representation. Therefore, although the imposition of long-run restrictions is generally more consistent with a wider class of macroeconomic theories when compared to alternative methods, it is not necessarily more robust to possible misspecification problems. The sensitivity analysis presented below addresses this potential problem and shows that the results are similar under alternative specifications.

17. If there were aggregation of the true disturbances within the estimated ones, then it is unlikely that this comingling would take the same form across different orderings and there would not be the similarity of results across the various identification schemes.

18. The estimation for the United Kingdom begins in 1963 because of data limitations on the availability of credit and money data. Also, we use GNP rather than GDP for Germany because their national accounts and IFS use GNP to measure output.

19. Note that these data are seasonally adjusted, which could lead to distortions in the estimated dynamics. However, the results of the model are consistent across different proxies and alternative identifying restrictions. Since different series have different seasonal adjustments, one would not expect such consistency if the seasonal adjustments were the driving force of the estimated dynamics.

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TABLE II
Results from Augmented Dickey-Fuller Tests Coefficients on Lagged Level Term

Variable	GY	*M2 / Y*	CNF / Y	CNF / TCR	*Y*	*M*
United States	−0.102	−0.070	−0.036	−0.061	−0.054	−0.034
	(−3.34)	(−2.40)	(−1.52)	(−2.54)	(−2.71)	(−1.91)
	(3)	(5)	(5)	(5)	(2)	(3)
Germany	−0.033	−0.110	−0.059	−0.034	−0.040	−0.058
	(−1.19)	(−2.62)	(−2.45)	(−2.51)	(−1.92)	(−2.02)
	(4)	(4)	(4)	(4)	(1)	(1)
United Kingdom	−0.077	−0.012	−0.013	−0.000	−0.070	−0.046
	(−2.31)	(−1.16)	(−0.82)	(0.03)	(−2.02)	(−3.65)
	(3)	(4)	(6)	(5)	(3)	(4)

Notes: *GY* = government size; *CNF* = credit to nonfinancial firms; *TCR* = total domestic credit; *Y* = real output; *M* = money supply. *T*-statistics in the first parentheses. Number of lagged dependent variables in the second parentheses. Critical value = 3.70.

can be attributed to financial intermediation shocks. These three tools will be used to assess the importance of financial intermediation shocks to the real sector and to judge the ability of the model to estimate correctly financial intermediation disturbances.

Impulse Response and Variance Decomposition Analysis

The dynamic responses of output growth to a one-standard-deviation financial intermediation shock are shown in Figure 1. In all cases, the shock induces fluctuations in the growth rate of output, where the growth rate increases either immediately or after one quarter. Moreover, the responses are statistically significant under the one-standard-error criterion used by Shapiro and Watson [1988]. Thus, the evidence favors the existence of financial intermediation generated business cycles.

While output reacts very similarly across countries in response to a financial intermediation disturbance, the size of the one-standard-deviation shock differs. Specifically, Germany and the United States have smaller one-standard-error shocks than does the United Kingdom. Moreover, the normalized magnitude of output's response is relatively large in the United States, while it is much smaller in the United Kingdom and Germany.[20] Table III presents the statistical details.

Table IV reports the decomposition of the variance of the forecast errors for output growth due to the four structural disturbances.[21] In almost all cases, the contribution of intermediation disturbances in explaining the variance of output growth's forecast error is similar across countries. However, the magnitudes do differ across models. For example, in Model I, 10%−11% of the variance of the four-quarter-ahead error is attributed to financial intermediation shocks (with standard errors ranging from 6.0 to 9.6). In Model III, at the same horizon, financial intermediation shocks explain 13%−17% of the variance (with standard errors of 6.2−9.9), which is not very different from Model I. The exception arises in Model II, where both Germany and the United States attribute a larger role to financial intermediation shocks, 19.4% and 34.6%, respectively, at four quarters (with standard errors of 9.0 and 12.1), while the United Kingdom's results indicate little role for financial intermediation in explaining output fluctuations.[22]

In summary, the above discussion indicates that when financial intermediation shocks occur, the pattern of output's dynamic response does not appear to be country specific. However, there are country-specific factors that influence the size of both the disturbances and responses. Although the empirical investigation cannot

20. In the subsection below, we lay out some institutional differences that may potentially account for the cross-country differences.

21. The variance decomposition results for other variables and for the level of output are available on request.

22. Notably, these results are consistent with the impulse response function analysis (see Figure 1).

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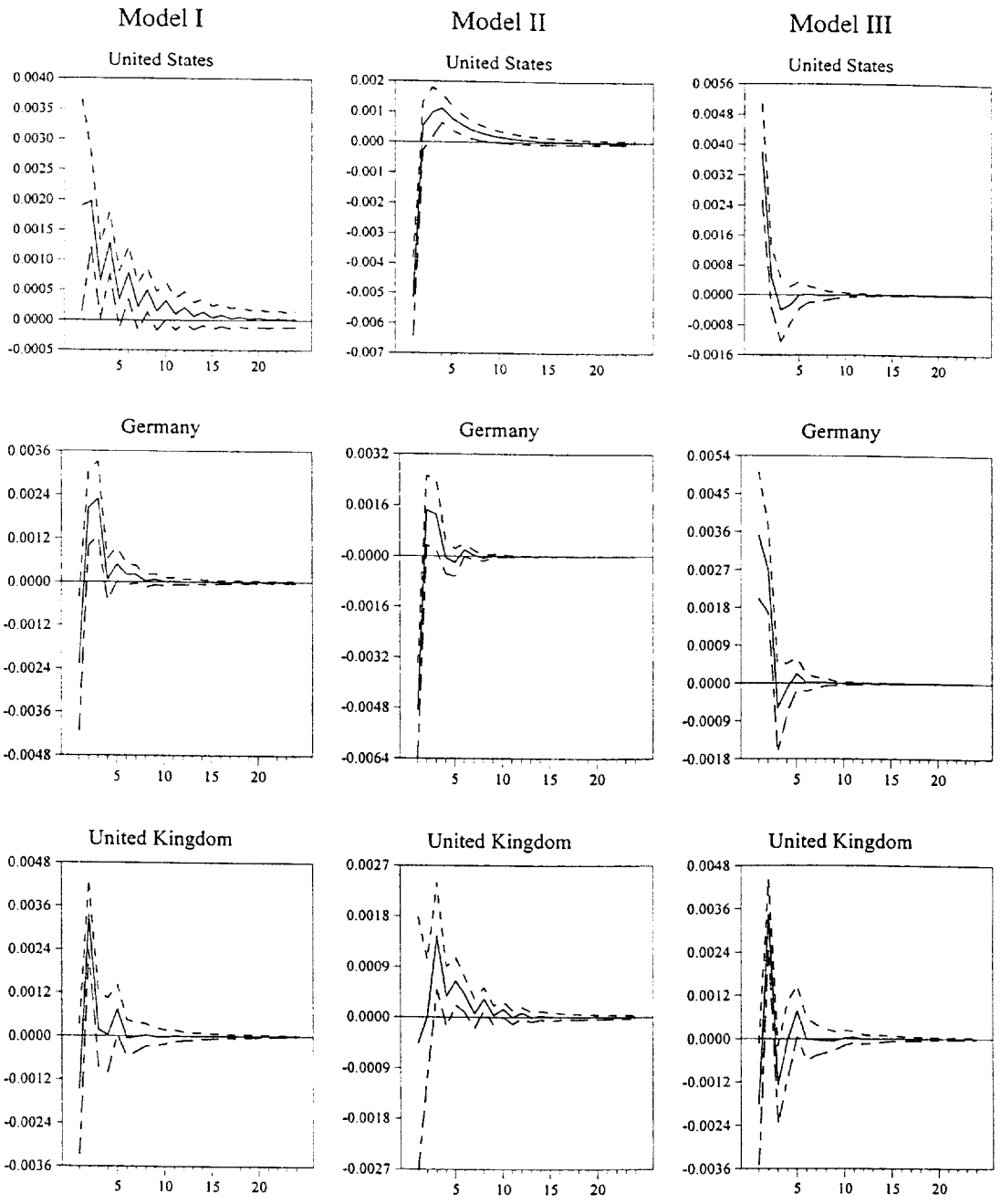
FIGURE 1
Output Growth Response to a Financial Intermediation Disturbance



pinpoint the exact channels through which financial intermediation shocks affect output, the discussion below postulates some plausible explanations for these country-specific differences.

First, the size of the shocks is larger in the United Kingdom. This is not surprising since it is the center of world's Eurocurrency markets and the majority of banks are foreign owned. The magnitude of the shocks can be

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TABLE III
Magnitudes of the Intermediation Shocks and the Responses of Output Levels

	Model I	Model II	Model III
United States:			
(i) Shock	.0095	.0112	.006
(ii) Response	.0085	.003	.0035
(iii) Normalized Response	.895	.268	.583
Germany:			
(i) Shock	.0144	.018	.0065
(ii) Response	.003	−.0022	.0057
(iii) Normalized Response	.208	−.122	.877
United Kingdom:			
(i) Shock	.042	.025	.036
(ii) Response	.0027	.003	.0009
(iii) Normalized Response	.064	.120	.025

Note: Row (iii) = (ii)/(i)

TABLE IV
Variance Decomposition of Output Growth's Forecast Error

Horizon (quarters)	Fiscal Shock			Intermediation Shock			Supply Shock			Monetary Shock		
					(i) United States							
	I	II	III	I	II	III	I	II	III	I	II	III
1	26.7 (16.6)	18.4 (11.1)	24.3 (15.0)	5.0 (9.2)	39.4 (18.1)	19.4 (12.3)	66.0 (15.3)	42.2 (19.5)	56.1 (16.0)	2.3 (4.7)	0.0 (3.5)	0.1 (2.6)
2	27.9 (16.8)	22.0 (11.2)	25.9 (14.8)	9.3 (9.8)	36.8 (15.9)	18.5 (11.5)	60.7 (14.6)	41.1 (17.6)	55.5 (15.2)	2.1 (4.3)	0.3 (3.4)	0.2 (2.5)
4	27.3 (16.3)	22.6 (11.0)	25.2 (13.8)	11.1 (9.6)	34.6 (12.1)	17.2 (9.9)	59.0 (13.9)	41.3 (14.1)	57.5 (13.1)	2.5 (4.4)	1.5 (3.2)	0.2 (2.5)
20	27.1 (16.6)	21.8 (11.2)	25.1 (13.6)	12.3 (10.0)	34.6 (10.9)	17.2 (9.8)	58.1 (14.5)	41.8 (12.9)	57.5 (12.9)	2.5 (4.3)	1.7 (3.1)	0.2 (2.6)
					(ii) Germany							
	I	II	III	I	II	III	I	II	III	I	II	III
1	14.4 (10.3)	13.4 (9.6)	11.9 (9.0)	4.0 (7.4)	17.7 (10.4)	9.5 (7.9)	80.6 (13.7)	68.6 (13.7)	74.3 (11.1)	1.1 (3.7)	0.3 (2.6)	4.4 (6.1)
2	14.1 (9.9)	13.3 (9.2)	11.2 (8.4)	6.9 (7.4)	18.8 (9.8)	14.1 (7.7)	77.8 (13.0)	67.6 (12.7)	70.0 (10.8)	1.1 (4.1)	0.3 (2.9)	4.7 (6.2)
4	14.1 (8.8)	13.4 (8.5)	11.4 (8.0)	10.3 (7.0)	19.4 (9.0)	14.1 (7.4)	74.4 (10.8)	66.8 (11.4)	69.3 (10.0)	1.2 (4.0)	0.4 (3.1)	5.3 (6.6)
20	14.0 (8.7)	13.4 (8.5)	11.4 (7.9)	10.5 (6.9)	19.5 (9.0)	14.1 (7.4)	74.3 (11.7)	66.7 (11.3)	69.2 (10.1)	1.2 (4.0)	0.4 (3.1)	5.3 (6.6)
					(iii) United Kingdom							
	I	II	III	I	II	III	I	II	III	I	II	III
1	32.8 (15.8)	47.6 (12.1)	37.4 (17.1)	2.1 (6.0)	0.2 (6.8)	3.2 (6.4)	64.6 (16.2)	51.0 (12.3)	57.7 (17.0)	0.6 (2.6)	1.3 (3.7)	1.7 (3.5)
2	29.4 (13.9)	47.7 (11.7)	33.2 (14.9)	11.5 (6.8)	0.2 (6.7)	13.0 (6.9)	57.3 (14.3)	50.8 (11.9)	51.5 (14.7)	1.8 (2.9)	1.4 (4.4)	2.3 (3.2)
4	32.0 (12.9)	50.1 (11.0)	34.4 (13.3)	10.6 (6.0)	1.8 (6.4)	13.0 (6.2)	53.8 (12.7)	46.4 (11.3)	47.4 (12.8)	3.5 (4.3)	1.7 (4.6)	5.3 (5.0)
20	32.1 (12.6)	50.0 (10.8)	34.5 (13.1)	10.9 (5.9)	2.3 (6.2)	13.3 (6.1)	53.5 (12.2)	46.0 (11.3)	47.0 (12.3)	3.6 (4.6)	1.8 (4.5)	5.2 (5.2)

Notes: Model I: financial intermediation = nonfinancial credit/output; Model II: financial intermediation = (M2)/output; Model III: financial intermediation = nonfinancial credit/total credit. Simulated standard errors based on 1,000 random draws are in parentheses.

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explained by the combination of the dynamic Eurocurrency market and the fact that foreign-owned banks are often not subject to domestic regulation and can innovate and conduct business in a much less constrained manner.

Second, the magnitude of output's response is larger in the United States than in the United Kingdom and in Germany. Again, we appeal to the predominance of the international money market in the case of the United Kingdom. When banks are foreign owned, it is likely that the benefits of better intermediation will accrue abroad. That is, intermediation shocks measured in the United Kingdom will have a smaller impact on domestic United Kingdom output because of the foreign banks proclivity to do business mostly with customers in their nation of origin. In the case of Germany, the argument can be made that banks' hefty participation on corporate boards gives them an advantage in monitoring and project evaluation. Therefore, in contrast to the United States, where innovation and deregulation may have enhanced banks ability to intermediate, German banks already enjoyed a preeminent position in that respect. As a consequence, one would expect that small improvements in the U.S. case could have large effects, whereas small improvements in the German case would not.[23]

Finally, Model II results differ from Models I and III in that the size of financial intermediation's contribution to the variance of the forecast error is much smaller in the United Kingdom than in Germany or the United States. Recall that the financial intermediation variable in Model II is measured from the liability side. Because the Eurocurrency market is so heavily concentrated in London, there is less likely to be a significant link between this measure of intermediation and domestic output in the United Kingdom when compared to Germany or the United States.

Historical Diagnostics

To further investigate whether we have accurately estimated the financial intermediation disturbance, we have recovered from the empirical model the portion of output movements driven by financial intermediation shocks.[24] We then discuss the plausibility of this output path given the historical narrative on regulatory and institutional factors in each country. This exercise is meant to see whether the estimated financial intermediation shocks are consistent with country-specific events. We believe that the results are suggestive of the importance of institutional and regulatory factors. Of course, in the present study, we are unable to pin down the exact channels through which these factors work to influence output; however, the results are clearly suggesting that future work in this area could be fruitful.

For brevity, Figure 2 shows these results for Model I. In general, the historical decompositions show a similar pattern for each country, independent of the model; the differences will be discussed below. In Germany and the United States, financial intermediation shocks have played a significant role in promoting output, while in the United Kingdom the opposite is true.

In the United States, financial innovation has been a continuous process beginning in the 1960s. This is reflected in its steady positive effect on output over the sample period. During 1975–81, the positive real effects of financial intermediation shocks started to diminish. In particular, oil crisis–induced high inflation in this period hindered banks' ability to evaluate projects and allocate funds.[25] In addition, disintermediation may have taken sufficient funds out of the banking system to inhibit their channeling loans to higher return projects. Then, the subsequent sharp response of output from 1983 to 1988 accompanied the deregulation of the banking system. Finally, the diminished output

23. One could also argue that banks have interfered with corporate governance. Indeed, there are incredibly few takeovers in German industry, indicating that the ability to remove less capable managers is diminished. However, this effect is distinct from the financial intermediation channel.

24. Note that the depicted output fluctuations are only a portion of total output movements. Of course, output will also be influenced by the other four disturbances.

25. High inflation, of course, may also have engendered financial innovation to avoid nominal interest rate ceilings, but this effect is likely to be secondary.

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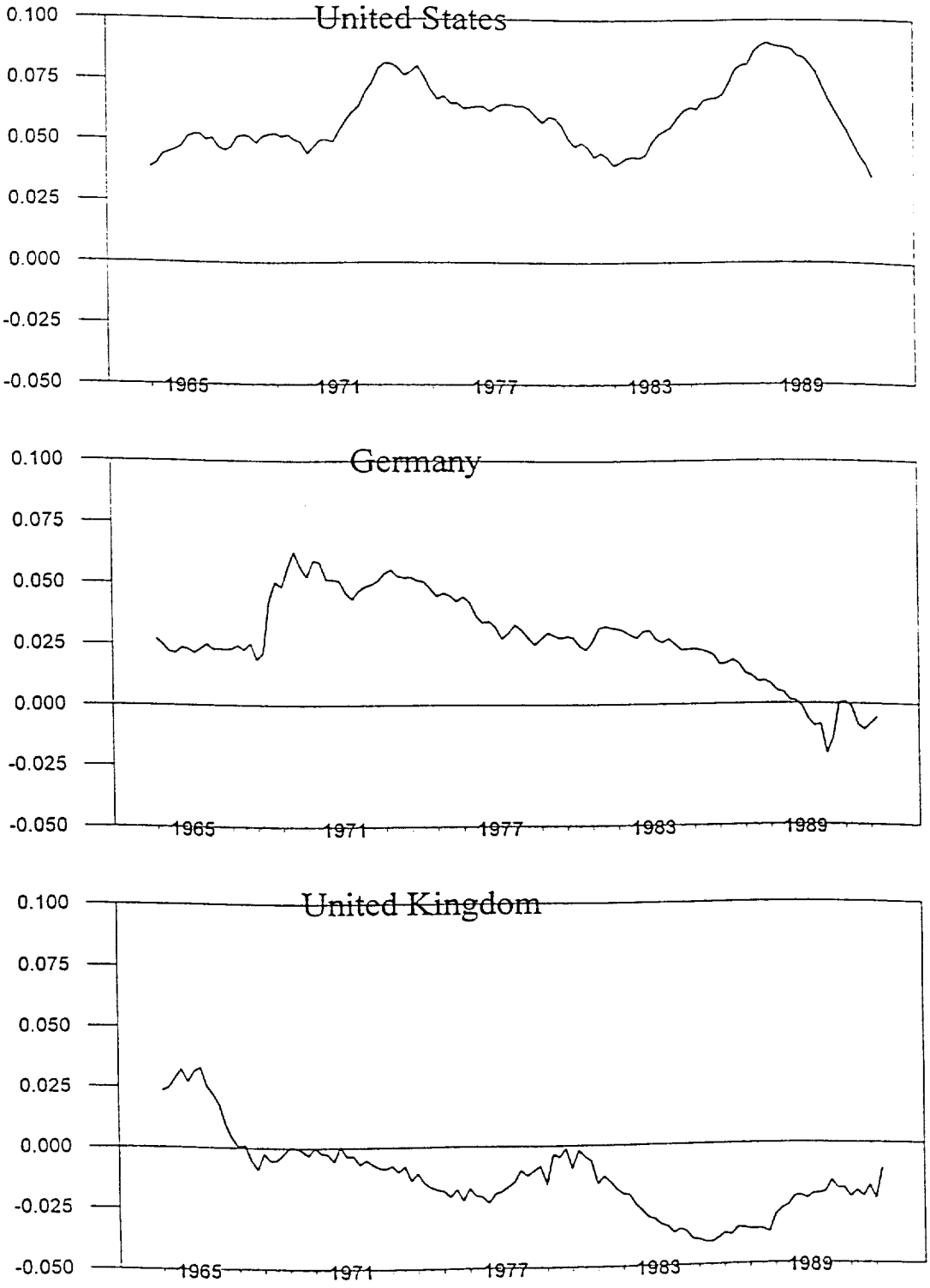
FIGURE 2
Historical Decomposition of Output Due to Financial Intermediation Shocks



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responses occurring over 1989–92 coincided with the reckoning of the savings and loan debacle, a similar problem in commercial banking and the subsequent tightening of regulation on all institutions.

The net contribution of financial intermediation shocks to output in Germany had always been positive until 1989. From 1963 to 1970, intermediation helped to increase output, though thereafter its output promoting effects began to diminish. The hallmarks of the German banking system are universal banking, high public ownership, and large participation in corporate governance.[26] Perhaps public ownership and the lack of competition relative to other countries reduce the pressures for financial innovation. More specifically, it is possible that, because German firms rely so heavily on banks, and because there is cooperation between the industrial and financial sectors, the pressures to find new ways to package assets and liabilities and to increase the efficiency of their operations are diminished.[27]

In the United Kingdom, financial intermediation shocks generated only small impacts on output fluctuations until the middle of the 1970s. Beginning in the early 1970s, financial intermediation shocks exert a prolong downward pressure on output. In 1971, the Bank of England's policy of controlling by way of credit limits changed to a policy acting through interest rates called the "Competition and Credit Control" policy. Specifically, banks were subject to interest rate ceilings that they could pay on smaller retail deposits. During the middle of the 1970s, those interest rate ceilings became binding. Moreover, from 1973 to 1975, the United Kingdom experienced a banking crisis. The combination of those two events ushered in a five-year prolonged and sharp downturn in output. Another period of decline was ushered in by the Banking Act of 1979, which tightened supervision and better defined authority. Historically, the regulatory and oversight environment in the United Kingdom had been an informal one. Oversight was done under an implicit agreements between banks and the Bank of England, where the latter agreed to provide liquidity services and the former to subject themselves to the moral authority of the Bank of England. As Britain's banking sector became more internationalized, the Bank of England lost some control as foreign banks were less inclined to submit to the informal authority of the Bank of England. The Banking Act of 1979 helped to remedy the situation. Finally, during the period from 1983 onward, financial intermediation disturbances exerted less of a drag on output. In 1983 the building societies abolished their cartel which had been effective in fixing interest rates.[28] In the following years, legislation was passed enabling the societies to expand greatly their scope of business, which they have done. Also in 1986, the securities market underwent a dramatic deregulation known as the "Big Bang," likely creating some spillover effects for the banking industry. It should also be noted that the magnitude of output fluctuations arising from intermediation shocks is much smaller than in the United States and Germany, because of the predominance of foreign banks in the United Kingdom, as discussed above.

Although the models tended to show generally similar historical decomposition results for any given country, there were some differences.[29] For the United States case, Models I and III (credit proxies) were very similar, whereas Model II (liability proxy) was slightly different. In particular, output fluctuations were more volatile, but with no

26. A 1979 report by the Monopoly Commission showed that German banks held 40% of outstanding shares (mostly through proxy) of the 100 largest firms.

27. This is consistent with the impulse response function results, indicating that, in two of the three German models, the long-run response of output to financial intermediation disturbances in statistically insignificant.

28. Building societies are banks whose initial purpose was to make residential loans. Unlike other banks in the United Kingdom, building societies had been subject to direct legislative control rather than informal suasion.

29. The historical decompositions results for the alternative proxies are available on request.

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discernible trend. In Germany, Models I and III show similar output movements in response to financial intermediation shocks, although there are minor discrepancies in the precise turning points. In contrast, Model II shows positive contributions to output from 1968 to 1982 and no trend thereafter. For the United Kingdom case, all models yield virtually identical patterns.

Thus, the estimated output movements arising from financial intermediation disturbances seems to accord well with the historical circumstances in each country. We interpret this as an additional piece of evidence in support of the ability of the empirical model to recover the structural financial intermediation disturbance accurately. Moreover, despite the qualitatively similar dynamic impulses, the historical pattern of the output effects of financial intermediation disturbances appears to be fairly country specific. That is, each country has faced a different set of intermediation disturbances, arriving at different times, that appear to be particular to the institutional and regulatory environment of that country.

V. SENSITIVITY ANALYSIS

In this section, we explore the sensitivity of our results to the choice of long-run restrictions used for identification and to alternative measures for the monetary aggregate.

Alternative Long-Run Identifying Restrictions

We estimate the model under two alternative plausible sets of restrictions. In the first alternative, we allow for the possibility that the long-run path of financial intermediation is exogenous to all disturbances other than its own shocks. Thus, the ordering of the system is financial intermediation, government size, output, and the money supply, and we shall call this specification model A. In the second alternative, we permit the long-run path of financial intermediation to be affected by technological shocks by ordering the system as follows: government size, output, financial intermediation, and money supply. We term this specification model B. The advantage to model B is that it recognizes the possibility that innovations in the banking sector may be influenced by developments in the communications and information-processing sectors. On the other hand, the disadvantage is that this specification will not allow the long-run path of output to be influenced by changes to the financial intermediation process. However, our primary focus is on the business cycle implications of financial intermediation disturbances, so by comparing the alternative results over various long-run specifications, we can draw some conclusions about the robustness of our results at the business cycle frequency.

Both models A and B were estimated three times, each using the different proxies for financial intermediation. Figures 3 and 4 depict the impulse response functions for output growth. Tables V and VI present the variance decomposition results.

The impulse-response functions indicate that the estimated dynamic response of output to a one-standard-deviation financial intermediation shock is very robust to the specification of the long-run causation. For each financial intermediation proxy, there is practically no difference in the estimated response between the benchmark model, model A and model B. The result remains that output growth increases in a statistically significant way in response to a positive financial intermediation shock (with a possible one-quarter lag).

The variance decomposition results for the alternative restrictions also tend support the conclusions drawn from the benchmark model. For example, at the four-quarter horizon for Germany, the benchmark model gave a range of 10.3 to 19.4 (across the financial intermediation proxies) for the portion of output growth's forecast error attributable to financial intermediation disturbances. That range was 12.0–22.0 for model A and 10.0–14.1 for model B. For the United Kingdom, the same range in the benchmark model is 1.8–13.1, 2.7–11.0 for model A and 8.0–19.8 in model B. For the United States the range is 11.1–34.6 for the benchmark model, 17.8–41.8 for model A and 4.9–37.0 for model B.

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FIGURE 3
Output Growth's Response to a Financial Intermediation Disturbance: Model A

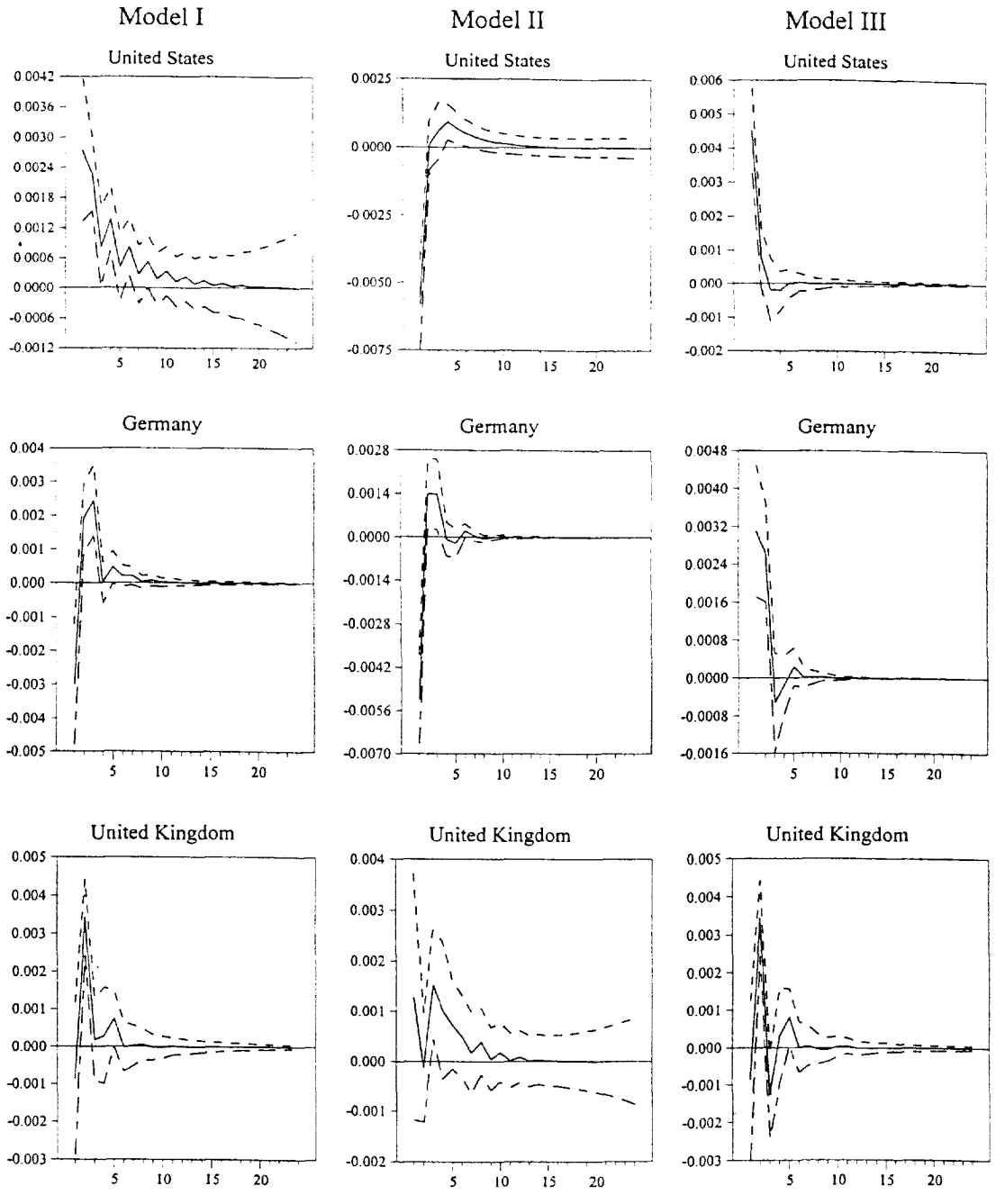

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FIGURE 4
Output Growth's Response to a Financial Intermediation Disturbance: Model B

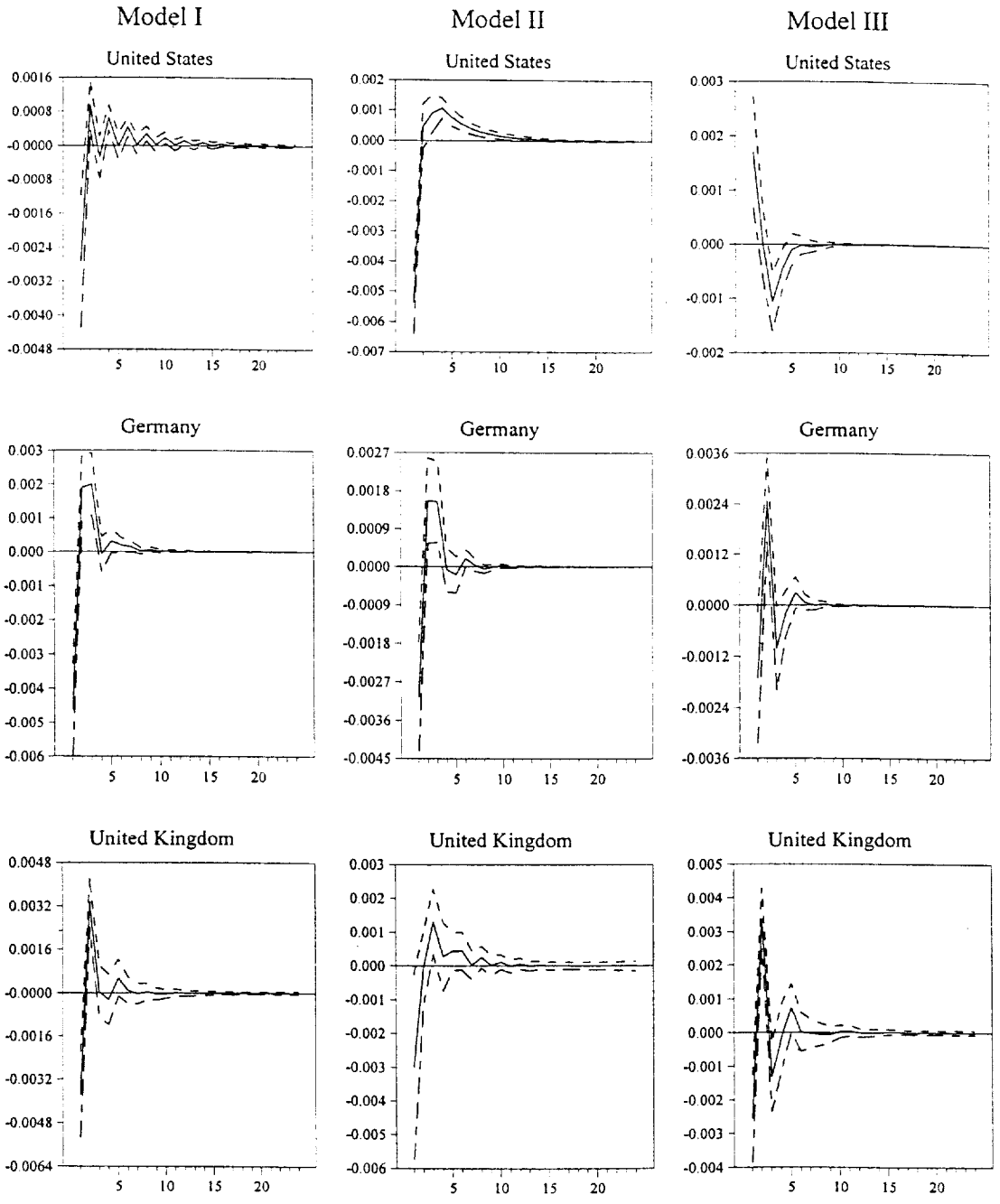

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TABLE V

Variance Decomposition of Output Growth's Forecast Error: Model A

Horizon (quarters)	Fiscal Shock			Intermediation Shock			Supply Shock			Monetary Shock		
					(i) United States							
	I	II	III	I	II	III	I	II	III	I	II	III
1	21.3	7.4	16.3	10.4	50.4	27.4	65.4	42.2	56.1	2.3	0.0	0.1
	(13.2)	(10.8)	(11.9)	(10.7)	(21.1)	(14.1)	(15.8)	(19.6)	(16.1)	(4.7)	(3.2)	(2.8)
2	21.3	12.2	18.0	15.9	46.5	26.4	60.1	41.0	55.5	2.1	0.3	0.2
	(12.4)	(10.2)	(11.6)	(11.3)	(18.6)	(13.5)	(15.0)	(14.7)	(15.4)	(4.2)	(3.1)	(2.7)
4	20.6	15.3	18.1	17.8	41.8	24.3	59.0	41.3	57.5	2.5	1.5	0.2
	(11.5)	(9.6)	(10.9)	(11.9)	(12.2)	(11.6)	(14.5)	(13.6)	(13.5)	(4.2)	(3.0)	(2.6)
20	20.3	15.3	18.0	19.1	41.1	24.2	58.1	41.8	57.5	2.5	1.8	0.2
	(11.1)	(9.6)	(10.9)	(13.8)	(12.2)	(11.5)	(14.9)	(13.6)	(13.3)	(4.2)	(3.0)	(2.6)
					(ii) Germany							
	I	II	III	I	II	III	I	II	III	I	II	III
1	11.4	10.7	14.0	7.0	20.4	7.4	80.6	68.6	74.3	1.1	0.3	4.4
	(10.5)	(8.5)	(8.9)	(9.0)	(11.3)	(6.3)	(13.8)	(13.8)	(11.4)	(3.6)	(2.4)	(6.1)
2	11.5	10.8	13.3	9.5	21.3	12.0	77.8	67.6	70.0	1.1	0.3	4.7
	(9.9)	(8.1)	(8.2)	(8.6)	(10.3)	(6.8)	(13.2)	(12.8)	(11.2)	(3.9)	(2.7)	(6.2)
4	11.2	10.9	13.5	13.2	22.0	12.0	74.4	66.8	69.3	1.2	0.4	5.3
	(9.1)	(7.6)	(7.7)	(7.7)	(9.3)	(6.4)	(12.0)	(11.5)	(10.3)	(3.9)	(2.9)	(6.4)
20	11.1	10.9	13.5	13.4	22.0	12.0	74.3	66.7	69.2	1.2	0.4	5.3
	(9.0)	(7.5)	(7.7)	(7.7)	(9.3)	(6.4)	(11.9)	(11.5)	(10.3)	(3.9)	(2.9)	(6.4)
					(iii) United Kingdom							
	I	II	III	I	II	III	I	II	III	I	II	III
1	34.2	46.4	39.9	0.7	1.3	0.7	64.6	51.0	57.7	0.6	1.3	1.7
	(15.8)	(15.9)	(16.8)	(6.0)	(8.3)	(6.5)	(15.9)	(15.7)	(16.8)	(2.7)	(4.3)	(3.5)
2	30.3	46.5	35.5	10.5	1.3	10.7	57.3	50.8	51.5	1.8	1.4	2.3
	(13.5)	(15.2)	(14.3)	(6.2)	(8.0)	(6.4)	(13.9)	(15.0)	(14.3)	(3.1)	(4.7)	(3.3)
4	32.9	48.2	36.4	9.8	3.7	11.0	53.8	46.4	47.4	3.5	1.7	5.3
	(12.3)	(13.7)	(12.7)	(5.9)	(8.7)	(6.1)	(12.4)	(13.3)	(12.6)	(4.3)	(4.6)	(4.9)
20	32.9	47.9	36.4	10.1	4.4	11.4	53.4	46.0	47.0	3.6	1.7	5.2
	(11.8)	(13.3)	(12.2)	(6.1)	(11.1)	(6.1)	(12.0)	(13.3)	(12.1)	(4.3)	(4.5)	(4.9)

Notes: Model I: financial intermediation = nonfinancial credit/output; Model II: financial intermediation = $(M2)$/output; Model III: financial intermediation = nonfinancial credit/total credit. Simulated standard errors based on 1,000 random draws are in parentheses.

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TABLE VI
Variance Decomposition of Output Growth's Forecast Error: Model B

Horizon (quarters)	Fiscal Shock			Intermediation Shock			Supply Shock			Monetary Shock		
					(i) United States							
	I	II	III	I	II	III	I	II	III	I	II	III
1	26.7	18.4	24.3	10.3	43.0	3.9	60.6	38.6	71.6	2.3	0.0	0.1
	(16.2)	(11.0)	(14.4)	(11.3)	(14.8)	(5.1)	(16.1)	(14.8)	(15.1)	(4.6)	(3.2)	(2.4)
2	27.9	22.0	25.9	10.5	39.9	3.7	59.6	37.8	70.3	2.1	0.3	0.2
	(16.5)	(11.4)	(14.4)	(9.8)	(13.3)	(4.6)	(16.1)	(14.5)	(14.9)	(4.1)	(3.2)	(2.3)
4	27.3	22.6	25.2	10.3	37.0	4.9	59.8	38.9	69.8	2.5	1.5	0.2
	(16.0)	(11.3)	(13.6)	(8.9)	(10.9)	(4.8)	(18.7)	(14.4)	(13.9)	(4.2)	(3.1)	(2.3)
20	27.1	21.8	25.1	10.5	36.7	4.9	59.9	39.7	69.8	2.5	1.8	0.2
	(16.2)	(11.3)	(13.4)	(7.9)	(10.0)	(4.8)	(18.1)	(13.2)	(13.8)	(4.2)	(3.0)	(2.3)
					(ii) Germany							
	I	II	III	I	II	III	I	II	III	I	II	III
1	14.4	13.4	11.9	16.6	6.9	8.6	67.9	79.3	81.5	1.1	0.3	4.4
	(10.0)	(9.4)	(8.8)	(9.2)	(5.8)	(4.4)	(13.8)	(11.0)	(11.0)	(3.8)	(2.6)	(5.7)
2	14.1	13.3	11.2	18.8	8.6	6.1	66.0	77.8	77.5	1.1	0.3	4.7
	(9.7)	(9.1)	(8.2)	(6.1)	(6.7)	(5.9)	(13.5)	(10.9)	(11.8)	(4.2)	(3.0)	(5.9)
4	14.1	13.4	11.4	20.6	10.0	7.2	64.1	76.2	76.1	1.2	0.4	5.3
	(8.6)	(8.4)	(7.7)	(6.9)	(7.0)	(5.6)	(12.1)	(10.3)	(11.0)	(4.3)	(3.3)	(6.2)
20	14.0	13.4	11.4	20.6	10.0	7.3	64.2	76.1	76.1	1.2	0.4	5.3
	(8.5)	(8.3)	(7.7)	(7.5)	(7.0)	(5.6)	(11.9)	(10.3)	(11.0)	(4.3)	(3.3)	(6.3)
					(iii) United Kingdom							
	I	II	III	I	II	III	I	II	III	I	II	III
1	32.8	47.6	37.4	13.4	7.3	6.3	53.2	43.8	54.6	0.6	1.3	1.7
	(16.3)	(15.7)	(17.4)	(11.3)	(13.7)	(6.6)	(17.2)	(18.6)	(17.1)	(2.5)	(4.5)	(3.4)
2	29.4	47.7	33.2	21.4	7.3	15.4	47.4	43.6	49.1	1.8	1.4	2.3
	(14.1)	(15.0)	(15.1)	(11.0)	(13.3)	(8.0)	(15.1)	(17.9)	(15.0)	(3.0)	(4.8)	(3.1)
4	32.0	50.1	34.4	19.8	8.0	15.3	44.7	40.2	45.1	3.5	1.7	5.2
	(12.9)	(13.6)	(13.4)	(9.5)	(11.3)	(6.8)	(13.6)	(16.0)	(13.3)	(4.2)	(4.8)	(4.8)
20	32.1	50.0	34.5	19.7	8.3	15.5	44.6	40.0	44.8	3.6	1.7	5.2
	(12.4)	(13.8)	(12.9)	(9.1)	(9.9)	(6.7)	(13.0)	(15.7)	(12.9)	(4.6)	(4.8)	(5.2)

Notes: Model I: financial intermediation = nonfinancial credit/output; Model II: financial intermediation = $(M2)$/output; Model III: financial intermediation = nonfinancial credit/total credit. Simulated standard errors based on 1,000 random draws are in parentheses.

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TABLE VII
Variance Decomposition of Output Growth's Forecast Error

	Fiscal Shock									Intermediation Shock								
	I			II			III			I			II			III		
Horizon	O	A	B	O	A	B	O	A	B	O	A	B	O	A	B	O	A	B
(i) United States:																		
1	27.6	21.6	27.6	13.9	4.2	13.9	20.8	10.6	20.8	3.41	9.4	12.8	39.5	49.3	37.3	22.4	32.5	3.4
	(10.0)	(6.8)	(9.9)	(3.3)	(1.1)	(3.2)	(6.9)	(2.6)	(6.8)	(1.3)	(2.4)	(3.5)	(18.0)	(25.7)	(15.0)	(6.5)	(12.3)	(0.3)
20	28.4	20.6	28.4	18.1	12.6	18.1	21.7	12.6	21.7	10.8	18.7	12.5	34.5	40.0	33.1	19.3	28.4	4.3
	(11.2)	(5.7)	(11.0)	(5.2)	(3.2)	(5.1)	(7.1)	(3.2)	(7.1)	(2.9)	(6.7)	(2.4)	(11.6)	(15.2)	(10.0)	(5.0)	(9.2)	(0.5)
(ii) Germany:																		
1	17.0	14.2	17.0	15.9	12.8	15.9	14.7	17.3	14.7	2.5	5.2	14.0	16.0	19.2	4.8	9.8	7.2	0.9
	(4.5)	(3.7)	(4.4)	(3.9)	(2.7)	(3.9)	(3.5)	(4.2)	(3.4)	(0.7)	(1.3)	(2.9)	(3.8)	(5.2)	(6.5)	(1.9)	(1.2)	(0.2)
20	16.3	13.6	16.3	15.7	12.7	15.7	14.3	16.5	14.0	8.2	10.9	17.4	17.4	20.4	7.6	14.0	11.8	6.2
	(4.0)	(3.3)	(3.9)	(3.7)	(2.6)	(3.7)	(3.2)	(3.8)	(3.1)	(1.7)	(2.4)	(3.9)	(4.0)	(5.3)	(1.7)	(3.1)	(2.4)	(1.0)
(iii) United Kingdom:																		
1	31.4	38.4	31.4	43.4	45.5	43.4	41.4	43.5	41.4	7.0	0.0	23.4	2.7	0.7	10.1	2.1	0.0	6.5
	(10.9)	(15.3)	(10.5)	(18.7)	(20.5)	(18.5)	(10.9)	(15.3)	(10.5)	(1.3)	(0.1)	(7.1)	(0.6)	(0.2)	(2.6)	(1.3)	(0.1)	(7.1)
20	29.7	32.8	29.7	42.0	43.5	42.0	36.6	38.1	36.6	17.0	13.8	30.5	5.2	3.7	12.1	13.7	12.2	17.4
	(10.0)	(10.9)	(9.7)	(17.2)	(17.5)	(16.9)	(10.0)	(10.9)	(9.7)	(3.6)	(3.1)	(9.3)	(1.0)	(0.9)	(3.0)	(3.6)	(3.1)	(9.3)

	Supply Shock									Monetary Shock								
	I			II			III			I			II			III		
Horizon	O	A	B	O	A	B	O	A	B	O	A	B	O	A	B	O	A	B
(i) United States:																		
1	66.6	66.6	57.2	44.4	44.4	46.6	55.5	55.5	74.5	2.4	2.4	2.4	2.2	2.2	2.2	1.4	1.4	1.4
	(40.7)	(41.1)	(34.1)	(21.3)	(21.4)	(23.3)	(29.6)	(29.8)	(52.6)	(0.4)	(0.4)	(0.4)	(0.3)	(0.3)	(0.3)	(0.2)	(0.2)	(0.2)
20	58.2	58.2	56.6	45.3	45.3	46.6	57.3	57.3	72.3	2.5	2.5	2.5	2.1	2.1	2.1	1.7	1.7	1.7
	(29.6)	(29.5)	(53.8)	(19.8)	(19.8)	(22.9)	(29.7)	(29.6)	(47.6)	(0.3)	(0.3)	(0.3)	(0.3)	(0.3)	(0.3)	(0.3)	(0.3)	(0.3)
(ii) Germany:																		
1	79.9	79.9	68.4	67.1	67.1	78.4	73.9	73.9	82.7	0.7	0.7	0.7	0.9	0.9	0.9	1.6	1.6	1.6
	(57.7)	(58.1)	(45.2)	(43.2)	(43.4)	(58.2)	(50.7)	(51.2)	(63.4)	(0.1)	(0.1)	(0.1)	(0.1)	(0.1)	(0.1)	(0.2)	(0.2)	(0.2)
20	74.1	74.1	64.9	65.2	65.2	75.0	69.2	69.2	77.4	1.5	1.5	1.5	1.7	1.7	1.7	2.5	2.5	2.5
	(46.5)	(46.4)	(38.8)	(38.2)	(38.2)	(50.0)	(41.6)	(41.6)	(52.0)	(0.3)	(0.3)	(0.3)	(0.3)	(0.3)	(0.3)	(0.5)	(0.4)	(0.4)
(iii) United Kingdom:																		
1	61.5	61.5	45.2	52.6	52.6	45.2	56.4	56.4	52.0	0.1	0.1	0.1	1.3	1.3	1.3	0.1	0.1	0.1
	(35.9)	(36.8)	(21.8)	(26.9)	(27.6)	(21.5)	(35.9)	(36.8)	(21.8)	(0.1)	(0.1)	(0.1)	(0.2)	(0.2)	(0.2)	(0.1)	(0.1)	(0.1)
20	52.1	52.1	38.5	50.2	50.2	43.3	49.3	49.3	45.6	1.2	1.2	1.2	2.6	2.6	2.6	0.4	0.4	0.4
	(24.1)	(24.4)	(15.8)	(22.8)	(23.3)	(18.8)	(24.1)	(24.4)	(15.8)	(0.3)	(0.3)	(0.3)	(0.5)	(0.5)	(0.4)	(0.3)	(0.3)	(0.3)

Notes: Model I: financial intermediation = nonfinancial credit/output; Model II: financial intermediation = $(M2)$/output; Model I: financial intermediation = nonfinancial credit/output; O = original ordering; A = Model A; B = Model B; Simulated standard errors based on 1,000 random draws are in parentheses.

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Finally, the historical decomposition results are also fairly similar for the alternative long-run restrictions. Using the other proxies, model A's estimated historical decompositions are again very similar to those produced by the benchmark model.[30]

Alternative Monetary Aggregate Measure

All of the above specifications retained the use of an $M1$ measure for the monetary aggregate. However, one may argue that a narrow measure of money would provide a better source for the true monetary shocks. Therefore, we have reestimated the benchmark model using reserves as the fourth variable.[31] Table VII presents briefly the variance decomposition analysis for this set of results. The results are virtually unchanged from the benchmark case. The only difference is that in Model IB for the United Kingdom financial intermediation is more important than in the benchmark case. However, this is the only difference in a regression model including three countries, each with three financial intermediation measures and three separate orderings (that is, 1 out of a total of 27). Thus, it is appropriate to claim that our findings are robust to alternative measures of monetary disturbances.

VI. CONCLUSION

Using various proxies for measures of financial intermediation, we have provided evidence that suggests that financial intermediation can have important short- and longer-run real effects, even in countries with nearly matured financial structures. In particular, the results support the idea of business cycles generated by financial intermediation disturbances. These are shocks that are separate from fiscal/monetary policy or output technology originated disturbances. Although the dynamic responses of output appear to be fairly similar across countries, there are variations in their magnitudes. In particular, the structure of the financial system in the United States, United Kingdom, and Germany parlay financial intermediation disturbances into output movements differently and generate country-specific financial intermediation shocks. We have provided some plausible explanations for these differences, but it is beyond the scope of this article to disentangle the channels through which financial intermediation disturbances are transmitted to the real sector. It is our belief that it may be fruitful to conduct future research toward understanding the transmission mechanism.

30. The historical decompositions for model B cannot be compared to the benchmark decompositions for the level of output because the former restricts the level not to respond persistently to intermediation disturbances. The specifics of this result can be obtained from the authors.

31. We choose reserves over high-powered money to avoid capturing shocks to international currency demand rather than policy shocks, though the VAR estimates are quite similar between these two measures. Another good measure would be non-borrowed reserves, but such data are difficult to obtain in a consistent manner across countries.

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