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Global Macro-Financial Cycles and Spillovers*

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Abstract

We develop a new dynamic factor model to jointly characterize global macroeconomic and financial cycles and the spillovers between them. The model decomposes macroeconomic cycles into the part driven by global and country-specific macro factors and the part driven by spillovers from financial variables. We consider cycles in macroeconomic aggregates (output, consumption, and investment) and financial variables (equity and house prices, and interest rates). The global macro factor plays a major role in explaining G-7 business cycles, but there are also sizeable spillovers from equity and house price shocks onto macroeconomic aggregates, at least over the past two decades, accounting for up to 20 percent of the variation in global business cycle fluctuations. These spillovers operate mainly through the global macro factor rather than the country-specific macro factors (i.e., these spillovers affect business cycles in all G-7 economies) and are stronger in the period leading up to and following the global financial crisis. We find weaker evidence of spillovers from macroeconomic cycles to financial variables, perhaps reflecting the predictive power of global financial markets.

JEL Classification: E32, F4, C32, C1

Keywords: Global business cycles; global financial cycles; common shocks; international spillovers; dynamic factor models.

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1. Introduction

Rising cross-border trade and financial flows, coupled with the increasing prominence of financial markets, appear to have intensified spillovers between financial markets and macroeconomic activity, both within and across economies. Even as the 2007-09 global financial crisis highlighted these linkages, it revealed substantial heterogeneity across countries in how their financial markets and economies were affected by the crisis and ensuing global recession. These and subsequent episodes highlight the need for a more nuanced analysis of business cycle transmission that accounts for various sources and channels of shock propagation across borders.

In this paper, we provide an empirical characterization of macroeconomic and financial cycles in a setting that allows us to analyze the relationships between these two types of cycles, including potential spillovers between them. Macroeconomic aggregates (output, consumption, investment) and financial market variables (financial asset prices and house prices) can serve as both sources of shocks and as channels of propagation. The empirical literature has mostly focused on only one of these channels at a time and often in the context of a single country, without accounting for both the potentially large feedback effects between them and cross-border spillovers. Another important issue, which existing empirical models have largely sidestepped, is whether comovement among macroeconomic and financial variables simply reflects common shocks or is the result of spillovers of country-specific or variable-specific shocks.

Addressing such questions requires a model that can capture cross-border spillovers across macroeconomic and financial cycles. For instance, during the global financial crisis, financial market spillovers appear to have been an important channel for the transmission of shocks across advanced economies, but there is limited formal evidence of this. The crisis also suggests extensive feedback between these two types of cycles, making it imperative to study them in a unified setting. Our objective, therefore, is to study the joint dynamics of business and financial cycles in a unified model that allows us to characterize these cycles as well as spillovers between them.

We develop a new dynamic factor model to capture spillovers in both directions across the financial sector and the macroeconomy.[1] Existing factor models attribute the observed comovement among multiple macroeconomic aggregates to a small set of underlying shocks and help identify the relative importance of different driving forces for national and global business cycles—global shocks, shocks specific to certain groups of countries, and country-specific shocks. However, we are also interested in the global propagation of shocks originating in one sector (macroeconomic or financial) to other sectors. The main innovation of our model is that it captures spillovers from one type of factor to another while allowing us to simultaneously analyze the dynamics of macroeconomic and financial variables. For example, our model allows us to analyze the quantitative importance of cross-border spillovers of shocks hitting different segments of financial markets onto macroeconomic variables through global and country-specific macroeconomic factors.

Our model distinguishes between common shocks and cross-border spillovers in a systematic fashion that accounts for global and country-specific factors, along with spillovers. Prior models, which typically do not disentangle spillovers from common shocks, arguably misidentify the magnitude of whichever source of

[1] We build on a large literature using dynamic factor models to characterize business and financial cycles within and across countries (see Stock and Watson 2011 and Breitung and Eickmeier 2016 for surveys of methods and applications). Using such models, Kose, Otrok, and Whiteman (2003, 2008) analyze the roles played by global and/or group-specific factors in driving global business cycles while Miranda-Agrippino and Rey (2020) estimate common factors across international financial asset prices.

fluctuations they focus on. For example, if there are significant spillovers from the financial to the macro sector, the role of common shocks on macro variables could be over-estimated in models that do not account for such spillovers.

We begin by examining whether there is a common global cycle in financial variables, similar to the one that has been documented for macroeconomic aggregates. Our empirical analysis focuses on the G-7 economies over the period 1985-2019. Using a dynamic factor model that comprises three key financial variables—equity prices, house prices, and interest rates—we find no evidence of a common global cycle (at business cycle frequencies) among these variables for the G-7 economies. Instead, we find evidence that there are global cycles specific to each financial variable (which are proxies for different asset classes)—there is a global equity price cycle, a separate global interest rate cycle, and a house price cycle. We then ask if there is a common cycle among real and financial variables—that is, do the shocks that drive cycles in macroeconomic aggregates also drive any of the financial cycles? The answer we find is again no. These results do not imply that global macroeconomic and financial cycles evolve independently of each other but, instead, help us sharpen the model in a manner that better captures the main, empirically relevant channels of spillovers.

We report four major findings. First, while the global macroeconomic (macro) factor plays an important role in explaining business cycle fluctuations, there are sizeable spillovers from specific financial variables—equity prices and house prices, in particular—to macroeconomic variables. Spillovers from the global interest rate factor also contribute to macroeconomic fluctuations but they are less important as sources of cross-border spillovers. Second, spillovers from the equity and housing markets operate mainly through the common (global) macro factor rather than the country-specific macro factors. This means, for instance, that movements in global equity prices influence the global macroeconomic cycle (i.e., the spillovers affect overall business cycles in all G-7 economies), in turn affecting fluctuations in domestic macroeconomic variables in our sample.

Third, common cycles among macroeconomic and financial variables, and also the spillovers from financial to macroeconomic variables, are stronger in the period leading up to and following the financial crisis. Fourth, we find little evidence of spillovers from macroeconomic cycles to financial cycles. One exception is in the case of interest rates, which experience significant spillovers from the global macro and U.S. country factors. In addition to these new results, we also confirm, consistent with the prior literature, that there are common business cycles, as reflected in the comovement of macroeconomic aggregates, among the G-7 economies. Our finding of common cycles in certain financial variables, especially equity prices and interest rates, also accords with the previous literature.

We focus on the G-7 economies since they account for a substantial fraction of world output and, given their levels of economic and financial integration, provide the best likelihood of finding significant macro-financial spillovers. However, our main results are preserved in a larger sample encompassing seven major emerging market economies and seven other small open economies. As expected, given the lower degree of trade and financial integration in this expanded sample, we find more modest comovement of macroeconomic and financial variables and weaker spillovers.

Macro-financial linkages—the two-way interactions between the real economy and the financial sector—have become a topic of substantial research interest (Cochrane 2017 and Claessens and Kose 2018). Shocks originating in the real economy can be propagated through asset prices, thereby amplifying business (macroeconomic) cycles. Imperfections in financial markets can intensify such propagation effects and, consequently, lead to more pronounced macroeconomic fluctuations. Conversely, shocks that

hit financial markets can result in more pronounced asset price movements and macroeconomic fluctuations (Bernanke, Gertler, and Gilchrist 1999). Through cross-border linkages, these developments can lead to international spillovers. A recent body of literature highlights the role of monetary or financial shocks in a center country, particularly the United States, on global financial and macroeconomic fluctuations (Miranda-Agrippino and Rey 2020, and Jiang et al. 2021).[2]

Our paper is also related to a rapidly growing finance literature on financial market integration, asset price movements, and macro-financial linkages. One strand of this literature concludes that highly integrated financial markets have resulted in asset prices becoming more synchronized, necessitating the joint analysis of global and country-specific factors in driving asset prices. For instance, using international cross-industry data, Bekaert, Hodrick, and Zhang (2009) provide strong evidence of international stock return comovement and Bekaert and Ermolov (2023) document the cross-country comovement of interest rates. Another strand examines macro-financial linkages. Stulz (1999) and Bekaert and Harvey (2003) document that one significant channel through which financial globalization influences the real sector is its effect on equity prices. Bekaert and Harvey (1997) show that international trade linkages impact equity market movements across countries. Bekaert, Engstrom, and Ermolov (2021) find that macro risks have a substantial impact on risk premiums and these risks also have a significant predictive power for the variance of bond returns.

Another set of studies examines the dynamics among different asset classes. For example, Bekaert et al. (2016) explore whether globalization is associated with increased comovement of asset returns globally, specifically examining equity, bond, and foreign exchange returns. Miranda-Agrippino and Rey (2020) argue that a common factor drives a sizeable portion of variation in equity prices, commodity prices, and bond indices.[3] Building on this work documenting financial cycles, a more recent empirical literature has emphasized macro-financial linkages. Using high frequency data for the U.S., euro area, and Japan over the period 2000-17, Bekaert, Hoerova, and Xu (2023) show that monetary policy and risk shocks in these economies affect domestic as well as international asset prices. They also document a strong global component of risk shocks, which is not driven by monetary policy.[4]

2. A New Dynamic Factor Model with Spillovers

Factor models have been used extensively in macroeconomics and finance to identify common factors that drive fluctuations in large multi-dimensional datasets. The generic representation of a dynamic latent factor model takes the following form:

[2] Some theoretical studies analyze the roles of leverage constraints, financial integration, global banks, and different types of financial shocks in explaining international business cycle comovement in the context of multi-country models with financial imperfections (Geanokoplos 2010; and Adrian, Colla, and Shin 2013). Perri and Quadrini (2018) and Schmitt-Grohé and Uribe (2021) present theoretical studies of international business cycle comovement in models with financial market imperfections.

[3] In related work, Cesa-Bianchi et al. (2015) find that real house price growth comove highly in advanced economies in the run-up to the U.S. subprime crisis, comoving also with other asset prices, but much less than equity prices. Diebold and Yilmaz (2015) analyze cross-country linkages in equity, foreign exchange, and bond markets. Jorda et al. (2019) document that the comovement in credit, house prices, and equity prices across 17 advanced economies has reached historical highs in the past three decades. Eickmeier and Ng (2015) and Ciccarelli, Ortega, and Valderrama (2016) also consider global macro-financial cycles and spillovers.

[4] Cesa-Bianchi et al. (2020) employ a multi-country panel VAR model and find strong evidence of the transmission of shocks to the global financial factor, especially stock market volatility shocks, to output growth. The literature on the global financial cycle emphasizes the importance of U.S. macro and financial variables on cross-border capital flows, financial asset prices, and international risk premiums (Cetorelli and Goldberg 2012; Buch, Bussiere, Goldberg, and Hills 2019; Durdu, Martin, and Zer 2019), although Cerutti, Claessens, and Rose (2019) show that common shocks drive little of the variation in global capital flows.

(1) $Y_t = \beta F_t + \Gamma_t$

(2) $\Gamma_t = \Psi(L)\Gamma_{t-1} + V_t \quad \text{with } E(V_t V_t') = \Omega$

(3) $F_t = \Phi(L)F_{t-1} + U_t \quad \text{with } E(U_t U_t') = I_K$

where Y_t is an n-dimensional vector of time series data. Γ_t is an $(n \times 1)$ vector of idiosyncratic components that captures fluctuations specific to a particular time series. Each element of Γ_t is assumed to follow an independent AR(q) process as in equation (2). Hence, $\Psi(L)$ is a block diagonal lag polynomial matrix and Ω is a covariance matrix that is restricted to be diagonal. The latent factors are denoted by the vector F_t.[5] This vector contains contemporaneous values of the factors as well as lags. The lags of the factor enter the state equation (3) to allow for dynamics in each factor.[6] $\Phi(L)$ is a matrix lag polynomial governing the evolution of these factors. The variance covariance matrix of this equation, $I_{k,}$ is assumed to be an identity matrix for normalization purposes. Typically, the matrix $\Phi(L)$ is restricted to be block diagonal.

Unlike most previous papers that have used this framework to study macroeconomic or financial cycles separately, our objective is to incorporate both macroeconomic and financial variables in a unified framework and, additionally, to analyze spillovers between them. The analogue of equation (1) for the most general form of a model that includes financial and real variables for multiple countries can be written as follows:

(4) $$\begin{bmatrix} Y^M_{i,j,t} \\ Y^F_{i,j,t} \end{bmatrix} = \beta_1 F_t + \beta_2 \begin{bmatrix} F^M_t \\ F^F_t \end{bmatrix} + \beta_3 \begin{bmatrix} F^M_{i,t} \\ F^F_{i,t} \end{bmatrix} + \beta_4 F_{j,t} + \beta_5 \begin{bmatrix} F^M_{j,t} \\ F^F_{j,t} \end{bmatrix} + \begin{bmatrix} \Gamma^M_{i,j,t} \\ \Gamma^F_{i,j,t} \end{bmatrix}$$

where the superscripts *M* and *F* stand for the blocks of macro and financial variables, respectively. The subscript *i* is an index for the variables in our model (i.e., 3 macro and 3 financial variables), and *j* and *t* indicate country and time indexes, respectively. F_t is a global factor that captures a common component encompassing both macro and financial variables across all countries while F^M_t *and* F^F_t indicate global factors specific to macroeconomic and financial variables, respectively. $F^M_{i,t}$ and $F^F_{i,t}$ (both of which are 3-dimensional vectors) then indicate common factors specific to variable *i*. Similarly, $F_{j,t}$ is a country-specific factor that captures a common component encompassing both macro and financial variables in country *j* while $F^M_{j,t}$ and $F^F_{j,t}$ indicate separate macro and financial factors, respectively, specific to country *j*. The Γ vectors represent idiosyncratic variation that is not captured by any of these common factors and is therefore specific to a particular time series.

The model above is too general to be useful for our purposes (and would cause identification problems), requiring us to put more structure on the model and the factors we can identify. We use empirical evidence (and some theory) in guiding this process.

There is extensive evidence on the existence of a global business cycle, especially among advanced economies. To examine if there is an analogous global financial cycle that spans a variety of asset markets, we used a version of the factor model described above to examine comovement of prices across G-7

[5] The set of equations (1)–(3) comprises a state space system where (1) and (2) combined correspond to the measurement equation and (3) corresponds to the state transition equation. This state space structure is exploited in the Gibbs sampling procedure when the model parameters are estimated.

[6] If we let *s* be the number of factors ($s < n$) and *p* be the order of the autoregressive process that each factor follows, then we can define $m = sp$ as the dimension of the state vector.

economies in three major financial markets—stock markets, government securities markets, and housing markets. Since our primary objective is to model spillovers between financial and macro variables rather than to precisely estimate a global financial cycle, we focus on a handful of financial variables that are viewed as relevant for macro fluctuations and also limit our analysis to relatively low (quarterly) frequencies rather than high-frequency (e.g., daily) financial market data.[7]

The main takeaway from our initial empirical exercises, which are described in detail in Appendix 1, is that the global financial factor does not play a major role in explaining the variance of fluctuations in any of these financial variables. Our findings are still consistent with studies that argue for the existence of a global financial cycle based on the cross-country comovement of one variable (Claessens, Kose, and Terrones 2011; Hirata et al. 2012; and Cesa-Bianchi, Cespedes, and Rebucci 2015). Indeed, we find that there is strong evidence of cross-country comovement of equity prices and interest rates, although somewhat less so for house prices. Our results do highlight, however, that there is limited empirical evidence of a global financial cycle that encompasses multiple financial markets or asset classes, at least for the major financial market indicators of interest to us.

2.1. A Dynamic Factor Model with Macro and Financial Variables

We now provide a more general representation of the framework and use that as the basis for developing a new dynamic factor model. This new model allows us to study spillovers between financial and macroeconomic (macro) variables while also disentangling such spillovers from common shocks. First, we use a set of zero restrictions (see Appendix 1) to estimate a series of models where the factors can be identified as common, macro, or financial. We allow all variables to load on the same common factor:

$$(5) \qquad Y_t = \begin{bmatrix} Y_t^M \\ Y_t^F \end{bmatrix} = \begin{bmatrix} \beta^M \\ \beta^F \end{bmatrix} [F_t^G] + \begin{bmatrix} \Gamma_t^M \\ \Gamma_t^F \end{bmatrix}$$

where the *M* superscript refers to the block of macroeconomic variables, the *F* superscript represents the block of financial variables and F_t^G is the global factor.

Using the above model, we begin by examining whether there is a common cycle between financial and macroeconomic variables, which would mean that they are driven in part by common shocks. We estimated such models combining in sequence three macro variables (quarterly real deseasonalized data on output, consumption, and investment) with one of the financial variables at a time. That is, we allow for a common factor across four variables—the three macro variables and the relevant financial variable. This approach builds on our findings in Appendix 1 that there is no common cycle among all three financial variables in our analysis.

We did not find a significant common component in any of the four-variable models. In other words, there is no common shock that jointly drives macroeconomic and financial variables. As shown in Appendix 1, there is no common factor that explains fluctuations in both the macroeconomic variables and equity prices. The common factor in this model explains about half of the total variance in equity prices but, on average, less than 8 percent of the variance in any of the macro variables. When each of the other financial

[7] Our database is described in more detail in Appendix Table A1. Financial and macroeconomic series are all at a quarterly frequency, seasonally adjusted, and deflated by the CPI for each country. We use growth rates of all variables and, following Stock and Watson (2012), remove low-frequency movements using the Local Mean method.

variables is included in the model, the common factor accounts for a sizable fraction of the variance in the macroeconomic variables but less than 11 percent and 3 percent, respectively, of the variance in house prices and interest rates.[8]

This motivated us to treat the macro and financial blocks as separate in the specification of the factor model, assuming block exogeneity of macro and financial factors. Specifically, this means that the macro variables have zero factor loading on the financial factor, and the financial factors have zero factor loadings on the macro variables. A benefit of this approach is that we cleanly label "macro" and "financial" factors by imposing these zero restrictions. This implies that we can rewrite equation (5) as:

$$(6) \qquad Y_t = \begin{bmatrix} Y_t^M \\ Y_t^F \end{bmatrix} = \begin{bmatrix} \beta^M & 0 \\ 0 & \beta^F \end{bmatrix} \begin{bmatrix} F_t^M \\ F_t^F \end{bmatrix} + \begin{bmatrix} \Gamma_t^M \\ \Gamma_t^F \end{bmatrix}$$

where the *M* superscript refers to the block of macroeconomic variables, the *F* superscript represents the block of financial variables, and the zeros stand for appropriately sized matrixes of zeros.

The next step is to impose restrictions on the factor loading matrices within the macro and financial blocks. Based on our earlier results, we estimate a sequence of macro-financial models where the financial block consists of one financial variable for each of the G-7 countries in our sample. This yields a financial block where Y_t^F is a 7x1 vector with the financial data for each country at time t, F_t^F is a single factor (but F_t^F is not scalar because the lags of that factor appear in the state equation), and β^F is non-zero for the relevant financial variable loading on the financial factor. The financial factor is then interpreted as a global factor for the relevant financial variable.

For the macro block, we partition the data to allow for global and country-specific macro factors. With our dataset comprising output, consumption, and investment for G-7 countries, the block will have one common macro factor and seven country-specific macro factors. Identification of the country factors is obtained by allowing only variables within each country to load on a particular factor, which we then label that country's factor. We do not have a country-specific financial factor because we did not find a common component across the financial variables within a country in our previous exercise. This is an empirical result, not an assumption. We do find that global and country-specific factors are both relevant for the macro block, which is consistent with previous literature (e.g., Kose, Otrok, and Whiteman, 2003, 2008).[9]

2.2. Modeling Macro-Financial Spillovers

As noted above, a standard assumption in the factor literature is that the matrix governing the evolution of the factors, $\Phi(L)$, is block diagonal. This assumption imposes a structure on the model that the latent factors evolve independently of each other. We now seek to relax this assumption in some dimensions to allow spillovers across the factors.

A spillover from one factor to another is captured by allowing one factor to load on lags of another factor as well as its own lags. For example, a global financial shock may affect the global macro factor with a lag. The only commonality across these variables comes from the spillovers that occur with a one (or more) period lag. There are no shocks that are common to the global macro and financial factors. If there were

[8] In Online Appendix 1, we discuss how our results relate to unconditional correlations between macro and financial variables.
[9] We do not allow for variable-specific macro factors in the baseline model. In Online Appendix 1, we show that this identification restriction (as we cannot include both country- and variable-specific macro factors) does not affect the main results.

a common shock, then the two types of variables would both load on one common factor. However, we find no evidence of a common factor across the macro and financial blocks. In other words, the comovement of macro and financial variables is driven only by spillovers.

We assume that spillovers occur with a one period lag. In the context of macroeconomic variables, the assumption implies that these variables are "sluggish" in their response to financial shocks. That sluggishness can arise from real or nominal rigidities, or, in the international context, from trade frictions.[10] Since macroeconomic data are released in the quarter after the data are realized, financial markets would react with a one quarter lag, justifying our assumption in the context of the model that captures spillovers from the macroeconomy to the financial sector.

To capture cross-factor spillovers, we relax the assumption that Φ(L) is strictly block diagonal. We could in principle allow this entire matrix to be unrestricted. In practice, this would result in a proliferation of parameters that would add uncertainty to the estimates and make the results harder to interpret. Instead, we turn on spillovers in sequence from one factor to another, focusing on those spillovers that are statistically and economically interesting. When we write that one factor spills over to another, we mean that we allow for non-zero coefficients in the relevant rows of Φ(L).

We concentrate on spillovers from the macro to the financial block, and vice versa. Shocks from the financial block are interpreted as global in nature even though this block contains only one variable at a time because, as documented above, there is a distinct global cycle and no country-specific financial cycle in the three financial variables we focus on. From the macro block, we have both country-specific and global macro shocks that can affect the financial cycles.[11] In order to highlight the roles of different spillovers, we isolate them by allowing for one type at a time.

Our spillover models can be described as follows: model 1+2, which combines model 1 (where the financial factor spills over to the world macro factor with lags) and model 2 (where country macro factors spill over to the world macro factor with lags) (equation 7), can be written as follows:

$$(7)\quad F_t^M = \phi^M(L)F_{t-1}^M + \phi^{M,F}(L)F_{t-1}^F + u_t^M$$
$$F_{j,t}^M = \phi_j^M(L)F_{j,t-1}^M + \phi_j^F(L)F_{t-1}^F + u_{j,t}^M$$

where F_t^M refers to the world macro factor, F_t^F is the world financial factor, $F_{j,t}^M$ refers to a country-specific macro factor, and the $\phi\ (L)$ are the relevant lag polynomials. The difference between these two channels is that the first imposes proportional responses (scaled by the factor loading) to the financial factor, meaning that the financial spillovers are symmetric across countries, while the second allows for asymmetric responses.

The combined model 3+4, which allows for the world macro factor (model 3) and U.S. country factor (model 4) to spill over to the financial factor, can be written as follows:

[10] Our assumption is equivalent to ordering macroeconomic variables after financial variables in a Cholesky identification of a VAR. Since we use quarterly data and assume that spillovers take place with a one period lag, our model framework is unable to capture spillovers at higher frequencies. We report robustness results with monthly data in the Online Appendix 1.

[11] We do not argue or show here that there are no cross-block spillovers within countries. Instead, we only focus on spillovers at the global level.

$$(8)\quad F_t^F = \phi^F(L)F_{t-1}^F + \phi^M(L)F_{t-1}^M + \phi_{us}^M(L)F_{US,t-1}^M + u_t^F$$

where $F_{US,t}^M$ refers to the U.S. macro factor and the $\phi(L)$ are the relevant lag polynomials (note that, to keep the notation from getting more complicated, we have not marked the ϕ separately from those in the previous two equations). In principle, any country can be used here; we choose the U.S. since, given its status as the largest economy with a dominant role in global finance, conventional wisdom is that spillovers from its economy are most likely to affect others.[12]

In addition, we estimate models that are decompositions of the combined models. For example, model 1 and model 2 would capture each of the two channels through which the financial factor affects macro variables. This yields variance decompositions where the overall spillover effects equal the sum of the variance contributions of the spillover effects from models 1 and 2. The same is true for models 3 and 4. The specifications and key assumptions for each model are summarized in Table A2 in the Appendix.

The combination of models such as models 1 and 2 yields the same result as estimating the two models separately because our spillover model does not deliver 'new' factors compared to a standard factor model.[13] The spillover parameters do not affect the estimates of the factors themselves. We have estimated models without spillovers and found factors that are identical to those with spillovers. The value added in our model is in the variance decompositions that break down the common factors into sources that are macro and financial in nature. Specifically, we know there is a significant common factor among key macroeconomic variables, i.e., a global business cycle. We document how much of that global business cycle is due to spillovers from financial variables—or, more precisely, how important are innovations that originate in the financial side of the economy for macro variables. Likewise, we document what proportion of financial cycles is attributable to innovations originating in macro variables.

2.3. Model Estimation and Identification

The estimation of the model is Bayesian, though we have strong priors only on the stationarity of the model. Since we are interested in the parameters of the model to measure spillovers, approximate solutions are not appropriate. The state space approach to estimating such models yields more accurate estimates of variance decompositions than the asymptotically justified principal components methods when the model includes multiple layers of factors (Jackson et al., 2016). The size of the model allows us, with some partitioning of the model into blocks, to evaluate its exact likelihood.

It is not possible to derive analytical solutions for the posterior distribution of the model. Therefore, we use numerical methods to simulate from the posterior distribution of model parameters and factors. We follow Kim and Nelson (1998) in using a state-space approach based on using a Gibbs sampler to sequentially sample from the posterior of the parameters conditional on the last draw of the factors and then the factors conditional on the draw of the parameters. The estimation procedure for state-space estimation of dynamic factor models is fairly well known. The specific procedure for drawing factors and parameters is described in Jackson et al. (2016).

[12] This assumption is supported by the empirical evidence that alternative models that assume the spillovers from macro sector in other G-7 countries than the United States did not provide any meaning effects. For instance, in the case of the model with spillovers from Germany, the estimated variance shares of the spillovers from macro factors were at most 2 percent.

[13] Our model does not provide a new estimate of the global common factor since our macro factor is in fact the same as in a standard model. Our model decomposes the movements in that common macro factor into shocks that are innovations to the factor itself, and shocks that originate elsewhere, such as the financial sector, and then spill over into the macro sector.

The number of lags that describe the evolution of the idiosyncratic shocks (q) and latent factors (p) are kept at 2 and 3, respectively.[14] Our priors for the model parameters are generally weak, with the exception that we impose stationarity on the dynamic components. The prior for the autoregressive coefficients in the law of motion of each idiosyncratic shock is $(0, \Omega_0)$. The variance terms of the prior Ω_0 are calculated numerically based on a prior over the roots of the polynomial. We specify a prior over each root of the polynomial that is N(0,0.5). We then draw the two roots and translate those roots into polynomial coefficients. If the polynomial is stationary, we retain the draw. These terms are averaged to get the elements of Ω_0.

The prior for the autoregressive coefficients that govern the evolution of each factor is specified similarly. When Φ(L) is block diagonal, the only variables that enter each factor equation are its own lags, and the prior for the autoregressive coefficients corresponding to these lags is $N(0, \Phi_0)$. As with the idiosyncratic terms, these values come from first specifying a prior over the roots of the polynomial and then translating it into priors for the coefficients. When the block diagonality is relaxed to allow for spillovers, lags of other factors also appear in the law of motion of one or more factors, depending on the exact specification of Φ(L). Accordingly, in these specifications the variance-covariance matrix Φ_0 is augmented to include priors for the coefficients of those lags.[15] The prior on all factor loading coefficients is $\mathrm{N}(0,1)$. The prior for the innovation variances in the observable equation is Inverted Gamma (0.1*T, 0.25^2). These priors are fairly diffuse and none of the results we report below are sensitive to changes in them.

The model faces standard identification issues that permeate this literature. Following the prior literature, we require that one factor loading for each factor be positive. Second, we normalize the innovation variances of the factors to unity as the scale of the factors is not identified. The additional parameters we estimate in the model cause no new problems for identification. To see this, consider the main blocks that we draw from in the Gibbs sampler. Drawing from the factors conditional on the parameters is a standard use of the Carter-Kohn version of the Kalman filter. The fact that there are fewer zero restrictions than usual has no effect on this step, as the filter itself is derived under the assumption that all elements are non-zero. Conditional on the factors, the parameters are drawn equation by equation. For example, drawing the $\phi^M_{US,t}$ term just requires that an additional regressor (the U.S. macro factor) appear in the regression. There is no concern about the factors being misidentified—say, as the world rather than U.S. factor—as the factors are identified through the zero restrictions on the factor loading equations.

2.4. Variance Decompositions

We quantify the relative importance of various factors by calculating how much of the unconditional variance of each observable variable can be attributed to which factor. In the benchmark case, the factors are assumed to be orthogonal so one can simply apply the variance operator to both sides of equation (1) and calculate the variance shares. However, in the model presented above, the factors are not orthogonal by assumption of the spillovers. Hence, we need an alternative method for quantifying the relative importance of different factors.

[14] That *q = p-1* is a matter of convenience as this allows us to perform quasi-differencing of the observables in a straightforward manner. We estimated some of the models with longer lags but the lags beyond 3 were typically not statistically significant.

[15] For example, the prior for the autoregressive coefficients in the law of motion of the world factor with spillovers from the financial factor (model 1) is then given by $N(0, \Phi_{00})$ where $\Phi_{00} = \begin{bmatrix} \Phi_0 & 0 \\ 0 & \Phi_1 \end{bmatrix}$.

Our approach is to use a forecast error variance decomposition and let the forecast horizon go to infinity. In a stationary system, the unconditional variance is the limit of the forecast error variance as the horizon goes to infinity, so this procedure still yields a decomposition of the unconditional variance of each series. This indicates how much of the variance in each observable variable is attributed to the innovations to each factor and is equivalent to writing out the MA(∞) representation of the model and then applying the variance operator.

In practice, we apply standard VAR forecasting formulas (with many zeros imposed on the VAR coefficients) to calculate the variance decompositions. These formulas trace the impact of an innovation to factor A on factor B at horizon *h*. The variance decompositions for observable variable Y then rescales the factor decomposition based on the factor loadings of Y on each factor. For example, denote the variance of the world macro factor explained by the financial factor at horizon H as $Var_H(F^M|F^F)$. The variance of U.S. output at horizon H due to the financial factor is then given by:

$$(11) \qquad Var_H(Y_{US}|F^F) = \frac{\left[b^M_{US,Y}\right]^2 Var_H(F^M|F^F)}{var_H(Y_{US})}$$

In this case, U.S. output does not load on the financial factor. Yet, the formula reveals that U.S. output does depend on the financial factor, due to the impact of the financial factor on the world macro factor. This is the spillover we attempt to measure.

We examine the variance decompositions at a horizon of 30 periods (quarters) in order to abstract from short-term fluctuations. The variance decompositions generally settle down after about 8 quarters, so our approach essentially focuses on a medium- to long-term forecasting horizon. The relative share of each factor's contribution to the forecasting error of each variable does not change substantially from short- to long-term forecasting horizons. The spillover effects, however, do increase over the first few quarters since these effects are generated from lags of the macro or financial factor.

An interesting ancillary question is whether the contributions of different factors have changed over time. In particular, a question is whether the financial crisis that hit the world economy in 2008-09 has a major bearing on the results. To address this issue, we first estimate the models over the full sample (1985-2019) and then separately over two partially overlapping periods: 1985-2007 and 1998-2019.[16] Second, we estimate our combined models 1 and 2 over 15 year rolling sub-periods with one year increments. This provides a better characterization of the evolution of the importance of common factors and spillovers in explaining variation in macroeconomic and financial variables, especially during the global financial crisis.

To avoid cluttering the tables in the main text, we mostly report variance decomposition results averaged across the G-7 economies. We do not report posterior coverage intervals for the variance decompositions (which, in turn, are posterior medians of the variance decompositions based on 10,000 draws). In the main text, we emphasize those results where the one standard deviation bands of the coverage intervals around the estimated medians do not include zero.

Based on this framework, our definition of a common cycle is a latent factor that is common across all countries and variables in a particular model (or relevant subsets thereof) and that excludes spillover

[16] The selection of these sub-samples is largely based on structural break tests performed using regressions of G-7 output growth on lagged output growth and growth rates of financial variables (equity prices and housing prices), and interest rates. The results indicate at least one structural break over the 1985-2019 period, particularly around the 2007-2009 global financial crisis.

effects.[17] These factors are consistent with well-known global (or country-specific) events, such as large macroeconomic and financial fluctuations around global recessions. We do not have a strict quantitative cutoff but emphasize those cases where the variance contributions of the common latent factor are statistically significant but are also economically meaningful in magnitude.[18] By construction, in our framework, any residual commonality among relevant variables that cannot be attributed to common factors (which capture contemporaneous comovement) is attributed to spillovers. We interpret the term macro-financial linkages to encompass both common cycles and spillovers, and our contribution in this paper is a framework that permits this distinction.

2.5. Estimated Global and Country-Specific Factors: A Reality Check

Figure 1 plots posterior median estimates of the global macro factor, the U.S. country factor, and global factors of the three financial variables, along with the respective 16 and 84 percent posterior quantile bands.[19] The estimated global factor tracks global output growth well and picks up the major peaks and troughs: the recession of the early 1990s; the 2001 recession and the subsequent recovery; and the global financial crisis. The U.S. country factor also picks up the main cyclical episodes. The correlation between the U.S. country factor and the global factor is about 0.16. The cross-country correlations among the country factors are quite low, implying that most of the business cycle comovement among G-7 countries is captured by the global macro factor, with little residual correlation among the country-specific cycles.

The estimated financial factors are also consistent with major developments in financial markets. The equity price factor is substantially more volatile than the common factors for each of the other financial variables. The posterior quantile bands for the house price factor are larger than those for the other financial variables, reflecting more variability across G-7 countries in the time series behavior of house prices. The volatility of the house price factor is high in the late 1980s-early 1990s and mid to late 2000s, reflecting boom-bust cycles in G-7 housing markets during these periods. Between these two periods, the house price factor has substantially lower volatility.

3. Empirical Results: Spillovers from the Financial Sector to the Macroeconomy

3.1. Global Spillovers

We first explore the role of spillovers from the financial sector in explaining macroeconomic fluctuations in G-7 countries using models 1 and 2 as well a combination of the two. Table 1 reports G-7 averages of variance decompositions based on these three models for each financial variable.[20]

Equity Prices. We first consider equity prices as the main measure of global financial market activity. The comparison of results from models 1 and 2 indicate that spillovers from equity markets to output and investment take place mostly through the global macro factor (rather than country-specific factors). For instance, the spillovers from the global equity price factor through the global macro factor in model 1 account for 7 percent of output fluctuations over the full sample period (see Table 1, Panel A, third column

[17] This is similar to the definition of the cycle used in the factor model and financial cycle literatures discussed earlier.
[18] For instance, the variance share of the estimated factors is sizeable—at least 10 percent of the total variation of the variable of interest, on average across countries (or in several countries at least).
[19] In Appendix Tables A3 and A4, we report posterior medians of factor loadings and factor vector-autoregressive coefficients.
[20] Appendix Tables A3 and A4 present key parameter estimates—the factor loadings and the vector-autoregressive coefficients on the factors. The posterior coverage intervals around the posterior medians of the estimated variance contributions are reported in Appendix Table A9.

marked SF). The spillovers through the country-specific macro factor (model 2) account for a much smaller share of output fluctuations—just 1.3 percent. The global equity price factor is responsible for 5 percent of the variation in investment in model 1 but only a negligible fraction of consumption fluctuations. The results from the combination of models 1 and 2 indicate that the spillovers through the global macro factor and country-specific factors are together responsible for 17 percent of output fluctuations, 6 percent of consumption fluctuations, and 11 percent of investment fluctuations in 1998-2019. These results collectively suggest that spillovers originating in equity markets play a significant, although not dominant, role in explaining macroeconomic fluctuations.

The potency of spillovers from equity markets has increased over time for all macroeconomic variables (see also Appendix 2). For example, the average variance of output due to spillovers from the global equity price factor (combination of models 1 and 2) increases from 7 percent in 1985-2007 to 17 percent in 1998-2019, mainly due to larger spillovers through the global macro factor.[21] Contributions of spillovers from equity markets to fluctuations in output and investment have become larger in 1998-2019 than those in the case of consumption. Interestingly, the comovement of equity prices, captured by the fraction of variance of equity prices accounted for by the global equity price factor (Table 1, column heading F), increased only modestly in 1998-2019 relative to 1985-2007 (from 50 to 59 percent in the combined model). Thus, it is not the greater integration of equity markets across the G-7 but the size of their spillover effects on to macro cycles that distinguishes the latter period from the former one.

How important are financial market spillovers relative to the global macro factor in driving macroeconomic fluctuations? Among the G-7 countries, the role of spillovers from the global equity markets is on average smaller but, relative to that of the global macro factors, is still sizeable (Figures A1 and A2). Specifically, over the period 1998-2019, the global macro factor (comparable numbers for spillovers from the global equity price factor are in parentheses) on average accounts for about 34 (17) percent of output fluctuations, 8 (6) percent of consumption fluctuations, and 22 (11) percent of investment fluctuations. While the average variance of output and investment explained by the global macro factor is higher in this period compared to 1985-2007, the corresponding increase in the relative importance of spillovers from the global equity price factor between the two periods is slightly larger.[22]

The global macro factor explains a larger fraction of the variance in output compared to that of consumption. This result is consistent with other evidence that, contrary to the predictions of standard international risk sharing models, output fluctuations are more correlated across countries than consumption fluctuations (Backus, Kehoe, and Kydland, 1992; Kose, Otrok, and Prasad, 2012). Country-specific factors account for one-quarter to one-third of fluctuations in output and investment, and an even higher share of consumption fluctuations, in the 1998-2019 period (Table 1, column C).

Given that the combined model captures both the global and country-specific channels of spillovers and the degree of comovement is higher in the period 1998-2019, in the rest of this sub-section we focus on the results from the combined model over the second period—the table does report results for the full sample and the earlier period.

[21] Nonoverlapping posterior coverage intervals around the posterior medians of the estimated variance contributions indicate "statistically significant" changes between the two periods. Our results indicate that the averages presented here are representative of patterns at the country level.

[22] As noted in Sections 1 and 2, these sizeable spillover effects suggest that the estimated role of common shocks could be significantly overstated in the case of the model without the spillovers—such as in the model 3+4 (as shown in Appendix 2).

House Prices. In Panel B of Table 1, we present results using house prices as the financial market variable. This is of particular interest as developments in U.S. and certain other G-7 housing markets seem to have played a significant role in precipitating the 2009 global recession and amplifying the recession's macroeconomic effects. The cross-country comovement of house prices, as captured by the share of fluctuations in this variable accounted for by the estimated global house price factor, is much smaller than that of equity prices, partly reflecting the non-tradable nature of housing markets. For the combined model, this share is only about 12 percent for the full sample and 20 percent for 1998-2019 (see column F, last row).

The role of the global house price factor in driving macroeconomic fluctuations is significant and increases over time. Based on the combined model for the period 1998-2019, the global house price factor on average accounts for about 16 percent of output fluctuations, 6 percent of consumption fluctuations, and 11 percent of investment fluctuations (last row of columns marked SF). Similar to the results with equity prices, the spillover effects on to the macroeconomy operate mainly through the global macro factor rather than the country-specific factor—in the case of output, the corresponding variance contributions are 15 percent and 2 percent, respectively.

The global macro factor plays an increasingly important role in explaining fluctuations in output and investment (Table 1 and Figure A3). Similar to the results with equity prices, and although the role of the global macro factor has become more pronounced in the second period, the relative importance of spillovers from the global house price factor nearly doubles between the two periods (the absolute increase in the variance contribution of the global macro factor is greater). Over the period 1998-2019, the average variance of output explained by the global macro factor is about two to three times larger than that of spillovers from the global house price factor (40 percent versus 16 percent), compared to a ratio of roughly four over the full sample (33 percent versus 8 percent).

Interest Rates. Panel C of Table 1 shows the results when we use short-term interest rates as the financial market variable. During 1998-2019, the variance contributions of the global interest-rate factor through the spillover effects on the global macro factor amount to 7 percent for output, 4 percent for consumption, and 5 percent for investment fluctuations (column SF, bottom row of the panel). As in the case for equity and house prices, a substantial portion of these spillovers takes place through the global macro factor. The average variance explained by spillovers through the country-specific factors are in the range of only about 1-2 percent. Although the importance of the global macro factor increases by more than twofold in the second period (48 percent versus 21 percent), the variance of output attributable to spillovers from the global interest rate factor registers only a marginal increase. The average variance of interest rates due to the global interest rate factor rose from 25 percent in 1985-2007 to 31 percent in 1998-2019 (column F). The degree of comovement of interest rates across G-7 countries is much higher than that of house prices, although lower than that of equity prices, especially in the aftermath of the global financial crisis. [23] Our headline results did not change when we used long-term interest rates (10-year bond yields, as documented in Online Appendix 1).

Evolution of Spillovers. Splitting the full sample into two overlapping periods has provided a coarse view of how the relative importance of different factors has shifted over time. To further explore this dimension of our results, we re-estimated the combined models 1 and 2 over 15-year rolling windows with one-year increments. In Figure A4, we present the average variance of output explained by the global macro factor

[23] For instance, Avdjiev et al. (2020) and Buch et al. (2019) document increases in the importance of the global factor in international liquidity flows around and after the global financial crisis, largely due to the transmission of U.S. monetary policies.

and spillovers stemming from the financial sector over these sub-periods. The results indicate a sharp increase over time in the importance of the global macro factor especially after the 2007-08 global financial crisis. Specifically, the average variance due to the global macro factor (over the 15-year rolling sub-periods) increases from about 20-30 percent from the early 2000s to roughly 35-55 percent after 2007, depending on which financial variable we use in estimating the model.[24]

While spillovers from the global equity and house price factors to output fluctuations have become larger after the global financial crisis, those associated with the global interest rate factor have not changed much. For example, prior to the 2007-08 crisis, spillovers from the global equity and house price factors on average account for 7 percent and 8 percent, respectively, of output variation over the 15-year rolling sub-periods. With the unfolding of the crisis, spillovers from these two factors on average account for 15-25 percent of output variance. These results echo our earlier findings from the two specific sub-samples (1985-2007 and 1998-2019). However, they also highlight significant changes in the nature of cross-border spillovers and the extent of comovement between the financial sector and the macroeconomy during periods of financial stress. There was naturally a steep increase in the importance of the global macro factor because of the global financial crisis, in addition to more pronounced spillovers from financial markets onto the macroeconomy since then.

3.2. Country-Specific Spillovers

We now present results for individual countries rather than G-7 averages. The composite spillovers from financial variables to output growth fluctuations, operating through both the global factor and the country-specific factors (combination of models 1 and 2), are shown for each country and macroeconomic variable in Appendix Tables A5-A6. Table A5 shows the combined spillovers over different periods. For all financial variables, these spillovers are usually much higher—or at least as high—during the period 1998-2019 relative to estimates based on the period 1985-2007 or the full sample. Hence, to conserve space, we mainly emphasize the results for 1998-2019.[25] Table A5 shows the breakdown of the variance contributions of different factors over the period 1998-2019.

Table A5 shows that there are significant spillovers from the global equity price factor to output in all G-7 countries. The average variance of output due to spillovers associated with the global equity price factor is about 17 percent, ranging from 10 percent in the U.S. to 24 percent in France. The spillover effects from the global house price factor are also large: it on average accounts for 16 percent of output fluctuations (ranging from 10-13 percent in Japan and the U.S. to 20-21 percent in France, Germany, and Italy). Comparing contributions of spillovers from the global equity and house price factors with that of the global macro factor shows that spillovers from the financial sector play an important role in driving macroeconomic fluctuations in some countries (Table A6). For example, in the U.K., the share of variance due to spillovers from the global equity price or the global house price factor is around one-half of the variation that is explained by the global macro factor. The importance of spillovers from the global interest rate factor is on average relatively smaller than that of other financial variables but still sizeable in the three eurozone countries (France, Germany, and Italy).

[24] These findings are consistent with other evidence of an increase in the extent of business cycle synchronization during periods of financial stress (e.g., Imbs, 2010; and Kalemli-Ozcan, Papaioannou, and Peydro (2013). We also experimented with alternative sample periods. For instance, when we restricted the sample period to 1998-2019, as suggested by a referee, the results were quite similar to those we reported for 1985-2019. We acknowledge that more recent shifts in the pattern of globalization could influence our results and we leave this for future work.

[25] We present a selection of the key results for output fluctuations over the period 1998-2019 in Appendix Figure A5 and detailed country-level results from the combined models in Appendix Table A10.

The global equity and house price factors play significant roles in driving U.S. output, consumption, and investment fluctuations, while the global interest rate factor plays a smaller role. The global macro factor accounts for 17 percent of the variance of U.S. output while the country factor accounts for about 39 percent. The results are roughly similar for U.S. investment fluctuations while the variance contribution of the global factor is much smaller for U.S. consumption fluctuations. The results are qualitatively similar independent of which financial indicator we use. In the case of output, the share of variance due to the spillovers from the global equity price factor is about two-thirds that of the global macro factor (10.4 percent versus 16.5 percent), confirming that financial market spillovers are important but less so than the global macro factor. In the case of the house price factor, this ratio is about one-half (10.6 percent versus 22.1 percent).

We turn next to a relatively smaller but more open economy, Canada, where one would *a priori* expect financial market spillovers to be larger than in the case of the U.S. We indeed find larger spillover effects from the financial cycle in Canada, especially when we use equity prices as the financial indicator. The global equity price factor accounts for the following variance shares: 13 percent of output fluctuations, 11 percent of consumption fluctuations, and 19 percent of investment fluctuations. The variance contributions are similar for each of the macro variables when we use house prices as the financial indicator, and 5-7 percent in the case of the global interest rate factor. Examining the breakdown of variance contributions shows that the global macro factor accounts for more of the fluctuations in all three Canadian macroeconomic aggregates than in the case of the U.S.

We also find sizeable financial market spillovers for other G-7 countries. For instance, over the period 1998-2019, 24 percent of output fluctuations, 7 percent of consumption fluctuations, and 18 percent of investment fluctuations in France are accounted for by the spillovers from the global equity price factor. The corresponding numbers based on the house price variable are 21 percent, 5 percent, and 17 percent, respectively. For Japan and the U.K., the contributions to the variance of output fluctuations from spillovers of the global equity and house prices are around 13-16 percent. These country-level results largely confirm the broader results based on the full G-7 sample.

3.3. Spillovers from the Macroeconomy to the Financial Sector

Next, we adapted the framework to understand the role of macroeconomic cycles in driving fluctuations in G-7 countries' financial markets. In particular, we evaluated spillovers (both individually and collectively) from the global macro factor and the U.S. country-specific macro factor to the financial sector. These results are presented and discussed in detail in Appendix A2. The main takeaway was that there is weaker evidence of spillovers from macroeconomic cycles to financial cycles compared with the spillovers from the financial sector to the macroeconomy.

Over the full sample period, the combined spillovers from the global and U.S. country-specific macro factors account for just 1-2 percent of the variance of equity prices and house prices (the relevant results are under the column heading SR). By contrast, the spillovers from these macro factors to interest rates are greater, amounting to 5 percent of the variance of interest rate fluctuations during the period 1998-2019.

We also estimated these models over 15 year rolling windows with one-year increments (see the Online Appendix for detailed results). Similar to the findings in the previous sub-section, the importance of the global financial factor in explaining fluctuations in equity prices, interest rates and house prices increases over time, especially after the global financial crisis. Nevertheless, at least in terms of average variance

contributions for the G-7 countries the global and U.S. macro factors have a relatively modest impact on global financial cycles. One exception is that of G-7 short-term interest rates, which seem to experience significant spillovers from the global and U.S. country-specific macro factors.[26]

Country-level results on the importance of spillovers from macroeconomic aggregates to financial variables were generally consistent with the averages discussed above. The spillovers from macro factors onto equity prices are quite muted for all countries, although in most cases the variance contributions do increase marginally in the second sub-sample. The largest spillover effects of macroeconomic cycles are on interest rates, with particularly large spillovers in the cases of France, Canada, and the U.S. While the average variance of short-term interest rates ascribed to spillovers from the macro factors increases only moderately from 1985-2007 to 1998-2019, this share increases markedly for three countries—France, Germany, and Italy. For house prices, the share of spillovers from macro factors increases substantially in Canada, France, Italy, and the U.K.

4. Interpretation and Extensions

Our main results can be summarized as follows. First, among the G-7 countries, there are sizeable spillovers from the global equity and house price factors onto macroeconomic fluctuations. These spillovers are responsible for a larger share of variation of output and investment than of consumption. Spillovers from the global interest rate factor are small and their contributions to macroeconomic fluctuations are relatively modest compared with those of equity and house prices.

Second, the global macro factor plays a more important role than the financial factor in explaining macroeconomic fluctuations but the relative importance of spillovers stemming from the financial sector is sizeable, especially in the case of equity and housing markets.[27] Third, spillovers from the global equity and house price factors operate mainly through the global macro factor rather than through the country-specific macro factors.

Fourth, the importance of spillovers from the equity price and house price global factors has risen over time. Specifically, it increased by more than twofold in the case of equity prices and by more than threefold in the case of house prices in 1998-2019. Given the global nature of the 2008-09 financial crisis, there has also been a substantial increase in the importance of the global macro factor in explaining macroeconomic fluctuations after 2007. Finally, both equity prices and interest rates display a high degree of cross-country comovement among G-7 countries, with this comovement intensifying in the period 1998-2019 relative to 1985-2007. Comovement of house prices is modest, even during the latter period.

4.1. Interpretation

Our results show the importance of spillovers from the financial sector to the macroeconomy.[28] In particular, spillovers from cross-country comovements in global equity and housing markets have a

[26] The posterior coverage intervals around the posterior medians of the estimated variance contributions are in Appendix Table A11.

[27] This result is broadly in line with Huo, Levchenko, and Pandalai-Nayar (2019) and Di Giovanni, Levchenko, and Mejean (2018) in that most of the business cycle synchronization among G-7 countries is accounted for by common or correlated shocks, while the cross-border transmission of shocks has an economically meaningful, but smaller, role in comovement.

[28] The variance decompositions we discuss here are a product of the factor loadings and the variances of the factors. In most cases, the loadings of the macroeconomic factors on the global macro factor are larger than the loadings on the country macro

significant influence on national business cycles even after accounting for the roles played by the global and country-specific macro factors. These results support theoretical studies linking developments in equity and housing markets to macroeconomic fluctuations. For example, equity price fluctuations can be associated with leverage cycles that translate into fluctuations in the real economy (Cesa-Bianchi, Rebucci, and Pesaran, 2020; Adrian, Colla, and Shin, 2013; Geanakoplos, 2010). Shocks originating in housing markets can be a source of macroeconomic fluctuations in the context of general equilibrium models (Iacoviello, 2005; Liu, Wang and Zha, 2015).

Our results indicate that spillovers from the global interest rate factor contribute to macroeconomic fluctuations, but their roles tend to be smaller than those of the global equity and house price factors. The small role of the interest rate factor in driving macroeconomic fluctuations in the period 1998-2019 may reflect the weak role of conventional monetary policy in influencing economic activity once policy rates in the G-7 economies approached the zero lower bound.

We also find that the combined spillovers from the global and U.S. country-specific macro factors account for just 1-2 percent of the variance of equity prices and house prices but as much as 5 percent of the variance of interest rate fluctuations during the period 1998-2019. Assuming that short-term interest rates are largely reflective of policy interest rates, this result implies that any commonality in the policy actions of G-7 central banks is influenced to a significant extent by common fluctuations in key macroeconomic variables in these countries. The contribution of the U.S. country-specific macro factor to the variance of fluctuations in interest rates is slightly larger than that of the global macro factor in the second sub-sample. This is consistent with the observation that the Great Recession that initially hit the U.S. rapidly induced monetary policy responses from other G-7 economies.

These results are generally supportive of the earlier findings in the literature. Some of these studies consider the predictive ability of macroeconomic variables for financial aggregates while others examine the explanatory power of the second moments of macro variables for the second moments of financial aggregates. In the context of interest rates, both theory and evidence point to the presence of an interest rate channel through which movements in policy rates have implications for macroeconomic outcomes (Woodford, 2003). Some empirical studies document that interest rates react to changes in macroeconomic variables (Gurkaynak and Wright, 2012). Jotikasthira, Le, and Lundblad (2015) report that shocks originating in the real economy affect interest rates and their synchronization across countries.[29]

The variable-specific financial cycles we identify become more prominent over time. In other words, the cross-country comovement among financial variables has intensified, especially in the period after the global financial crisis. Similarly, the spillovers from financial cycles to macroeconomic variables have increased and, while they remain modest even towards the end of the sample, the spillovers from macroeconomic cycles to financial variables have also tended to rise. Thus, our results indicate that global macro-financial linkages are becoming stronger over time.

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factors. The loadings of equity prices on the global financial factor are much greater than the loadings of other financial variables on their corresponding financial factors, confirming the evidence we presented earlier in the paper on the substantial comovement of equity prices among G-7 countries.

[29] Some other studies analyze the importance of macroeconomic variables for financial markets, Engle, Ghysels, and Sohn (2013), and Acalin and Rebucci (2020). Cesa-Bianchi, Rebucci, and Pesaran (2020) find that the global macro financial factor accounts for hardly any of the variation in financial indicators and a relatively small share of output variation. Some of these studies consider macro-financial interactions at lower frequencies (rather than the quarterly data we employ here) and others examine the impact of surprise macroeconomic announcements (rather than the realized data as we do here).

4.2. Extensions

We briefly discuss two extensions of our main results. These extensions focus on the use of monthly (instead of quarterly data) and the use of an expanded set of countries (including other advanced economies and emerging market economies). We present the detailed results of these extensions in the Online Appendix.

Monthly data. One question is whether our use of quarterly data drives the key results, for instance by conflating common shocks and spillovers. If shocks are transmitted rapidly from financial to real variables and vice versa, our model would underestimate spillovers. The macro aggregates we study are available only at a quarterly frequency and reported with a lag. Nevertheless, in order to investigate this issue further, we used monthly industrial production as an indicator of macroeconomic cycles, focusing on the period 1998-2019. The degree of comovement of financial variables is higher in monthly data than in quarterly data. The global factor has a significant explanatory role only for the variance of equity prices and there is little evidence of strong comovement between industrial production and any financial variable. When we allow for spillovers from financial variables to the macroeconomy, we find significant spillovers only from equity prices, while the spillover effects from industrial production to the financial variables are small. Thus, our main results on the relative importance of different spillovers are preserved when we use monthly data.

Larger country sample. In our baseline estimations, we have focused on the G-7 economies, which collectively dominate global GDP and finance, but emerging markets now account for a large share of global GDP and play an important role in global business cycles. We therefore extended our dataset to consider two larger samples: (i) the G-7 plus seven large emerging market economies—Brazil, China, India, Indonesia, Mexico, Russia, and Turkey (referred to as the EM-7, following Huidrom et al. 2020), and (ii) G-7, EM-7 and seven other open economies—Australia, Chile, South Korea, Spain, Sweden, Switzerland, and Thailand.[30]

The empirical results based on the expanded country groups are broadly in line with the baseline G-7 results, although the degree of global synchronization (both among macro and financial variables) and the spillover effects weaken as we include EM-7 or other countries in the sample, consistent with earlier studies.[31] As might be expected, the comovement of macro variables becomes weaker as we incorporate more diverse groups of economies. For instance, the average share of output variance attributable to the global macro factor is 34 percent for the G-7 economies but only 25-32 percent based on the expanded samples. In the version of the model with all 21 countries, the variance contribution of the global factor is highest among the G-7 (36 percent), followed by other open economies (22 percent), and the EM-7 (18 percent). The relative contributions of the common financial factor to the variance of the relevant financial variables—a measure of financial market synchronization—follow a similar pattern.[32] For example, the average share of the variance in equity prices accounted for by the corresponding global

[30] The expanded datasets involved a variety of compromises because of constraints in the availability of data. The Online Appendix provides further details on the sources and construction of the extended datasets.

[31] See, for instance, Kose, Otrok, and Prasad (2012). In contrast, Caballero, Fernandez, and Park (2019) find that corporate bond spreads are correlated across emerging market countries and that corporate borrowing serves as a conduit through which external financial factors can drive economic activity in these economies.

[32] This is broadly consistent with the findings of Bekaert, Harvey, and Mondino (2023) and Cesa-Bianchi, Cespedes, and Rebucci (2015) who find that, despite the forces of globalization, equity and housing markets are still segregated between developed and emerging markets.

financial factor is 59 percent for the G-7 economies, while the share is 48-53 percent, on average, for the expanded country groups.

Consistent with the baseline results, in the extended samples the financial spillovers onto macro variables are most sizeable from the common factors for equity prices and house prices. For instance, spillover effects from the equity price factor, on average, account for about 10 percent of output variance in models incorporating the EM-7 as well as in the 21-country sample. Again, the spillover effects are more pronounced for the G-7 than for other economies. Macro spillovers onto financial variables remain small in the extended country samples. In the baseline model, the macro factors had significant spillover effects onto interest rates; the average of these spillovers is halved when we include the EM-7 and other countries, reflecting the more idiosyncratic movements of short-term rates in those countries. The macro spillovers to house price fluctuations remain at around 4 percent in the extended samples. Nevertheless, emerging markets and small open economies experience significant spillovers, especially from financial shocks and mainly through global macro factors.[33]

While some of the spillovers to emerging market and small open economies might seem small, the intrinsically higher business cycle volatility in these economies, their more constrained policy tools (relative to large advanced economies), and the weaker transmission mechanisms of policies in response to shocks, render policymakers in these economies concerned about even modest spillovers. Both macro and financial spillovers from large advanced economies, for instance, have been shown to have large effects on emerging market economies even while severely constraining their monetary policy responses (see, e.g., Rey 2015). Thus, particularly in the context of these economies, understanding the direction and intensity of macro-financial spillover effects, as well as their evolution over time, is crucial from a welfare perspective.[34]

5. Conclusion

Our objective in this paper was to provide a joint empirical characterization of macroeconomic and financial cycles, and the linkages between these cycles. We developed a new dynamic factor model that allows us to study business cycle comovement, evaluate the magnitude of financial market spillovers onto real macroeconomic aggregates (and vice versa), and differentiate between global shocks and spillovers. We applied the model to quarterly macroeconomic and financial market data for the G-7 economies over the period 1985-2019.

The major novelty of our factor model is that it enables us to distinguish between common shocks and spillovers from one sector to another. For instance, we are able to capture the extent to which spillovers from financial markets affect global business cycles. This provides an economically useful decomposition of the observed cross-country comovement of key macroeconomic and financial variables. The model is general enough that we can also model spillovers from one country to others. This adds a second layer to our understanding of the nature of comovement. The model allows us to analyze if it is the transmission of country-specific shocks or the prevalence of common shocks that drives global business cycle comovement.

[33] Cesa-Bianchi, Cespedes, and Rebucci (2015) find that house prices are less synchronized across emerging markets than across advanced economies while a global liquidity shock has a stronger impact on house prices and consumption in emerging markets.

[34] Some studies consider policy and financial spillovers in dynamic general equilibrium models. Some of these studies document the importance of separating spillovers from common shocks to better assess financial spillovers (Georgiadis and Jancokova 2020).

Our main findings are as follows. Over the period 1985-2019, there is evidence of common business cycles, as reflected in the comovement of macroeconomic aggregates, among the G-7 economies. There are also common cycles specific to certain financial variables, especially equity prices and interest rates. The global macro factor plays an important role in explaining fluctuations in macroeconomic variables but there are also quantitatively significant spillovers from shocks to specific financial variables—equity prices and house prices, in particular—on to macroeconomic variables. Interest rates (and credit) do matter as well but they are quantitatively less important as sources of such spillover effects. Common cycles among real and financial variables, respectively, and also the spillovers from financial to real variables are stronger in the period leading up to and following the financial crisis. These results, including the cross-country comovement of macro and financial variables and macro-financial spillovers, are similar but weaker in magnitude in broader samples that include major emerging market economies and other small open economies.

This work could be extended in a number of directions. First, it would be useful to investigate how business cycle dynamics play out at the sectoral level in response to financial shocks and, in turn, how aggregate business and financial cycles are affected by sectoral dynamics. Second, in light of our findings, it would be worth exploring in more detail the two-way spillovers between domestic and global macro-financial cycles in the context of specific asset classes and their price dynamics. Finally, it would be interesting to consider how policy responses, including monetary, fiscal, and financial sector policies, shape the transmission channels and feedback effects between different groups of countries. This may require a different class of models, however.

Table 1. Variance Decompositions: Spillovers from Financial Sector to Macroeconomy (Models 1, 2, and Combined Models 1&2; G-7 Averages)

A. Model with Equity Prices

	Output				Consumption				Investment				Equity prices	
	W	C	SF	I	W	C	SF	I	W	C	SF	I	F	I
	Model 1													
1985-2019	31.4	33.1	7.4	28.2	7.1	29.2	1.7	62.0	20.1	24.4	4.7	50.8	56.0	44.0
1985-2007	23.5	39.7	3.6	33.2	7.7	29.7	1.2	61.5	18.8	23.2	2.8	55.2	42.7	57.3
1998-2019	34.6	24.7	15.4	25.3	8.6	31.3	3.9	56.3	22.3	17.0	10.0	50.6	59.6	40.4
	Model 2													
1985-2019	40.0	32.6	1.3	26.1	10.2	28.0	1.1	60.7	26.2	23.1	1.0	49.8	55.9	44.1
1985-2007	30.3	36.5	2.1	31.1	10.8	29.1	1.6	58.5	24.3	21.6	1.3	52.8	50.6	49.4
1998-2019	47.0	25.6	1.9	25.5	12.3	28.6	2.1	57.0	31.0	16.7	1.2	51.1	59.2	40.8
	Model 1&2													
1985-2019	31.7	33.6	8.7	26.0	7.3	29.6	2.9	60.3	20.6	22.5	5.7	51.2	55.9	44.1
1985-2007	21.5	39.0	6.5	33.0	6.8	29.5	3.0	60.6	17.0	23.0	4.8	55.2	50.4	49.6
1998-2019	33.6	24.4	17.3	24.7	8.3	30.7	6.2	54.8	22.1	16.1	11.4	50.4	59.3	40.7

B. Model with House Prices

	Output				Consumption				Investment				House prices	
	W	C	SF	I	W	C	SF	I	W	C	SF	I	F	I
	Model 1													
1985-2019	33.7	33.0	6.2	27.2	8.1	28.1	1.5	62.3	21.4	25.0	3.9	49.6	12.4	87.6
1985-2007	25.7	38.6	3.6	32.2	8.9	29.7	1.3	60.0	20.0	22.7	2.8	54.4	10.7	89.3
1998-2019	38.8	23.1	14.7	23.4	10.5	31.0	3.9	54.6	26.3	16.0	9.9	47.9	19.8	80.2
	Model 2													
1985-2019	37.0	33.3	2.0	27.7	8.1	28.4	1.5	62.0	23.6	23.8	1.3	51.3	10.5	89.5
1985-2007	27.6	37.8	3.2	31.4	9.0	29.8	2.3	58.8	21.7	21.6	2.0	54.7	10.6	89.4
1998-2019	50.0	23.7	1.9	24.4	13.8	28.1	2.2	55.9	33.9	16.8	1.3	48.0	20.4	79.6
	Model 1&2													
1985-2019	33.0	33.7	8.2	25.2	7.8	29.0	3.1	60.1	21.4	22.1	5.4	51.2	12.4	87.6
1985-2007	19.2	41.8	5.9	33.2	5.5	30.2	3.2	61.0	16.3	25.2	4.2	54.3	9.6	90.4
1998-2019	39.8	21.9	16.1	22.3	11.2	28.9	6.3	53.6	27.7	15.4	11.1	45.8	20.0	80.0

C. Model with Interest Rates

	Output				Consumption				Investment				Interest rates	
	W	C	SF	I	W	C	SF	I	W	C	SF	I	F	I
	Model 1													
1985-2019	38.5	34.4	1.3	25.9	9.6	28.0	0.3	62.1	25.0	23.2	0.8	50.9	24.5	75.5
1985-2007	26.4	38.1	3.0	32.5	9.2	29.1	1.1	60.5	20.4	23.6	2.4	53.7	24.3	75.7
1998-2019	48.8	23.2	4.4	23.6	14.0	28.9	1.3	55.8	32.7	16.5	3.0	47.8	30.5	69.5
	Model 2													
1985-2019	39.6	33.5	1.4	25.6	10.0	27.6	1.1	61.2	25.9	22.8	1.0	50.4	24.7	75.3
1985-2007	27.2	38.6	2.2	31.9	9.1	29.7	1.7	59.5	21.7	22.2	1.4	54.8	23.9	76.1
1998-2019	48.8	24.6	1.6	25.1	12.9	29.0	2.0	56.1	32.7	17.6	1.1	48.6	31.2	68.8
	Model 1&2													
1985-2019	38.9	32.6	3.0	25.5	9.9	27.6	1.6	61.0	25.6	22.9	2.1	49.5	24.6	75.4
1985-2007	20.6	41.4	5.9	32.1	6.4	33.0	3.6	57.0	18.4	26.4	4.5	50.7	24.9	75.1
1998-2019	48.0	22.2	7.1	22.7	13.8	28.6	3.5	54.1	33.3	16.0	5.0	45.7	30.9	69.1

Notes: In each cell, the variance share attributable to the relevant factor is reported, based on the models with spillovers. The share is averaged across the G-7 countries at a horizon of 30 quarters. The variance contributions are attributed to: W (global macro factor), C (country-specific macro factor), F (global financial factor), SF (spillovers from financial to macro factors), and I (idiosyncratic factor). In Model 1, the financial factor spills over to the global macro factor. In Model 2, the financial factor spills over directly to the country-specific macro factor. Models 1&2 combined captures both channels through which the financial factor affects macro fluctuations. See Table A2 in the Appendix for more details on the model specification.

Table 2. Variance Decompositions
(Models With Only Financial Variables; 1998-2019)

A. Equity Prices

	One Factor Model		Two Factor Model			Three Factor Model			
	Global	Idiosyncratic	Global	Variable	Idiosyncratic	Global	Variable	Country	Idiosyncratic
Canada	64.4	35.6	1.9	67.3	30.8	0.7	67.8	0.2	30.7
France	63.1	36.9	20.9	68.8	10.4	35.9	55.7	0.2	7.0
Germany	64.7	35.3	14.5	67.1	18.4	25.9	55.4	0.8	16.2
Italy	45.4	54.6	19.4	53.1	27.4	33.7	41.7	0.3	24.8
Japan	45.8	54.2	5.3	46.6	48.1	2.6	49.5	32.6	14.7
United Kingdom	78.7	21.3	1.5	79.0	19.5	0.7	79.4	0.8	18.1
United States	74.3	25.7	3.0	79.6	17.4	0.7	81.8	2.0	14.5
Average	62.3	37.7	9.5	65.9	24.6	14.3	61.6	5.3	18.0

B. House Prices

	One Factor Model		Two Factor Model			Three Factor Model			
	Global	Idiosyncratic	Global	Variable	Idiosyncratic	Global	Variable	Country	Idiosyncratic
Canada	8.7	91.3	1.1	8.2	90.7	0.5	28.6	44.3	26.2
France	6.9	93.1	0.7	16.8	82.5	0.2	14.3	2.9	82.5
Germany	0.0	100.0	1.5	0.7	97.8	0.8	0.6	8.0	90.3
Italy	8.2	91.8	0.9	5.6	93.5	0.1	29.0	0.4	70.0
Japan	0.0	100.0	0.1	11.3	88.6	0.1	0.3	7.7	91.7
United Kingdom	6.7	93.3	1.6	76.2	22.1	0.6	82.1	1.6	14.9
United States	0.6	99.4	2.1	15.0	82.8	0.2	0.4	29.3	69.6
Average	4.4	95.6	1.2	19.1	79.7	0.4	22.2	13.4	63.6

C. Interest Rates

	One Factor Model		Two Factor Model			Three Factor Model			
	Global	Idiosyncratic	Global	Variable	Idiosyncratic	Global	Variable	Country	Idiosyncratic
Canada	1.3	98.7	0.9	0.6	98.6	0.2	65.7	5.6	24.5
France	0.6	99.4	0.7	61.2	38.2	0.5	40.5	2.2	55.3
Germany	1.3	98.7	3.3	33.5	63.2	2.7	27.5	1.3	67.5
Italy	0.3	99.7	0.6	19.1	80.4	0.4	9.0	1.0	88.9
Japan	0.6	99.4	2.7	1.5	95.9	0.6	5.2	10.0	83.3
United Kingdom	4.1	95.9	0.3	14.6	85.0	0.7	17.2	1.2	80.3
United States	0.1	99.9	6.4	27.0	66.6	0.8	44.8	40.6	13.7
Average	1.2	98.8	2.1	22.5	75.4	0.8	30.0	8.9	59.1

Notes: In each cell, the variance share attributable to the relevant factor is reported. The variance contributions are attributed to: Global (global factor), Variable (variable-specific factor), Country (country-specific factor), and Idiosyncratic (idiosyncratic factor). The one-factor model refers to the dynamic factor model that includes only a global factor common to all variables and countries: $Y_t^{i,j} = \beta_{global} f_t^{global} + \varepsilon_t^{i,j}$, where *i* and *j* are the variable and country indexes, respectively. The two-factor model includes: (i) a global factor common to all variables and countries; and (ii) variable-specific factors that capture common cross-country fluctuations specific to each financial variable: $Y_t^{i,j} = \beta_{global} f_t^{global} + \beta^i f_t^i + \varepsilon_t^{i,j}$. The three-factor model includes (i) a global factor common to all variables and countries; (ii) variable-specific factors that capture common cross-country fluctuations specific to each financial variable; and (iii) country-specific factors that capture the comovement of all financial variables within a particular country: $Y_t^{i,j} = \beta_{global} f_t^{global} + \beta^i f_t^i + \beta^j f_t^j + \varepsilon_t^{i,j}$. The last row in each panel shows the unweighted average of variance contributions in the respective columns.

Table 3. Variance Decompositions: (Models With Macroeconomic and Financial variables; 1985-2019)

A. Equity prices

	Output		Consumption		Investment		Equity price	
	Global	Idiosyncratic	Global	Idiosyncratic	Global	Idiosyncratic	Global	Idiosyncratic
Canada	4.6	95.4	12.0	88.0	12.7	87.3	68.3	31.7
France	7.1	92.9	1.5	98.5	3.6	96.4	49.6	50.4
Germany	3.0	97.0	0.1	99.9	0.4	99.6	53.1	46.9
Italy	7.8	92.2	4.8	95.2	1.1	98.9	34.2	65.8
Japan	5.0	95.0	0.8	99.2	0.1	99.9	33.6	66.4
United Kingdom	9.9	90.1	5.2	94.8	0.1	99.9	72.0	28.0
United States	16.2	83.8	14.4	85.6	15.1	84.9	76.5	23.5
Average	7.6	92.4	5.5	94.5	4.7	95.3	55.3	44.7
Median	7.1	92.9	4.8	95.2	1.1	98.9	53.1	46.9

B. House prices

	Output		Consumption		Investment		House prices	
	Global	Idiosyncratic	Global	Idiosyncratic	Global	Idiosyncratic	Global	Idiosyncratic
Canada	26.4	73.6	14.8	85.2	30.2	69.8	11.7	88.3
France	63.4	36.6	9.7	90.3	59.9	40.1	29.2	70.8
Germany	35.3	64.7	0.5	99.5	20.8	79.2	0.1	99.9
Italy	50.4	49.6	16.2	83.8	20.6	79.4	12.4	87.6
Japan	22.9	77.1	2.7	97.3	10.0	90.0	2.9	97.1
United Kingdom	29.7	70.3	10.9	89.1	9.2	90.8	16.6	83.4
United States	26.5	73.5	16.2	83.8	30.0	70.0	0.3	99.7
Average	36.4	63.6	10.1	89.9	25.8	74.2	10.5	89.5
Median	29.7	70.3	10.9	89.1	20.8	79.2	11.7	88.3

C. Interest Rates

	Output		Consumption		Investment		Interest rates	
	Global	Idiosyncratic	Global	Idiosyncratic	Global	Idiosyncratic	Global	Idiosyncratic
Canada	24.8	75.2	15.8	84.2	27.3	72.7	2.7	97.3
France	23.6	76.4	13.2	86.8	28.2	71.8	2.6	97.4
Germany	63.5	36.5	9.6	90.4	57.1	42.9	0.5	99.5
Italy	34.9	65.1	0.6	99.4	20.9	79.1	1.1	98.9
Japan	48.9	51.1	16.4	83.6	20.9	79.1	1.1	98.9
United Kingdom	22.0	78.0	2.2	97.8	9.4	90.6	1.6	98.4
United States	27.1	72.9	9.5	90.5	7.6	92.4	5.6	94.4
Average	35.0	65.0	9.6	90.4	24.5	75.5	2.2	97.8
Median	27.1	72.9	9.6	90.4	20.9	79.1	1.6	98.4

Notes: In each cell, the variance share attributable to the relevant factor is reported, based on the one-factor standard dynamic factor model: $Y_t^{i,j} = \beta_{global} f_t^{global} + \varepsilon_t^{i,j}$. The variance contributions are attributed to: Global (global factor) and Idiosyncratic (idiosyncratic factor). The rows marked "Average" and "Median" represent unweighted averages and medians, respectively, of the variance contributions in each column.

Table 4. Variance Decompositions: Spillovers From Macroeconomy to Financial Markets (Models 3, 4 and Combined Models 3&4; G-7 Averages)

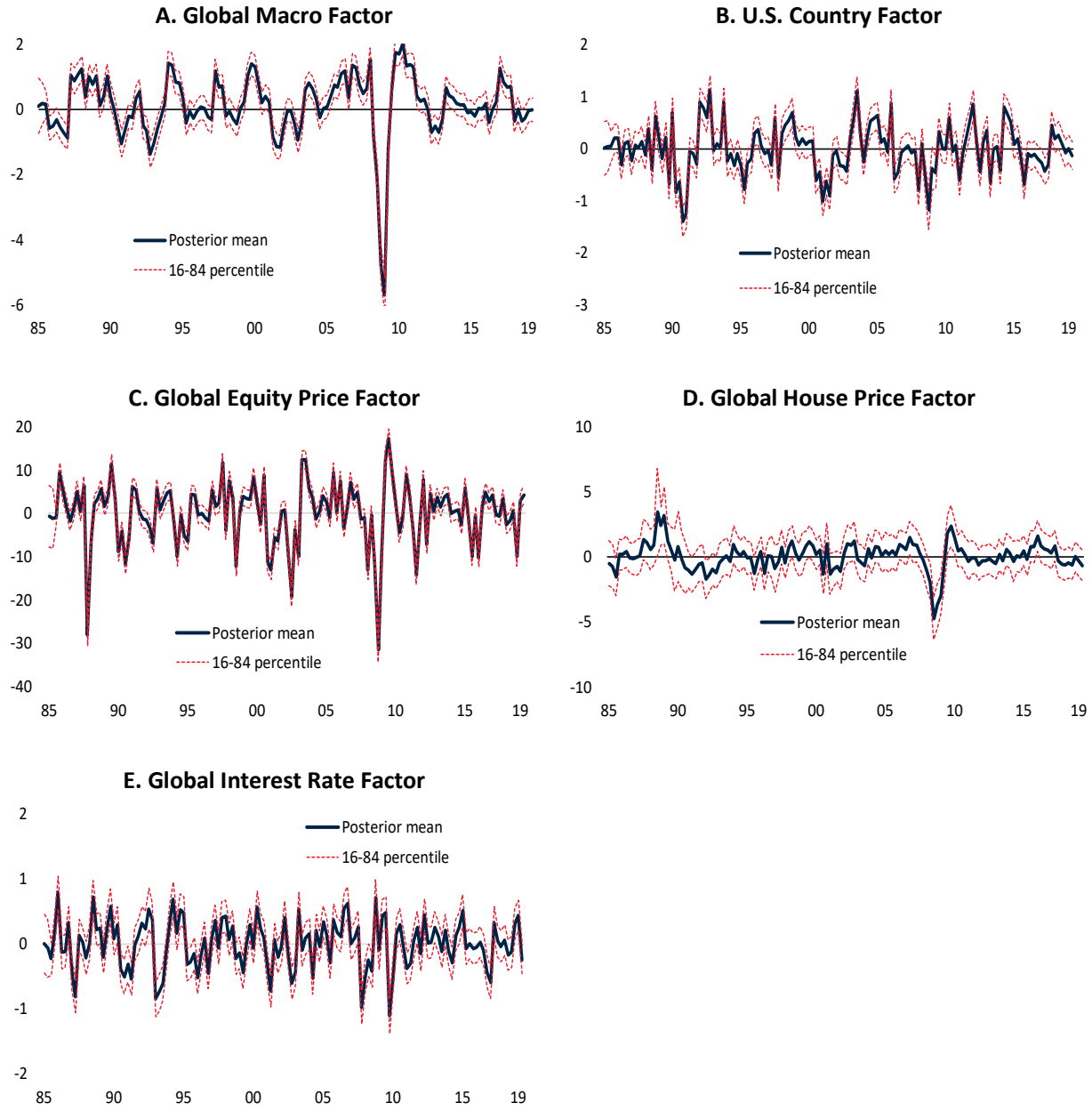
A. Model With Equity Prices

	Output			Consumption			Investment			Equity prices		
	W	C	I	W	C	I	W	C	I	SR	F	I
	Model 3											
1985-2019	39.6	34.8	25.6	9.8	28.5	61.7	25.7	24.2	50.0	0.7	55.6	43.7
1985-2007	22.7	43.0	34.3	6.7	30.9	62.4	17.6	25.3	57.1	0.5	50.5	49.0
1998-2019	49.5	26.2	24.3	13.4	30.3	56.3	33.4	17.8	48.8	1.0	58.9	40.1
	Model 4											
1985-2019	40.8	32.2	27.0	10.2	28.3	61.5	26.6	23.9	49.5	0.3	55.4	44.3
1985-2007	29.9	37.7	32.4	10.5	29.6	59.8	23.7	22.8	53.6	0.3	50.4	49.3
1998-2019	49.7	25.4	24.9	13.4	28.9	57.7	33.0	17.2	49.7	0.4	58.9	40.7
	Model 3&4											
1985-2019	39.2	34.4	26.4	9.6	29.0	61.4	25.3	24.5	50.1	1.0	55.1	43.9
1985-2007	25.3	41.1	33.6	8.0	30.4	61.6	19.0	25.5	55.4	0.8	50.4	48.8
1998-2019	49.0	26.4	24.6	12.9	30.0	57.0	31.7	18.3	50.1	1.3	58.3	40.4

B. Model With House Prices

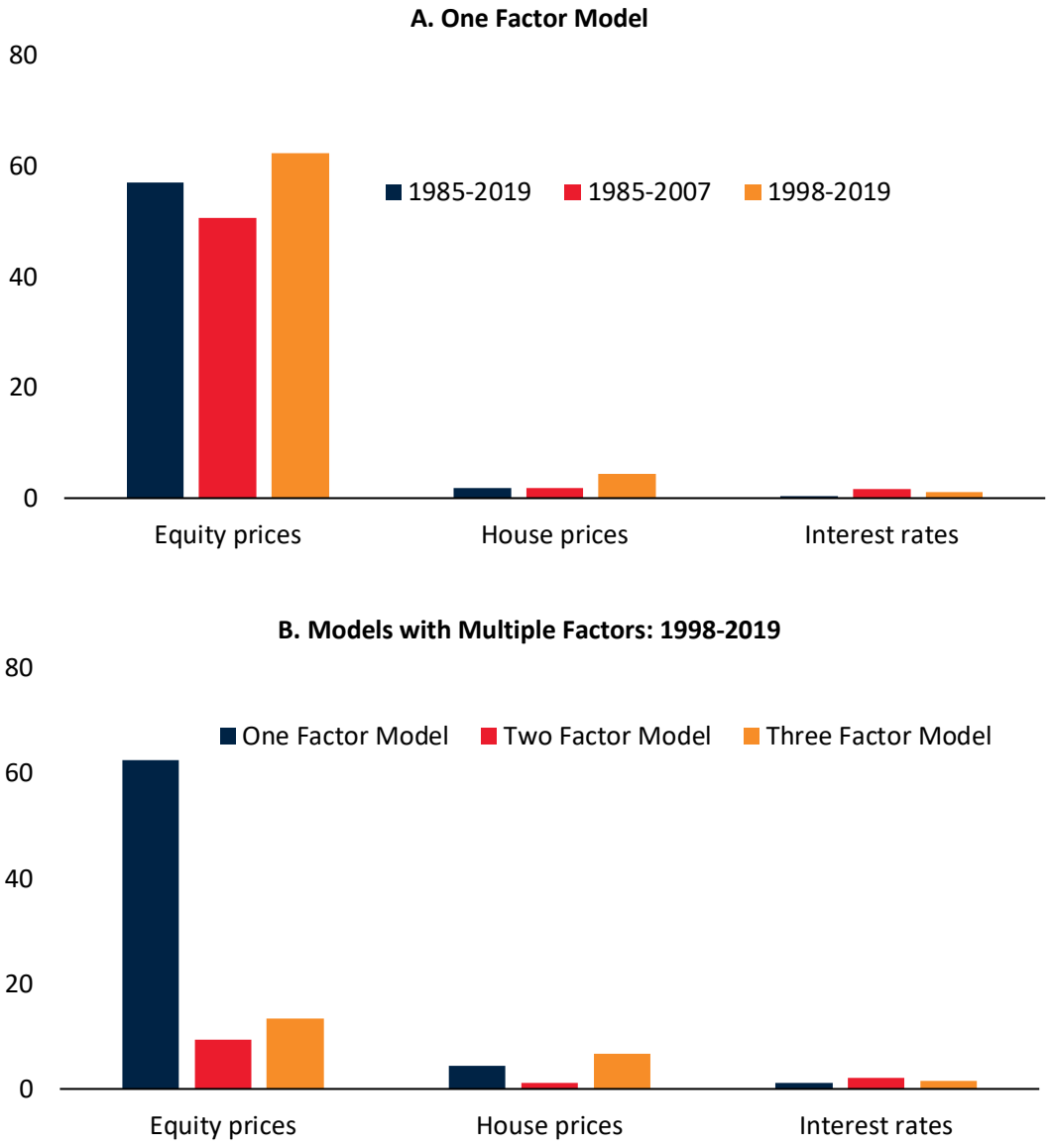
	Output			Consumption			Investment			House prices		
	W	C	I	W	C	I	W	C	I	SR	F	I
	Model 3											
1985-2019	40.7	33.7	25.6	10.3	28.5	61.2	26.6	23.9	49.4	0.9	11.6	87.5
1985-2007	23.9	42.0	34.1	7.3	31.1	61.7	18.2	24.9	56.9	0.5	8.4	91.1
1998-2019	48.9	26.5	24.5	12.8	30.2	57.0	31.8	18.0	50.2	2.8	17.5	79.8
	Model 4											
1985-2019	39.3	33.5	27.2	9.7	27.8	62.4	25.2	24.4	50.4	0.5	11.4	88.1
1985-2007	29.2	38.4	32.3	9.9	29.6	60.5	22.7	23.0	54.2	0.5	7.8	91.7
1998-2019	48.4	26.4	25.2	13.0	28.8	58.2	30.8	17.8	51.4	1.1	18.0	80.9
	Model 3&4											
1985-2019	39.8	34.2	26.0	9.8	28.8	61.5	25.8	24.3	50.0	1.2	11.0	87.8
1985-2007	23.2	42.2	34.7	7.0	30.3	62.7	17.7	25.6	56.6	0.9	8.5	90.7
1998-2019	49.5	26.0	24.5	13.0	30.3	56.7	33.0	18.2	48.9	3.9	17.9	78.2

Figure 1. Estimates of Macroeconomic and Financial Factors (1985-2019)



Notes: The factors shown as solid lines are posterior means. The dashed lines represent the 16 and 84 percent posterior quantile bands. Panels A and B are based on the combined Model 1&2 and Panels C to E are based on the combined Model 3&4 estimated over the full sample (1985-2019). In Model 1, the financial factor spills over to the global macro factor. In Model 2, the financial factor spills over directly onto the country-specific macro factor. Models 1 and 2 combined capture both channels through which the financial factor affects macro fluctuations. In Model 3, the global macro factor spills over to the financial factor. In Model 4, the U.S. country factor spills over to the financial factor. Models 3 and 4 combined capture both channels through which the macro factors affect financial markets. See Table A2 in the Appendix for more details on the model specification.

Figure 2. Variance Contributions of the Global Factor: Models With Only Financial Variables



Notes: These figures show the variance contributions of the global factor based on variance decompositions from standard dynamic factor models estimated for the three financial variables (equity prices, house prices, and interest rates). See the notes to Table 1 for the three models.

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APPENDIX

A.1. Is There a Global Financial Cycle (at Business Cycle Frequencies)?

There is extensive evidence on the existence of a global business cycle, especially among advanced economies. To examine if there is an analogous global financial cycle that spans a variety of asset markets, we use a version of the factor model described above to examine comovement of prices across G-7 economies in three major financial markets—stock markets, government securities markets, and housing markets.[35] [36] Since our primary objective is to model spillovers between financial and macro variables rather than to precisely estimate a global financial cycle, we focus on a handful of financial variables that are viewed as relevant for macro fluctuations and also limit our analysis to relatively low (quarterly) frequencies rather than high-frequency (e.g., daily) financial market data.

The model incorporates (i) a global financial factor common to all financial variables (and all countries); (ii) a factor common to each financial variable; (iii) a country factor common to all financial variables in each country; and (iv) an idiosyncratic component for each series. While, in principle, all variables can load on all factors in these models, we want to make a clear distinction in our model between global, country-specific, and financial variable-specific factors in this appendix. In order to identify such factors, we follow Kose, Otrok, and Whiteman (2003) and impose zero restrictions on some of the β parameters. This implies that, for example, only the equity price variable in each country has a non-zero factor loading on the factor we label "equity prices". The model can then be written as:

$$(5) \qquad Y_t^{i,j} = \beta_{global} f_t^{global} + \beta_{fin\ variable_i} f_t^{fin\ variable_i} + \beta_{country_j} f_t^{country_j} + \varepsilon_t^{i,j}$$

$$(6) \qquad \varepsilon_t^{i,j} = \varphi^{i,j}(L)\varepsilon_{t-1}^{i,j} + \nu_t^{i,j}$$

$$(7) \qquad f_t^m = \varphi^m(L) f_{t-1}^m + \mu_t^m \text{ for m = 1...(1+ I + J).}$$

where $Y_t^{i,j}$ represents financial variable *i* in country *j* in quarter *t*. f_t^m denotes the latent factors (1 global factor, *I* variable-specific factors, and *J* country-specific factors) and $\varepsilon_t^{i,j}$ denote the residual idiosyncratic terms. The terms $\varphi^m(L)$ and $\varphi^{i,j}(L)$ are the lag polynomial operators which define the autoregressive processes of the factors and the idiosyncratic terms, respectively. The innovations to the factors and idiosyncratic terms, μ_t^m and $\nu_t^{i,j}$ respectively, are mutually orthogonal across all equations and are assumed to be normally distributed. The β parameters are factor loadings and capture the sensitivity of each observable variable to the latent factors.

[35] More details about our database are in Appendix Table A1. Financial and macroeconomic series are all at a quarterly frequency, seasonally adjusted, and deflated by the CPI for each country. We use growth rates of all variables and, following Stock and Watson (2012), remove low-frequency movements using the Local Mean method.

[36] Throughout this paper, we follow the early studies on dynamic factor estimation and define "cycle" as a common latent factor across cross-country data. We assume that the cycle should be significant both economically and statistically: (i) the factors should identify the apparent global (or country-specific) events—such as large macroeconomic and financial fluctuations around global recessions and recoveries, (ii) the confidence intervals of the estimated factors do not include zero around such events, and (iii) the variance share of the estimated factors is sizeable—at least 10 percent of total variations in the variables of interest, on average across countries or in several countries at least.

We begin with the most basic one-factor version of this model that allows for only a global factor common to all variables and countries. Figure 2 (Panel A) shows the contributions of the global factor to the variance of each series. The variance contributions of the global factor are sizable for equity prices but small for the other variables. We then split the full sample into two overlapping sub-samples: a pre-crisis sample (1985-2007) and a recent sample (1998-2019). The first period excludes the global financial crisis while the second one includes part of the period of the Great Moderation and the subsequent crisis. The variance contributions of the global factor are on average higher in the second period for all three financial variables. For instance, the contribution of the global factor to the variance of equity price fluctuations rises from 51 percent in the first period to 62 percent in the latter period. For the other variables—housing prices, and interest rates—the variance contributions of the global factor are less than 10 percent in both periods.[37]

The residual variance could in principle be accounted for by other factors that could be common across specific groups of the data. In Table 2, we present results for the one-factor model as well as two other versions of our basic model that also include (i) variable-specific factors that capture common cross-country fluctuations specific to each financial variable, and (ii) both variable-specific factors and country-specific factors that capture the comovement of all financial variables within a particular country. Since comovement of financial market variables appears to be stronger in the period 1998-2019, we show only the results for the models estimated over that period.

The contribution of the global factor to the variance of equity price fluctuations is smaller in the multi-factor models, accounting on average for 10-14 percent of the variance in the two extended versions of the model (Panel B in Figure 2). In the model with three factors, the variance contributions of the global factor to fluctuations in equity prices are sizeable for only a few countries. Rather, variable-specific financial factors account for the bulk of the fluctuations. For fluctuations in equity prices, the common equity price factor is responsible on average for roughly 62 percent of variation across countries in the three-factor model. For house prices and interest rates, the variable-specific factor accounts on average for one-fifth to one-third of the variance and the global factor for less than 3 percent. Country-specific factors in general play a minor role, although they do play a role in explaining house price fluctuations in Canada and the U.S. and interest rate fluctuations in Japan and the U.S.

The main takeaway is that the global financial factor does not play a major role in explaining the variance of fluctuations in any of these financial variables. Our findings are still consistent with papers that argue for the existence of a global financial cycle based on the cross-country comovement of one variable.[38] Indeed, we find that there is strong evidence of cross-country comovement of equity prices and interest rates, although somewhat less so for house prices. Our results do highlight, however, that there is limited empirical evidence of a global financial cycle that encompasses multiple financial markets or asset classes, at least for the major financial market indicators of interest to us.

We acknowledge there is other evidence of cross-country financial market synchronization at higher frequencies, especially in response to unanticipated policy shocks, financial disruptions, and news shocks.[39] However, the quarterly frequency that we focus on is more relevant for analyzing the linkages

[37] We also examined the importance of different factors for the period 2008-2019. Relative to the period 1998-2019, the variance shares explained by the global factor increase for almost all financial variables.

[38] See Claessens, Kose, and Terrones (2011), Hirata et al. (2012), and Cesa-Bianchi, Cespedes, and Rebucci (2015).

[39] For example, a rich literature on contagion employs higher-frequency data to analyze the extent of comovement of different types of asset prices across countries (Forbes, 2013). Miranda-Agrippino and Rey (2020) find that one global factor explains an

between the financial sector and the macroeconomy (we conduct some robustness exercises with monthly data in Online Appendix 1). Our finding that there is no broad-based global financial cycle (at business cycle frequencies) that encompasses multiple asset markets will play an important role in the construction of our new empirical model.

A2. Spillovers from the Macroeconomy to the Financial Sector

A2.1. Global Spillovers

We now seek to understand the role of macroeconomic cycles in driving fluctuations in G-7 countries' financial markets. To do this, we evaluate spillovers from the global macro factor and the U.S. country-specific macro factor to the financial sector using models 3 and 4, respectively. In addition, we estimate a combination of these two models in which spillovers from the macroeconomy to financial markets are transmitted through both the global and U.S. country-specific macro factors. Table 4 presents the G-7 averages of variance decompositions based on these three models for each financial variable.

Our main finding is that there is weaker evidence of spillovers from macroeconomic cycles to financial cycles compared with the spillovers from the financial sector to the macroeconomy. Over the full sample period, the combined spillovers from the global and U.S. country-specific macro factors account for just 1-2 percent of the variance of equity prices and house prices (the relevant results are under the column heading SR). By contrast, the spillovers from these macro factors to interest rates are greater, amounting to 5 percent of the variance of interest rate fluctuations during the period 1998-2019. Assuming that short-term interest rates are largely reflective of policy interest rates, this result implies that any commonality in the policy actions of G-7 central banks is influenced to a significant extent by common fluctuations in key macroeconomic variables in these countries. The contribution of the U.S. country-specific macro factor to the variance of fluctuations in interest rates is slightly larger than that of the global macro factor in the second sub-sample. This is consistent with the observation that the Great Recession that initially hit the U.S. rapidly induced monetary policy responses from other G-7 economies.

The relative roles of spillovers from the macroeconomy to the financial sector across the two models and over time are quite different than those of spillovers from the financial sector to the macroeconomy (Appendix Figure A1). Spillovers from either of the macro factors on to global financial factors are quite muted. Moreover, the variance of financial variables accounted for by spillovers from the macro factors does not change much over time except in the case of interest rates. In light of these observations, we again focus on the results from the combined model in the 1998-2019 period.

Comparing Tables 1 and 4 reveals the importance of separating out the spillover effects of financial factors from global business cycles that reflect macroeconomic phenomena. For the period 1998-2019, the variance contribution of the global macro factor to output fluctuations in each country is on average about 49 percent when we allow for spillovers from the macroeconomy to equity prices (Table 4, Panel A, column W, last row). When we allow for spillovers from equity prices to the global macro and country-specific factors, the variance contributions of the macro factors drop to an average of 34 percent (Table 1, Panel A, last row, column W). The difference is accounted for by the spillovers from the global financial factor on to the global and country-specific macro factors.

important part of the variance of a large cross section of equity prices, commodity prices, and bond indices. Rey (2015) argues that there is a global financial cycle in capital flows, asset prices, and credit. By contrast, Cerutti, Claessens, and Rose (2017) conclude that there is no significant global financial cycle in capital flows.

Returning to the results in Table 4, over the second sub-sample the global macro factor accounts for about 48-50 percent of output fluctuations, 13 percent of consumption fluctuations, and 31-33 percent of investment fluctuations (depending on the financial variable used). The global financial factor on average accounts for about 58 percent of equity price fluctuations and 30 percent of interest rate fluctuations (see column marked F). These shares are higher when the model is estimated over the period 1998-2019 compared to the period 1985-2007. The global financial factor plays a less important role in explaining house price comovement.

We also estimated the combined models 3 and 4 over 15 year rolling windows with one-year increments (see Appendix Figure A6). Similar to the findings in the previous section, the importance of the global financial factor in explaining fluctuations in equity prices and interest rates (but not house prices) increases over time, especially after the global financial crisis. Specifically, the average variance of equity prices in G-7 countries due to the global financial factor increased from about 47 percent from the early 2000s to roughly 60 percent after 2007 in the case of equity prices.

Spillovers from the macroeconomy to house prices have increased slightly after the global financial crisis. Prior to the 2008-09 crisis, spillovers from the macro factors on average accounted for 1 percent of the variation in house prices over the 15 year rolling sub-periods. With the onset of the crisis, this share rose to 4 percent. Spillovers from the macro factors to interest rates have not changed much over time, explaining around 4-6 percent of total variation in interest rates. Spillovers from the macro factors on to global equity prices have not changed much over time either.

In short, at least in terms of average variance contributions for the G-7 countries the global and U.S. macro factors have a relatively modest impact on global financial cycles. One exception is that of G-7 short-term interest rates, which seem to experience significant spillovers from the global and U.S. country-specific macro factors.[40]

A2.2. Country-Specific Spillovers

Next, we examine country-level results on the importance of spillovers from macroeconomic aggregates to financial variables. The composite spillovers to financial variables from macroeconomic fluctuations, operating through both the global and U.S. country-specific macro factors (combination of models 3 and 4), are shown for each country and each macroeconomic variable in Tables A7 and A8 (Appendix Figure A7 highlights key results). We again focus on the results for 1998-2019.

Appendix Table A7 shows that the spillovers from the global and U.S. country-specific macro factors to financial variables are smaller than those from the financial sector to the macroeconomy across countries. The largest spillover effects of macroeconomic cycles are on interest rates, with particularly large spillovers in the cases of France, Canada, and the U.S.

Global comovement is clearly most pronounced for equity prices. The estimated global equity price factor accounts for one-third or more of the fluctuations in domestic equity prices for all countries. The global

[40] The posterior coverage intervals around the posterior medians of the estimated variance contributions are in Appendix Table A11. Our results in this section are generally supportive of earlier findings in the literature. On the importance of macroeconomic variables for financial markets, see Stock and Watson (2003), Christiansen, Schmeling, and Schrimpf (2012), Diebold and Yilmaz (2010, 2015), Engle, Ghysels, and Sohn (2013), and Acalin and Rebucci (2020). However, Cesa-Bianchi, Rebucci, and Pesaran (2020) find that the global macro factor accounts for hardly any of the variation in financial indicators.

comovement in interest rates is also pronounced, with the global factor accounting for more than half of the total variance in interest rates in Canada and the U.S., and around one-quarter in France and Germany. For house prices, the contribution of the global financial factor is typically smaller. These results are consistent with those in Appendix 1 (which were based on single or multiple factor models estimated on financial variables alone) and the literature discussed in that Appendix.

The importance of spillovers from the global and U.S. country-specific macro factors to the global interest rate factor rises over time (Appendix Table A8). While the average variance of short-term interest rates ascribed to spillovers from the macro factors increases only moderately from 1985-2007 to 1998-2019, this share increases markedly for three countries—France, Germany, and Italy. For house prices, the share of spillovers from macro factors increases substantially in Canada, France, Italy, and the U.K. The spillovers from macro factors onto equity prices are quite muted for all countries, although in most cases the variance contributions do increase marginally in the second sub-sample.

A3. Results With Extended Country Samples

We have focused on the G-7 economies, which collectively dominate global GDP and finance, but emerging markets now account for a large share of global GDP and play an important role in global business cycles (Kalemli-Özcan, 2019). We therefore extended our dataset to include additional groups of countries. In addition to the sample of G-7 economies, we consider two larger samples: (i) the G-7 plus seven large emerging market economies—Brazil, China, India, Indonesia, Mexico, Russia, and Turkey (referred to as the EM-7, following Huidrom et al. 2020), and (ii) G-7, EM-7 and seven other open economies—Australia, Chile, South Korea, Spain, Sweden, Switzerland, and Thailand. However, we were unable to obtain consistent data for all the macroeconomic and financial variables in our analysis over the entire sample period for these larger groups of countries (and the data constraints proved even more severe when we tried to increase the sample size beyond these two additional groups). Hence, we retain the G-7 results as the baseline but present extensions using data for these larger groups of countries over the period 1998-2019 for the spillover models 1+2 and 3+4.

The results based on the larger country groups are broadly in line with the baseline G-7 results, although the strength of global synchronization (both among macro and financial variables) and the spillover effects weaken as we include EM-7 or other countries in the sample. We summarize the results in Tables A24 and A25. First, as might be expected, the comovement of macro variables becomes weaker as we incorporate more diverse groups of economies. For instance, the average share of output variance attributable to the global macro factor is 34 percent for the G-7 economies but only 25-32 percent based on the expanded samples. In the version of the model with all 21 countries, the variance contribution of the global factor is highest among the G-7 (36 percent), followed by other open economies (22 percent), and the EM-7 (18 percent). The relative contributions of the common financial factor to the variance of the relevant financial variables—a measure of financial market synchronization—follows a similar pattern.[41] For example, the average share of the variance in equity prices accounted for by the corresponding global financial factor is 59 percent for the G-7 economies, while the share is 48-53 percent, on average, for the expanded country groups.

[41] This is broadly consistent with the findings of Bekaert, Harvey, and Mondino (2023) and Cesa-Bianchi, Cespedes, and Rebucci (2015) who find that, despite the forces of globalization, equity and housing markets are still segregated between developed and emerging markets.

In line with the baseline results we reported in the main text, the financial spillovers onto macro variables are most sizeable from the common factors for equity prices and house prices (Table A24, column SF). For instance, spillover effects from the equity price factor on average account for about 10 percent of output variance in models incorporating the EM-7 as well as in the 21-country sample. Again, the spillover effects are more pronounced for the G-7 than for other economies. Macro spillovers onto financial variables remain small in the extended country samples (Table A25, column SR). In the baseline model, the macro factors had significant spillover effects onto interest rates; the average of these spillovers is halved when we include the EM-7 and other countries, reflecting the more idiosyncratic movements of short-term rates in those countries. The macro spillovers to house price fluctuations remain at around 4 percent in the extended samples.

The results with the extended country samples point to some significant but in other ways limited comovement of macroeconomic and financial cycles as well as macro-financial spillovers across diverse country groups. One clear conclusion is that such synchronization and the magnitudes of spillovers are stronger among the G-7 than when we include emerging markets, consistent with earlier studies (e.g., Kose, Otrok, and Prasad, 2012). Nevertheless, emerging markets and small open economies experience significant spillovers, especially from financial shocks and mainly through global macro factors.[42]

[42] Cesa-Bianchi, Cespedes, and Rebucci (2015) find that house prices are less synchronized across emerging markets than across advanced economies while a global liquidity shock has a stronger impact on house prices and consumption in emerging markets. The larger degree of comovement among G-7 countries will reflect more homogenous business and financial cycles—including monetary policies—which is partly due to the greater financial and economic integration to the global markets in advanced economies than EMDEs. Having said that, we acknowledge that our inference is based on the variance share of the common factors and their spillover effects, focusing on the "relative importance" of the global cycle and the spillover effects on domestic variables. In the case of EMDEs, where macroeconomic and financial market volatility are historically much greater than in advanced economies, the pure magnitude of the impact of the global cycles is likely to be greater on EMDEs than on advanced economies (Rey 2015, among others).

ONLINE APPENDIX
(not intended for publication)

Global Macro-Financial Cycles and Spillovers

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Online Appendix A1. Robustness Tests: Alternative Specifications and Variables

In this Appendix, we report results from a broad array of extensions to the baseline specifications as well as various additional robustness tests.

A1.1. Alternative Specifications and Factors

We begin by considering the use of HP-filtered data (instead of using the local mean method for removing low-frequency variation in the data). The main results for models 1-4 were preserved (see Appendix Table A12). Next, we consider alternative specifications that allow for other combinations of factors. The aim is to address potential concerns about whether the factors we have estimated could be capturing other driving forces that do not enter into our baseline model.

We estimate a standard dynamic factor model for the three macroeconomic variables that, in addition to a global factor, allows for variable-specific macroeconomic factors instead of country-specific factors. Over the full sample, the global factor on average accounts for one-third of the variation in output in G-7 countries while the variable-specific factor accounts for less than 10 percent (see Appendix Table A13). The global factor generally accounts for a larger share of output variation in each country than the variable-specific factor and the same pattern holds for consumption and investment fluctuations, with only a couple of exceptions. The relative importance of the global factor generally rises and that of the variable-specific factors falls over the period 1998-2019 relative to 1985-2007. In short, estimating the model using this combination of factors confirms the importance of the global factor and suggests that leaving out the variable-specific factors is unlikely to have influenced our main results.

We also estimated a version of the model that includes all three financial variables and allows for global and country-specific financial factors. In other words, we also allow for country-specific financial cycles that encompass equity prices, house prices, and interest rates. The results indicate that the global financial factor is important mainly for equity prices, which is consistent with the baseline results in Appendix 1 (see Appendix Table A14). Country-specific financial factors on average explain only a modest fraction of the variance in equity prices and interest rates but matter more for house prices. Overall, the results validate our modeling choice of including one financial variable in the baseline model at a time, rather than incorporating all three financial variables and additional factors (which would, moreover, complicate interpretation of the results).

A simple way to check the validity of our factor model specification is to compare the contemporaneous correlations between macro and financial variables in our dataset with the implied correlations of the corresponding pairs of variables based on our dynamic factor models.[43] In the data, the average correlation (G-7 averages) of macro variables with equity and house prices is 0.13 and 0.16, respectively, over the period 1985-2019. Interest rates are not correlated with macroeconomic variables (average correlation coefficient: 0.03). The implied contemporaneous correlations from our estimated models are quite close to the actual correlations in the case of equity prices (0.11) and interest rates (0.02). The implied correlation between macro variables and house prices (0.04) is lower than the actual correlation, which may partly reflect our results on the weaker role of the global factor for G-7 house prices compared

[43] Due to the lack of common shocks between macro and financial variables and the orthogonality of the idiosyncratic terms, the implied correlation between any pair of macro and financial variables is given by: $\beta^M \beta^F corr(F^M, F^F)$, where β^M and β^F are factor loadings of the macro and financial variables, respectively, and $corr(F^M, F^F)$ is the correlation coefficient between the estimated global macro and financial factors. Any differences between the actual and implied correlations reflect the unmodelled correlation in the factors that would be ruled out with this parametric approach.

to other financial variables. Overall, the dynamic factor estimation results capture the correlations between macro and financial variables well.

A1.2. Credit Growth as an Alternative Financial Variable

We have focused on asset prices in three major financial markets with potential macro implications. We now consider an additional quantity variable that is relevant for macro outcomes—growth in real credit to the nonfinancial sector (see Appendix Figure A8 and Appendix Table A15 for detailed results).

Consistent with other financial factors as well as macroeconomic factors, the global credit factor tracks global recessions and subsequent recoveries. The magnitude of spillovers originating from the global credit factor is, however, smaller than that of other financial variables: the global credit factor (models 1 and 2 combined) on average accounts for only 4-6 percent of the variance of output, consumption, and investment in G-7 economies during 1998-2019. We find negligible spillovers from the global macroeconomic factor and U.S. macro factor (models 3 and 4) to the global credit factor.

Our findings are broadly consistent with those in Helbling et al. (2011), who document that shocks originating in credit markets appear to play a smaller role during "normal" business cycles and a larger one during periods of financial stress. Other studies argue for a more prominent role for credit shocks in explaining the global dimension of the Great Recession (Perri and Quadrini, 2018) and in accounting for macro fluctuations at the country level (e.g., Gilchrist and Zakrajsek, 2012).[44]

A1.3. Long-term versus Short-term Interest Rates

Next, we replace the short-term interest rates used in our baseline models (yields on 3-month government paper) with long-term interest rates (ten-year government bond yields). We examined variance decomposition results for spillovers between macro factors and the long-term interest rate factor (Appendix Table A16). The results are in general similar to those using short-term interest rates, with a few noteworthy differences. First, the spillovers from the global long-term interest rate factor to macro variables (combination of models 1 and 2) are slightly larger (by about 2-3 percentage points) than was the case with short-term interest rates. Second, the spillovers from macro factors to long-term interest rates are also greater than was the case for short-term rates. Third, comovement among G-7 long-term interest rates, as measured by the average variance contributions of the common interest rate factor to interest rate fluctuations in each country, is higher than for short-term government bond yields. One interpretation is that global macro fluctuations are associated not only with cross-country comovement of short-term interest rates (via coordinated monetary policies) but also comovement of inflation expectations and risk premia, which are additional determinants of long-term bond yields. We leave a deeper analysis of this issue for future work.

A1.4. Alternative House Price Series

We use house price data from Haver Analytics for our benchmark results. We now examine whether the results would be affected if we were to use BIS real house price indexes instead. The results were quite similar even in terms of magnitudes (see Appendix Table A17). For instance, the spillover effects of the

[44] We note the contention of some authors that indicators of credit standards applied by lenders and credit spreads are better indicators than credit growth to assess the strength of linkages between credit markets and the macroeconomy (Lown and Morgan, 2006; Meeks, 2012; Gilchrist and Zakrajsek, 2012; Faust et al., 2013).

house price factor on average account for 17 percent of the variance of output during 1998-2019 (16 percent in the baseline, Panel B of Table 1). The spillover effects from macro factors to house prices remain small and the average contribution of the global house price factor to the variance of house prices in each country is similar for both house price variables.

A1.5. Does the United States Drive the Main Results?

The U.S. remains dominant in the world economy and in international finance. To test whether our results, including the estimates of various global factors, could simply be proxying for the influence of the U.S, we re-estimated models 1 and 3 excluding the U.S. from the dataset (Appendix Table A18).[45] Comparing the results regarding spillovers to the corresponding ones in Tables 3 and 6, most of the main results (in terms of average variance contributions) look similar. One exception is that the spillover effects from the global house price factor and the global interest rate factor to macroeconomic variables are smaller when the U.S. is left out. Moreover, the degree of comovement among equity prices and house prices decreases substantially when the U.S. is excluded. Clearly, the U.S. is an important driver of global cycles in those two financial markets, but the nature of financial-macroeconomic spillovers that are our main focus is not just an artifact of U.S. economic dominance.

A1.6. Alternative Sub-samples

The two overlapping sub-samples we have used so far represent the pre-global financial crisis (1985-2007) and post-Asian crisis (1998-2019) periods. We now check the sensitivity of the sub-sample results when we split the sample into two nonoverlapping periods of roughly equal length: 1985-2000 and 2001-2019 (see Appendix Table A19). The variance shares (for all three macro variables) of the global macroeconomic factor and spillovers from the equity and house price factors double between the two periods, while the shares of the country-specific macro factors are halved. These results, which indicate rising comovement and increasing spillovers over time, are consistent with those reported in Section 4 based on the original sub-samples and also those based on the 15-year rolling windows (Figure A4).[46] Variance decompositions based on the combined models 3 and 4, which capture macro to financial spillovers, estimated over the two new sub-samples are again consistent with those based on the baseline sub-samples and the rolling-window estimations. For instance, the spillover effects from macro to financial variables are sizeable only in the case of interest rates.

A1.7. Restricted Model with Output Alone

The baseline model includes three macro variables--output, consumption, and investment. A potential concern about our baseline results is that a low degree of comovement between these macro variables in some countries could in turn lower the measured synchronicity between macro and financial cycles. To address this concern, we re-estimated the spillover models using only output and each of the financial

[45] We have already quantified the direct impact of the U.S. on global macro-financial linkages. In particular, Model 4 quantifies the spillover effects from the U.S. macro factor onto each financial variable, showing that the U.S. has a sizeable impact on the dynamics in short-term interest rates in the G-7. The remaining question then is the sensitivity of estimates of the global macroeconomic and financial factors, and their spillover effects, to the exclusion of U.S. data.

[46] In addition, we tested the sample period (2010-19) that excludes the period around the GFC, and find that the overall spillovers effects from financial variables (equity prices, housing prices, and interest rates) are still sizeable (13.4 percent, 9.2 percent, and 6.1 percent, respectively) on output based on the model 1+2, although the effects are somewhat smaller compared to those estimated using the sample periods that include the GFC.

variables. Since only one type of macro variable is included, we estimated only spillover models 1 and 3 (we cannot estimate models 2 and 4 because, with just one macro variable, there are no country-specific macro factors). The main results presented in the previous sections do not change qualitatively in the model with only output and a financial variable (see Appendix Table A20), although these results are less useful in tracing the spillover channels than our baseline model (as, for instance, we cannot include a U.S. macro factor). The results confirm that output and financial variables (in particular, equity prices) are each synchronized globally and there are substantial spillovers from financial to macro factors, operating through the global macro factor.

A1.8. Higher-Frequency (Monthly) Data

An important issue is whether our use of quarterly data drives the key results, for instance by conflating common shocks and spillovers. If shocks are transmitted rapidly from financial to real variables and vice versa, our model would underestimate actual spillovers. As discussed earlier, while asset prices move quickly in response to news and other shocks, macro variables tend to be more sluggish in general. Moreover, the economy-wide aggregates we study are available only at a quarterly frequency and reported with a lag. Nevertheless, in order to investigate this issue further, we use monthly industrial production as an indicator of macroeconomic cycles. We focus on the period 1998-2019 and, with just one macroeconomic variable, only models 1 and 3 are applicable in analyzing spillovers.[47]

Variance decompositions from a single factor model applied to each financial variable showed that the global financial factor accounts for a large fraction of the variance of equity prices but not of the other two financial variables (Appendix Table A21, Panel A). We also estimated models that include industrial production and each financial variable in turn, allowing for one common global factor (Appendix Table A21, Panel B). The global factor has a significant explanatory role only for the variance of equity prices and there is little evidence of strong comovement between industrial production and any financial variable. These results are broadly consistent with our benchmark results based on quarterly data.

When we allow for spillovers from financial variables to the macroeconomy (model 1), we find significant spillovers only from equity prices (Appendix Table A22).[48] Moreover, the shares of variance in industrial production accounted for by the global macro factor are much larger than the shares accounted for by spillover effects. The spillover effects from industrial production to the financial variables (model 3) are small (Appendix Table A23). Reflecting the cross-country comovement of financial variables that we found even in the quarterly data, the global financial factor accounts for a substantial fraction of the variance of each financial variable. The degree of comovement of financial variables is higher in the monthly data than in the quarterly data. Other than that, our main results on the relative importance of different spillovers are preserved when we use monthly data.[49]

[47] Monthly data on house prices was available for only four of the G-7 countries: Canada, Japan, U.K., and U.S. We use monthly growth rates of all variables except interest rates, for which we use the change in levels. As in the previous exercises, the Stock and Watson (2012) local mean approach is used to eliminate long-term trends in the data.

[48] The global house price factor exhibits smaller spillover effects onto the macroeconomic factor than in the benchmark results. However, since the monthly global house price factor is extracted from data for only four countries, this direct comparison might not be appropriate.

[49] In the benchmark results, one interesting finding was a sizable spillover from the U.S. country factor to interest rates. We cannot replicate that result here since we do not have country-specific macro factors based on multiple macro variables.

Online Appendix A2. Additional Tables and Figures

Table A1. Database

Variable	Definition	Source	Transformation
Output	Real GDP	Haver Analytics	Growth (in percent)
Consumption	Real private consumption	Haver Analytics	Growth (in percent)
Investment	Real gross fixed capital formation	Haver Analytics	Growth (in percent)
Equity Prices	Equity price index	Haver Analytics	Growth (in percent)
Housing Prices	Real housing price index	Haver Analytics, OECD	Growth (in percent)
Interest Rates	3-month treasury bill yields	Federal Reserve Economic Data, OECD	Difference (in percentage points)
Credit	Domestic credit	Federal Reserve Economic Data, Haver Analytics	Growth (in percent)

Notes: Data series cover the 1985-2019 period. Macroeconomic aggregates and financial variables are all seasonally adjusted. Financial variables are deflated by the CPI of each country. We use growth rates of all variables (except interest rates) and, following Stock and Watson (2012), remove low-frequency movements using the Local Mean method.

Table A2. List of Spillover Models and Main Assumptions

Model	Specification	Key assumptions
Measurement equation	$Y_t = \begin{bmatrix} Y_t^M \\ Y_t^F \end{bmatrix} = \begin{bmatrix} \beta^M & 0 \\ 0 & \beta^F \end{bmatrix} \begin{bmatrix} F_t^M \\ F_t^F \end{bmatrix} + \begin{bmatrix} \Gamma_t^M \\ \Gamma_t^F \end{bmatrix}$ $\Gamma_t = \Psi(L)\Gamma_{t-1} + V_t$ with $E\left(V_t V_t\right) = \Omega$	The macro variables load on to world macro and country-specific macro factors. The financial variables load on to the financial factor. There is no common factor for both macro and financial variables.
Factor evolution		
Standard Factor Model (without spillovers)	$F_t^M = \phi^M(L)F_{t-1}^M + u_t^M$ $F_{j,t}^M = \phi_j^M(L)F_{j,t-1}^M + u_{j,t}^M$ $F_t^F = \phi^F(L)F_{t-1}^F + u_t^F$	The world macro factor, country-specific macro factors, and financial factors evolve as AR processes. There are no spillovers between different factors.
Spillover Model 1	$F_t^M = \phi^M(L)F_{t-1}^M + \phi^{M,F}(L)F_{t-1}^F + u_t^M$	The financial factor spills over to the world macro factor.
Spillover Model 2	$F_{j,t}^M = \phi_j^M(L)F_{j,t-1}^M + \phi_j^F(L)F_{t-1}^F + u_{j,t}^M$	The financial factor spills over to country-specific macro factors. These two models can be combined to evaluate the total spillovers emanating from the financial factor and operating through different macro channels. All spillovers occur with a lag of one or more periods.
Spillover Model 3	$F_t^F = \phi^F(L)F_{t-1}^F + \phi^M(L)F_{t-1}^M + u_t^F$	The world macro factor spills over onto the financial factor.
Spillover Model 4	$F_t^F = \phi_{US}^F(L)F_{t-1}^F + \phi_{us}^M(L)F_{US,t}^M + u_{US,t}^F$	The U.S. macro factor spills over onto the financial factor. These two models can be combined to evaluate the total spillovers emanating from macro factors. All spillovers occur with a lag of one or more periods.

Notes: F represents factors, $\phi(L)$ represents the relevant lag polynomial matrices, u represents the innovations to the factors, the superscripts *M* and *F* stand for "macroeconomic" and "financial" respectively, and *j* is the country index.

Table A3. Factor Loadings
(Model 1&2; 1998-2019)

	Factor	Output	Consumption	Investment	Equity Prices	House Prices	Interest Rates
Canada	**Global Macro Factor**	0.38	0.28	1.62			
	Country-Specific Factor	0.24	0.11	0.22			
	Financial Factor				0.68	0.18	0.37
	Constant	-0.08	-0.05	-0.36	-0.66	0.04	0.04
France	**Global Macro Factor**	0.40	0.14	0.73			
	Country-Specific Factor	0.36	0.49	0.41			
	Financial Factor				0.90	0.27	0.56
	Constant	-0.07	-0.02	-0.12	-0.88	0.09	0.01
Germany	**Global Macro Factor**	0.74	0.02	1.11			
	Country-Specific Factor	0.35	0.33	0.97			
	Financial Factor				1.05	0.02	0.30
	Constant	-0.14	-0.01	-0.23	-1.02	0.01	0.00
Italy	**Global Macro Factor**	0.53	0.12	0.73			
	Country-Specific Factor	0.35	0.46	0.81			
	Financial Factor				0.81	0.56	0.54
	Constant	-0.09	-0.01	-0.12	-0.81	0.07	0.01
Japan	**Global Macro Factor**	0.61	0.16	0.55			
	Country-Specific Factor	0.58	0.61	0.62			
	Financial Factor				0.59	-0.18	0.06
	Constant	-0.12	-0.04	-0.14	-0.60	0.01	0.00
United Kingdom	**Global Macro Factor**	0.36	0.24	0.92			
	Country-Specific Factor	0.26	0.15	0.40			
	Financial Factor				0.58	0.21	0.60
	Constant	-0.07	-0.05	-0.21	-0.55	0.17	0.01
United States	**Global Macro Factor**	0.29	0.15	0.81			
	Country-Specific Factor	0.56	0.38	1.28			
	Financial Factor				0.60	0.59	0.26
	Constant	0.00	0.01	-0.04	-0.55	0.13	0.02

Notes: This table shows posterior medians of factor loadings based on the combined Model 1 and 2, which captures spillovers to the global macro factor (Model 1) and to country-specific macro factor (Model 2) through which the financial factor affects macro activity.

Table A4. Factor Vector-autoregressive Coefficients (1998-2019)

A. Global Macro and Country-Specific Factors (Model 1&2)

			Financial Factor		
	Lags	Own Factor	Equity Prices	House Prices	Interest Rates
Global Macro Factor	**1**	0.55	0.04	0.09	0.10
	2	-0.13	0.00	-0.01	0.20
	3	-0.03	0.02	-0.07	-0.01
Country-Specific Factor					
Canada	**1**	0.17	0.00	0.00	-0.05
	2	-0.13	0.00	0.01	0.02
	3	-0.02	0.00	-0.01	-0.01
France	**1**	-0.28	0.01	0.00	0.05
	2	-0.06	-0.01	0.02	0.07
	3	-0.01	0.01	-0.02	-0.02
Germany	**1**	-0.29	0.00	-0.04	-0.05
	2	-0.12	0.00	0.03	-0.10
	3	0.04	0.01	0.03	-0.02
Italy	**1**	0.55	0.01	0.04	0.15
	2	-0.07	0.00	-0.04	0.05
	3	0.02	0.00	0.00	0.00
Japan	**1**	0.02	0.01	0.04	0.06
	2	-0.17	-0.01	0.01	0.10
	3	-0.08	0.00	-0.06	-0.02
United Kingdom	**1**	1.03	0.00	0.04	-0.01
	2	-0.53	0.01	0.00	-0.05
	3	-0.07	0.00	-0.01	-0.05
United States	**1**	0.24	0.01	0.01	0.08
	2	0.09	0.00	0.01	-0.14
	3	0.03	0.00	-0.02	0.00

B. Financial Factors (Model 3&4)

	Lags	Own Factor	Global Macro Factor	U.S. Country Factor
Financial Factor				
Equity Prices	**1**	0.36	-0.09	0.42
	2	-0.07	-0.23	0.08
	3	-0.03	-0.02	0.00
House Prices	**1**	0.65	0.21	0.24
	2	0.07	-0.43	-0.01
	3	-0.05	-0.03	0.01
Interest Rates	**1**	0.19	0.02	0.13
	2	-0.12	-0.04	-0.02
	3	0.02	0.07	-0.01

Notes: This table shows factor VAR coefficients (posterior medians) for the global macro factor and country-specific factors, based on the results of the combined Models 1 and 2 (in Panel A). The corresponding coefficients for financial factors are based on the results of the combined Model 3 and 4 (in Panel B). Combined Model 1 and 2 captures spillovers to the global macro factor (Model 1) and to country-specific macro factor (Model 2) through which the financial factor affects macro activity. Combined Model 3 and 4, which captures spillovers from the global macro factor (Model 3) and from the U.S. country factor (Model 4) through which the financial sector is affected. See Table A2 in the Appendix for more details on the model specification.

Table A5. Country-Specific Variance Decompositions:
Spillovers from Financial Sector to Macroeconomy (Combined Models 1&2)

		Equity prices			House prices			Interest rates		
		Y	C	I	Y	C	I	Y	C	I
Canada	**1985-2019**	6.6	3.9	7.7	6.5	3.9	6.9	2.5	1.2	2.7
	1985-2007	4.4	1.7	2.8	5.4	2.4	3.2	5.5	2.7	3.5
	1998-2019	13.1	11.2	18.7	12.5	10.6	17.1	5.6	4.7	7.2
France	**1985-2019**	13.4	2.6	11.0	11.3	2.3	9.4	4.0	1.9	2.9
	1985-2007	12.8	4.0	11.3	8.0	3.3	6.8	7.8	4.7	7.0
	1998-2019	24.1	6.7	17.5	20.6	5.2	17.4	8.9	3.3	7.3
Germany	**1985-2019**	9.5	1.2	5.0	8.5	1.4	4.6	3.1	0.9	1.9
	1985-2007	5.8	2.0	4.3	5.1	2.2	3.4	4.3	1.8	3.6
	1998-2019	22.3	2.0	12.2	19.6	1.6	11.3	8.2	1.1	5.2
Italy	**1985-2019**	11.5	3.5	4.5	10.1	3.9	4.6	3.1	1.9	2.0
	1985-2007	8.7	5.7	5.6	6.0	3.9	4.6	5.9	4.0	4.7
	1998-2019	22.4	6.8	8.3	20.1	8.2	8.5	8.9	6.1	4.3
Japan	**1985-2019**	6.9	2.4	3.0	6.4	2.3	2.8	2.7	1.5	1.2
	1985-2007	5.0	2.7	2.9	4.8	3.2	2.8	4.8	2.5	2.6
	1998-2019	13.4	3.8	5.8	12.9	4.5	6.0	5.9	2.5	2.8
United Kingdom	**1985-2019**	6.3	2.6	1.6	7.5	3.5	1.9	2.4	1.3	0.7
	1985-2007	2.9	1.6	1.2	5.6	3.4	2.0	4.5	3.6	1.6
	1998-2019	15.4	5.5	3.3	16.2	6.1	3.6	6.9	2.6	1.6
United States	**1985-2019**	6.6	4.0	7.1	7.1	4.6	7.5	3.1	2.2	3.2
	1985-2007	5.9	3.7	5.4	6.5	4.3	6.8	8.3	5.8	8.8
	1998-2019	10.4	7.1	14.0	10.6	7.8	13.8	5.5	4.3	6.7
Average	**1985-2019**	8.7	2.9	5.7	8.2	3.1	5.4	3.0	1.6	2.1
	1985-2007	6.5	3.0	4.8	5.9	3.2	4.2	5.9	3.6	4.5
	1998-2019	17.3	6.2	11.4	16.1	6.3	11.1	7.1	3.5	5.0

Notes: This table shows the variance shares attributable to spillovers from the financial sector to the macroeconomy. The relevant spillovers are from the global financial factors (equity prices, house prices, and interest rates) to fluctuations in macro variables through the global macro factor and the country-specific macro factor. The results are based on the combined Model 1 & 2, which captures spillovers to the global macro factor (Model 1) and to the country-specific macro factor (Model 2) through which the financial factor affects macro activity. Y, C, and I refer to output, consumption, and investment, respectively. See Table A2 in the Appendix for more details on the model specification.

Table A6. Country-Specific Variance Decompositions: Spillovers From Financial Sector to Macroeconomy (Models 1&2; 1998-2019)

		Equity prices			House prices			Interest rates		
		Y	C	I	Y	C	I	Y	C	I
Canada	**Global Macro Factor**	26.2	22.9	40.1	32.5	28.2	46.4	40.8	34.6	55.8
	Country-Specific Factor	12.7	9.6	3.7	11.4	6.4	6.5	9.5	7.8	5.9
	Idiosyncratic Factor	48.1	56.3	37.5	43.5	54.8	29.9	44.1	52.9	31.2
	Financial Spillovers	13.1	11.2	18.7	12.5	10.6	17.1	5.6	4.7	7.2
France	**Global Macro Factor**	48.3	6.8	36.4	55.3	8.9	47.9	66.2	10.9	57.7
	Country-Specific Factor	15.5	30.5	5.5	13.3	33.2	4.4	14.0	30.8	4.8
	Idiosyncratic Factor	12.1	56.0	40.6	10.8	52.7	30.3	10.9	55.0	30.1
	Financial Spillovers	24.1	6.7	17.5	20.6	5.2	17.4	8.9	3.3	7.3
Germany	**Global Macro Factor**	46.4	0.6	22.5	52.5	0.8	27.7	62.2	1.1	32.5
	Country-Specific Factor	15.4	25.1	25.1	14.6	22.7	24.2	15.9	21.7	26.8
	Idiosyncratic Factor	15.9	72.2	40.3	13.4	74.8	36.7	13.7	76.2	35.5
	Financial Spillovers	22.3	2.0	12.2	19.6	1.6	11.3	8.2	1.1	5.2
Italy	**Global Macro Factor**	46.0	5.8	15.4	52.2	8.7	19.5	62.4	11.3	23.7
	Country-Specific Factor	16.2	53.2	14.5	14.2	50.2	14.2	14.5	49.9	14.3
	Idiosyncratic Factor	15.4	34.3	61.8	13.5	32.8	57.8	14.2	32.7	57.7
	Financial Spillovers	22.4	6.8	8.3	20.1	8.2	8.5	8.9	6.1	4.3
Japan	**Global Macro Factor**	24.0	2.2	9.7	28.5	3.0	12.4	34.6	3.8	15.1
	Country-Specific Factor	39.8	50.6	21.9	38.2	49.9	21.8	38.6	50.2	22.1
	Idiosyncratic Factor	22.8	43.4	62.6	20.4	42.7	59.9	20.9	43.4	59.9
	Financial Spillovers	13.4	3.8	5.8	12.9	4.5	6.0	5.9	2.5	2.8
United Kingdom	**Global Macro Factor**	27.8	10.3	6.4	35.5	14.3	8.8	43.5	17.2	11.2
	Country-Specific Factor	32.8	9.5	3.3	27.7	7.7	3.2	28.4	7.8	3.4
	Idiosyncratic Factor	24.0	74.7	87.0	20.5	72.0	84.4	21.2	72.4	83.8
	Financial Spillovers	15.4	5.5	3.3	16.2	6.1	3.6	6.9	2.6	1.6
United States	**Global Macro Factor**	16.5	9.8	24.3	22.1	14.5	31.1	26.6	17.7	37.0
	Country-Specific Factor	38.6	36.4	38.7	33.6	32.2	33.6	34.1	31.9	34.6
	Idiosyncratic Factor	34.5	46.7	23.0	33.8	45.5	21.5	33.8	46.2	21.6
	Financial Spillovers	10.4	7.1	14.0	10.6	7.8	13.8	5.5	4.3	6.7
Average	**Global Macro Factor**	33.6	8.3	22.1	39.8	11.2	27.7	48.0	13.8	33.3
	Country-Specific Factor	24.4	30.7	16.1	21.9	28.9	15.4	22.2	28.6	16.0
	Idiosyncratic Factor	24.7	54.8	50.4	22.3	53.6	45.8	22.7	54.1	45.7
	Financial Spillovers	17.3	6.2	11.4	16.1	6.3	11.1	7.1	3.5	5.0

Notes: In each cell, the variance share attributable to the relevant factor is reported. The results are based on the combined Model 1&2, which capture spillovers of the global financial factor to the global macro factor (Model 1) and to the country-specific macro factor (Model 2). Y, C, and I refer to output, consumption, and investment, respectively. See Table A2 in the Appendix for more details on the model specification.

Table A7. Country-Specific Variance Decompositions: Spillovers From Macroeconomy to Financial Markets (Model 3&4; 1998-2019)

		Equity prices	House prices	Interest rates
Canada	**Global Financial Factor**	56.5	24.1	54.9
	Idiosyncratic Factor	42.2	70.6	35.9
	Macroeconomic Spillovers	1.3	5.3	9.2
France	**Global Financial Factor**	59.4	15.8	33.7
	Idiosyncratic Factor	39.3	80.5	60.8
	Macroeconomic Spillovers	1.4	3.7	5.6
Germany	**Global Financial Factor**	61.4	4.5	24.4
	Idiosyncratic Factor	37.2	94.6	71.6
	Macroeconomic Spillovers	1.4	1.0	4.0
Italy	**Global Financial Factor**	44.6	39.7	14.3
	Idiosyncratic Factor	54.3	52.1	83.3
	Macroeconomic Spillovers	1.0	8.2	2.4
Japan	**Global Financial Factor**	33.5	11.0	11.1
	Idiosyncratic Factor	65.7	86.6	87.0
	Macroeconomic Spillovers	0.8	2.4	1.9
United Kingdom	**Global Financial Factor**	78.0	25.4	17.7
	Idiosyncratic Factor	20.2	69.1	79.2
	Macroeconomic Spillovers	1.8	5.5	3.0
United States	**Global Financial Factor**	74.6	5.1	51.1
	Idiosyncratic Factor	23.7	93.8	40.3
	Macroeconomic Spillovers	1.7	1.1	8.6
Average	**Global Financial Factor**	58.3	17.9	29.6
	Idiosyncratic Factor	40.4	78.2	65.4
	Macroeconomic Spillovers	1.3	3.9	4.9

Notes: In each cell, the variance share attributable to the relevant factor is reported. The results are based on the combined Model 3 and 4, which capture spillovers from the global macro factor (Model 3) and from the U.S. country factor (Model 4) to financial markets. See Table A2 in the Appendix for more details on the model specification.

Table A8. Country-Specific Variance Decompositions: Spillovers From Macroeconomy to Financial Markets (Model 3&4)

		Equity prices	House prices	Interest rates
Canada	**1985-2019**	1.1	1.3	3.7
	1985-2007	0.9	0.5	5.2
	1998-2019	1.3	5.3	9.2
France	**1985-2019**	1.0	0.9	2.2
	1985-2007	1.0	1.7	3.9
	1998-2019	1.4	3.7	5.6
Germany	**1985-2019**	1.0	0.2	3.1
	1985-2007	0.9	0.6	6.9
	1998-2019	1.4	1.0	4.0
Italy	**1985-2019**	0.7	0.8	2.0
	1985-2007	0.6	0.5	4.5
	1998-2019	1.0	8.2	2.4
Japan	**1985-2019**	0.4	1.0	1.0
	1985-2007	0.1	1.5	1.5
	1998-2019	0.8	2.4	1.9
United Kingdom	**1985-2019**	1.3	3.9	1.5
	1985-2007	1.0	0.7	2.5
	1998-2019	1.8	5.5	3.0
United States	**1985-2019**	1.3	0.3	3.9
	1985-2007	1.1	0.8	5.4
	1998-2019	1.7	1.1	8.6
Average	**1985-2019**	1.0	1.2	2.5
	1985-2007	0.8	0.9	4.3
	1998-2019	1.3	3.9	4.9

Notes: This table shows the variance shares attributable to spillovers from the macroeconomy to financial markets. The relevant spillovers are from macroeconomic agregates to the global financial factors (equity prices, house prices, and interest rates) through the global macro factor and the U.S. country factor. The results are based on the combined Models 3 and 4, which capture spillovers from the global macro factor (Model 3) and from the U.S. country factor (Model 4) to the financial sector. See Table A2 in the Appendix for more details on the model specification.

Table A9. Confidence Bands for Variance Decompositions (Average across G-7 countries; Model 1&2)

A. Equity Prices

	Output				Consumption				Investment				Equity prices	
	W	C	SF	I	W	C	SF	I	W	C	SF	I	F	I
	1985-2019													
Mean	31.7	33.6	8.7	26.0	7.3	29.6	2.9	60.3	20.6	22.5	5.7	51.2	55.9	44.1
33%	27.9	29.5	6.4	23.1	5.4	24.9	1.9	56.5	17.4	17.9	4.0	49.0	53.4	41.3
66%	33.8	37.1	9.8	29.3	8.2	32.9	3.2	64.5	22.3	24.1	6.4	55.3	58.5	46.4
	1985-2007													
Mean	21.5	39.0	6.5	33.0	6.8	29.5	3.0	60.6	17.0	23.0	4.8	55.2	50.4	49.6
33%	18.5	32.6	4.7	27.2	4.8	24.1	2.0	55.0	14.0	17.5	3.2	49.8	47.2	45.7
66%	26.2	42.1	8.3	34.8	8.9	32.8	3.8	64.1	20.7	24.6	6.1	58.5	54.1	52.5
	1998-2019													
Mean	33.6	24.4	17.3	24.7	8.3	30.7	6.2	54.8	22.1	16.1	11.4	50.4	59.3	40.7
33%	29.7	19.6	13.7	21.2	6.0	24.7	4.2	49.9	18.8	12.3	8.6	46.6	56.0	36.8
66%	36.5	27.1	19.7	27.4	9.5	34.3	7.0	60.1	24.5	18.0	12.9	53.7	63.0	43.7

B. House Prices

	Output				Consumption				Investment				House prices	
	W	C	SF	I	W	C	SF	I	W	C	SF	I	F	I
	1985-2019													
Mean	33.0	33.7	8.2	25.2	7.8	29.0	3.1	60.1	21.4	22.1	5.4	51.2	12.4	87.6
33%	29.3	29.4	5.0	21.5	5.8	24.5	1.8	56.9	18.2	18.0	3.1	48.0	2.6	85.6
66%	35.9	37.2	9.5	28.0	8.9	31.6	3.5	64.4	23.7	24.4	6.2	54.3	13.8	97.2
	1985-2007													
Mean	19.2	41.8	5.9	33.2	5.5	30.2	3.2	61.0	16.3	25.2	4.2	54.3	9.6	90.4
33%	15.4	36.1	2.9	28.4	3.4	24.9	1.4	56.4	12.1	19.5	2.0	49.9	2.1	90.2
66%	22.1	46.0	6.2	36.7	6.3	34.0	3.3	66.1	19.0	28.1	4.4	58.8	9.4	97.7
	1998-2019													
Mean	39.8	21.9	16.1	22.3	11.2	28.9	6.3	53.6	27.7	15.4	11.1	45.8	20.0	80.0
33%	50.1	8.1	8.0	8.9	14.8	18.5	3.9	36.3	36.8	6.9	6.1	23.7	14.2	76.3
66%	69.4	15.5	15.7	16.0	30.6	27.9	7.4	49.8	56.4	12.6	11.8	36.7	23.4	85.5

C. Interest Rates

	Output				Consumption				Investment				Interest rates	
	W	C	SF	I	W	C	SF	I	W	C	SF	I	F	I
	1985-2019													
Mean	38.9	32.6	3.0	25.5	9.9	27.6	1.6	61.0	25.6	22.9	2.1	49.5	24.6	75.4
33%	35.3	28.2	1.7	22.3	7.5	23.5	0.9	57.5	22.2	18.8	1.1	46.4	20.3	71.7
66%	42.0	35.9	3.2	28.3	11.3	30.5	1.7	64.6	28.1	25.4	2.2	53.2	28.0	79.4
	1985-2007													
Mean	20.6	41.4	5.9	32.1	6.4	33.0	3.6	57.0	18.4	26.4	4.5	50.7	24.9	75.1
33%	16.9	35.7	3.0	26.6	4.2	27.1	1.7	51.1	14.7	20.8	2.4	45.8	19.3	70.8
66%	22.7	46.4	6.2	36.2	7.2	37.7	3.7	62.7	20.5	29.6	4.8	55.9	28.9	80.4
	1998-2019													
Mean	48.0	22.2	7.1	22.7	13.8	28.6	3.5	54.1	33.3	16.0	5.0	45.7	30.9	69.1
33%	43.0	17.4	3.9	19.0	9.7	22.7	1.8	49.3	28.2	11.9	2.7	41.6	26.6	65.4
66%	51.9	24.8	8.0	25.5	15.5	31.8	3.8	59.7	36.5	17.9	5.5	49.8	34.3	73.2

Notes: In each cell, posterior median and 16 and 84 percentiles of the variance share attributable to the relevant factor at a horizon of 30th quarter is reported. The variance contributions are attributed to: W (global macro factor), C (country-specific macro factor), SF (spillovers from financial to macro factors), F (global financial factor), and I (idiosyncratic factor). Combined Model 1 and 2 captures spillovers to the global macro factor and to country-specific macro factor through which the financial factor affects macro activity. See Table A2 in the Appendix for more details on the model specification.

Table A10. Variance Decompositions for G-7 Countries
(Model 1&2 and Model 3&4; Country-Specific; 1998-2019)

A. Canada

	Output				Consumption				Investment				Financial		
	W	C	SF	I	W	C	SF	I	W	C	SF	I	SR	F	I
	Model 1&2														
Equity prices	26.2	12.7	13.1	48.1	22.9	9.6	11.2	56.3	40.1	3.7	18.7	37.5		57.7	42.3
House prices	32.5	11.4	12.5	43.5	28.2	6.4	10.6	54.8	46.4	6.5	17.1	29.9		29.5	70.5
Interest rates	40.8	9.5	5.6	44.1	34.6	7.8	4.7	52.9	55.8	5.9	7.2	31.2		60.6	39.4
	Model 3&4														
Equity prices	38.4	16.6		45.0	34.0	6.3		59.7	56.4	6.8		36.7	1.3	56.5	42.2
House prices	39.4	14.7		45.9	33.4	6.6		60.0	56.8	9.6		33.6	5.3	24.1	70.6
Interest rates	38.1	19.2		42.7	33.3	6.4		60.3	56.0	6.6		37.4	9.2	54.9	35.9

B. France

	Output				Consumption				Investment				Financial		
	W	C	SF	I	W	C	SF	I	W	C	SF	I	SR	F	I
	Model 1&2														
Equity prices	48.3	15.5	24.1	12.1	6.8	30.5	6.7	56.0	36.4	5.5	17.5	40.6		60.6	39.4
House prices	55.3	13.3	20.6	10.8	8.9	33.2	5.2	52.7	47.9	4.4	17.4	30.3		17.3	82.7
Interest rates	66.2	14.0	8.9	10.9	10.9	30.8	3.3	55.0	57.7	4.8	7.3	30.1		32.4	67.6
	Model 3&4														
Equity prices	69.0	17.7		13.3	9.5	29.5		61.0	52.1	6.5		41.4	1.4	59.4	39.3
House prices	69.5	17.8		12.7	9.4	33.2		57.3	58.5	6.2		35.4	3.7	15.8	80.5
Interest rates	67.9	18.7		13.4	9.3	27.5		63.3	50.5	7.4		42.1	5.6	33.7	60.8

C. Germany

	Output				Consumption				Investment				Financial		
	W	C	SF	I	W	C	SF	I	W	C	SF	I	SR	F	I
	Model 1&2														
Equity prices	46.4	15.4	22.3	15.9	0.6	25.1	2.0	72.2	22.5	25.1	12.2	40.3		62.3	37.7
House prices	52.5	14.6	19.6	13.4	0.8	22.7	1.6	74.8	27.7	24.2	11.3	36.7		3.9	96.1
Interest rates	62.2	15.9	8.2	13.7	1.1	21.7	1.1	76.2	32.5	26.8	5.2	35.5		17.8	82.2
	Model 3&4														
Equity prices	64.7	18.5		16.9	0.8	22.7		76.5	30.0	31.7		38.3	1.4	59.4	39.3
House prices	65.0	19.3		15.7	0.9	22.2		77.0	30.5	30.3		39.2	1.0	4.5	94.6
Interest rates	63.3	19.5		17.2	0.8	24.4		74.8	28.4	31.8		39.8	4.0	24.4	71.6

D. Italy

	Output				Consumption				Investment				Financial		
	W	C	SF	I	W	C	SF	I	W	C	SF	I	SR	F	I
	Model 1&2														
Equity prices	46.0	16.2	22.4	15.4	5.8	53.2	6.8	34.3	15.4	14.5	8.3	61.8		45.5	54.5
House prices	52.2	14.2	20.1	13.5	8.7	50.2	8.2	32.8	19.5	14.2	8.5	57.8		42.1	57.9
Interest rates	62.4	14.5	8.9	14.2	11.3	49.9	6.1	32.7	23.7	14.3	4.3	57.7		13.7	86.3
	Model 3&4														
Equity prices	66.4	17.2		16.4	10.0	54.5		35.5	22.1	15.4		62.5	1.0	44.6	54.3
House prices	65.5	17.8		16.7	9.4	55.9		34.6	21.5	15.9		62.6	8.2	39.7	52.1
Interest rates	64.4	19.0		16.6	9.5	54.3		36.2	21.0	16.9		62.0	2.4	14.3	83.3

E. Japan

	Output				Consumption				Investment				Financial		
	W	C	SF	I	W	C	SF	I	W	C	SF	I	SR	F	I
	Model 1&2														
Equity prices	24.0	39.8	13.4	22.8	2.2	50.6	3.8	43.4	9.7	21.9	5.8	62.6		34.0	66.0
House prices	28.5	38.2	12.9	20.4	3.0	49.9	4.5	42.7	12.4	21.8	6.0	59.9		10.1	89.9
Interest rates	34.6	38.6	5.9	20.9	3.8	50.2	2.5	43.4	15.1	22.1	2.8	59.9		13.6	86.4
	Model 3&4														
Equity prices	33.9	42.8		23.3	3.5	53.1		43.4	13.4	24.6		62.0	0.8	33.5	65.7
House prices	34.1	43.0		22.9	3.5	53.3		43.2	13.6	24.3		62.2	2.4	11.0	86.6
Interest rates	33.9	42.5		23.6	3.7	52.0		44.3	13.6	23.9		62.6	1.9	11.1	87.0

F. United Kingdom

	Output				Consumption				Investment				Financial		
	W	C	SF	I	W	C	SF	I	W	C	SF	I	SR	F	I
	Model 1&2														
Equity prices	27.8	32.8	15.4	24.0	10.3	9.5	5.5	74.7	6.4	3.3	3.3	87.0		79.2	20.8
House prices	35.5	27.7	16.2	20.5	14.3	7.7	6.1	72.0	8.8	3.2	3.6	84.4		32.3	67.7
Interest rates	43.5	28.4	6.9	21.2	17.2	7.8	2.6	72.4	11.2	3.4	1.6	83.8		13.8	86.2
	Model 3&4														
Equity prices	43.5	32.6		24.0	15.9	8.4		75.7	9.7	3.5		86.8	1.8	78.0	20.2
House prices	43.9	32.3		23.7	15.9	8.1		76.0	9.9	3.5		86.6	5.5	25.4	69.1
Interest rates	42.9	32.8		24.4	15.2	8.3		76.4	9.3	3.6		87.1	3.0	17.7	79.2

G. United States

	Output				Consumption				Investment				Financial		
	W	C	SF	I	W	C	SF	I	W	C	SF	I	SR	F	I
	Model 1&2														
Equity prices	16.5	38.6	10.4	34.5	9.8	36.4	7.1	46.7	24.3	38.7	14.0	23.0		75.6	24.4
House prices	22.1	33.6	10.6	33.8	14.5	32.2	7.8	45.5	31.1	33.6	13.8	21.5		4.6	95.4
Interest rates	26.6	34.1	5.5	33.8	17.7	31.9	4.3	46.2	37.0	34.6	6.7	21.6		64.4	35.6
	Model 3&4														
Equity prices	27.1	39.8		33.1	16.9	35.8		47.3	37.8	39.3		22.9	1.7	74.6	23.7
House prices	29.0	37.2		33.8	18.8	32.7		48.5	39.9	37.5		22.6	1.1	5.1	93.8
Interest rates	27.6	39.2		33.3	17.3	35.1		47.7	38.3	38.7		23.0	8.6	51.1	40.3

Notes: This table shows the country-specific variance shares attributable to spillovers from the financial (equity prices, house prices, and interest rates) to macroeconomic aggregates (model 1 and 2) and from the macroeconomy to financial sector (model 3 and 4). The variance contributions are attributed to: W (global macro factor), C (country-specific macro factor), SF (spillovers from financial to macro factors), F (global financial factor), and I (idiosyncratic factor) in the case of the combined Model 1 and 2, and W (global macro factor), C (country-specific macro factor), SR (spillovers from macro to financial factors), F (global financial factor), and I (idiosyncratic factor) in the case of the Model 3 and 4. See Table A2 in the Appendix for more details on the model specification.

Table A11. Confidence Bands for Variance Decompositions
(Average across G-7 countries; Model 3+4)

A. Equity Prices

	Output			Consumption			Investment			Equity prices		
	W	C	I	W	C	I	W	C	I	SR	F	I
	1985-2019											
Mean	39.2	34.4	26.4	9.6	29.0	61.4	25.3	24.5	50.1	1.0	55.1	43.9
33%	35.7	30.1	23.0	7.2	24.7	58.1	21.9	20.4	46.9	0.4	52.6	41.1
66%	42.6	37.6	28.9	10.9	31.9	65.2	28.1	27.1	53.3	1.0	57.7	46.3
	1985-2007											
Mean	25.3	41.1	33.6	8.0	30.4	61.6	19.0	25.5	55.4	0.8	50.4	48.8
33%	20.7	36.0	29.2	5.0	25.0	57.0	14.7	20.4	51.1	0.3	47.2	45.0
66%	28.2	45.4	36.9	9.1	34.4	66.3	21.6	28.5	59.7	0.8	53.9	51.8
	1998-2019											
Mean	49.0	26.4	24.6	12.9	30.0	57.0	31.7	18.3	50.1	1.3	58.3	40.4
33%	45.1	21.3	20.9	9.7	24.6	52.6	27.6	14.0	46.3	0.6	55.1	36.6
66%	52.9	29.5	27.4	14.8	33.3	61.8	35.1	20.4	53.6	1.4	61.8	43.4

B. House Prices

	Output			Consumption			Investment			House prices		
	W	C	I	W	C	I	W	C	I	SR	F	I
	1985-2019											
Mean	39.8	34.2	26.0	9.8	28.8	61.5	25.8	24.3	50.0	1.2	11.0	87.8
33%	36.2	29.9	22.8	7.4	24.6	58.1	22.3	20.3	46.6	0.2	2.3	84.1
66%	43.0	37.6	28.4	11.2	31.8	65.2	28.4	26.9	53.2	1.2	13.8	97.3
	1985-2007											
Mean	23.2	42.2	34.7	7.0	30.3	62.7	17.7	25.6	56.6	0.9	8.5	90.7
33%	20.1	37.0	28.9	4.7	26.0	57.1	14.1	20.3	52.1	0.3	4.5	86.6
66%	27.6	46.5	36.7	8.6	34.8	66.1	20.8	28.4	60.5	0.9	11.9	94.7
	1998-2019											
Mean	49.5	26.0	24.5	13.0	30.3	56.7	33.0	18.2	48.9	3.9	17.9	78.2
33%	20.1	37.0	28.9	4.7	26.0	57.1	14.1	20.3	52.1	0.3	4.5	86.6
66%	27.6	46.5	36.7	8.6	34.8	66.1	20.8	28.4	60.5	3.9	11.9	94.7

C. Interest Rates

	Output			Consumption			Investment			Interest rates		
	W	C	I	W	C	I	W	C	I	SR	F	I
	1985-2019											
Mean	39.1	34.6	26.3	9.5	28.7	61.7	25.2	24.6	50.2	2.5	24.3	73.2
33%	35.7	30.4	23.0	7.3	24.5	58.5	22.0	20.7	47.0	1.5	20.2	69.5
66%	42.1	37.9	28.9	10.9	31.6	65.5	27.8	27.2	53.3	2.8	27.4	77.4
	1985-2007											
Mean	24.2	41.7	34.1	7.3	31.7	61.0	18.1	24.7	57.2	4.3	23.4	72.3
33%	20.0	36.5	29.6	4.7	26.4	56.6	14.1	19.9	52.9	2.5	18.6	67.7
66%	26.9	46.0	37.5	8.3	35.6	65.7	20.4	27.8	61.4	4.8	27.1	77.7
	1998-2019											
Mean	48.3	27.2	24.4	12.7	29.7	57.6	31.0	18.4	50.6	4.9	29.6	65.4
33%	44.8	21.1	21.7	9.2	24.9	51.9	27.4	14.1	46.5	3.2	25.1	61.5
66%	52.5	28.9	28.2	14.4	34.6	61.5	34.7	20.4	53.7	5.6	32.6	70.2

Notes: In each cell, the posterior mean and 16 and 84 percentiles of the variance share attributable to the relevant factor at a horizon of 30th quarter are reported. The variance contributions are attributed to: W (global macro factor), C (country-specific macro factor), SR (spillover from macro factors to global financial factor), F (global financial factor), and I (idiosyncratic factor). Combined Model 3 and 4, which captures spillovers from the global macro factor and from the U.S. country factor through which the financial sector is affected. See Table A2 in the Appendix for more details on the model specification.

Table A12. Variance Decompositions
(Average across G-7, HP-filtered data)

A. Equity Price

	Output				Consumption				Investment				Financial		
	W	C	SF	I	W	C	SF	I	W	C	SF	I	SR	F	I
	Model 1														
1985-2019	46.8	26.0	5.2	22.0	14.6	27.5	1.5	56.4	33.8	20.2	3.6	42.4		55.2	44.8
1985-2007	31.6	34.4	5.0	29.0	12.2	27.2	1.9	58.6	25.9	22.4	4.1	47.7		50.9	49.1
1998-2019	34.4	25.4	15.1	25.2	8.8	31.3	3.8	56.1	22.4	17.5	9.8	50.2		57.5	42.5
	Model 2														
1985-2019	51.2	26.0	0.9	21.9	15.8	29.0	1.1	54.1	36.7	19.3	0.7	43.3		55.3	44.7
1985-2007	34.9	33.6	1.9	29.6	13.2	28.3	1.6	56.9	28.1	22.2	1.4	48.4		50.7	49.3
1998-2019	55.7	21.3	1.5	21.5	17.9	28.1	2.0	52.1	39.4	15.7	1.0	43.8		57.0	43.0
	Model 3														
1985-2019	46.2	30.2		23.6	13.3	28.5		58.3	32.2	22.1		45.8	0.5	55.5	43.9
1985-2007	34.8	35.7		29.5	13.0	29.2		57.7	27.3	24.8		47.9	0.4	50.6	48.9
1998-2019	47.3	26.6		26.1	12.7	31.7		55.6	31.0	18.5		50.5	0.8	56.2	43.1
	Model 4														
1985-2019	58.1	23.1		18.8	19.9	26.1		54.0	42.4	18.6		39.0	0.2	55.2	44.6
1985-2007	39.5	32.3		28.3	15.6	27.3		57.2	31.8	22.7		45.5	0.3	50.9	48.8
1998-2019	47.0	27.2		25.7	12.5	30.0		57.5	30.6	18.0		51.4	0.4	56.4	43.2

B. House price

	Output				Consumption				Investment				House prices		
	W	C	SF	I	W	C	SF	I	W	C	SF	I	SR	F	I
	Model 1														
1985-2019	36.5	32.3	4.1	27.1	9.2	30.0	1.0	59.8	24.2	22.8	2.7	50.2		9.3	90.7
1985-2007	28.4	36.1	3.9	31.7	10.4	28.9	1.4	59.3	22.2	23.0	3.0	51.8		8.2	91.8
1998-2019	52.3	18.3	10.3	19.1	18.6	27.8	3.6	50.0	38.0	14.1	7.4	40.5		15.8	84.2
	Model 2														
1985-2019	42.4	31.2	1.8	24.7	11.4	28.1	1.5	58.9	28.9	21.8	1.2	48.0		11.3	88.7
1985-2007	38.6	31.7	2.4	27.3	15.9	26.4	1.9	55.8	31.0	21.4	1.6	46.0		9.1	90.9
1998-2019	51.1	23.4	1.8	23.7	15.3	28.7	2.2	53.8	34.4	17.1	1.2	47.3		15.6	84.4
	Model 3														
1985-2019	47.0	29.2		23.8	13.4	28.8		57.7	31.4	22.5		46.1	1.0	13.3	85.7
1985-2007	32.8	35.5		31.8	12.2	30.2		57.6	25.6	24.5		49.9	0.5	10.4	89.1
1998-2019	48.2	24.8		27.0	13.0	30.8		56.3	30.6	23.7		45.7	2.1	16.7	81.2
	Model 4														
1985-2019	51.3	26.9		21.8	16.0	27.4		56.6	34.9	21.0		44.1	0.5	11.7	87.7
1985-2007	37.2	31.0		31.7	14.6	27.4		58.0	30.6	23.3		46.2	0.3	8.2	91.5
1998-2019	46.9	23.5		29.5	12.4	29.5		58.1	28.7	26.4		44.9	0.7	17.0	82.3

Panel C. Interest Rates

	Output				Consumption				Investment				Financial		
	W	C	SF	I	W	C	SF	I	W	C	SF	I	SR	F	I
	Model 1														
1985-2019	50.1	26.4	1.9	21.6	15.9	27.2	0.6	56.3	36.0	20.0	1.3	42.6		24.5	75.5
1985-2007	27.6	37.5	2.7	32.3	9.5	29.3	1.0	60.2	21.8	24.8	2.1	51.4		24.1	75.9
1998-2019	62.2	15.9	6.7	15.2	23.7	26.0	2.6	47.7	46.4	13.0	5.0	35.5		30.8	69.2
	Model 2														
1985-2019	58.9	22.2	2.3	16.6	21.3	25.5	0.8	52.4	44.1	17.2	1.7	37.0		24.5	75.5
1985-2007	43.0	29.5	1.6	25.9	18.3	26.3	1.4	53.9	35.0	19.9	1.2	43.9		24.2	75.8
1998-2019	51.7	22.8	2.0	23.5	16.0	29.3	0.6	54.1	35.4	16.7	1.3	46.6		30.7	69.3
	Model 3														
1985-2019	38.2	34.7		27.1	9.5	29.5		61.1	25.2	24.4		50.4	0.9	25.1	74.0
1985-2007	27.4	40.2		32.4	9.1	29.6		61.3	21.2	25.2		53.6	2.4	24.4	73.2
1998-2019	48.2	27.0		24.8	12.9	30.9		56.2	31.8	18.0		50.3	2.4	30.8	66.8
	Model 4														
1985-2019	49.8	27.6		22.7	15.5	27.4		57.1	35.3	20.4		44.3	1.1	23.8	75.0
1985-2007	44.7	29.8		25.5	19.5	25.7		54.7	35.1	22.1		42.8	1.6	23.4	75.0
1998-2019	52.5	24.5		23.0	15.6	28.7		55.7	35.5	17.0		47.6	1.8	30.2	68.0

Notes: In each cell, the variance share attributable to the relevant factor at a horizon of 30th quarter is reported. The variance contributions are attributed to: W (global macro factor), C (country-specific macro factor), SF (spillovers from financial to macro factors), SR (spillover from global financial factor), F (global financial factor), and I (idiosyncratic factor). Combined Model 1 and 2 captures spillovers to the global macro factor (Model 1) and to country-specific macro factor (Model 2) through which the financial factor affects macro activity. Combined Model 3 and 4, which captures spillovers from the global macro factor (Model 3) and from the U.S. country factor (Model 4) through which the financial sector is affected. See Table A2 in the Appendix for more details on the model specification.

Table A13. Variance Decompositions: Models With Only Macroeconomic Variables, With Variable-Specific Factors

A. 1985-2019

	Output			Consumption			Investment		
	Global	Variable	Idiosyncratic	Global	Variable	Idiosyncratic	Global	Variable	Idiosyncratic
Canada	39.4	0.2	60.4	40.4	18.7	40.9	8.3	55.8	35.9
France	32.9	19.6	47.5	13.5	11.8	74.6	46.3	0.2	53.5
Germany	43.8	0.3	55.9	26.9	0.3	72.8	11.6	13.8	74.6
Italy	0.0	83.6	16.4	12.8	1.7	85.5	1.6	0.4	98.0
Japan	31.5	0.1	68.4	34.9	0.3	64.9	31.7	0.5	67.8
United Kingdom	38.9	15.9	45.2	5.4	59.5	35.1	12.1	8.6	79.3
United States	7.6	6.0	86.4	13.9	0.6	85.5	38.7	0.3	61.0
Average	27.7	18.0	54.3	21.1	13.3	65.6	21.5	11.4	67.2
Median	32.9	6.0	55.9	13.9	1.7	72.8	12.1	0.5	67.8

B. 1985-2007

	Output			Consumption			Investment		
	Global	Variable	Idiosyncratic	Global	Variable	Idiosyncratic	Global	Variable	Idiosyncratic
Canada	55.3	24.8	19.8	3.6	1.9	94.5	11.1	3.3	85.7
France	63.8	0.4	35.9	0.1	1.0	98.9	0.3	35.5	64.2
Germany	62.3	17.1	20.5	0.1	1.3	98.6	0.2	1.3	98.5
Italy	42.2	40.7	17.1	1.2	5.2	93.6	0.2	2.9	96.9
Japan	15.4	0.1	84.6	1.0	42.5	56.5	0.1	0.1	99.8
United Kingdom	62.9	26.3	10.8	0.1	3.6	96.3	0.8	3.5	95.7
United States	69.3	0.8	29.8	3.8	23.6	72.6	2.3	0.3	97.4
Average	53.0	15.7	31.2	1.4	11.3	87.3	2.1	6.7	91.2
Median	62.3	17.1	20.5	1.0	3.6	94.5	0.3	2.9	96.9

C. 1998-2019

	Output			Consumption			Investment		
	Global	Variable	Idiosyncratic	Global	Variable	Idiosyncratic	Global	Variable	Idiosyncratic
Canada	37.4	4.3	58.3	23.6	3.7	72.7	37.5	7.1	55.4
France	60.7	0.8	38.5	12.3	0.3	87.4	50.9	0.8	48.3
Germany	50.9	5.7	43.4	0.1	1.4	98.5	27.2	0.6	72.2
Italy	51.5	9.3	39.3	17.4	2.2	80.5	26.5	21.6	51.9
Japan	25.3	0.7	74.0	0.8	1.0	98.1	17.8	1.4	80.8
United Kingdom	45.5	1.2	53.3	14.8	42.2	42.9	17.4	0.3	82.3
United States	40.0	18.9	41.1	33.0	4.8	62.2	41.1	11.3	47.6
Average	44.5	5.8	49.7	14.6	8.0	77.5	31.2	6.1	62.7
Median	45.5	4.3	43.4	14.8	2.2	80.5	27.2	1.4	55.4

Notes: In each cell, the variance share attributable to the relevant factor is reported based on the two-factor model: $Y_t^{i,j} = \beta_{global} f_t^{global} + \beta^i f_t^i + \varepsilon_t^{i,j,k}$. The variance contributions are attributed to: Global (global factor), Variable (variable-specific factor), and Idiosyncratic (idiosyncratic factor). The rows marked "Average" and "Median" represent unweighted averages and medians, respectively, of the variance contributions shown in each column.

Table A14. Variance Decompositions: Models With Financial Variables

A. 1985-2019

	Equity prices			House prices			Interest rates		
	Global	Country	Idiosyncratic	Global	Country	Idiosyncratic	Global	Country	Idiosyncratic
Canada	61.0	26.2	12.8	0.0	70.6	29.3	0.0	0.1	99.9
France	5.5	0.8	93.7	0.0	0.1	99.8	70.3	21.0	8.6
Germany	2.0	5.8	92.2	47.1	40.9	12.0	4.7	1.1	94.3
Italy	64.7	0.2	35.1	0.0	3.1	96.8	0.1	3.5	96.3
Japan	0.6	0.9	98.5	0.1	2.4	97.6	71.9	19.5	8.6
United Kingdom	0.1	48.0	51.9	29.6	54.8	15.6	1.1	1.1	97.8
United States	65.0	0.4	34.6	0.9	0.0	99.0	4.1	0.3	95.6
Average	28.4	11.8	59.8	11.1	24.6	64.3	21.7	6.7	71.6
Median	5.5	0.9	51.9	0.1	3.1	96.8	4.1	1.1	95.6

B. 1985-2007

	Equity prices			House prices			Interest rates		
	Global	Country	Idiosyncratic	Global	Country	Idiosyncratic	Global	Country	Idiosyncratic
Canada	55.3	24.8	19.8	0.1	1.3	98.6	0.1	0.1	99.8
France	3.6	1.9	94.5	0.2	1.3	98.5	62.9	26.3	10.8
Germany	11.1	3.3	85.7	42.2	40.7	17.1	0.1	3.6	96.3
Italy	63.8	0.4	35.9	1.2	5.2	93.6	0.8	3.5	95.7
Japan	0.1	1.0	98.9	0.2	2.9	96.9	69.3	0.8	29.8
United Kingdom	0.3	35.5	64.2	15.4	0.1	84.6	3.8	23.6	72.6
United States	62.3	17.1	20.5	1.0	42.5	56.5	2.3	0.3	97.4
Average	28.1	12.0	59.9	8.6	13.4	78.0	19.9	8.3	71.8
Median	11.1	3.3	64.2	1.0	2.9	93.6	2.3	3.5	95.7

C. 1998-2019

	Equity prices			House prices			Interest rates		
	Global	Country	Idiosyncratic	Global	Country	Idiosyncratic	Global	Country	Idiosyncratic
Canada	66.4	2.7	30.9	0.6	49.3	50.1	1.0	1.6	97.4
France	7.4	6.2	86.5	2.6	1.1	96.3	78.1	6.2	15.6
Germany	1.3	69.8	28.8	51.4	1.4	47.2	5.2	4.3	90.5
Italy	67.7	0.5	31.8	6.6	0.3	93.1	0.5	1.3	98.2
Japan	4.6	1.9	93.5	0.1	57.9	42.0	76.2	3.5	20.3
United Kingdom	3.3	63.3	33.4	49.1	35.6	15.3	0.2	40.7	59.1
United States	67.9	0.5	31.6	0.1	0.7	99.2	5.8	0.5	93.6
Average	31.2	20.7	48.1	15.8	20.9	63.3	23.9	8.3	67.8
Median	7.4	2.7	31.8	2.6	1.4	50.1	5.2	3.5	90.5

Notes: In each cell, the variance share attributable to the relevant factor is reported. The variance contributions are attributed to: Global (global factor), Country (country-specific factor), and Idiosyncratic (idiosyncratic factor), based on the two-factor model: $Y_t^{i,j} = \beta_{global} f_t^{global} + \beta_j \ f_t^{\ j} + \varepsilon_t^{i,j,k}$.

Table A15. Variance Decompositions: Credit Growth as the Financial Variable (G-7 Averages)

A. Models 1, 2 and 1&2

	Output				Consumption				Investment				Credit	
	W	C	SF	I	W	C	SF	I	W	C	SF	I	F	I
	Model 1													
1985-2019	36.4	34.5	2.6	26.6	8.7	29.0	0.6	61.7	23.3	23.3	1.6	51.8	13.5	86.5
1985-2007	21.9	40.9	2.4	34.8	6.8	29.4	0.7	63.1	17.1	23.6	1.9	57.4	11.5	88.5
1998-2019	46.6	23.5	4.8	25.0	12.8	30.1	1.3	55.7	31.6	17.0	3.3	48.2	9.6	90.4
	Model 2													
1985-2019	39.9	32.4	1.9	25.9	10.2	27.0	1.6	61.2	26.1	23.0	1.4	49.5	15.9	84.1
1985-2007	44.0	28.9	3.0	24.1	19.2	26.6	2.5	51.7	38.6	17.7	2.1	41.6	18.8	81.2
1998-2019	61.9	17.5	1.5	19.1	21.5	26.5	2.1	49.9	45.5	14.3	1.2	39.1	14.5	85.5
	Model 1&2													
1985-2019	38.8	31.8	4.2	25.3	10.0	27.2	2.2	60.6	25.5	22.8	2.9	48.8	16.0	84.0
1985-2007	19.7	42.6	6.5	31.2	7.1	28.1	3.7	61.0	13.3	31.7	5.0	50.0	18.7	81.3
1998-2019	50.1	21.1	6.4	22.4	15.2	28.0	3.7	53.1	35.2	15.4	4.6	44.8	14.4	85.6

Notes: In each cell, the variance share attributable to the relevant factor is reported. The share is averaged across the G-7 countries at a horizon of 30 quarters. The variance contributions are attributed to: W (global macro factor), C (country-specific macro factor), F (global financial factor), SF (spillovers from financial to macro factors), and I (idiosyncratic factor). In Model 1, the financial factor spills over to the global macro factor. In Model 2, the financial factor spills over directly to country-specific macro factor. Models 1 and 2 combined capture both channels through which the financial factor affects macro activity.

B. Models 3, 4 and 3&4

	Output			Consumption			Investment			Credit		
	W	C	I	W	C	I	W	C	I	SR	F	I
	Model 3											
1985-2019	31.7	37.9	30.4	13.7	41.3	44.9	19.8	41.9	38.2	0.5	6.0	93.5
1985-2007	13.8	52.7	33.4	6.8	31.2	62.1	8.0	48.4	43.6	0.5	11.1	88.4
1998-2019	42.4	30.9	26.7	12.1	32.0	55.8	27.0	29.3	43.7	0.6	8.3	91.1
	Model 4											
1985-2019	35.2	33.0	31.9	13.9	31.4	54.7	21.3	37.8	40.9	0.8	9.4	89.7
1985-2007	13.6	48.0	38.4	6.6	36.4	57.0	7.8	46.6	45.6	0.5	5.7	93.9
1998-2019	13.6	48.0	38.4	6.6	36.4	57.0	7.8	46.6	45.6	0.5	5.7	93.9
	Model 3&4											
1985-2019	33.9	36.3	29.8	12.9	31.8	55.3	20.0	38.3	41.7	0.5	5.8	93.7
1985-2007	14.6	50.8	34.6	8.0	31.0	61.1	8.8	46.9	44.3	0.6	5.6	93.8
1998-2019	43.0	31.8	25.2	12.4	27.9	59.7	27.1	28.3	44.6	0.8	7.4	91.8

Notes: In each cell, the variance share attributable to the relevant factor is reported. The share is averaged across the G-7 countries at a horizon of 30 quarters. The variance contributions are attributed to: W (global macro factor), C (country-specific macro factor), F (global financial factor), SR (spillovers from macro to financial factor), and I (idiosyncratic factor). In Model 3, the global macro factor spills over to the financial factor. In Model 4, the U.S. country factor spills over to the financial factor. Models 3 and 4 combined capture both channels through which the macro factors affect financial sector. See Table A2 in the Appendix for more details on the model specification.

Table A16. Variance Decompositions: Long-term Interest Rates (G-7 Average; Model 1&2 and Model 3&4)

	Output				Consumption				Investment				Interest rates		
	W	C	SF	I	W	C	SF	I	W	C	SF	I	SR	F	I
	Models 1 & 2														
1985-2019	38.7	32.4	2.5	26.4	9.8	27.8	1.4	61.0	25.3	23.5	1.8	49.4		32.6	67.4
1985-2007	25.2	37.9	4.6	32.3	8.4	29.3	2.5	59.8	20.9	22.0	3.5	53.7		31.0	69.0
1998-2019	47.7	21.1	10.1	21.0	14.1	28.2	4.6	53.1	33.7	15.1	7.3	43.9		40.7	59.3
	Models 3 & 4														
1985-2019	34.4	41.7		23.8	8.0	44.1		47.9	22.2	34.2		43.6	2.3	22.6	75.1
1985-2007	27.6	46.4		26.0	18.1	33.6		48.3	23.2	36.6		40.3	1.9	19.8	78.3
1998-2019	40.7	36.0		23.3	9.9	41.2		48.9	27.0	27.6		45.4	7.7	31.0	61.2

Notes: In each cell, the variance share attributable to the relevant factor is reported. The shares are averaged across the G-7 countries at a horizon of 30 quarters. The variance contributions are attributed to: W (global macro factor), C (country-specific macro factor), F (global financial factor), SF (spillovers from financial to macro factor), SR (spillovers from macro to financial factor), and I (idiosyncratic factor). The results in the upper panel are based on the combined Model 1&2, which captures spillovers of the global financial factor to macro variables through both the global macro factor and the country-specific macro factor. The results in the lower panel are based on the combined Model 3&4, which captures spillovers of the global macro factor and the U.S. country factor onto the global factor for long-term interest rates. See Table A2 in the Appendix for more details on the model specification.

Table A17. Variance Decompositions: Alternative House Price Indicator (G-7 Averages)

A. Model 1 and 2

	Output				Consumption				Investment				House prices	
	W	C	SF	I	W	C	SF	I	W	C	SF	I	F	I
	Model 1													
1985-2019	35.6	33.8	4.1	26.5	8.7	28.6	1.0	61.7	22.8	23.0	2.6	51.5	9.1	90.9
1985-2007	22.9	40.5	3.4	33.2	7.7	29.0	1.2	62.2	17.0	25.2	2.6	55.2	8.5	91.5
1998-2019	41.0	24.9	8.1	26.1	10.4	31.3	2.1	56.3	27.2	17.4	5.4	50.0	9.8	90.2
	Model 2													
1985-2019	39.2	32.8	1.7	26.3	10.1	27.7	1.4	60.8	25.3	23.4	1.2	50.2	12.7	87.3
1985-2007	24.1	40.4	1.8	33.7	7.7	30.2	0.6	61.5	19.6	23.0	1.5	55.9	6.3	93.7
1998-2019	52.2	23.0	2.0	22.8	15.5	27.6	2.3	54.6	36.3	16.6	1.3	45.9	16.3	83.7
	Model 1&2													
1985-2019	34.8	31.8	5.8	27.6	8.5	28.3	2.2	61.0	22.3	24.4	3.9	49.4	15.6	84.4
1985-2007	19.1	40.4	6.4	34.1	5.6	29.9	3.2	61.3	14.9	22.1	4.4	58.7	9.8	90.2
1998-2019	36.6	22.8	16.7	23.8	9.7	30.2	6.4	53.7	25.0	16.0	11.4	47.6	16.6	83.4

Notes: In each cell, the variance share attributable to the relevant factor is reported. The share is averaged across the G-7 countries at a horizon of 30 quarters. The variance contributions are attributed to: W (global macro factor), C (country-specific macro factor), F (global financial factor), SF (spillovers from financial to macro factors), and I (idiosyncratic factor). In Model 1, the financial factor spills over to the global macro factor. In Model 2, the financial factor spills over directly to country-specific macro factor. Models 1 and 2 combined capture both channels through which the financial factor affects macro fluctuations. See Table A2 in the Appendix for more details on the model specification.

B. Model 3 and 4

	Output			Consumption			Investment			House prices		
	W	C	I	W	C	I	W	C	I	SR	F	I
	Model 3											
1985-2019	35.2	37.6	27.2	7.7	40.2	52.1	21.8	31.0	47.1	1.2	9.1	89.7
1985-2007	24.1	43.5	32.5	10.6	35.2	54.2	21.4	28.3	50.3	1.5	10.0	88.6
1998-2019	44.6	31.0	24.4	10.3	35.9	53.8	28.2	23.6	48.2	1.6	9.3	89.0
	Model 4											
1985-2019	43.0	34.9	22.1	12.4	40.4	47.2	29.1	30.7	40.2	1.0	9.8	89.2
1985-2007	24.0	42.5	33.5	14.9	26.5	58.6	13.6	39.9	46.6	1.0	9.7	89.3
1998-2019	44.7	29.8	25.4	10.3	34.9	54.7	27.7	23.1	49.2	0.8	7.5	91.7
	Model 3&4											
1985-2019	34.2	40.4	25.4	7.6	42.7	49.7	21.7	32.9	45.4	1.3	6.9	91.9
1985-2007	28.5	40.4	31.1	15.1	32.8	52.0	26.6	25.2	48.2	1.0	5.9	93.1
1998-2019	46.5	28.5	25.0	11.4	35.1	53.5	29.3	22.5	48.2	1.5	6.4	92.1

Notes: In each cell, the variance share attributable to the relevant factor is reported. The share is averaged across the G-7 countries at a horizon of 30 quarters. The variance contributions are attributed to: W (global macro factor), C (country-specific macro factor), F (global financial factor), SR (spillovers from macro to financial factor), and I (idiosyncratic factor). In Model 3, the global macro factor spills over to the financial factor. In Model 4, the U.S. country factor spills over to the financial factor. Models 3 and 4 combined capture both channels through which the macro factors affect financial markets. See Table A2 in the Appendix for more details on the model specification.

Table A18. Variance Decompositions: Dataset Excluding the U.S. (G-6 Averages)

A. Model 1

	Output				Consumption				Investment				Financial	
	W	C	SF	I	W	C	SF	I	W	C	SF	I	F	I
	Equity prices													
1985-2019	31.4	36.4	5.0	27.2	4.6	40.0	0.8	54.6	18.3	26.6	3.0	52.2	47.3	52.7
1985-2007	19.7	44.2	1.7	34.4	6.6	38.1	0.6	54.8	19.1	29.0	1.6	50.2	43.3	56.7
1998-2019	34.7	29.9	10.2	25.2	6.1	37.3	1.8	54.8	19.3	18.3	5.7	56.6	50.6	49.4
	House prices													
1985-2019	34.3	35.1	2.8	27.8	5.6	39.5	0.5	54.4	19.9	25.6	1.6	52.9	11.6	88.4
1985-2007	20.6	43.4	1.9	34.1	7.3	36.7	0.7	55.3	20.2	26.7	1.9	51.3	12.9	87.1
1998-2019	41.5	28.8	4.4	25.3	8.2	34.3	0.9	56.6	22.5	18.4	2.4	56.6	6.6	93.4
	Interest rates													
1985-2019	36.4	36.1	1.4	26.1	6.5	38.6	0.3	54.6	22.4	23.0	0.9	53.8	18.8	81.2
1985-2007	22.1	42.7	1.6	33.6	8.2	36.2	0.6	54.9	21.7	24.4	1.5	52.4	18.1	81.9
1998-2019	41.8	30.2	1.9	26.1	7.9	35.2	0.4	56.5	23.0	19.5	1.1	56.4	26.5	73.5

Notes: In each cell, the variance share attributable to the relevant factor is reported. The results are based on Model 1, which captures spillovers from the financial sector to the macroeconomy through the global macro factor. The dataset for this exercise comprises six of the G-7 countries; the U.S. is excluded. See Table A2 in the Appendix for more details on the model specification.

B. Model 3

	Output			Consumption			Investment			Financial		
	W	C	I	W	C	I	W	C	I	SR	F	I
	Equity prices											
1985-2019	37.0	37.9	25.1	6.3	38.2	55.5	22.3	26.1	51.6	0.4	47.2	52.4
1985-2007	20.6	47.6	31.7	7.2	40.2	52.6	20.8	31.8	47.4	0.4	43.3	56.3
1998-2019	55.1	25.0	19.9	13.2	33.3	53.5	32.1	17.7	50.2	0.8	51.6	47.6
	House prices											
1985-2019	37.7	35.7	26.6	6.6	40.4	53.0	23.1	24.5	52.4	0.6	11.2	88.2
1985-2007	20.3	47.6	32.1	7.2	38.8	54.0	20.3	31.9	47.8	0.5	11.9	87.6
1998-2019	46.2	30.2	23.6	9.1	36.0	54.9	26.2	19.5	54.2	0.5	8.2	91.3
	Interest rates											
1985-2019	38.9	33.6	27.5	7.5	41.7	50.9	24.7	21.6	53.7	0.9	19.2	79.9
1985-2007	21.4	46.1	32.5	7.3	38.4	54.3	20.5	31.4	48.2	1.0	19.2	79.8
1998-2019	48.2	28.4	23.4	9.9	35.5	54.5	27.4	18.9	53.7	1.0	26.5	72.5

Notes: In each cell, the variance share attributable to the relevant factor is reported. The share is averaged across the G-7 countries at a horizon of 30 quarters. The variance contributions are attributed to: W (global macro factor), C (country-specific macro factor), F (global financial factor), SR (spillovers from macro to financial factor), and I (idiosyncratic factor). In Model 3, the global macro factor spills over to the financial factor. See Table A2 in the Appendix for more details on the model specification.

Table A19. Variance Decompositions: Alternative Sub-Samples (G-7 Averages)

A. Model 1 and 2

	Output				Consumption				Investment				Financial variable	
	W	C	SF	I	W	C	SF	I	W	C	SF	I	F	I
	Equity prices													
1985-2000	29.8	32.4	8.6	29.2	12.6	28.4	5.0	54.0	25.9	21.1	6.9	46.1	43.7	56.3
2001-2019	50.4	13.5	23.2	12.9	23.8	18.8	13.9	43.4	33.2	18.9	16.3	31.5	60.6	39.4
	House prices													
1985-2000	17.8	39.2	7.7	35.4	7.8	27.8	4.7	59.7	13.2	28.7	6.0	52.1	9.8	90.2
2001-2019	40.5	21.8	18.9	18.7	12.7	26.3	7.7	53.3	27.9	16.9	13.1	42.1	20.3	79.7
	Interest rates													
1985-2000	13.4	45.7	6.0	34.9	7.8	27.8	3.5	60.9	8.3	36.8	5.1	49.8	19.6	80.4
2001-2019	55.8	18.1	9.2	16.9	20.9	22.9	4.7	51.5	36.6	17.8	6.5	39.1	29.7	70.3

Notes: In each cell, the variance share attributable to the relevant factor is reported. The share is averaged across the G-7 countries at a horizon of 30 quarters. The variance contributions are attributed to: W (global macro factor), C (country-specific macro factor), F (global financial factor), SF (spillovers from financial to macro factors), and I (idiosyncratic factor). The results are based on the combined Models 1 and 2, which capture financial market spillovers to macro aggregates through the global macro factor and country-specific macro factors. See Table A2 in the Appendix for more details on the model specification.

B. Model 3 and 4

	Output			Consumption			Investment			Financial variable		
	W	C	I	W	C	I	W	C	I	SR	F	I
	Equity prices											
1985-2000	25.2	45.4	29.4	15.6	33.9	50.5	16.9	38.3	44.8	1.1	37.9	61.1
2001-2019	69.2	17.2	13.6	31.3	26.1	42.5	40.3	24.4	35.2	1.5	54.6	43.8
	House prices											
1985-2000	25.9	45.5	28.6	16.4	33.7	49.8	17.5	39.1	43.3	1.2	5.5	93.3
2001-2019	67.4	18.2	14.5	32.7	24.0	43.3	37.3	27.6	35.1	0.4	3.6	96.1
	Interest rates											
1985-2000	31.6	41.4	27.1	22.7	29.4	47.8	21.1	37.6	41.3	2.6	12.4	85.1
2001-2019	46.0	29.2	24.8	12.4	33.2	54.4	30.1	24.1	45.9	5.3	26.3	68.4

Notes: In each cell, the variance share attributable to the relevant factor is reported. The share is averaged across the G-7 countries at a horizon of 30 quarters. The variance contributions are attributed to: W (global macro factor), C (country-specific macro factor), F (global financial factor), SR (spillovers from macro to financial factor), and I (idiosyncratic factor). The results are based on the combined Models 3 and 4, which capture spillovers of macro fluctuations onto financial markets through the global macro factor and the U.S. country factor. See Table A2 in the Appendix for more details on the model specification.

Table A20. Variance Decompositions: Model With Output Only
(Model 1; average across G-7 countries)

A. Spillover model from financial to macro factors

	Model with equity prices						Model with house prices						Model with interest rates					
	Output				Financial variable		Output				Financial variable		Output				Financial variable	
	W	C	SF	I	F	I	W	C	SF	I	F	I	W	C	SF	I	F	I
	1985-2019																	
Baseline	31.4	33.1	7.4	28.2	56.0	44.0	33.7	33.0	6.2	27.2	12.4	87.6	38.5	34.4	1.3	25.9	24.5	75.5
Alternative	33.4		6.9	59.7	55.0	45.0	35.6		5.7	58.8	19.3	80.7	26.4		1.6	59.1	26.4	73.6
	1985-2007																	
Baseline	23.5	39.7	3.6	33.2	42.7	57.3	25.7	38.6	3.6	32.2	10.7	89.3	26.4	38.1	3.0	32.5	24.3	75.7
Alternative	24.6		5.1	70.2	50.4	49.5	24.3		3.6	72.1	17.9	82.1	27.7	-	3.4	68.9	23.4	76.0
	1998-2019																	
Baseline	34.6	24.7	15.4	25.3	59.6	40.4	38.8	23.1	14.7	23.4	19.8	80.2	48.8	23.2	4.4	23.6	30.5	69.5
Alternative	39.9		12.5	47.6	52.9	47.1	41.2		11.4	47.4	14.4	85.6	49.9		2.7	47.3	36.8	63.2

Notes: In each cell, the variance share attributable to the relevant factor is reported. The share is averaged across the G7 countries at a horizon of 30 quarters, based on Model 1. "Baseline" indicates the results based on the model with output, consumption, investment, and a financial variable. "Alternative" indicates the results based on the model with output and a financial variable. The variance contributions are attributed to: W (global macro factor), C (country-specific macro factor), F (global financial factor), SF (spillovers from financial to macro factors), and I (idiosyncratic factor). In Model 1, the financial factor spills over onto the global macro factor. See Table A2 in the Appendix for more details on the model specification.

B. Spillover model from macro to financial factors

	Model with equity prices						Model with house prices						Model with interest rates					
	Output			Financial variable			Output			Financial variable			Output			Financial variable		
	W	C	I	SR	F	I	W	C	I	SR	F	I	W	C	I	SR	F	I
	1985-2019																	
Baseline	39.6	34.8	25.6	0.7	55.6	43.7	40.7	33.7	25.6	0.9	11.6	87.5	40.0	33.9	26.1	1.0	24.9	74.1
Alternative	35.7		64.3	1.9	49.9	48.2	34.2		65.8	2.0	18.6	79.4	34.3		65.7	1.5	27.0	71.5
	1985-2007																	
Baseline	22.7	43.0	34.3	0.5	50.5	49.0	23.9	42.0	34.1	0.5	8.4	91.1	24.0	41.6	34.4	3.0	24.2	72.8
Alternative	22.7		77.3	0.6	51.1	48.2	22.6		77.4	2.6	23.9	73.5	22.7		77.3	2.9	23.9	73.2
	1998-2019																	
Baseline	49.5	26.2	24.3	1.0	58.9	40.1	48.9	26.5	24.5	2.8	17.5	79.8	48.6	26.2	25.3	2.1	30.8	67.1
Alternative	43.0		57.0	0.9	56.7	42.5	43.5		56.5	1.9	23.1	74.9	44.5		55.5	2.5	35.8	61.8

Notes: In each cell, the variance share attributable to the relevant factor is reported. The share is averaged across the G7 countries at a horizon of 30 quarters, based on Model 3. "Baseline" indicates the results based on the model with output, consumption, investment, and a financial variable. "Alternative" indicates the results based on the model with output and a financial variable. The variance contributions are attributed to: W (global macro factor), C (country-specific macro factor), F (global financial factor), SR (spillovers from macro to financial factors), and I (idiosyncratic factor). In Model 3, the macro factor spills over onto the financial factor. See Table A2 in the Appendix for more details on the model specification.

Table A21. Variance Decompositions:

(Monthly Industrial Production and Financial Variables; Percent)

A. Models With Only Monthly Financial Variables

	Equity price		House price		Interest rate	
	Global	Idiosyncratic	Global	Idiosyncratic	Global	Idiosyncratic
Canada	47.8	52.2	0.0	100.0	0.4	99.6
France	93.0	7.0			3.4	96.6
Germany	84.3	15.7			0.0	100.0
Italy	76.4	23.6			0.0	100.0
Japan	45.3	54.7	0.4	99.6	1.1	98.9
United Kingdom	72.8	27.2	2.4	97.6	0.1	99.9
United States	69.2	30.8	0.6	99.4	0.8	99.2
Average	69.8	30.2	0.8	99.5	0.8	99.2

Notes: In each cell, the variance share attributable to the relevant factor is reported based on one-factor model : $Y_t^{i,j} = \beta_{global} f_t^{global} + \varepsilon_t^{i,j}$. The variance contributions are attributed to: Global (global factor) and Idiosyncratic (idiosyncratic factor).

B. Models With Industrial Production and Financial Variables

	IP		Equity prices		IP		House prices		IP		Interest rates	
	Global	Idiosyncratic	Global	Idiosyncratic	Global	Idiosyncratic	Global	Idiosyncratic	Global	Idiosyncratic	Global	Idiosyncratic
Canada	0.1	99.9	46.1	53.9	6.5	93.5	10.6	89.4	9.4	90.6	0.2	99.8
France	1.1	98.9	96.6	3.4	12.7	87.3			16.7	83.3	0.1	99.9
Germany	0.9	99.1	86.7	13.3	22.1	77.9			22.5	77.5	3.1	96.9
Italy	0.6	99.4	78.1	21.9	14.3	85.7			17.5	82.5	1.4	98.6
Japan	0.4	99.6	44.5	55.5	22.3	77.7	1.0	99.0	24.2	75.8	0.2	99.8
United Kingdom	0.3	99.7	71.2	28.8	7.0	93.0	9.9	90.1	8.7	91.3	0.1	99.9
United States	1.5	98.5	65.1	34.9	12.6	87.4	3.8	96.2	12.5	87.5	1.5	98.5
Average	0.7	99.3	69.8	30.2	13.9	86.1	6.3	93.7	15.9	84.1	0.9	99.1
Median	0.6	99.4	71.2	28.8	12.7	87.3	6.9	93.1	16.7	83.3	0.2	99.8

Notes: In each cell, the variance share attributable to the relevant factor is reported based on the one-factor model for each type of financial variable (equity price, house price, or interest rates) and industrial production: $Y_t^{i,j} = \beta_{global} f_t^{global} + \varepsilon_t^{i,j}$. The variance contributions are attributed to: Global (global factor) and Idiosyncratic (idiosyncratic factor).

Table A22. Variance Decompositions:
Spillover Model 1 With Industrial Production and Financial Variables
(1998-2019)

A. Equity Price

	Industrial Production			Equity prices	
	Global	Spillover	Idiosyncratic	Global	Idiosyncratic
Canada	12.5	5.6	81.9	45.7	54.3
France	11.0	4.8	84.1	93.2	6.8
Germany	21.1	9.3	69.7	84.6	15.4
Italy	15.7	6.9	77.4	76.5	23.5
Japan	18.0	7.9	74.1	47.6	52.4
United Kingdom	8.4	3.7	87.8	73.4	26.6
United States	22.3	9.9	67.8	69.8	30.2
Average	15.6	6.9	77.6	70.1	29.9

B. House Price

	Industrial Production			Interest rates	
	Global	Spillover	Idiosyncratic	Global	Idiosyncratic
Canada	18.9	0.4	80.7	51.8	48.2
France	17.7	0.4	81.9	8.6	91.4
Germany	32.3	0.7	67.1	18.7	81.3
Italy	25.1	0.5	74.3	8.1	91.9
Japan	29.2	0.6	70.1	11.2	88.8
United Kingdom	14.3	0.3	85.4	13.5	86.5
United States	32.2	0.7	67.1	83.5	16.5
Average	24.2	0.5	75.2	27.9	72.1

C. Interest Rates

	Industrial Production			House prices	
	Global	Spillover	Idiosyncratic	Global	Idiosyncratic
Canada	16.7	2.6	80.7	2.1	97.9
France	15.6	2.4	82.0		
Germany	28.6	4.3	67.1		
Italy	22.2	3.4	74.4		
Japan	25.5	3.9	70.6	22.2	77.8
United Kingdom	12.3	1.9	85.8	57.4	42.6
United States	28.1	4.3	67.6	2.6	97.4
Average	21.3	3.2	75.5	21.1	78.9

Notes: In each cell, the variance share attributable to the relevant factor is reported at a horizon of 30 quarters. The variance contributions are attributed to: Global (global macro factor), Financial (global financial factor), Spillover (spillovers from financial to macro factors), and Idiosyncratic (idiosyncratic factor). In Model 1, the global financial factor influences macroeconomic aggregates through its spillover onto the global macro factor.

Table A23. Variance Decompositions:
Spillover Model 3 With Industrial Production and Financial Variables
(1998-2019)

A. Equity Price

	Industrial Production		Equity prices		
	Global	Idiosyncratic	Global	Spillover	Idiosyncratic
Canada	19.1	80.9	44.0	1.3	54.7
France	18.0	82.0	90.7	2.7	6.6
Germany	32.5	67.5	82.0	2.4	15.6
Italy	25.3	74.7	74.2	2.2	23.6
Japan	29.6	70.4	45.5	1.3	53.2
United Kingdom	14.7	85.3	71.1	2.1	26.8
United States	33.0	67.0	67.5	2.0	30.6
Average	24.6	75.4	67.9	2.0	30.1

B. House Price

	Industrial Production		House prices		
	Global	Idiosyncratic	Global	Spillover	Idiosyncratic
Canada	18.8	81.2	3.2	0.3	96.5
France	17.8	82.2			
Germany	33.0	67.0			
Italy	25.4	74.6			
Japan	29.8	70.2	1.3	0.1	98.5
United Kingdom	14.4	85.6	59.4	4.3	36.3
United States	32.9	67.1	0.3	0.0	99.7
Average	24.6	75.4	16.0	1.2	82.8

C. Interest Rates

	Industrial Production		Interest rates		
	Global	**Idiosyncratic**	**Global**	**Spillover**	**Idiosyncratic**
Canada	19.9	80.1	47.9	3.1	49.0
France	18.9	81.1	7.7	0.5	91.7
Germany	33.9	66.1	16.8	1.1	82.1
Italy	26.5	73.5	7.3	0.5	92.2
Japan	30.2	69.8	10.8	0.7	88.5
United Kingdom	14.9	85.1	12.8	0.8	86.4
United States	34.2	65.8	79.7	5.2	15.0
Average	25.5	74.5	26.1	1.7	72.1

Notes: In each cell, the variance share attributable to the relevant factor is reported at a horizon of 30 quarters. The variance contributions are attributed to: Global (global macro factor), Financial (global financial factor), Spillover (spillovers from macro to financial factors), and Idiosyncratic (idiosyncratic factor). In Model 3, the global macro factor spills over to the global financial factor. See Table A2 in the Appendix for more details on the model specification.

Table A24. Variance Decompositions: Spillovers From Financial Sector to Macroeconomy (Models 1&2; extended country sample; averages for country groups)

	Output				Consumption				Investment				Financial variables	
	W	C	SF	I	W	C	SF	I	W	C	SF	I	F	I
Model with equity prices														
G7	33.6	24.4	17.3	24.7	8.3	30.7	6.2	54.8	22.1	16.1	11.4	50.4	59.3	40.7
G7+EM7	32.0	27.5	11.2	29.2	13.3	20.9	5.5	60.3	23.1	25.7	8.6	42.6	53.0	47.0
G7+EM7+others	25.4	29.5	9.3	35.8	10.2	22.3	4.3	63.2	16.7	23.4	6.3	53.6	48.3	51.7
Model with house prices														
G7	39.8	21.9	16.1	22.3	11.2	28.9	6.3	53.6	27.7	15.4	11.1	45.8	20.0	80.0
G7+EM7	29.0	28.8	8.3	33.8	11.8	21.8	3.9	62.4	20.4	26.5	6.3	46.8	13.0	87.0
G7+EM7+others	37.5	25.4	8.5	28.6	17.3	19.9	4.4	58.5	26.6	20.8	6.2	46.3	16.8	83.2
Model with interest rates														
G7	48.0	22.2	7.1	22.7	13.8	28.6	3.5	54.1	33.3	16.0	5.0	45.7	30.9	69.1
G7+EM7	33.5	34.4	3.3	28.8	14.1	28.6	2.1	55.1	22.5	35.4	2.8	39.3	20.7	79.3
G7+EM7+others	30.9	33.6	3.3	32.2	13.4	28.0	2.2	56.3	19.6	30.0	2.5	47.9	15.5	84.5

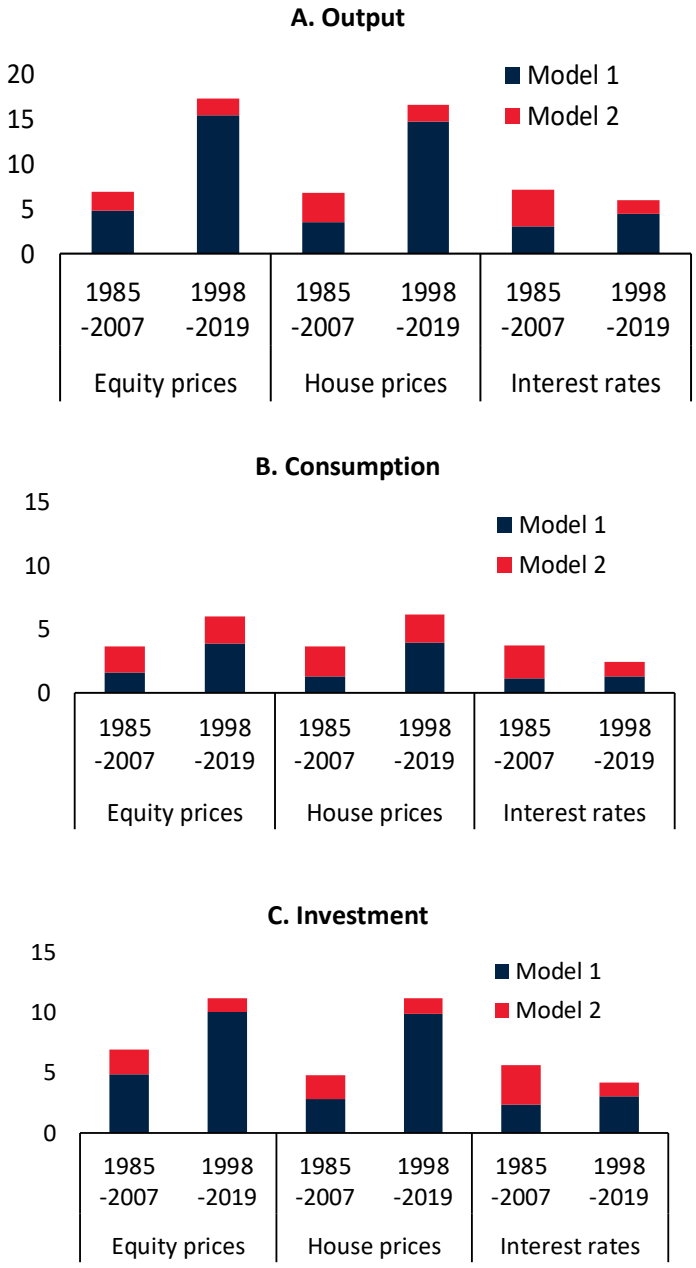
Notes: In each cell, the variance share attributable to the relevant factor is reported. The share is averaged across the G7 countries (upper rows) or G7+EM7 / GM7+EM7+7 other small open economies (lower rows) at a horizon of 30 quarters, based on the combined Model 1 and 2. The variance contributions are attributed to: W (global macro factor), C (country-specific macro factor), F (global financial factor), SF (spillovers from financial to macro factors), and I (idiosyncratic factor). In Model 1, the financial factor spills over to the global macro factor. In Model 2, the financial factor spills over directly to the country-specific macro factor. Models 1 and 2 combined captures both channels through which the financial factor affects macro fluctuations. See Table A2 in the Appendix for more details on the model specification.

Table A25. Variance Decompositions: Spillovers From Macroeconomy to Financial Sector
(Models 3&4; extended country samples; averages across country groups)

	Output			Consumption			Investment			Financial variables		
	W	C	I	W	C	I	W	C	I	SR	F	I
Model with equity prices												
G7	49.0	26.4	24.6	12.9	30.0	57.9	31.7	18.3	50.1	1.3	58.3	40.4
G7+EM7	38.6	29.5	31.9	15.3	22.9	61.8	27.4	26.7	45.9	1.1	47.9	51.0
G7+EM7+others	40.7	27.1	32.2	18.0	21.4	60.6	28.1	22.5	49.4	1.4	47.2	51.3
Model with house prices												
G7	49.5	26.0	24.5	13.0	30.3	56.7	33.0	18.2	48.9	3.9	17.9	78.2
G7+EM7	37.7	30.0	32.3	15.2	22.4	62.4	26.5	26.8	46.7	3.2	12.7	84.1
G7+EM7+others	34.4	28.5	37.1	13.9	22.7	63.4	22.5	24.2	53.3	4.2	15.7	80.0
Model with interest rates												
G7	48.3	27.2	24.4	12.7	29.7	57.6	31.0	18.4	50.6	4.9	29.6	65.4
G7+EM7	40.4	28.4	31.2	16.7	21.9	61.4	28.9	25.9	45.2	2.3	19.7	78.1
G7+EM7+others	41.1	27.3	31.6	17.7	21.3	61.0	28.3	22.3	49.3	2.2	14.4	83.5

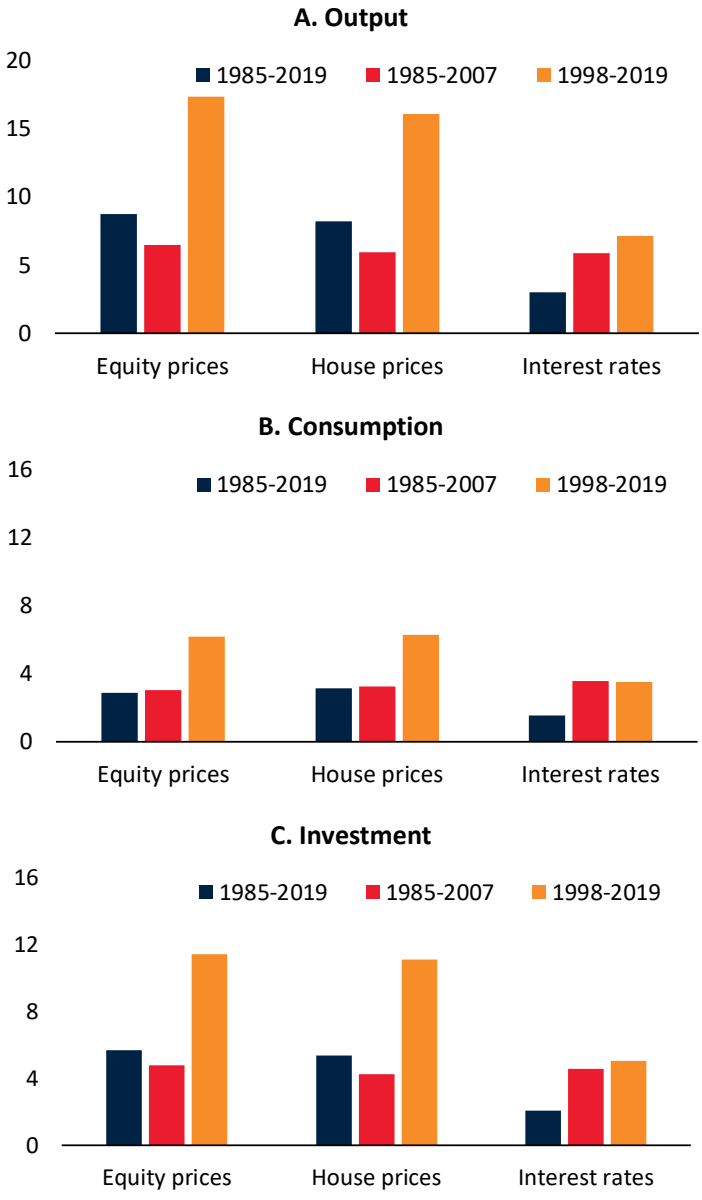
Notes: In each cell, the variance share attributable to the relevant factor is reported. The share is averaged across the G7 (upper rows) or G7+EM7 / GM7+EM7+7 other small open economies (lower rows) countries at a horizon of 30 quarters. The variance contributions are attributed to: W (global macro factor), C (country-specific macro factor), F (global financial factor), SR (spillovers from macro to financial factor), and I (idiosyncratic factor). In Model 3, the global macro factor spills over to the financial factor. In Model 4, the U.S. country factor spills over to the financial factor. Model 3 and 4 combined captures both channels through which the macro factors affect fluctuations in financial markets. See Table A2 in the Appendix for more details on the model specification.

Figure A1. Variance Decompositions:
Spillovers From Financial Sector to Macroeconomy
(Models 1 and 2; G-7 Averages)



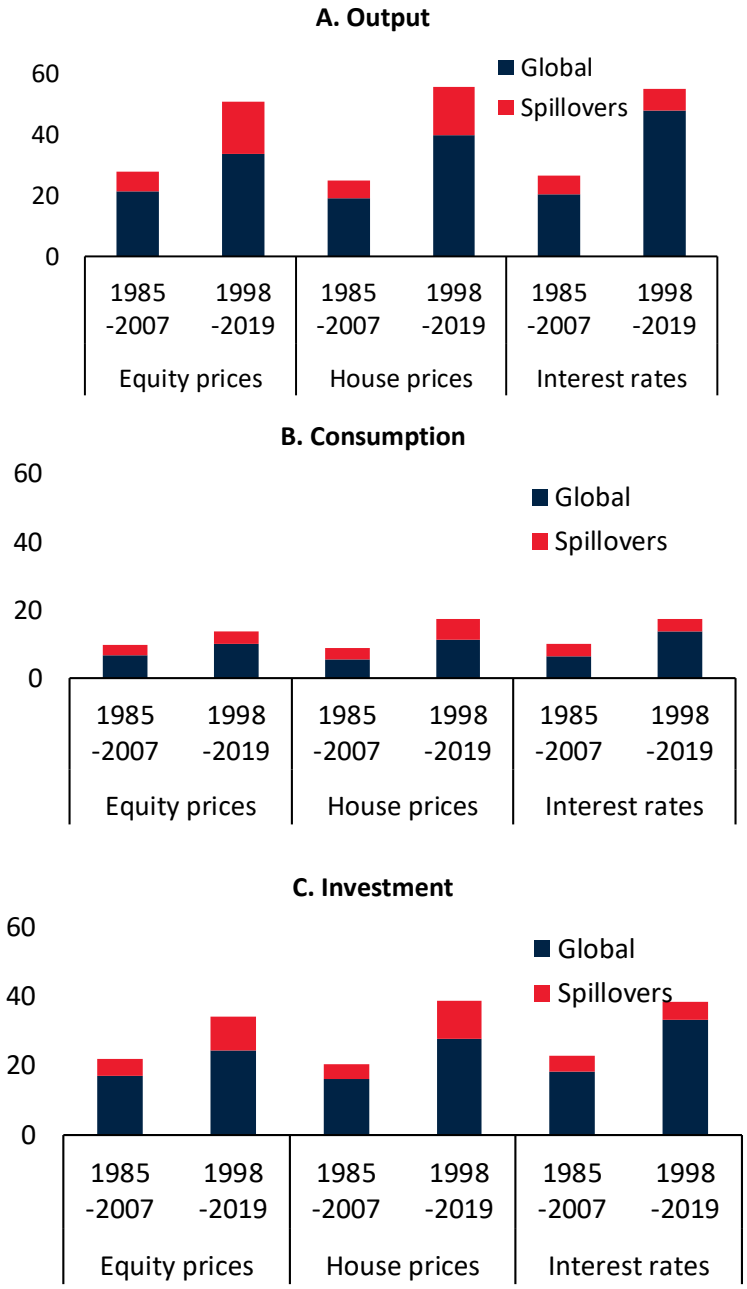
Notes: These figures show spillovers from the global financial factors (equity prices, house prices, and interest rates) to fluctuations in macro variables through the global macro factor and the country-specific macro factor. In Model 1, the financial factor spills over to the global macro factor. In Model 2, the financial factor spills over directly to country-specific macro factor. See Table A2 in the Appendix for more details on the model specification.

Figure A2. Variance Decompositions: Spillovers From Financial Sector to Macroeconomy (Model 1&2; G-7 Averages)



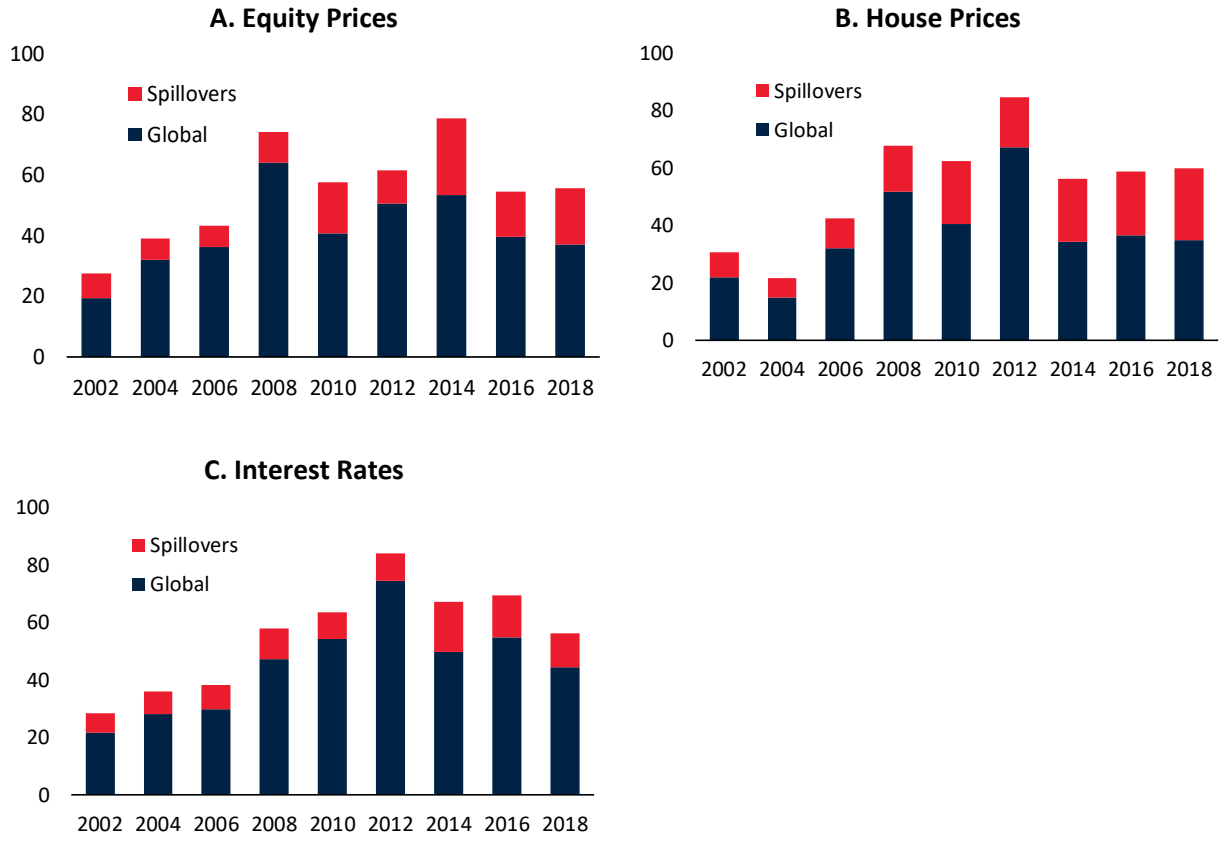
Notes: These figures show spillovers from the global financial factors (equity prices, house prices, and interest rates) to fluctuations in macro variables, based on the combined Model 1 and 2, which captures spillovers to the global macro factor (Model 1) and to country-specific macro factor (Model 2) through which the financial factor affects macro activity. See Table A2 in the Appendix for more details on the model specification.

Figure A3. Variance Decompositions:
Spillovers From Financial Sector to Macroeconomy
(Model 1&2; G-7 Averages)



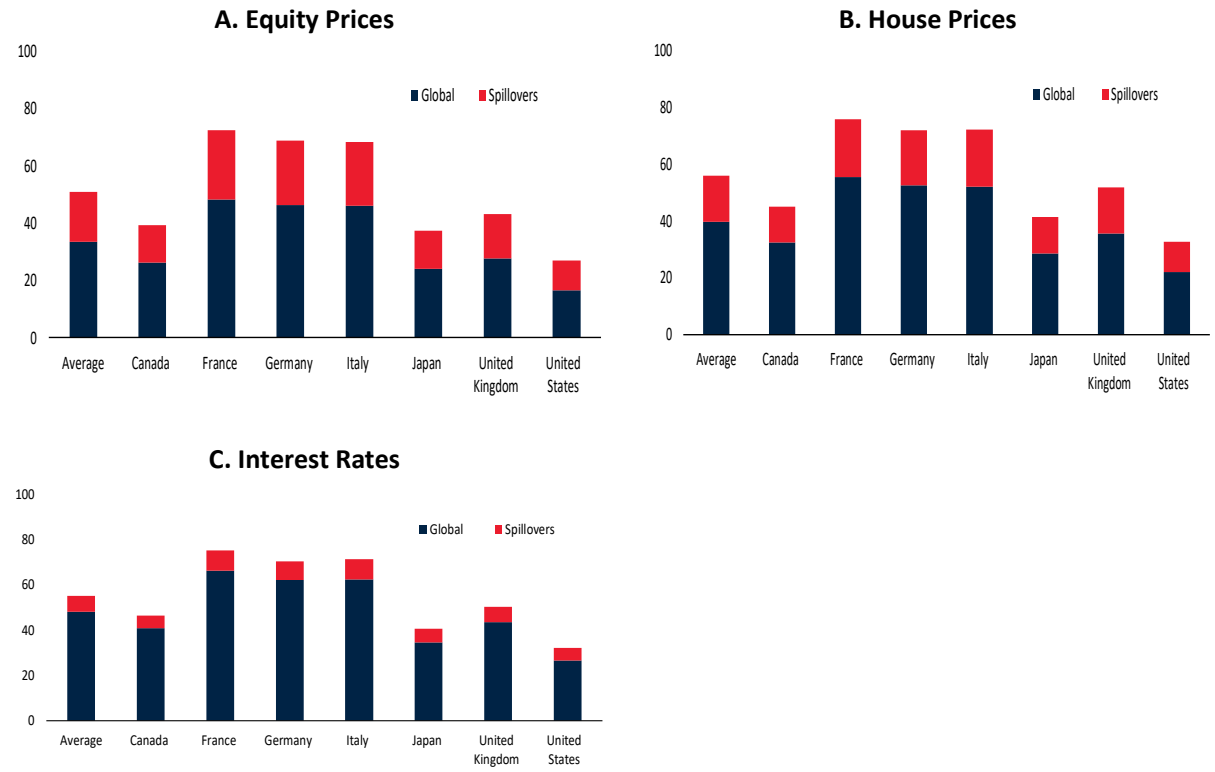
Notes: These figures show the variance decompositions for the global macro factor ("global") and spillovers from financial factors (equity prices, house prices, and interest rates) to fluctuations in macro variables ("spillovers"). The results are based on the combined Model 1 and 2, which captures spillovers to the global macro factor (Model 1) and to country-specific macro factor (Model 2) through which the financial factor affects macro activity. See Table A2 in the Appendix for more details on the model specification.

Figure A4. Variance Decompositions: Spillovers From Financial Sector to Output (15-Year Rolling Windows; Model 1&2; G-7 Averages; 1985-2019)



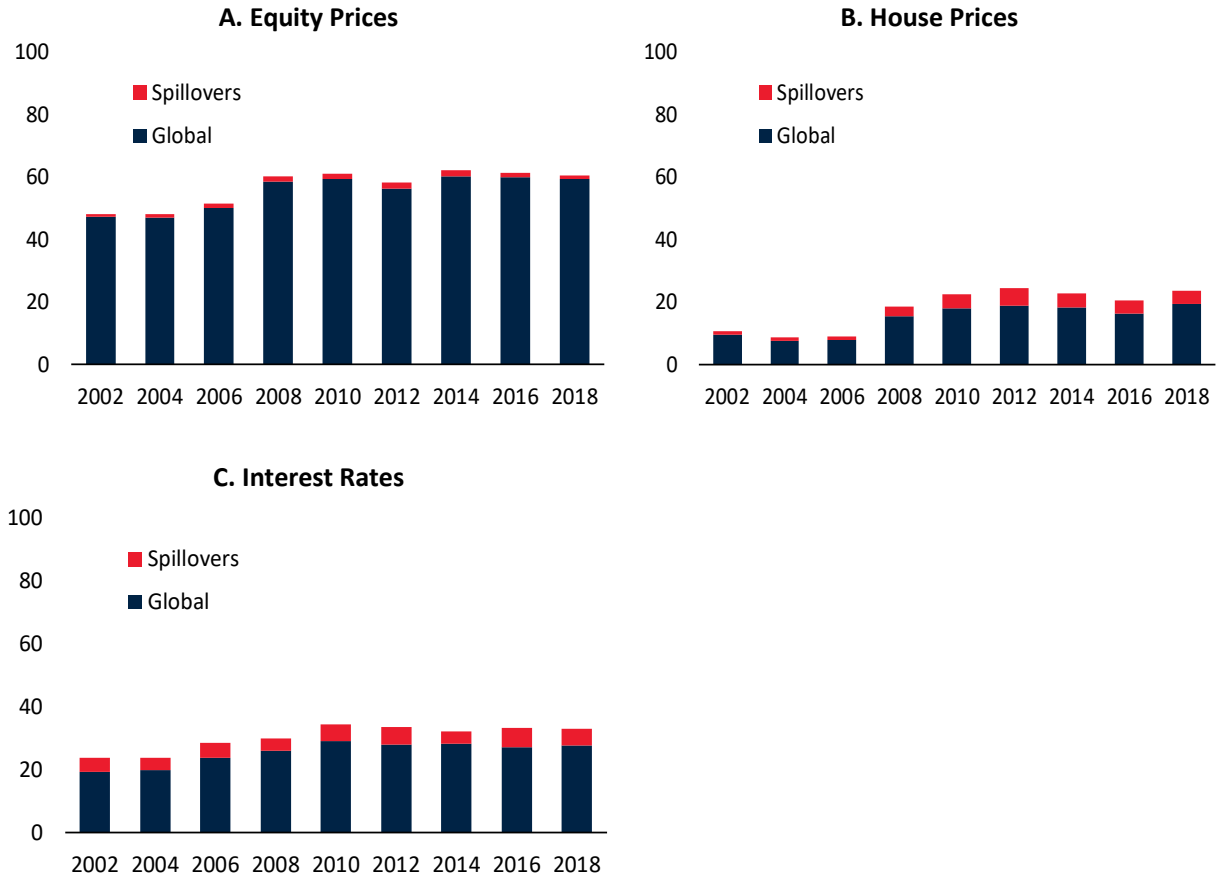
Notes: These figures are based on variance decompositions from estimates over 15-year (trailing) rolling windows. The bars show the average (for the G-7 countries) shares of output variance accounted for by the global macro factor ("global") and spillovers from financial factors ("spillovers"). The results are based on the combined Model 1 and 2, which captures spillovers of the financial factor on output fluctuations through the global macro factor (Model 1) and the country-specific macro factor (Model 2). See Table A2 in the Appendix for more details on the model specification.

Figure A5. Country-Specific Variance Decompositions: Spillovers From Financial Sector to Macroeconomy (Model 1&2; Output; 1998-2019)



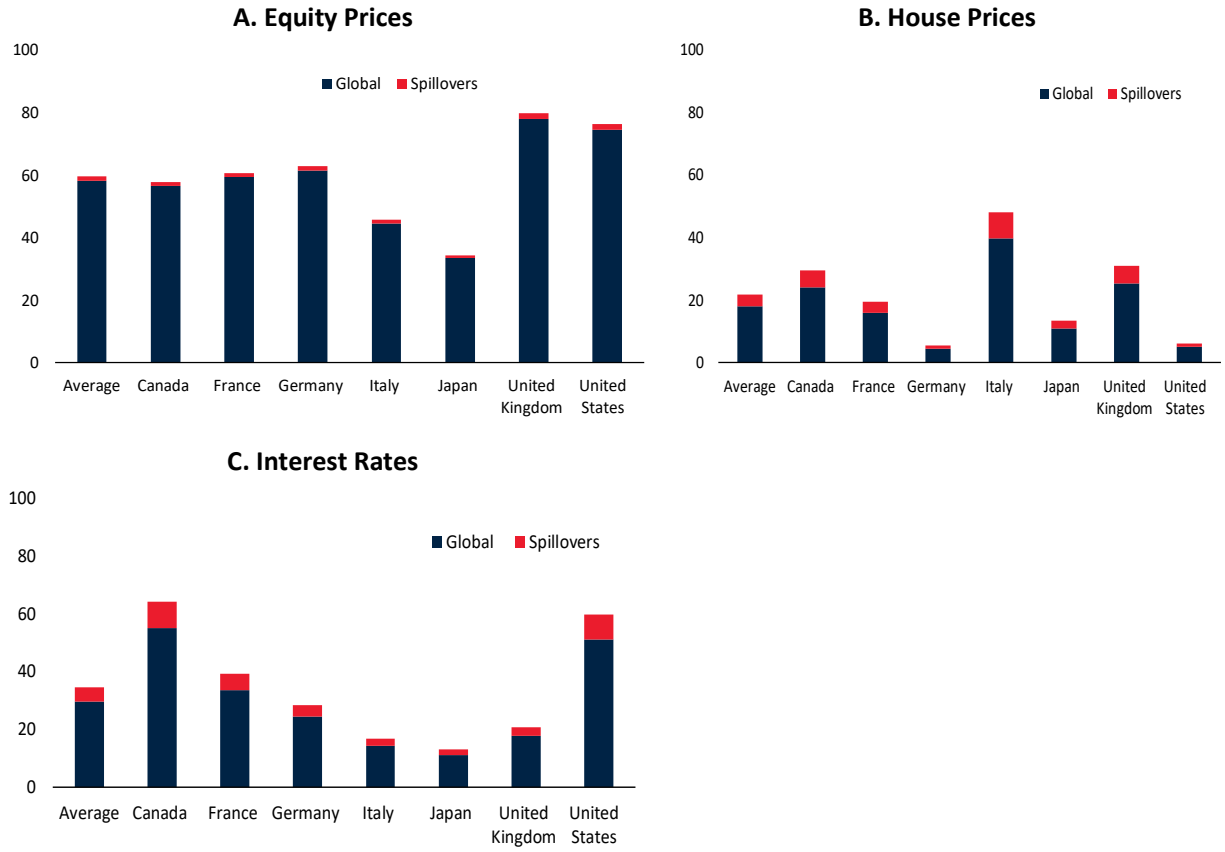
Notes: The bars show the shares of output variance in each country accounted for by the global macro factor ("global") and spillovers from financial factors ("spillovers"). The results are based on the combined Model 1 and 2, which captures spillovers of the financial factor on output fluctuations through the global macro factor (Model 1) and the country-specific macro factor (Model 2). See Table A2 in the Appendix for more details on the model specification.

Figure A6. Variance Decompositions: Spillovers From Macroeconomy to Financial Sector (15-Year Rolling Windows; Model 3&4; G-7 Averages; 1985-2019)



Notes: These figures are based on variance decompositions from model estimates over 15-year (trailing) rolling windows. The bars show the average (for the G-7 countries) shares of the variance in fluctuations of financial variables accounted for by the global financial factor ("global") and by spillovers from macroeconomic aggregates. The results are based on the combined Model 3 and 4, which captures spillovers of macro fluctuations onto financial markets through the global macro factor (Model 3) and the U.S. country factor. See Table A2 in the Appendix for more details on the model specification.

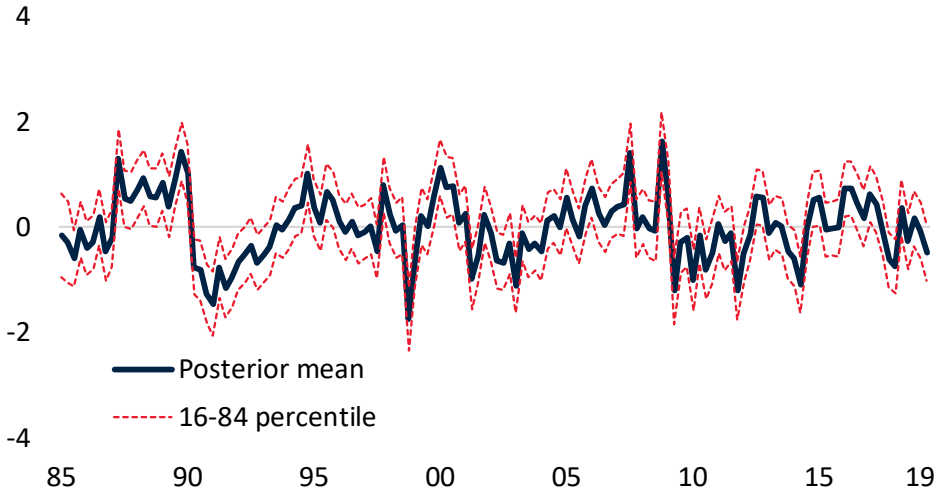
Figure A7. Country-Specific Variance Decompositions: Spillovers From Macroeconomy to Financial Sector (Model 3&4; 1998-2019)



Notes: In each panel, the bars show the country-specific shares of the variance of the relevant financial variable that is accounted for by the global financial factor ("global") and spillovers from macro variables to financial factors ("spillovers"). The results are based on the combined Model 3 and 4, which captures spillovers from the macroeconomy onto financial markets through the global macro factor (Model 3) and the U.S. country factor (Model 4). See Table A2 in the Appendix for more details on the model specification.

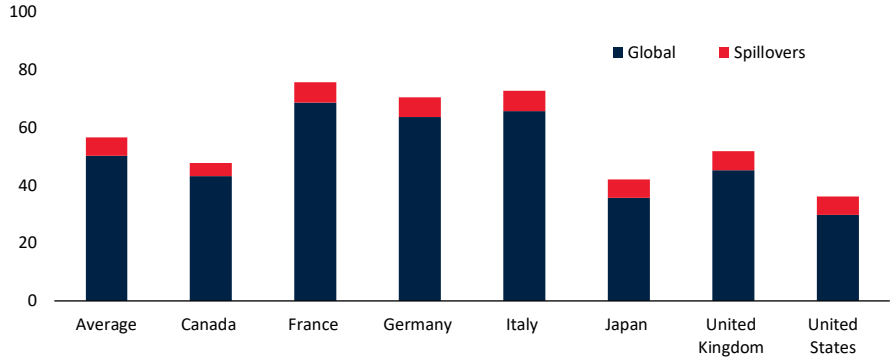
Figure A8. Dynamic Factor Model Estimation Results With Credit Growth

A. Global Credit Factor
(1985-2019)



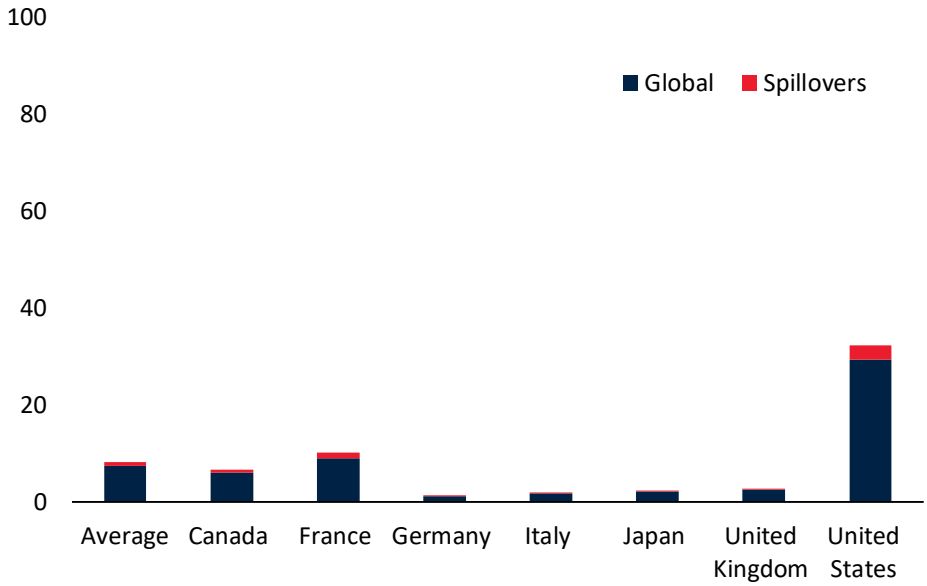
Notes: The factors shown as solid lines are posterior medians based on the combined Model 3&4 estimated over the full sample (1985-2019). The dashed lines represent the 16 and 84 percent posterior quantile bands. In Model 3, the global macro factor spills over to the financial factor. In Model 4, the U.S. country factor spills over to the financial factor. Models 3 and 4 combined capture both channels through which the macro factors affect the financial sector.

B. Variance Decompositions: Spillovers From Financial Sector to Macroeconomy
(1998-2019)



Notes: These figures show the variance decompositions for the global macro factor ("global") and spillovers from the credit factor to fluctuations in macro variables ("spillovers"). The results are based on the combined Model 1 and 2, which captures spillovers to the global macro factor (Model 1) and to country-specific macro factor (Model 2) through which the financial factor affects macro activity. See Table A2 in the Appendix for more details on the model specification.

C. Variance Decompositions: Spillovers From Macroeconomy to Financial Sector (1998-2019)



Notes: These figures show the variance decompositions for the global financial factor ("global") and spillovers from macro to financial factors ("spillovers"). The results are based on the combined Model 3 and 4, which captures spillovers from the global macro factor (Model 3) and from the U.S. country factor (Model 4) through which the financial sector is affected. See Table A2 in the Appendix for more details on the model specification.