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ABSTRACT

In this paper, we quantify the changes in the relationship between international forces and many key US macroeconomic variables over the 1984-2005 period, and analyze changes in the monetary policy transmission mechanism. We do so by estimating a Factor-Augmented VAR on a large set of US and international data series. We find that the role of international factors in explaining US variables has been changing over the 1984-2005 period. However, while some US series have become more correlated with global factors, there is little evidence suggesting that these factors have become systematically more important. We don't find strong evidence of a change in the transmission mechanism of monetary policy due to global forces. Taking our point estimates literally, global forces do not seem to have played an important role in the US monetary transmission mechanism between 1984 and 1999. In addition, since the year 2000, the initial response of the US economy following a monetary policy shock --- the first 6 to 8 quarters --- is essentially the same as the one that has been observed in the 1984-1999 period. However, point estimates suggest that the growing importance of global forces might have contributed to reducing some of the persistence in the responses, two or more years after the shocks. Overall, we conclude that if global forces have had an effect on the monetary transmission mechanism, this is a recent phenomenon.

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1 Introduction

In many respects, the economic integration of the U.S. economy with the rest of the world has deepened in the last two decades. International trade has continued to expand more rapidly than economic activity in industrialized countries. For the US, the amount of goods and services imported and exported which represented 18% of GDP in the mid-1980's represents more than 27% in 2005. But the globalization of finance has shown a much more dramatic development. During the same period, the ratio of foreign assets and liabilities to GDP has increased from approximately 80% to more than 300% in the 23 most industrialized economies, according to Lane and Milesi-Ferretti (2006). As global economic integration is spreading, it is often argued that macroeconomic variables in one country — whether they pertain to measures of economic activity, inflation, or interest rates — should increasingly reflect events occurring in the rest of the world.[1]

Such developments raise naturally two sets of questions which we attempt to address in this paper. First, to what extent have international factors affected the determination of key macroeconomic variables in the US economy? Is it the case that with the recent globalization, this economy has become more strongly affected by international factors? Second, has the very rapid globalization of finance weakened the ability of US monetary policy to influence domestic financial market conditions, and through it, the rest of the economy? In other words, does a change in the Federal Funds rate have a smaller impact on the US economy now than it used to?

Central bankers and economists in the financial press have pointed out the fact that while the US central bank raised the Federal funds rate target by 425 basis points between June 2004 and July 2006, long-term rates remained at historically low levels with the ten-year Treasury bond yield increasing by less than 40 basis points and the twenty-year yield actually falling by 20 basis points during that time. This phenomenon, which former Federal Reserve Chairman Alan Greenspan labeled "conundrum" highlights the fact that US long-term interest rates may have become more dependent on international factors than had been observed historically. As then Governor Bernanke

[1] For example, the President of the Federal Reserve Bank of Dallas, Richard Fisher, and Michael Cox (2007) have argued that domestic inflation may be increasingly determined in the rest of the world. Advocating a "new inflation equation," they conclude that "globalization has been changing how we consume as well as the way we do business. It's high time economic doctrine caught up." The Economist (2005), citing Stephen Roach, chief economist of Morgan Stanley, and the 2005 annual report of the Bank for International Settlements suggests that global forces have become more important relative to domestic factors in determining inflation in individual countries.

(2005) explained, a more extensive global financial integration and the increased amount of savings outside the US — in particular in developing economies — may have resulted in a "global saving glut" which may have put downward pressures on long-term interest rates. A casual look at such recent historical episodes raises the possibility that the long-term yields may respond less to changes in Federal funds rates than in the past. Given that monetary policy does at least in part affect the economy through its effect on long-term rates, it is natural to wonder about the implications of the globalization of finance for the effectiveness of monetary policy. Certainly, the answers to such questions have key implications for a proper understanding of the determinants of economic fluctuations, and for policy.

To address these questions, we provide in this paper an empirical assessment of the synchronization between international factors and key US economic variables. We then investigate whether the importance of these global forces has changed for the US economy over the last two decades, and how such a possible change has affected the transmission of monetary policy.

The general empirical framework that we consider is a factor-augmented vector autoregression model (FAVAR), as described in Bernanke, Boivin and Eliasz (2005), but extended to explicitly include international or "global" factors. One of its key features is to provide estimates of macroeconomic factors that affect the data of interest by systematically exploiting all information from a large set of economic indicators. In our application, we estimate the empirical model based on the information from a large number of macroeconomic indicators, and disaggregated data for the US, as well as a large set of macroeconomic indicators for the 15 major US trade partners. By identifying US monetary policy shocks, this framework allows us to uncover the transmission of such shocks to a large set of macroeconomic indicators. Our interest in studying the responses to monetary policy shocks does not reside in the fact that these shocks are important. In fact, it is well-known that they contribute only little to US output fluctuations. Rather, we find the responses to such shocks interesting as they allow us to trace out the effects of monetary policy on the economy.

Many studies have provided evidence that key macroeconomic variables display substantial comovements across countries. For instance, Kose, Otrok and Whiteman (2003), analyzing output, consumption and investment data from 60 countries over the 1960-1990 period, document that a

large fraction of business cycles fluctuations of developed economies is accounted by a common world factor. The latter factor — a component of economic activity which is common to all countries considered — explains more than one third of output fluctuations in the US and in Europe.[2] Ciccarelli and Mojon (2005) argue that inflation in industrialized economies is also largely a global phenomenon: they find that on average, about 70% of inflation variance is attributable to a common global factor given by the component of inflation that is common across countries. Moreover, Ehrmann, Fratzscher, and Rigobon (2005) show that shocks to money, bond and equity markets result in substantial spillovers between the US and Europe.

Other researchers have recently examined whether the importance of such comovements across regions has changed over time. The evidence regarding the output synchronization is mixed. Kose, Prasad and Terrones (2003) report evidence of stronger comovements of output in industrialized countries with a world factor, since the early 1980's, than in the preceding two decades. However, Doyle and Faust (2005), testing for changes in comovements among real activity measures for the G7 countries find very few statistically significant changes over the 1960-2000 period. When looking at their point estimates, they even find some evidence of a fall in the correlation across countries since the early 1980s. Such a reduced synchronization is in fact consistent with findings of Helbling and Bayoumi (2003), Monfort, Renne, Ruffer and Vitale (2003), Heathcote and Perri (2004), Stock and Watson (2005), and Kose, Otrok and Whiteman (2005). According to Stock and Watson (2005), and Kose et al. (2005), the fact that the output correlations across countries were particularly high in the 1970s may reflect unusually strong common shocks, such as large movements in oil prices, during that period. These authors thus argue that the reduction in the

[2] Similar comovements in economic activity have been documented for more restricted sets of countries. Gerlach (1988) found that industrial production is positively correlated across several OECD countries. Backus, Kehoe and Kydland (1995) and Baxter (1995) found that business cycles share similarities in major industrial economies. Gregory, Head and Raynauld (1997) in an early estimation of a factor model on economic activity data for the G7 countries, detected a significant common factor across countries. Bergman, Bordo and Jonung (1998), analyzing more than one hundred years of data, found that the synchronization in activity across 13 industrialized countries remains strong regardless of the monetary regime. Forni, Hallin, Lippi and Reichlin (2000), proposing a generalized dynamic factor model and applying it to data of 10 European economies, find that a common European activity factor explains between 35% and 96% of the volatility in countries' GDP. Clark and Shin (2000), similarly find that a common factor accounts substantial variations in industrial production of European economies, and Lumsdaine and Prasad (2003), examining correlations between industrial output in 17 OECD countries and a common component, find evidence of a world business cycle and of a European business cycle. Canova, Ciccarelli and Ortega (2004), estimating a Bayesian panel VAR model on G7 data find also a significant world business cycle, but find no evidence of a cycle specific to the Euro area, in contrast to some of the other studies.

volatility of common international shocks since in the early 1980s, compared to the 1960s and 1970s, provides an important explanation for the reduced synchronization among G7 countries since the early 1980s, and that the correlation in output across countries would have been larger, had the international common shocks been as important in the 1980s and the 1990s, as they were in the 1960s and 1970s.

In addition, some authors have argued that the development of trade in goods and services, especially with low-cost producing economies such as China and India may have altered the relationship between some measure of the output gap and domestic inflation (see, e.g., Rogoff (2004), Borio and Filardo (2006), Ihrig et al. (2007)).

While we also seek to characterize changes US macroeconomic dynamics due to global forces, our paper distinguishes itself from the papers just mentioned in several respects.

First, in general, global co-movements among macro variables could arise from the presence of exogenous global — or worldwide — shocks, or from the international transmission of domestic shocks. Our central focus in this paper is the implications for monetary policy of the changes in the role of global forces. It is thus important to stress that while we allow for the presence of global shocks like in many of the papers just cited, our interest will be mainly on the characterization of the international transmission of regional shocks. In particular, we determine to what extent the transmission of U.S. monetary policy shocks — as measured by exogenous changes in the Federal funds rate — to key US economic variables such as long-term interest rates, output, inflation, and so on, has been altered by global forces.

Second, in order to identify the monetary transmission mechanism, we jointly model multiple dimensions of the US economy. Thus, rather than restricting ourself to the comparison of a single type of measures across regions of the world — e.g. only economic activity measures or only inflation measures — we adopt a more general and encompassing approach which allows us to compare a set of factors summarizing the US macroeconomic dynamics with those summarizing the rest of the world's macroeconomic dynamics. Another contribution is hence to consider a much broader set of macroeconomic indicators than has been used before in order to document the changes in the importance of global forces for the determination of US measures of real activity, inflation, interest rates and various other series.

Finally, we focus on the evolution since 1984. Our sample includes the period during which the globalization of financial flows accelerated significantly and allows us to sidestep an important issue: the considerable changes that occurred in the preceding decade. The period of large common shocks, in the 1970s and the early 1980s, during which the business cycles of many countries were strongly correlated, was followed in the US by a rapid adjustment — called "great moderation" — to a regime characterized by lower output volatility.[3] Some studies have explained the reduction in volatility with a reduced volatility of shocks (e.g., Stock and Watson (2002a), Sims and Zha (2006), Justiniano and Primiceri (2006), Smets and Wouters (2007)). In addition, as documented in Clarida, Galí and Gertler (2000), Boivin (2006), Cogley and Sargent (2001, 2005), Boivin and Giannoni (2002, 2006a), the systematic response of US monetary policy to fluctuations in inflation and output has changed significantly around 1980, revealing a greater tendency to stabilize inflation fluctuations. As Boivin and Giannoni (2006a) emphasize, such a change in policy can explain in large part why the responses of output and inflation to an unexpected change in the Federal funds rate of a given size have been much smaller since the early 1980s, than they were in the 1960s and 1970s. By considering the period after 1984, i.e., a period during which both the variance of the shocks may reasonably be assumed to have remained constant and the systematic monetary policy rule has not been found to have dramatically changed, we hope to better isolate the effect of international factors.

It is important to stress, however, that our sample is relatively short: it contains a bit more than 20 years of quarterly data. We expect a priori that this will make statistical relationships harder to detect and will constitute an important constraint on the richness of the models that we can contemplate in the empirical exercise below. This is an important sense in which we see our analysis as an exploration of how important global forces might have become for the US economy. But as the results seem to suggest, there is still sufficient statistical information in the sample that allows us to learn something useful about changes in the economy in the recent past.

Our findings can be summarized as follows. First, we find that common factors capture on

[3] Many researchers have documented a sharp drop in the volatility of the US real GDP in the early 1980s (see, e.g., McConnell and Perez-Quiros (2000), Blanchard and Simon (2001), Boivin and Giannoni (2002), Stock and Watson (2002a)). Stock and Watson (2005) show that other G7 countries with the exception of France have similarly experienced lower output volatility since the mid-1980s compared to the previous decades.

average a sizable fraction of the fluctuations in US macroeconomic indicators. This provides support for the use of our empirical model. Second, there is evidence that the role of international factors in explaining US variables has been changing over the 1984-2005 period, but this evolution is not systematic across series, and it is difficult to see a pattern suggesting that they have become generally more important. Some variables such as the long-term interest rates, as well as import and export prices, however, do display a systematic increase of their correlation with global factors throughout our sample.

We don't find strong statistical evidence of a significant change in the transmission mechanism of monetary policy due to global forces. Taking our point estimates literally, global forces do not seem to have played an important role in the US monetary transmission mechanism between 1984 and 1999. Also, since 2000, the initial response of the US economy following a monetary policy shock — the first 6 to 8 quarters — is essentially that same as the one that has been observed in the 1984-1999 period. However, point estimates suggest that the growing importance of global forces might have contributed to reducing some of the persistence in the responses, two or more years after the shocks.

Overall, we conclude that if global forces have had an effect on the monetary transmission mechanism, this is a recent phenomenon. This means however that we will need more data before we can get strong statistical conclusions on this question.

The rest of the paper is organized as follows. In Section 2, we describe the econometric framework adopted and the estimation approach. In Section 3, we present empirical results on the comovements between international factors and US data, and document changes in these relationships over the last two decades. In Section 4, we document to what extent the role of global factors has changed the transmission mechanism of monetary policy. Section 5 concludes.

2 Econometric Framework: FAVAR

One key objective of this study is to evaluate the importance of the rest of the world in the transmission of US monetary policy. That is, we seek to estimate to what extent the response of the rest of the world's economy enhances or mitigates the effect of US monetary policy on the US

economy, and, importantly, whether this has changed over time. The FAVAR model described in Bernanke, Boivin and Eliasz (2005) (BBE) provides a natural framework to address these questions. In this section, we describe the empirical model and our estimation approach.

2.1 Description of FAVAR

The econometric framework that we consider is based on the FAVAR extended to include international factors. We consider two regions: the US economy and the rest of the world, which we denote with *. We assume that in each region, the state of the economy, which is possibly unobserved, can be summarized by a $K \times 1$ vector C_t in the US, and a $K^* \times 1$ vector C_t^* for the rest of the world. We measure the state of the economy in each region with large vectors of macroeconomic indicators, denoted by X_t for the US, and X_t^* for the rest of the world. These vectors are of dimension $N \times 1$ and $N^* \times 1$ respectively. The indicators are assumed to relate to the state of the economy in each region according to the observation equations

$$X_t = \Lambda C_t + e_t \quad (1)$$

$$X_t^* = \Lambda^* C_t^* + e_t^* \quad (2)$$

where Λ and Λ^* are matrices of factor loadings of appropriate dimensions, and the $N \times 1$ (respectively $N^* \times 1$) vectors e_t and e_t^* contain (mean-zero) series-specific components that are uncorrelated with the common components C_t (respectively C_t^*), but are allowed to be serially correlated and weakly correlated across indicators. The number of common factors is assumed to be small relative to the number of indicators, i.e., $N > K$ and $N^* > K^*$.

Under this structure, C_t and C_t^* constitute two sets of components which are common to all data series in the respective region and in general correlated across regions. Equations (1)–(2) reflect the fact that the common factors represent pervasive forces that drive the common dynamics of the data, and summarize at each date the state of the economy in each region. The variables in X_t are thus noisy measures of the underlying unobserved factors C_t. Note that it is in principle not restrictive to assume that X_t depends only on the current values of the factors, as C_t can always

capture arbitrary lags of some fundamental factors.[4] The unobserved factors should reflect general region-specific economic conditions such as "economic activity," the "general level of prices," the level of "productivity," and key dimensions of the interest-rate term structure, which may not easily be captured by a few time series, but rather by a wide range of economic variables.

The dynamics of the common factors are modeled as a structural VAR

$$\Phi_0 \begin{bmatrix} C_t^* \\ C_t \end{bmatrix} = \Phi(L) \begin{bmatrix} C_{t-1}^* \\ C_{t-1} \end{bmatrix} + \begin{bmatrix} v_t^* \\ v_t \end{bmatrix} \tag{3}$$

where Φ_0 is a matrix of appropriate size on which we will later impose some restrictions, $\Phi(L)$ is a conformable lag polynomial of finite order, and the "structural" shocks v_t and v_t^* are assumed to be iid with mean zero and diagonal covariance matrix Q and Q^* respectively. While these shocks are uncorrelated, anyone of these shocks may affect common factors of the other region immediately or over time, through the off-diagonal elements of Φ_0 and $\Phi(L)$. This structural VAR has a reduced-form representation obtained by premultiplying on both sides of (3) by Φ_0^{-1} :

$$\begin{bmatrix} C_t^* \\ C_t \end{bmatrix} = \begin{bmatrix} \Psi_{11}(L) & \Psi_{12}(L) \\ \Psi_{21}(L) & \Psi_{22}(L) \end{bmatrix} \begin{bmatrix} C_{t-1}^* \\ C_{t-1} \end{bmatrix} + \begin{bmatrix} u_t^* \\ u_t \end{bmatrix} \tag{4}$$

where the reduced-form innovations u_t and u_t^* are cross-correlated.

Since we will ultimately be interested in characterizing the effects of monetary policy on the economy, we include in the vector of US common components an observable measure of the monetary policy stance. As in most related VAR applications, we assume that the Federal funds rate, R_t, is the policy instrument. The latter will be allowed to have pervasive effect throughout the economy and will thus be considered as a common component of all US data series. We thus write

$$C_t = \begin{bmatrix} F_t \\ R_t \end{bmatrix},$$

where F_t is a vector of latent macroeconomic factors summarizing the behavior of the US economy.

[4] This is why Stock and Watson (1999) refer to (1) as a dynamic factor model.

2.2 Interpreting the FAVAR structure in an international context

The empirical model we just laid out is a dynamic factor model that links a large set of observable indicators to a small set of common components through the observation equations (1)–(2). The evolution of these common components is specified by the transition equation (3) or its reduced-form representation (4). It is useful to spell out more clearly the economic interpretation of this empirical model and, in particular, the relationship with possible underlying structural models.

As in Bernanke, Boivin and Eliasz (2005) and in Boivin and Giannoni (2006b), we interpret the unobserved factors, C_t and C_t^* as corresponding to theoretical concepts or variables that would enter a structural macroeconomic model. For instance, open-economy dynamic general equilibrium models such as those of Benigno and Benigno (2001), Clarida, Galí, and Gertler (2002), Lubik and Schorfheide (2005), and those of many papers collected in Galí and Gertler (2007) fully characterize the equilibrium evolution of inflation, output, interest rates, net exports and other variables in two regions. In terms of the notation in our empirical framework, all of these variables would be in C_t and C_t^*. The dynamic evolution of these variables implied by such open-economy models can be approximated by an unrestricted VAR of the form (4).[5] If all of these macroeconomic concepts were perfectly observed, the system (4) would boil down to a standard multi-country VAR and could be estimated directly, as in, e.g., Eichenbaum and Evans (1995), Grilli and Roubini (1995,1996), Cushman and Zha (1997), Kim and Roubini (2000), Scholl and Uhlig (2006). In such a case, there would be no need to use the large set of indicators X_t.

However, there are reasons to believe that not all relevant concepts are perfectly observed. First, some macroeconomic concepts are simply measured with error.[6] Second, some of the macroeconomic variables which are key for the model's dynamics may be fundamentally latent. For instance, the concept of "potential output" often critical in monetary model cannot be measured directly. By using a large data set, one is able to extract empirically the components that are most important in explaining fluctuations in the entire data set. While each common component does not need to represent any single economic concept, the common components C_t and C_t^* should constitute a

[5] For a formal description of the link between the solution of a DSGE model in state-space form and a VAR see, e.g., Fernández-Villaverde, Rubio-Ramírez, Sargent and Watson (2007) and references therein.

[6] Boivin and Giannoni (2006b) argue, for example, that inflation is imperfectly measured by any single indicator, and that it is important to use multiple indicators of it for proper inference.

linear combination of all of the relevant latent variables driving the set of noisy indicators X_t and X_t^*, to the extent that we extract the correct number of common components from the data set.

An advantage of this empirical framework is that it provides, both for the US and the international data sets, summary measures of the state of these economies at each date, in the form of factors which may summarize many features of the economy. We thus do not restrict ourselves simply to measures of inflation or output. Another advantage of our approach, as BBE argue, is that this framework should lead to a better identification of the monetary policy shock than standard VARs, because it explicitly recognizes the large information set that the Federal Reserve and financial market participants exploit in practice, and also because, as just argued, it does not require to take a stand on the appropriate measures of prices and real activity which can simply be treated as latent common components. Moreover, for a set of identifying assumptions, a natural by-product of the estimation is to provide impulse response functions for any variable included in the data set. This is particularly useful in our case, since we want to understand the effect of globalization on the transmission of monetary policy to a wide range of economic variables.

The empirical model (1)–(2) and (4) provides a convenient decomposition of all data series into components driven by the US factors C_t (i.e., the Federal funds rate and other US latent factors F_t), non-US latent factors C_t^*, and by series-specific components unrelated to the general state of the economies, e_t or e_t^*. For instance, (1) specifies that indicators of measures of US economic activity or inflation are driven by the Federal funds rate R_t, US latent factors F_t, and a component that is specific to each individual series (representing e.g., measurement error or other idiosyncrasies of each series). The dynamics of the US common components are in turn specified by (4).

Note that the factors C_t and C_t^* summarizing macroeconomic conditions in the US, respectively in the rest of the world, may be affected both by their own region-specific shocks and by worldwide or "global" shocks. In fact, since reduced-form innovations u_t and u_t^* may be cross-correlated, they could be expressed as the sum of a component that is common both the US and the rest of the world, possibly due to "global" shocks and a component that is exclusively region specific. The

reduced-from VAR may thus be rewritten as

$$C_t^* = \Psi_{11}(L) C_{t-1}^* + \Psi_{12}(L) C_{t-1} + \Gamma_1 g_t + \varepsilon_t^* \quad (5)$$

$$C_t = \Psi_{21}(L) C_{t-1}^* + \Psi_{22}(L) C_{t-1} + \Gamma_2 g_t + \varepsilon_t \quad (6)$$

where g_t is a vector of "global" exogenous shocks, and ε_t^*, ε_t are disturbances that are specific to each region and uncorrelated across regions.[7]

2.3 Estimation

As in Stock and Watson (2002b) and BBE, we estimate our empirical model using a variant of a two-step principal component approach which we briefly outline here. We refer to these papers for a more detailed description.

The first step consists of extracting principal components from X_t and X_t^* to obtain consistent estimates of the common factors under the structure laid out. In the second step, the Federal funds rate is added to the estimated factors and the VAR in equation (4) is estimated. Note that in the first step, BBE do not impose the constraint that the Federal funds rate is one of the common components. So if this interest rate is really a common component, it should be captured by the principal components. To remove the Federal funds rate from the space covered by the principal components, BBE perform a transformation of the principal components exploiting the different behavior of what they call "slow moving" and "fast moving" variables, in the second step. Our implementation is slightly different, however. We adopt a more direct approach which consists of imposing the constraint that Federal funds rate is one of the factors in the first-step estimation. This guarantees that the estimated latent factors recover dimensions of the common dynamics not captured by the Federal funds rate.[8] To do so, we adopt the following procedure in the first step of the estimation. Starting from an initial estimate of F_t, denoted by $F_t^{(0)}$ and obtained as the first $K-1$ principal components of X_t, we iterate through the following steps:

[7] In this respect, C_t and C_t^* have a different interpretation than the world factors estimated by, e.g., Gregory et al. (1997), Forni et al. (2000), Kose et al., (2003), Ciccarelli and Mojon (2005). While these authors estimate a world factor and orthogonal region (or country)-specific factors, our estimated C_t and C_t^* contain both fluctuations in regional and world factors.

[8] We thank Olivier Blanchard for pointing us in that direction.

1. Regress X_t on $F_t^{(0)}$ and R_t, to obtain $\hat{\lambda}_R^{(0)}$

2. Compute $\tilde{X}_t^{(0)} = X_t - \hat{\lambda}_R^{(0)} R_t$

3. Estimate $F_t^{(1)}$ as the first $K-1$ principal components of $\tilde{X}_t^{(0)}$

4. Back to 1.

Having estimated the factors C_t and C_t^* and the factor loadings Λ, Λ^*, we can estimate the VAR (4). As we will argue in Section 4, the matrix polynomial $\Psi_{21}(L)$ will be of particular interest to us, as it captures the effects of international factors on domestic variables. For now, note that the VAR coefficients $\Psi_{ij}(L)$ are identified provided that the variance-covariance matrix of the innovations $[u_t^{*\prime}, u_t']'$ is nonsingular. A sufficient condition for this is that the variance-covariance matrices of ε_t^* and ε_t be both full-ranked in the VAR representations (5)–(6).[9] In that case, C_t^* Granger causes C_t, and the domestic factors C_t do not constitute sufficient statistics to uncover the dynamics of the domestic economy. In other words, the domestic economy is not a statistical "island." Alternatively, if the rest of the world had no region-specific shocks, so that $E(\varepsilon_t^* \varepsilon_t^{*\prime}) = 0$, then $\Psi_{21}(L)$ would not be identified, as international factors would bring no additional information. The estimate of the VAR coefficients $\Psi_{21}(L)$ will thus rely on the presence of independent variations originating in the rest of the world, and the Granger-causality tests that we report below will guarantee that there is indeed sufficient such variation.

2.4 Data

The data we use for the estimation of the FAVAR are a balanced panel of 720 quarterly series for the period running from 1984:1 to 2005:2. The data series are listed in the Appendix. They comprise 671 US series. Among these, there are 129 macroeconomic indicators that measure economic activity, employment, prices, interest rates, exchange rates and other key financial variables. In addition, we include the 542 series of disaggregate consumption, and consumer and producer price series used in Boivin, Giannoni and Mihov (2007). As discussed in that paper, disaggregate price

[9] In terms of IV intuition, to estimate $\Psi_{12}(L)$, we need some independent variation in C_t^* in order to be able to use it as an instrument for itself in equation (6). For a formal treatment of this argument, see Hausman and Taylor (1983).

data provide useful information for the appropriate estimation of the monetary policy shocks, and are found to mitigate the price puzzle obtained in conventional VARs or factor models which omit that information. For the rest of the world, we consider a panel of 49 quarterly data series for the 15 main US trade partners. This data set includes for each country, measures of economic activity, prices, and short and long-term interest rates (if available). All data series have been transformed to induce stationarity, and the transformations applied are indicated in the Appendix.

2.5 Preferred specification of the FAVAR

For the model selection, there are two important observations to keep in mind. First, the sample size severely constrains the class of specifications we can consider, especially the number of lags in (4), as the number of factors gets large. Second, in trying to identify the monetary policy transmission mechanism, we are more worried about bias than efficiency. Available information criteria for selecting the number of factors are thus not clearly adequate in that respect. Our general approach for selecting our preferred specification has thus been to try with up to twenty domestic factors and up to 10 foreign factors.

It turns out that irrespective of the number of factors that we include, the Bayesian information criterion selects 1 lag in (4) over the post-1984 sample. We found that including more than 10 domestic factors and 4 global factors did not change substantially the dynamic response of the economy to monetary policy, although, obviously, the uncertainty around the estimates increases with more factors. In fact, very similar results are obtained with as few as 6 domestic factors and 3 foreign factors, although point estimates suggest some price puzzle for some of the price series.

Our preferred specification thus includes 10 domestic latent factors and 4 global factors, and the transition equation (4) has 1 lag.

3 International Factors and US Economic Dynamics

Several studies have recently attempted to the determine the degree of comovement of a few macroeconomic series across countries. For instance Kose, Otrok, Whiteman (2003, 2005), Stock and Watson (2005) study the comovement of economic activity measures and Ciccarelli and Mojon

(2005) focus on inflation. In this paper, rather than restricting ourself to the comparison of a single type of measures across regions of the world, we use our FAVAR framework to compare how the factors summarizing the US macroeconomic dynamics relate to the rest of the world's factors.[10] If global forces are important to describe the dynamics of the US economy, they should be captured by the latent factor space of the FAVAR. We use the common factors extracted from our large data set and determine the fraction of fluctuations in US indicators of real activity, inflation and interest rates that can be explained by US and global factors respectively. After showing to what extent key US economic variables co-move with US and international factors, we determine whether these relationships have changed since the mid-1980s. We then attempt to measure whether foreign factors do "cause" (in a Granger sense) fluctuations in US factors. In the next section, we report how monetary policy shocks affect a large number of variables, how the transmission mechanism has changed over time, and to what extent the change is due to international factors.

3.1 Comovements between US and international factors

We first start by determining to what extent US variables are correlated with US and foreign factors. Table 1 reports the fraction of the volatility in the series listed in the first column that is explained by the 11 US factors C_t (i.e., 10 latent factors and the Federal funds rate), the 4 foreign factors C_t^*, and all factors taken together. This corresponds to the R^2 statistics obtained by the regressions of these variables on the appropriate set of factors, for the entire 1984:1-2005:2 sample. Note that since the US and international factors are allowed to be correlated, the fraction of the variance in any given variable explained by the US factors (first column) plus that explained by the international factors (second column) do not correspond to the fraction of the variance explained jointly by both sets of factors (third column). However, by comparing the numbers in the third column to the sum of the other two columns, we may have a rough sense of how the determinants of the variable of interest may be correlated across countries.

Looking at Table 1, several observations are worth mentioning. First, the entire US data set X_t is on average quite strongly correlated with the common factors. On average, all factors explain 45%

[10] Justiniano (2004) similarly studies the comovement of multiple macroeconomic series between Canada, Australia, and the rest of the world.

	US factors	Intl. factors	All factors
All US data X_t (average over all US data)	0.39	0.13	0.45
Selected US indicators			
Interest rate (Federal funds)	1.00	0.65	1.00
GDP	0.30	0.18	0.37
Consumption	0.28	0.14	0.33
Investment	0.50	0.08	0.51
Exports	0.38	0.31	0.57
Imports	0.45	0.18	0.55
GDP deflator	0.54	0.33	0.69
Consumption deflator (PCE)	0.66	0.37	0.70
Investment deflator	0.53	0.11	0.58
Export deflator	0.58	0.08	0.65
Import deflator	0.42	0.06	0.49
Consumer price index (CPI)	0.50	0.23	0.56
Producer price index (PPI)	0.78	0.03	0.81
Industrial production	0.79	0.12	0.84
Employment (total nonfarm)	0.84	0.34	0.85
Real personal expenditures: durable goods	0.29	0.01	0.29
Real personal expenditures: nondurable goods	0.77	0.09	0.80
Price of personal expenditures: durable goods	0.58	0.43	0.68
Price of personal expenditures: nondurable goods	0.85	0.03	0.87
Price of personal expenditures: services	0.67	0.46	0.74
Long-term interest rate (10 years)	0.91	0.86	0.93
US dollar (trade-weighted nominal exchange rate)	0.74	0.27	0.78

Table 1: R2 for regressions of selected US series on various sets of factors (sample 1984:1- 2005:2)

of the variance of US series. Most of the common fluctuations in US series is however provided by US factors, as the R^2 for these factors amounts to 0.39. However, foreign factors do also appear to be correlated with US data series, with an R^2 of 0.13. Note that, at this point, we do not attempt to determine the origin of the fluctuations in the factors and the direction of causality between US and international factors. We realize that in general US variables may be affected by global economic shocks which impact simultaneously US and international factors. Instead, we attempt to assess to what extent international factors can explain fluctuations in various US macroeconomic variables with information that is not contained in US factors.

Looking at selected US indicators, we find that quarterly growth rates of measures of real economic activity such as quarterly averages of industrial production and employment display very high correlations with the US factors (R^2 statistics of 0.79 and 0.84 respectively). It may be surprising that other activity measures such as real GDP or consumption from the national income accounts do not appear as strongly correlated with the US factors, especially when compared with existing evidence based on similar factor models. However, this is purely an artifact of our use of quarterly growth for GDP components mixed with quarterly averages of monthly data. In fact, the quarterly growth rates of the GDP components display more high-frequency variability than those of (the quarterly averages of) employment and industrial production. Since that variability is not well captured by US factors, a large fraction of these series volatility is explained by the idiosyncratic terms. Were we to consider year-over-year growth rates of the variables, GDP and consumption would display much larger contributions of US factors. The important point, however, is that most of the fluctuations in industrial production, consumption, investment or employment indicators are determined by domestic factors. While these indicators display some correlation with the international factors, the additional explanatory power of the latter factors is relatively low. In fact, The R^2 obtained for these variables by them regressing on all factors are not much higher than those found by regressing only on the US factors.

Quite naturally, the picture is different for US real exports and imports, as they appear to be much more strongly related to international factors. Adding the international factors to the US factors increases the fraction of the variance of exports explained from 0.38 to 0.57, and raises the R^2 of imports from 0.45 to 0.55. These global factors thus contain substantial information not

already contained in US factors, and which is correlated with real exports and imports. Real GDP then reflects the descriptions of its underlying components: while domestic factors are certainly key, adding the international factors increases the R^2 by 7 percentage points.

For US quarterly inflation rates, the importance of international factors varies sensibly depending on the price index used. Inflation of the producer price index, for instance is well described by US factors and displays very little correlation with international factors. However, growth rates of the US GDP deflator and of consumer prices, whether based on the CPI or the personal PCE deflator, are more correlated with international factors. The latter factors explain 37% of fluctuations in inflation of the PCE deflator. Nonetheless, the international factors don't seem to explain much more of consumer price inflation than what is explained by US domestic factors. This suggests that the US and international factors which explain well inflation are strongly correlated. This is consistent with Ciccarelli and Mojon (2005), who find that an important component of consumer price inflation is shared globally. For the GDP deflator, however, global factors contain information not included in US factors. In fact, regressing this indicator on all factors raises the R^2 to 0.69 compared to 0.54, when we consider only US factors. One possible explanation is that export prices depend sensibly on international factors in a way that is not captured by US factors. The inflation rate of the exports' deflator does however not appear to be strongly correlated with international factors, over our entire sample. As we will see below, though, this low correlation with international factors is deceptive as it appears to be due to considerable instability over the sample.

The nominal exchange rate is strongly correlated with domestic factors, and the R^2 with international factors is 0.27, but these global factors seem to contain surprisingly little information no already contained in the domestic factors, and the R^2 with all factors is only a little higher than the one with only US factors.

Finally for nominal interest rates, the Federal funds rate is by assumption a US factor, but it is also strongly correlated with international factors. Similarly, the long-term US interest rate is very strongly correlated with US and international factors. This suggests that all of the countries considered in our data set are affected by a common factor resembling US interest rates.

3.2 Have US and international forces become more strongly correlated?

Overall, the evidence reported in Table 1 indicates that most selected key US variables are strongly correlated with US factors and to a lesser extent with international factors. Such results have been obtained for the sample that runs from 1984:1 to 2005:2. As mentioned in the introduction, though, the US economy's trade in goods and services with the rest of the world has expanded considerably, and the financial globalization, as measured by the sum of external assets and liabilities, has developed at an unprecedented pace, during this period.

Such dramatic developments are likely to have affected the relationship between US variables and international factors. To date, however, the evidence about change in the synchronization of the US economy with the rest of the world is mixed. While Kose, Prasad and Terrones (2003) find stronger comovements of output in industrialized countries with a world factor, since the early 1980's, than in the preceding two decades, Doyle and Faust (2005) little evidence of statistically significant changes, and Helbling and Bayoumi (2003), Monfort, Renne, Ruffer and Vitale (2003), Heathcote and Perri (2004), Stock and Watson (2005), and Kose, Otrok and Whiteman (2005) find reductions in the synchronization of output fluctuations across countries. In addition, these studies typically consider the period subsequent to the mid-1980s as a whole, and do not allow for changes during that period.

Several observers have nonetheless suggested that key macroeconomic variables might have become more dependent on the state of the economy in the rest of the world, in the last few years. Chairman Bernanke (2007) pointed out that long-term interest rates in the US have become sensibly more correlated with those of Germany and other industrialized economies. Some have argued that US inflation may have become more strongly affected by international developments, such as the rise of China as a source of goods and services sold in the US (see, e.g., Rogoff (2004), Kamin, Marazzi, Schindler (2006), Borio and Filardo (2006), Ihrig et al. (2007)). While some US variables may well have become more strongly correlated with international factors, our framework allows us to assess whether a large number of macroeconomic variables in the US have become systematically more synchronized with the factors of its major trade partners.

It is important to keep in mind that a formal empirical analysis of the recent changes due

to the greater globalization is difficult, and faces limits, as the data samples are still very short. Nevertheless, our framework provides a rich account of these changes since 1984, which can show to what extent the global components have revealed changes in the correlations with US variables. Figures 1-2 document the comovement of US variables with global forces over time. They show the fraction of the variability in US variables explained by the global factors, where the estimation is done using a 10 year rolling window. The dates correspond to the mid-point of that window.

These figures reveal several interesting results. First, they show that international factors have *not* become more strongly correlated with a *broad* set of US variables since 1984. The regressions of the US common components on all international components result in R^2 statistics that have not increased on average. Second, despite a fairly constant correlation between international and US factors, when taken as a whole, the importance of global forces on some individual US variables has varied considerably over the sample. Part of that variation certainly reflects the short samples, and may exaggerate the nature of the true changes. Nonetheless, the R^2 of the regression of real GDP growth on international factor fell from 1995 (corresponding to the period that spans 1990-2000) to 2000 (i.e., the period that spans 1995-2005). A similar evolution can be found for consumption, investment and imports, though the R^2 found at the end of the sample are not very different from those obtained at the beginning of the sample. US exports, however, do seem to be more strongly correlated with international factors after the mid-1990s, with R^2 doubling from approximately 0.20 to 0.40.

In terms of prices, inflation in export prices is increasingly more correlated with the international factors throughout the sample. While international factors explain only about 20% of the variance of the export prices' inflation rate around 1990, they explain close to 70% of this variance a decade later. Import prices similarly see their correlation with international factors steadily increase over time. This is consistent with the idea that import prices have been rising more slowly than other consumer prices due in part to an increase in imports from low-cost emerging economies. In fact, Kamin, Marazzi and Schindler (2006) find that trade with China has reduced inflation in import prices by about 1 percentage point. This ends up being reflected in a greater correlation the international factors with US inflation as measured by the CPI, but surprisingly, there is no such

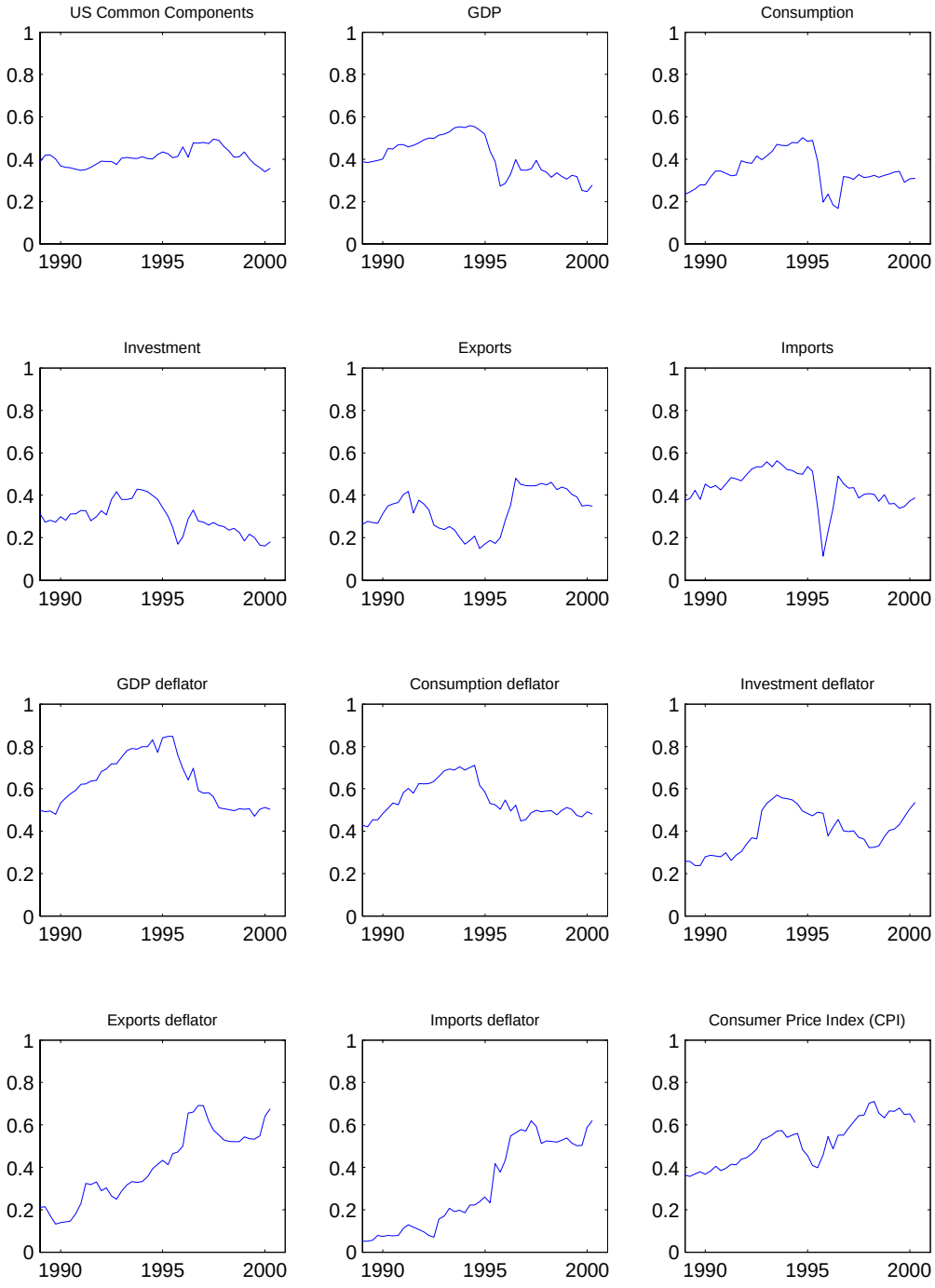

Figure 1: Fraction of the variance of indidual series explained by global factors, in regressions with 10-year rolling windows.

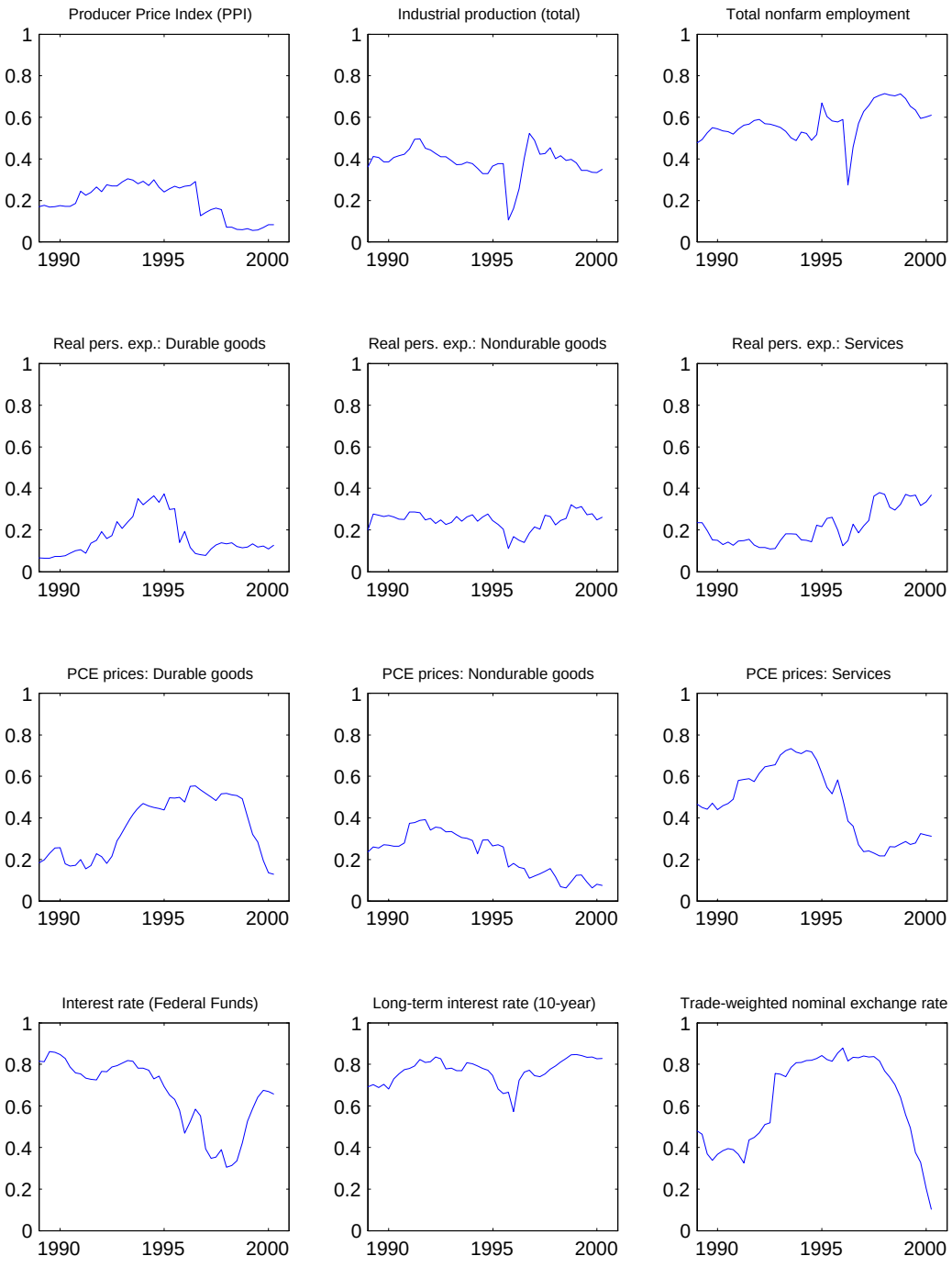

Figure 2: Fraction of the variance of indidual series explained by global factors, in regressions with 10-year rolling windows.

effect on the inflation rate of PCE prices. In addition, there is no evidence that the GDP deflator has become more strongly correlated with international factors since the mid-1990s. If anything, the R^2 statistic has decreased since 1995 for the inflation based on the GDP deflator and on the PCE deflator. These findings contrast sharply with the claims often made that US inflation may have become increasingly determined in the rest of the world (e.g., Borio and Filardo (2006)), but are consistent with the results of Ihrig, Kamin, Lindner and Marquez (2007).

Regarding interest rates, the Federal funds rate appears very strongly correlated with international factors until the mid-1995s, and again by the year 2000. But in the second half of the 1990s, the Federal funds rate appears to disconnect from the international factors for several years. For 10-year rates, the correlation with international factors seems to increase by the late 1990s, a fact consistent with the finding by Bernanke (2007) that long-term yields in industrialized countries have become more strongly correlated in the last few years. While we do not attempt to determine why that correlation has increased, we note that it does not necessarily imply that US rates are determined to a greater extent on foreign capital market. In fact, such a finding is also consistent with the idea that US monetary policy may now have larger effects on international bond markets at the same time as it affects US financial markets (see Ehrmann, Fratzscher and Rigobon, 2005; Faust et al. 2006).

Finally, while the value of the US dollar seems to have been strongly correlated with international factors for a large part of the 1990s, the recent decline in the value of the dollar appears to have had little relation with global factors. Instead, it has been much more determined by US domestic factors.

While these Table 1 and Figures 1 and 2 have provided an interesting account of the relationship between various US macroeconomic variables and international factors, the numbers reported are however merely correlations, and do not imply that fluctuations in US variables such as the Federal funds rate are caused by changes in international conditions. It may well be that changes in US conditions may be sufficiently important to cause changes in foreign factors.

	Full sample	84:1-94:4	95:1-05:2
Factor 1	0.00	0.00	0.00
Factor 2	0.00	0.00	0.00
Factor 3	0.00	0.00	0.18
Factor 4	0.04	0.06	0.01
Factor 5	0.07	0.24	0.35
Factor 6	0.00	0.00	0.00
Factor 7	0.01	0.10	0.00
Factor 8	0.03	0.29	0.04
Factor 9	0.05	0.38	0.00
Factor 10	0.00	0.00	0.03
Fed. funds rate	0.00	0.00	0.00

Table 2: Granger-causality tests for international factors affecting US factors. Table reports p-values.

3.3 Testing the relevance of global forces for US fluctuations

3.3.1 Granger causality tests

To check formally whether global forces do matter for US fluctuations, we now turn to Granger causality tests. Results are presented in Table 2. In Panel A, we test whether the lags of all international factors, C^*_{t-1}, jointly have predictive power for the current values of US factors C_t listed in the first column, over and beyond lags of domestic factors, C_{t-1}. Under the null hypothesis, foreign factors have no predictive power. The table suggests that all but one US common factors, including the Fed funds rate, are Granger-caused by international factors at the 5% level over the entire sample considered. The evidence is somewhat weaker when we perform the test over the 1984:1 to 1994:4 period. At this stage, this might only be reflecting lower power of the test over the smaller sub-samples. Interestingly, however, combined with the evidence that we report in Section 4, it seems that global factors were not very important to explain US economic dynamics before the late 1990's.

This evidence implies that the feedback from the rest of the world to the US economy as measured by $\Psi_{21}(L)$, and to which we return in Section 4, are identified.

3.3.2 Has the influence of international factors on US factors increased over the last two decades?

As the comparison of the Granger causality tests between the two subsamples crudely suggests, the relationship of the global factors with the US economy might have changed over time. In fact, if there is any content to the claims that the greater economic integration between the US and the rest of the world has affected the dynamics of US economic variables, the Granger causality relationship must have changed over time.

One way to get formal evidence on this question is to test for the stability of the Granger causality relationships. We do so using the Quandt likelihood ratio test (QLR), the asymptotic distribution of which has been derived by Andrews (1993).[11] We apply the test jointly to all global factors.

The results are reported in Table 3. As is clear from the table, we reject stability at the 5% level in most cases. Based on this, one important observation is that even though we have a fairly short sample, the latter contains sufficient information to allow us to detect statistically significant changes. It remains to be investigated whether these changes have been sufficiently important, economically speaking, to affect the transmission mechanism of monetary policy. Interestingly, the Federal funds rate is the only variable for which the stability is not rejected. The data thus suggests that while the setting of the Federal funds rate is has been affected by global factors, the role of the latter factors does not seem to have changed significantly in our sample.

4 Implications for the Monetary Transmission Mechanism

In the last section, we determined that some of US factors have become more synchronized with international factors over the last two decades. A natural question that arises then is to what extent has US monetary policy become more constrained by the expansion of international trade, and to a larger extent by the much greater globalization of finance. Do global forces mitigate the effects of US monetary policy more than they used to?

There is little doubt that, despite this globalization, the Federal Reserve has retained its capacity

[11] In doing so, we ignore the uncertainty in the factor estimates. When the cross section of macro indicators is large, the uncertainty in the factor estimates should be negligible asymptotically (see Bai and Ng (2006)).

	Joint-Global
Factor 1	41.59**
Factor 2	85.17**
Factor 3	47.53**
Factor 4	38.14**
Factor 5	102.15**
Factor 6	34.92**
Factor 7	30.90**
Factor 8	20.78**
Factor 9	17.44*
Factor 10	62.20**
Fed. funds rate	15.94

Table 3: Stability tests for Granger-causality coefficients of international factors affecting future US factors. Table reports QLR statistics and confidence level (* = 10 percent; ** = 5 percent).

to align the Federal funds rate with its target rate by managing the supply of funds in the interbank market. It is thus still reasonable to think of the Federal funds rate as being the instrument of monetary policy. As other short-term rates such as yields on 3-month or 6 month US Treasury securities remain very strongly correlated with actual Federal funds rate (the correlation between the Federal funds rate and 3-months securities is above 0.99 for the period 1984-2007 and has remained as high since 2000) they can still be viewed as primarily affected by monetary policy.

Clearly, longer-term interest rates reflect at least in part expectations of future short-term rates, and depend on announcements provided by central bankers. Longer-term rates have however become more strongly correlated with international factors in recent years, as mentioned above. Part of this change may reflect a greater influence of international capital markets on US long-term rates.[12] Alternatively, US factors may have more impact on international capital markets (see Ehrmann, Fratzscher, Rigobon (2005), Faust et al. (2006)). At the same time, since monetary policy's effect on other variables such as economic activity and inflation is believed to depend partly on long-term rates, it is possible that these other variables might have become less affected by Federal funds rate movements. In addition, the increase in international trade in goods and services may explain why US import and export prices have become more correlated with international factors. A natural question then is what are the implications of these changes for the transmission

[12] See, e.g., Bernanke (2005) for an argument that increased saving in emerging economies and in oil-producing countries has contributed to maintaining low long-term US interest rates.

of US monetary policy?

4.1 Empirical strategy

In the context of our FAVAR framework, we can characterize the transmission mechanism of monetary policy by computing the response of selected macroeconomic series to an identified monetary policy shock. In the spirit of VAR analyses, we impose only the minimum number of restrictions needed to identify the policy shock. This allows us to document some facts about the evolution of the monetary transmission mechanism that should not be otherwise contaminated by auxiliary assumptions.

Recall that the structural representation of our VAR transition equation takes the form (3), where again $C_t = [F_t', R_t]'$. To identify monetary policy shocks, i.e., the surprise changes in the Federal funds rate, we assume that the latent factors F_t and C_t^* cannot respond to innovations in R_t in the period of the shock. The Fed funds rate, however, is allowed to respond to contemporaneous fluctuations in such factors. We thus impose the restriction that the matrix Φ_0 in (3) has ones on the main diagonal, and zeroes in the last column, except for the lower right element, which is one. This has the implication that the monetary policy shock enters only in the last element of the innovations vector u_t in the reduced-form VAR (4), which we repeat here for convenience:

$$\begin{bmatrix} C_t^* \\ C_t \end{bmatrix} = \begin{bmatrix} \Psi_{11}(L) & \Psi_{12}(L) \\ \Psi_{21}(L) & \Psi_{22}(L) \end{bmatrix} \begin{bmatrix} C_{t-1}^* \\ C_{t-1} \end{bmatrix} + \begin{bmatrix} u_t^* \\ u_t \end{bmatrix}.$$

As mentioned above, the matrix polynomials $\Psi_{12}(L)$ and $\Psi_{21}(L)$ determine the magnitude of the spillovers between the US and the rest of the world's economic variables. When $\Psi_{21}(L) = 0$, the rest of the world has no spillovers on the US economy, meaning that fluctuations in foreign economic variables do not cause (in the sense of Granger) any fluctuations in US variables. Following a US monetary policy shock, $\Psi_{21}(L)$ measures the extent to which the rest of the world contributes to the transmission of the US monetary policy domestically.

Our strategy involves computing impulse response functions to a monetary policy shock in the system above, and comparing them to those obtained with different values of $\Psi_{21}(L)$. The difference

between these impulse responses provides a measure of the importance of the endogenous response of the rest of the world in the US transmission of monetary policy. (Note that in both cases, C_t^* is allowed to move only in response to the monetary shock.) In addition, to the extent that the greater integration of the world economies has changed the role played by the rest of the world in the transmission of US monetary policy, this should imply a change in $\Psi_{21}(L)$. Consequently, by documenting the changes over time in $\Psi_{21}(L)$ and its implications on the impulse response functions, it is possible to evaluate whether globalization has reduced the ability of US monetary policy to affect domestic variables.

To illustrate more directly the exercise we perform, let us consider a simplified version of this model in which the macroeconomic factors are actually observed. To fix ideas more concretely, think of the set of relevant domestic factors C_t as being given by the domestic (or world) interest rate R_t and domestic real activity Y_t, and the foreign factors C_t^* as corresponding foreign real activity Y_t^*. Let us assume that the structural model relating these variables is as follows:

$$\begin{aligned} Y_t^* &= \psi_{11} Y_{t-1}^* + \psi_{12} Y_{t-1} + \psi_{13} R_{t-1} + g_t + \varepsilon_t^* \\ Y_t &= \psi_{21} Y_{t-1}^* + \psi_{22} Y_{t-1} + \psi_{23} R_{t-1} + g_t + \varepsilon_t \\ R_t &= \phi Y_{t-1} + \eta_t \end{aligned}$$

where ε_t^* and ε_t are region-specific output shocks and g_t is a worldwide shock. The first two equations are reduced-form equations determining output in both regions, while the third equation can be interpreted as an interest-rate rule, so that η_t can be viewed as a monetary policy shock.

In this context, our approach consists of comparing the impulse response functions of Y_t and R_t implied by this unrestricted system, with those obtained for different values of ψ_{21}. For instance, setting $\psi_{21} = 0$ is equivalent to assuming that domestic variables are not affected by international developments. Comparing the two sets of impulse response functions thus provides a way to assess the importance of the "feedback" or "spillover" from the rest of the world in explaining the transmission mechanism of monetary policy.

In this simple context, whether or not our strategy identifies the effect of international factors — i.e. the effect of Y_t^* — in the transmission mechanism of monetary policy depends solely on

whether the parameter ψ_{21} is identified. As mentioned in section 2, ψ_{21} is identified provided that the variances of ε_t and ε_t^* are nonzero. If $var(\varepsilon_t^*)$ were equal to zero, the system would be reduced-ranked and it would not be possible to identify separately all the parameters ψ_{ij}, as Y_t^* and Y_t would be perfectly collinear. Notice that the condition that $var(\varepsilon_t) > 0$ and $var(\varepsilon_t^*) > 0$ is equivalent to saying that Y_t^* Granger causes Y_t (conditional on past values of Y_t).

It is important to note that our analysis does not identify directly "worldwide shocks" which would affect simultaneously domestic and international factors (such as the shock g_t) in the example above, in the absence of further restrictions. It is however not necessary to identify such global shocks in order to quantify the effects of international factors of the transmission of US monetary policy shocks.

For illustration purposes, in this simple example, we assumed that the factors C_t and C_t^* were perfectly observed. In our application, however, these factors are unobserved and relate to a large set informative variables according to (1) and (2). This does not change any of the arguments just made in the context of the simple example. Once we have estimates of C_t and C_t^*, we are back in the world described in the previous example. The matrix polynomial $\Psi_{21}(L)$ is similarly identified when the matrix $var(\varepsilon_t^*)$ is full rank or, alternatively, provided that C_t^* Granger causes C_t.

4.2 Implementation

In estimating the FAVAR over the sample 1984:1-2005:2, we allow for the possibility that the international factors may affect US variables differently after the year 2000. More specifically, we expand the VAR system of our FAVAR with a dummy variable interacted with all the lags of the foreign factors. More precisely, we estimate the following system

$$\begin{bmatrix} C_t^* \\ C_t \end{bmatrix} = \begin{bmatrix} \Psi_{11}(L) & \Psi_{12}(L) \\ \Psi_{21}(L) & \Psi_{22}(L) \end{bmatrix} \begin{bmatrix} C_{t-1}^* \\ C_{t-1} \end{bmatrix} + \begin{bmatrix} \Psi_{11}^d(L) \\ \Psi_{21}^d(L) \end{bmatrix} d_t C_{t-1}^* + \begin{bmatrix} u_t^* \\ u_t \end{bmatrix},$$

where d_t takes the value 0 for the period 1984:1-1999:4 and 1 after. That means that the coefficients on the lag international factors in the equations for C_t are equal to $\Psi_{21}(L)$ for 1984:1-1999:4, and to $\Psi_{21}(L) + \Psi_{21}^d(L)$ thereafter. Given that our preferred specification has only one lag, notice that

allowing for this form of instability requires estimating 4 additional parameters per equation, so it is not too costly in terms of degrees of freedom.

4.3 The effects of monetary policy shocks

Figures 3 and 4 show the estimated impulse responses of a set of macroeconomic indicators to a tightening of monetary policy, that is, an innovation in the Federal funds rate corresponding to an unexpected increase of 25 basis points. The solid lines represent the responses computed using the relationship between the US factors and the international factors as estimated during the 1984:1 to 1999:4 period, along with the 70% confidence intervals.[13] The dashed lines, instead, display the responses using the same FAVAR, but assuming that the US and international factors relate as estimated after 2000. A comparison of these two sets of impulse responses allows us to gauge the effects on the monetary transmission mechanism of the changes in the relationship between international factors and US variables. In fact, between the two sets of responses, the only relationships that are allowed to change are those that describe how foreign factors end up affecting US data. Note that by doing so, we maximize the length of our sample in the estimation, yet we allow for a change in the role of international factors.

As the impulse responses based on the effects of international factors estimated for the 1984:1 - 1999:4 sample reveal in Figures 3 and 4, an unexpected tightening in monetary policy results in a gradual decline in real GDP, which tends to revert back to the original level after about 3 years. Other measures of activity, such as industrial production and employment both respond in a similar way. Consumption also shows a similar although smaller response, while investment falls much more. Together with the fall in domestic demand, imports fall in response to the interest rate increase. The reduction in imports appears to be reinforced by a significant appreciation in the value of the US dollar, lasting about 2 years following the shock. Exports to the rest of the world also fall significantly following the monetary tightening. This is consistent with the fact that the US dollar appreciates, and that output in foreign trade partners falls (not reported).

All price indices (reported in levels) show little response on impact, but also tend to fall pro-

[13] The confidence intervals were obtained using Kilian's (1998) bootstrap procedure.

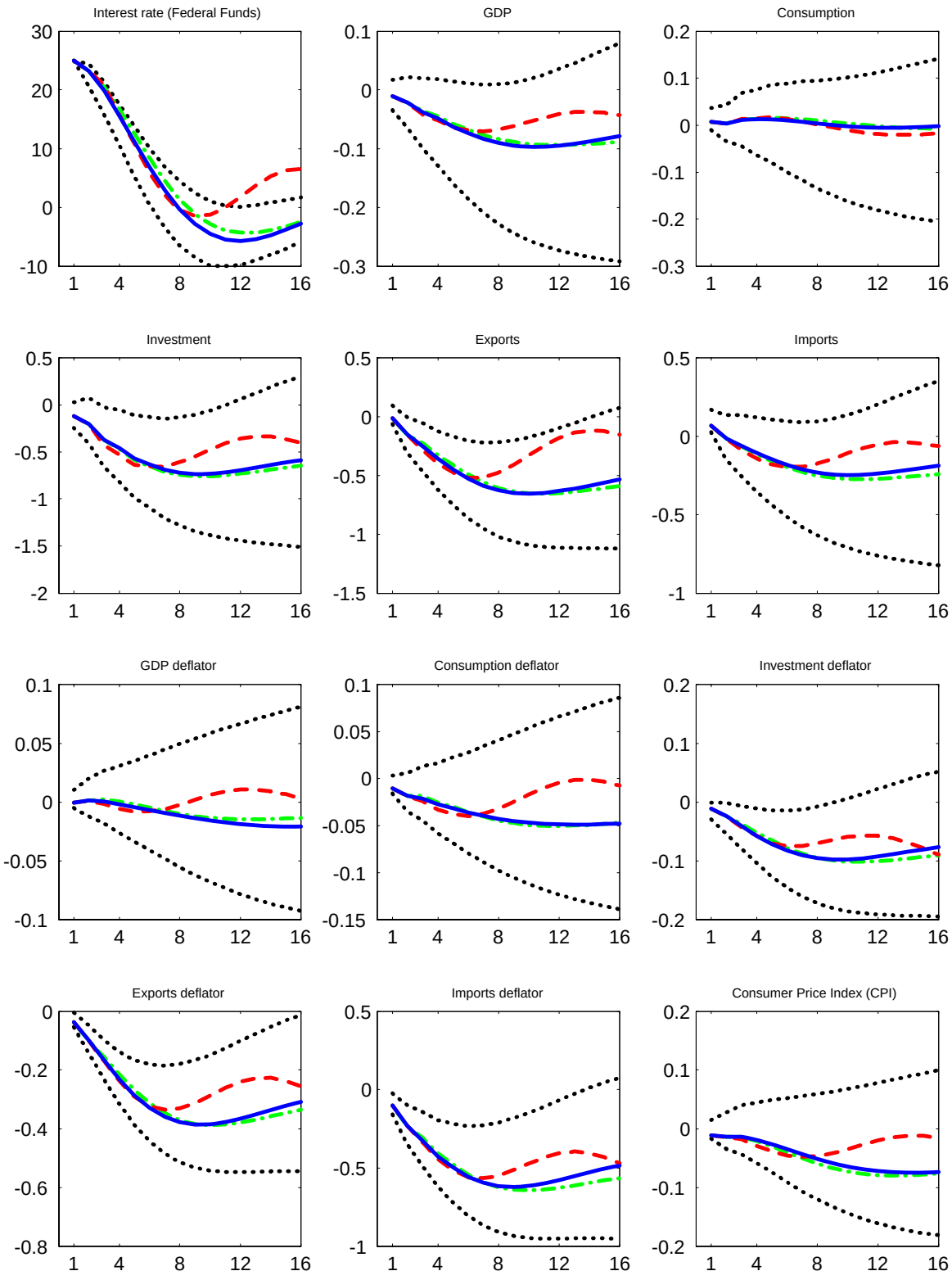

Figure 3: Impulse responses to an identified monetary policy shock

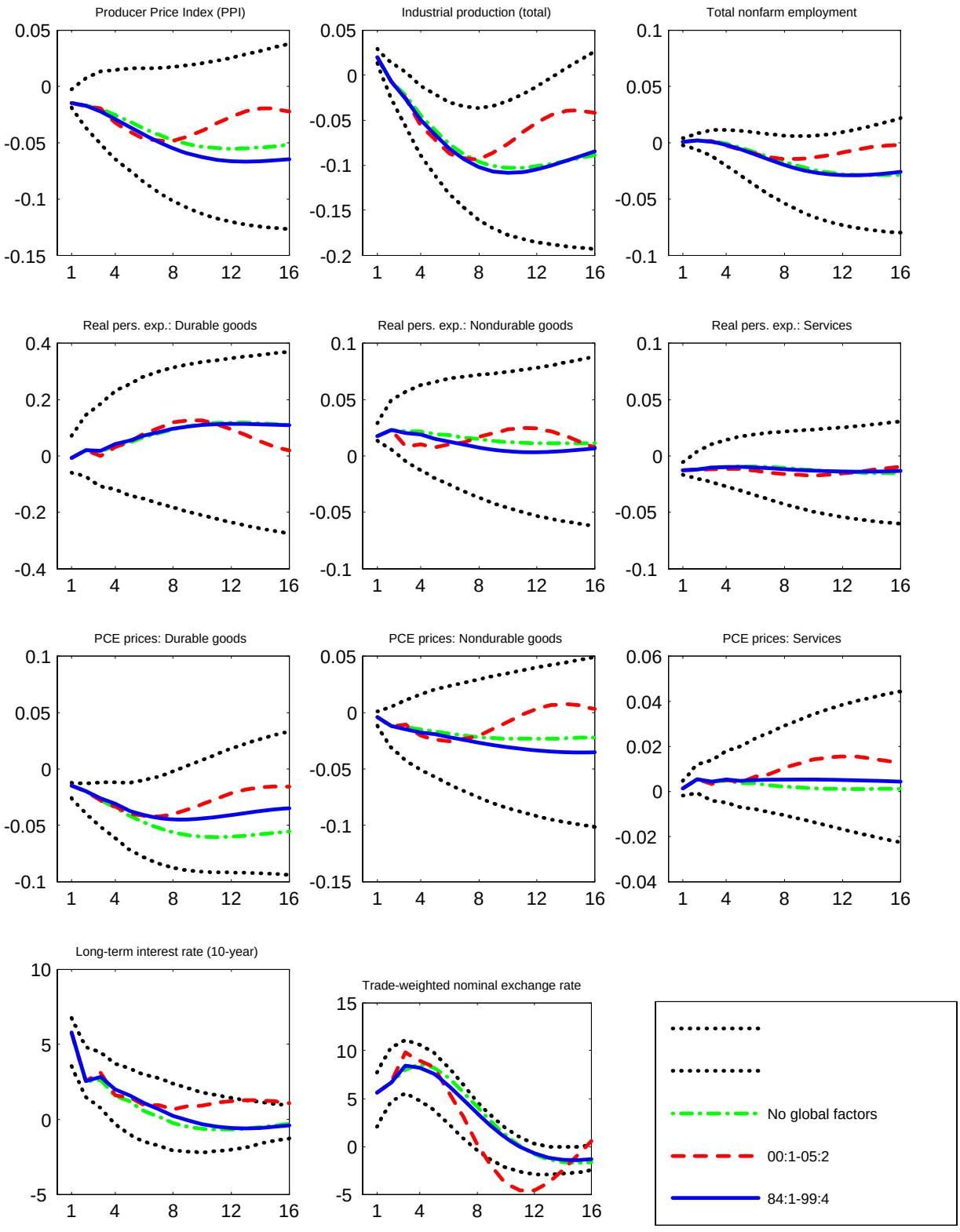

Figure 4: Impulse responses to an identified monetary policy shock (cont.)

gressively, and in a persistent way, following the monetary tightening. However, while the import and export price deflators seem to respond rapidly to the shock, it takes about 3 quarters for the GDP deflator and the CPI to show any movement. While the import price response may reflect a slowing domestic economy, the response of export prices may be explained by a drop in foreign demand for US goods, due both to an appreciating US dollar and to a slowing foreign economy.

4.4 Has the role of global forces on the US monetary transmission changed?

We find little overall evidence that global forces have had a important effect on the US monetary transmission mechanism, and find little evidence of change over the last several years. To determine to what extent the response of macroeconomic variables to a monetary tightening has changed recently, we compare the impulse responses based on the FAVAR involving the link between domestic and international factors as estimated since 2000 (dashed lines) to those based on international factors in the 1984-1999 period (solid lines). One interesting conclusion that emerges from this exercise is that the variables display in both cases almost identical responses in the first 6 to 7 quarters following the shock. After that, the responses based on the most recent international factors reveal a slightly more rapid return to the initial level. The output and various measures of prices, for instance, show less persistent responses to the monetary tightening. But most changes are not statistically significant. Only for the Federal funds rate, the long-term interest rate and the exchange rate do we have sharper evidence that the impulse responses have changed after 3 or 4 years, when using the more recent factors. And the expectation of a higher Federal funds rate three or more years following the shock is reflected in a slightly higher value of the 10-year yield.

The changes in the impulse responses just documented were obtained by allowing a different relationship between the US and international factors starting in the year 2000. For robustness, we checked with alternative break dates, and found that in all cases, the changes were similar or smaller than those reported in the figures. This suggests that if there has been a change in the response to monetary policy shock, this phenomenon is very recent.

In brief, we found no evidence that the responses of a large number of key US variables to monetary policy shocks have changed in the first 6-7 quarters following the shock. However, we found some evidence that the relationship between US and international factors has changed in

such a way as to imply a lower persistence in the response to monetary policy shocks 8 or more quarters after the shock.

How important are global forces for the monetary transmission? When the Federal Reserve changes the course of monetary policy, it affects both US and international factors. The response of the latter may in turn constrain the response of the US economy. A crude way of assessing the role of global forces in the transmission of US monetary policy it to report the responses of US macroeconomic variables to a monetary policy shock, but assuming that the US factors do not respond to global factors. Specifically, we compute the responses of the monetary shock by setting to zero the submatrices Ψ_{21} and Ψ_{21}^d referring to the international factors C_t^*. These impulse responses that abstract from international factors are shown with dashed-dotted lines in Figures 3 and 4.

A striking conclusion is that these responses almost perfectly replicate those estimated with the international factors in the 1984-1999 period (solid lines). It follows that the global factors in that period don't seem to have more than a marginal impact on the response of the US economy to monetary shocks. Of course, we are *not* saying that global factors do not have an impact on the economy, and that the Federal Reserve does not need to give any consideration to the international economic situation. In fact, as we reported in the previous section, several key variable *are* strongly correlated with international factors. Our results suggest, however, that *conditional on changing the Federal funds rate* in a particular way, the response of the main US macroeconomic variables have been little affected by the response of international factors.

It is important, however, to keep in mind that in the counterfactual experiment just described as well as in our assessment of the change over time in the effect of foreign factors, we assume that the coefficients measuring the response of US variables to US factors as well as those characterizing the dynamics of the US factors do not change. While we would in principle want to allow for possible changes over time in the latter coefficients, such exercises are unfortunately unlikely to provide reliable results in our empirical model, given the number of extra parameters that we would need to estimate, and given our relatively short sample. Such an assumption may well not be satisfied. For instance, several authors have argued that the slope of the Phillips curve relating US inflation to domestic measures of marginal costs or of activity may have changed following the

greater economic integration of the US with the rest of the world. However, Sbordone (2007) and Woodford (2007) argue, in simple calibrated models, that such changes are unlikely to be large. Another possibility is that the processes determining expectations about future domestic variables be altered by the greater openness of the domestic economy. By not letting the relationships among domestic variables change in our empirical model with the increased globalization, we are technically subject to the Lucas critique. One would thus need a fully-specified forward-looking structural model to account for this issue.

5 Conclusion

It has been widely documented that international trade has continued to advance, and that the globalization of finance has seen an extraordinary expansion since the mid 1980s. In this context, several observers have argued that global factors may now have a greater influence than in the past on the determination of key US macroeconomic variables, and that conditions in international capital markets may impose more constraints on the transmission of monetary policy.

In this paper, we have attempted to quantify the changes in the relationship between international forces and the US economy over the 1984-2005 period. To do so, we have used an empirical model that allows us to summarize the macroeconomic conditions of the US economy and of the rest of the world with a small number of factors. This framework allows us to quantify the extent of comovement between many key US macroeconomic variables and international factors. It allows us to characterize empirically the transmission of monetary policy shocks to a large set of macroeconomic indicators.

Our findings can be summarized as follows. First, we find that common factors capture on average a sizable fraction of the fluctuations in US macroeconomic indicators. This provides support to the use of our empirical model. Second, there is evidence that the role of international factors in explaining US variables has been changing over the 1984-2005 period, but this evolution is not systematic across series, and it is difficult to see a pattern suggesting that international factors have become generally more important. Some variables such as the long-term interest rates, as well as import and export prices, however, do display a systematic increase of their correlation with global

factors throughout our sample.

We don't find strong statistical evidence of a significant change in the transmission mechanism of monetary policy due to global forces. Taking our point estimates literally, global forces do not seem to have played an important role in the US monetary transmission mechanism between 1984 and 1999. This does not mean that global factors do not have an impact on the economy, as other shocks, such as international shocks, may have an important effect on US economic variables. However, our results suggest that *conditional on a monetary policy shock* in the US, the response of the main US macroeconomic variables have been little affected by the response of international factors.

In addition, since the year 2000, the initial response of the US economy following a monetary policy shock — the first 6 to 8 quarters — is essentially the same as the one that has been observed in the 1984-1999 period. However, point estimates suggest that the growing importance of global forces might have contributed to reducing some of the persistence in the responses, two or more years after the shocks.

Overall, we conclude that if global forces have had an effect on the monetary transmission mechanism, this is a recent phenomenon. This means however that we will need more data before we can get strong statistical conclusions on this question.

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APPENDIX: Data Sets

1 – US Macroeconomic series

Format contains series number; series mnemonic; data span (in quarters); transformation code and series description as appears in the database. The transformation codes are: 1 – no transformation; 2 – first difference; 4 – logarithm; 5 – first difference of logarithm. Second differencing of logarithms was not used. Our main data set contains 17 quarterly series and 112 monthly series with no missing observations. Quarterly averages of monthly series were taken. The series were taken from DRI/McGraw Hill's Basic Economics database, and Data Insight's US Central database.

	National Income and Products Accounts (NIPA)			
1	GDPR.Q	1983:4-2005:2	5	Real Gross Domestic Product Billions of Chained (2000) Dollars, SAAR
2	CR.Q	1983:4-2005:2	5	Real Personal Consumption Expenditures Billions of Chained (2000) Dollars, SAAR
3	IR.Q	1983:4-2005:2	5	Real Gross Private Domestic Investment Billions of Chained (2000) Dollars, SAAR
4	XR.Q	1983:4-2005:2	5	Real Exports Billions of Chained (2000) Dollars, SAAR
5	MR.Q	1983:4-2005:2	5	Real Imports Billions of Chained (2000) Dollars, SAAR
6	GR.Q	1983:4-2005:2	5	Real Government Consumption Exp. & Gross Invest., Bil. of Chained (2000) Dollars, SAAR
7	X.Q	1983:4-2005:2	5	Exports of Goods and Services Billions of Dollars, SAAR
8	XFY.Q	1983:4-2005:2	5	Income Receipts from the Rest of the World Billions of Dollars, SAAR
9	M.Q	1983:4-2005:2	5	Imports of Goods and Services Billions of Dollars, SAAR
10	MFY.Q	1983:4-2005:2	5	Income payments to the Rest of the World Billions of Dollars, SAAR
11	MTAXATRF.Q	1983:4-2005:2	5	Current Taxes And Transfer Payments To Rest of the World (net) Bil. of Dollars, SAAR
12	JPGDP.Q	1983:4-2005:2	5	Gross Domestic Product Price Index (2000=100), SA
13	JPC.Q	1983:4-2005:2	5	Personal Consumption Expenditures Price Index (2000=100), SA
14	JPI.Q	1983:4-2005:2	5	Gross Private Domestic Investment Price Index (2000=100), SAAR
15	JPX.Q	1983:4-2005:2	5	Exports Price Index (2000=100), SA
16	JPM.Q	1983:4-2005:2	5	Imports Price Index (2000=100), SA
17	JPG.Q	1983:4-2005:2	5	Government Consumption Expenditures & Gross Investment Price Index (2000=100), SA
	OUT ---------- Real Output and Income			
18	IPS11	1983:4-2005:2	5	Industrial Production Index - Products, Total
19	IPS299	1983:4-2005:2	5	Industrial Production Index - Final Products
20	IPS12	1983:4-2005:2	5	Industrial Production Index - Consumer Goods
21	IPS13	1983:4-2005:2	5	Industrial Production Index - Durable Consumer Goods
22	IPS18	1983:4-2005:2	5	Industrial Production Index - Nondurable Consumer Goods
23	IPS25	1983:4-2005:2	5	Industrial Production Index - Business Equipment
24	IPS32	1983:4-2005:2	5	Industrial Production Index - Materials
25	IPS34	1983:4-2005:2	5	Industrial Production Index - Durable Goods Materials
26	IPS38	1983:4-2005:2	5	Industrial Production Index - Nondurable Goods Materials
27	IPS43	1983:4-2005:2	5	Industrial Production Index - Manufacturing (SIC)
28	IPS67e	1983:4-2005:2	5	Industrial Production Index - Mining NAICS=21
29	IPS68e	1983:4-2005:2	5	Industrial Production Index - Electric and Gas Utilities
30	IPS10	1983:4-2005:2	5	Industrial Production Index - Total Index
31	PMI	1983:4-2005:2	5	Purchasing Managers' Index (SA)
32	PMP	1983:4-2005:2	5	NAPM Production Index (Percent)
33	PYQ	1983:4-2005:2	5	Personal Income (Chained) (Bil 2000$, SAAR)
34	MYXPQ	1983:4-2005:2	5	Personal Income Less Transfer Payments (Chained) (Bil 2000$,SAAR)
35	IPS307	1983:4-2005:2	5	Industrial Production Index - Residential Utilities
36	IPS316	1983:4-2005:2	5	Industrial Production Index - Basic Metals
	EMP ---------- Employment and Hours			
37	LHEL	1983:4-2005:2	5	Index of Help-Wanted Advertising In Newspapers (1967=100;SA)
38	LHELX	1983:4-2005:2	4	Employment: Ratio; Help-Wanted Ads: No. Unemployed Clf
39	LHEM	1983:4-2005:2	5	Civilian Labor Force: Employed, Total (Thous., SA)
40	LHNAG	1983:4-2005:2	5	Civilian Labor Force: Employed, Nonagric. Industries (Thous., SA)
41	LHUR	1983:4-2005:2	1	Unemployment Rate: All Workers, 16 Years & Over (%, SA)
42	LHU680	1983:4-2005:2	1	Unemploy. by Duration: Average(Mean) Duration in Weeks (SA)

43	LHU5	1983:4-2005:2	1	Unemploy. by Duration: Persons Unempl.Less Than 5 Wks (Thous., SA)
44	LHU14	1983:4-2005:2	1	Unemploy. by Duration: Persons Unempl.5 To 14 Wks (Thous., SA)
45	LHU15	1983:4-2005:2	1	Unemploy. by Duration: Persons Unempl.15 Wks + (Thous., SA)
46	LHU26	1983:4-2005:2	1	Unemploy. by Duration: Persons Unempl.15 To 26 Wks (Thous., SA)
47	BLS_LPNAG	1983:4-2005:2	5	Total Nonfarm Employment (SA) - CES0000000001
48	BLS_LP	1983:4-2005:2	5	Total Private Employment (SA) - CES0500000001
49	BLS_LPGD	1983:4-2005:2	5	Goods-Producing Employment (SA) - CES0600000001
50	BLS_LPMI	1983:4-2005:2	5	Natural Resources and Mining Employment (SA) - CES1000000001
51	BLS_LPCC	1983:4-2005:2	5	Construction Employment (SA) - CES2000000001
52	BLS_LPEM	1983:4-2005:2	5	Manufacturing Employment (SA) - CES3000000001
53	BLS_LPED	1983:4-2005:2	5	Durable Goods Manufacturing Employment (SA) - CES3100000001
54	BLS_LPEN	1983:4-2005:2	5	Nondurable Goods Manufacturing Employment (SA) - CES3200000001
55	BLS_Ser.-EMP	1983:4-2005:2	5	Service-Providing Employment (SA) - CES0700000001
56	BLS_Tra.EMP	1983:4-2005:2	5	Trade, Transportation, and Utilities Employment (SA) - CES4000000001
57	BLS_Ret.- EMP	1983:4-2005:2	5	Retail Trade Employment (SA) - CES4200000001
58	BLS_Whol. EMP	1983:4-2005:2	5	Wholesale Trade Employment (SA) - CES4142000001
59	BLS_Fin.-EMP	1983:4-2005:2	5	Financial Activities Employment (SA) - CES5500000001
60	BLS_P-Ser.EMP	1983:4-2005:2	5	Private Service-Providing Employment (SA) - CES0800000001
61	BLS_LPGOV	1983:4-2005:2	5	Government Employment (SA) - CES9000000001
62	BLS_LPHRM	1983:4-2005:2	1	Manufacturing Average Weekly Hours of Production Workers (SA) - CES3000000005
63	BLS_LPMOSA	1983:4-2005:2	1	Manufacturing Average Weekly Overtime of Production Workers (SA) - CES3000000007
64	PMEMP	1983:4-2005:2		NAPM Employment Index (Percent)
	HSS ---------- Housing Starts and Sales			
65	HSFR	1983:4-2005:2	4	Housing Starts: Nonfarm (1947-58); Total Farm&Nonfarm(1959-); (Thous. U., SA)
66	HSNE	1983:4-2005:2	4	Housing Starts: Northeast (Thous. U., SA)
67	HSMW	1983:4-2005:2	4	Housing Starts: Midwest (Thous. U., SA)
68	HSSOU	1983:4-2005:2	4	Housing Starts: South (Thous. U., SA)
69	HSWST	1983:4-2005:2	4	Housing Starts: West (Thous. U., SA)
70	HSBR	1983:4-2005:2	4	Housing Authorized: Total New Private Housing Units (Thous., SAAR)
71	HMOB	1983:4-2005:2	4	Mobile Homes: Manufacturers' Shipments (Thous. U., SAAR)
	INV ---------- Real Inventories and Inventory-Sales Ratios			
72	PMNV	1983:4-2005:2	1	NAPM Inventories Index (Percent)
	ORD---------- Orders and Unfilled Orders			
73	PMNO	1983:4-2005:2	1	NAPM New Orders Index (Percent)
74	PMDEL	1983:4-2005:2	1	NAPM Vendor Deliveries Index (Percent)
75	MOCMQ	1983:4-2005:2	5	New Orders (Net) - Consumer Goods & Materials, 1996 Dollars (BCI)
76	MSONDQ	1983:4-2005:2	5	New Orders, Nondefense Capital Goods, In 1996 Dollars (BCI)
	SPR ---------- Stock Prices			
77	FSPCOM	1983:4-2005:2	5	S&P's Common Stock Price Index: Composite (1941-43=10)
78	FSPIN	1983:4-2005:2	5	S&P's Common Stock Price Index: Industrials (1941-43=10)
79	FSDXP	1983:4-2005:2	1	S&P's Composite Common Stock: Dividend Yield (% Per Annum)
80	FSPXE	1983:4-2005:2	1	S&P's Composite Common Stock: Price-Earnings Ratio (%, NSA)
81	FSDJ	1983:4-2005:2		Common Stock Prices: Dow Jones Industrial Average
	EXR ---------- Exchange Rates			
82	JRXTWCNS@06.M	1983:4-2005:2	1	Trade-weighted value of the US Dollar (Nominal, 1995=100)
83	EXRSW	1983:4-2005:2	5	Foreign Exchange Rate: Switzerland (Swiss Franc Per U.S.$)
84	EXRJAN	1983:4-2005:2	5	Foreign Exchange Rate: Japan (Yen Per U.S.$)
85	EXRUK	1983:4-2005:2	5	Foreign Exchange Rate: United Kingdom (Cents Per Pound)
86	EXRCAN	1983:4-2005:2	5	Foreign Exchange Rate: Canada (Canadian $ Per U.S.$)
	INT ---------- Interest Rates			
87	FYFF	1983:4-2005:2	1	Interest Rate: Federal Funds (Effective) (% Per Annum, NSA)
88	FYGM3	1983:4-2005:2	1	Interest Rate: U.S.Treasury Bills,Sec Mkt,3-Mo.(% Per Ann, NSA)
89	FYGM6	1983:4-2005:2	1	Interest Rate: U.S.Treasury Bills,Sec Mkt,6-Mo.(% Per Ann, NSA)
90	FYGT1	1983:4-2005:2	1	Interest Rate: U.S.Treasury Const Maturities,1-Yr.(% Per Ann, NSA)
91	FYGT5	1983:4-2005:2	1	Interest Rate: U.S.Treasury Const Maturities,5-Yr.(% Per Ann, NSA)

92	FYGT10	1983:4-2005:2	1	Interest Rate: U.S.Treasury Const Maturities,10-Yr.(% Per Ann, NSA)
93	FYAAAC	1983:4-2005:2	1	Bond Yield: Moody's AAA Corporate (% Per Annum)
94	FYBAAC	1983:4-2005:2	1	Bond Yield: Moody's BAA Corporate (% Per Annum)
95	SFYGM3	1983:4-2005:2	1	Spread FYGM3 - FYFF
96	SFYGM6	1983:4-2005:2	1	Spread FYGM6 - FYFF
97	SFYGT1	1983:4-2005:2	1	Spread FYGT1 - FYFF
98	SFYGT5	1983:4-2005:2	1	Spread FYGT5 - FYFF
99	SFYGT10	1983:4-2005:2	1	Spread FYGT10 - FYFF
100	SFYAAAC	1983:4-2005:2	1	Spread FYAAAC - FYFF
101	SFYBAAC	1983:4-2005:2	1	Spread FYBAAC - FYFF
	MON ---------- Money and Credit Quantity Aggregates			
102	FM1	1983:4-2005:2	5	Money Stock: M1(Curr,Trav.Cks,Dem Dep,Other Ck'able Dep) (Bil$, SA)
103	FM2	1983:4-2005:2	5	Money Stock:M2(M1+O'nite Rps,Euro$,G/P&B/D Mmmfs&SAv&Sm Time Dep (Bil$, SA)
104	FM3	1983:4-2005:2	5	Money Stock: M3(M2+Lg Time Dep,Term Rp's&Inst nnly Mmmfs) (Bil$, SA)
105	FM2DQ	1983:4-2005:2	5	Money Supply - M2 In 1996 Dollars (BCI)
106	FMFBA	1983:4-2005:2	5	Monetary Base, Adj for Reserve Requirement Changes (Mil$, SA)
107	FMRRA	1983:4-2005:2	5	Depository Inst Reserves: Total,Adj For Reserve Req Chgs (Mil$, SA)
108	FMRNBA	1983:4-2005:2	5	Depository Inst Reserves: Nonborrowed,Adj Res Req Chgs (Mil$, SA)
109	FCLBMC	1983:4-2005:2	1	Wkly Rp Lg Com'l Banks: Net Change Com'l & Indus Loans (Bil$, SAAR)
110	CCINRV	1983:4-2005:2	5	Consumer Credit Outstanding - Nonrevolving(G19)
111	IMFCLNQ	1983:4-2005:2		Commercial & Industrial Loans Oustanding In 1996 Dollars
	PRI ---------- Price Indexes			
112	PMCP	1983:4-2005:2	1	NAPM Commodity Prices Index (Percent)
113	PWFSA	1983:4-2005:2	5	Producer Price Index: Finished Goods (82=100,SA)
114	PWFCSA	1983:4-2005:2	5	Producer Price Index: Finished Consumer Goods (82=100,SA)
115	PWIMSA	1983:4-2005:2	5	Producer Price Index: Intermed Mat.Supplies & Components (82=100,SA)
116	PWCMSA	1983:4-2005:2	5	Producer Price Index: Crude Materials (82=100,SA)
117	PUNEW	1983:4-2005:2	5	CPI-U: All Items (82-84=100,SA)
118	PU83	1983:4-2005:2	5	CPI-U: Apparel & Upkeep (82-84=100,SA)
119	PU84	1983:4-2005:2	5	CPI-U: Transportation (82-84=100,SA)
120	PU85	1983:4-2005:2	5	CPI-U: Medical Care (82-84=100,SA)
121	PUC	1983:4-2005:2	5	CPI-U: Commodities (82-84=100,SA)
122	PUCD	1983:4-2005:2	5	CPI-U: Durables (82-84=100,SA)
123	PUXF	1983:4-2005:2	5	CPI-U: All Items Less Food (82-84=100,SA)
124	PUXHS	1983:4-2005:2	5	CPI-U: All Items Less Shelter (82-84=100,SA)
125	PUXM	1983:4-2005:2	5	CPI-U: All Items Less Medical Care (82-84=100,SA)
126	PSCCOM	1983:4-2005:2	5	Spot Market Price Index: BLS & CRB: All Commodities (1967=100)
	AHE ---------- Average Hourly Earnings			
127	BLS_LEHCC	1983:4-2005:2	5	Construction Average Hourly Earnings of Production Workers (SA) - CES2000000006
128	BLS_LEHM	1983:4-2005:2	5	Manufacturing Average Hourly Earnings of Production Workers (SA) - CES3000000006
	OTH ---------- Miscellaneous			
129	HHSNTN	1983:4-2005:2	1	U. of Michigan Index of Consumer Expectations (Bcd-83)

2 – US Personal Consumption Expenditures (price indexes and nominal expenditure)

Format is as above: series number; series; data span (in quarters); transformation code and series description as appears in the database. The transformation for all data was first difference of logarithms, which is coded as 5. This data set contains 194 monthly price series on Personal Consumption Expenditures with no missing observations, and 194 monthly real consumption series on Personal Consumption Expenditures. Quarterly averages were taken of all series. We describe here the 194 price series. The 194 corresponding real consumption series were ordered and transformed in a similar fashion. Series were downloaded from the underlying tables of the Bureau of Economic Analysis.

1	P1NDCG3	1983:4 - 2005:2	5	New domestic autos
2	P1NFCG3	1983:4 - 2005:2	5	New foreign autos
3	P1NETG3	1983:4 - 2005:2	5	Net transactions in used autos
4	P1MARG3	1983:4 - 2005:2	5	Net purchases of used autos: Used auto margin
5	P1REEG3	1983:4 - 2005:2	5	Net purchases of used autos: Employee reimbursement
6	P1TRUG3	1983:4 - 2005:2	5	Trucks, new and net used
7	P1REVG3	1983:4 - 2005:2	5	Recreational vehicles
8	P1TATG3	1983:4 - 2005:2	5	Tires and tubes
9	P1PAAG3	1983:4 - 2005:2	5	Accessories and parts
10	P1FNRG3	1983:4 - 2005:2	5	Furniture, including mattresses and bedsprings
11	P1MHAG3	1983:4 - 2005:2	5	Major household appliances
12	P1SEAG3	1983:4 - 2005:2	5	Small electric appliances
13	P1CHNG3	1983:4 - 2005:2	5	China, glassware, tableware, and utensils
14	P1RADG3	1983:4 - 2005:2	5	Video and audio goods, including musical instruments, and computer goods
15	P1FLRG3	1983:4 - 2005:2	5	Floor coverings
16	P1CLFG3	1983:4 - 2005:2	5	Clocks, lamps, and furnishings
17	P1TEXG3	1983:4 - 2005:2	5	Blinds, rods, and other
18	P1WTRG3	1983:4 - 2005:2	5	Writing equipment
19	P1HDWG3	1983:4 - 2005:2	5	Tools, hardware, and supplies
20	P1LWNG3	1983:4 - 2005:2	5	Outdoor equipment and supplies
21	P1OPTG3	1983:4 - 2005:2	5	Ophthalmic products and orthopedic appliances
22	P1GUNG3	1983:4 - 2005:2	5	Guns
23	P1SPTG3	1983:4 - 2005:2	5	Sporting equipment
24	P1CAMG3	1983:4 - 2005:2	5	Photographic equipment
25	P1BCYG3	1983:4 - 2005:2	5	Bicycles
26	P1MCYG3	1983:4 - 2005:2	5	Motorcycles
27	P1BOAG3	1983:4 - 2005:2	5	Pleasure boats
28	P1AIRG3	1983:4 - 2005:2	5	Pleasure aircraft
29	P1JRYG3	1983:4 - 2005:2	5	Jewelry and watches
30	P1BKSG3	1983:4 - 2005:2	5	Books and maps
31	P1GRAG3	1983:4 - 2005:2	5	Cereals
32	P1BAKG3	1983:4 - 2005:2	5	Bakery products
33	P1BEEG3	1983:4 - 2005:2	5	Beef and veal
34	P1PORG3	1983:4 - 2005:2	5	Pork
35	P1MEAG3	1983:4 - 2005:2	5	Other meats
36	P1POUG3	1983:4 - 2005:2	5	Poultry
37	P1FISG3	1983:4 - 2005:2	5	Fish and seafood
38	P1GGSG3	1983:4 - 2005:2	5	Eggs
39	P1MILG3	1983:4 - 2005:2	5	Fresh milk and cream
40	P1DAIG3	1983:4 - 2005:2	5	Processed dairy products
41	P1FRUG3	1983:4 - 2005:2	5	Fresh fruits
42	P1VEGG3	1983:4 - 2005:2	5	Fresh vegetables
43	P1PFVG3	1983:4 - 2005:2	5	Processed fruits and vegetables
44	P1JNBG3	1983:4 - 2005:2	5	Juices and nonalcoholic drinks
45	P1CTMG3	1983:4 - 2005:2	5	Coffee, tea and beverage materials
46	P1FATG3	1983:4 - 2005:2	5	Fats and oils
47	P1SWEG3	1983:4 - 2005:2	5	Sugar and sweets
48	P1OFDG3	1983:4 - 2005:2	5	Other foods
49	P1PEFG3	1983:4 - 2005:2	5	Pet food
50	P1MLTG3	1983:4 - 2005:2	5	Beer and ale, at home
51	P1WING3	1983:4 - 2005:2	5	Wine and brandy, at home
52	P1LIQG3	1983:4 - 2005:2	5	Distilled spirits, at home
53	P1ESLG3	1983:4 - 2005:2	5	Elementary and secondary school lunch
54	P1HSLG3	1983:4 - 2005:2	5	Higher education school lunch
55	P1OPMG3	1983:4 - 2005:2	5	Other purchased meals
56	P1APMG3	1983:4 - 2005:2	5	Alcohol in purchased meals
57	P1CFDG3	1983:4 - 2005:2	5	Food supplied to employees: civilians

58	P1MFDG3	1983:4 - 2005:2	5	Food supplied to employees: military
59	P1FFDG3	1983:4 - 2005:2	5	Food produced and consumed on farms
60	P1SHUG3	1983:4 - 2005:2	5	Shoes
61	P1WGCG3	1983:4 - 2005:2	5	Clothing for females
62	P1WICG3	1983:4 - 2005:2	5	Clothing for infants
63	P1WSGG3	1983:4 - 2005:2	5	Sewing goods for females
64	P1WUGG3	1983:4 - 2005:2	5	Luggage for females
65	P1MBCG3	1983:4 - 2005:2	5	Clothing for males
66	P1MSGG3	1983:4 - 2005:2	5	Sewing goods for males
67	P1MUGG3	1983:4 - 2005:2	5	Luggage for males
68	P1MICG3	1983:4 - 2005:2	5	Standard clothing issued to military personnel (n.d.)
69	P1GASG3	1983:4 - 2005:2	5	Gasoline and other motor fuel
70	P1LUBG3	1983:4 - 2005:2	5	Lubricants
71	P1OILG3	1983:4 - 2005:2	5	Fuel oil
72	P1LPGG3	1983:4 - 2005:2	5	Liquefied petroleum gas and other fuel
73	P1TOBG3	1983:4 - 2005:2	5	Tobacco products
74	P1SOAG3	1983:4 - 2005:2	5	Soap
75	P1CSMG3	1983:4 - 2005:2	5	Cosmetics and perfumes
76	P1OPHG3	1983:4 - 2005:2	5	Other personal hygiene goods
77	P1SDHG3	1983:4 - 2005:2	5	Semidurable house furnishings
78	P1CLEG3	1983:4 - 2005:2	5	Cleaning preparations
79	P1LIGG3	1983:4 - 2005:2	5	Lighting supplies
80	P1PAPG3	1983:4 - 2005:2	5	Paper products
81	P1RXDG3	1983:4 - 2005:2	5	Prescription drugs
82	P1NRXG3	1983:4 - 2005:2	5	Nonprescription drugs
83	P1MDSG3	1983:4 - 2005:2	5	Medical supplies
84	P1GYNG3	1983:4 - 2005:2	5	Gynecological goods
85	P1DOLG3	1983:4 - 2005:2	5	Toys, dolls, and games
86	P1AMMG3	1983:4 - 2005:2	5	Sport supplies, including ammunition
87	P1FLMG3	1983:4 - 2005:2	5	Film and photo supplies
88	P1STSG3	1983:4 - 2005:2	5	Stationery and school supplies
89	P1GREG3	1983:4 - 2005:2	5	Greeting cards
90	P1ARTG3	1983:4 - 2005:2	5	Expenditures abroad by U.S. residents: Government expenditures abroad
91	P1ARSG3	1983:4 - 2005:2	5	Expenditures abroad by U.S. residents: Other private services
92	P1REMG3	1983:4 - 2005:2	5	Less: Personal remittances in kind to nonresidents
93	P1MGZG3	1983:4 - 2005:2	5	Magazines and sheet music
94	P1NWPG3	1983:4 - 2005:2	5	Newspapers
95	P1FLOG3	1983:4 - 2005:2	5	Flowers, seeds, and potted plants
96	P1OMHG3	1983:4 - 2005:2	5	Owner occupied mobile homes
97	P1OSTG3	1983:4 - 2005:2	5	Owner occupied stationary homes
98	P1TMHG3	1983:4 - 2005:2	5	Tenant occupied mobile homes
99	P1TSPG3	1983:4 - 2005:2	5	Tenant occupied stationary homes
100	P1TLDG3	1983:4 - 2005:2	5	Tenant landlord durables
101	P1FARG3	1983:4 - 2005:2	5	Rental value of farm dwellings
102	P1HOTG3	1983:4 - 2005:2	5	Hotels and motels
103	P1HFRG3	1983:4 - 2005:2	5	Clubs and fraternity housing
104	P1HHEG3	1983:4 - 2005:2	5	Higher education housing
105	P1HESG3	1983:4 - 2005:2	5	Elem and second education housing
106	P1TGRG3	1983:4 - 2005:2	5	Tenant group room and board
107	P1TGLG3	1983:4 - 2005:2	5	Tenant group employee lodging
108	P1ELCG3	1983:4 - 2005:2	5	Electricity
109	P1NGSG3	1983:4 - 2005:2	5	Gas
110	P1WSMG3	1983:4 - 2005:2	5	Water and sewerage maintenance
111	P1REFG3	1983:4 - 2005:2	5	Refuse collection
112	P1LOCG3	1983:4 - 2005:2	5	Local and cellular telephone
113	P1INCG3	1983:4 - 2005:2	5	Intrastate toll calls
114	P1ITCG3	1983:4 - 2005:2	5	Interstate toll calls
115	P1DMCG3	1983:4 - 2005:2	5	Domestic service, cash
116	P1DMIG3	1983:4 - 2005:2	5	Domestic service, in kind
117	P1MSEG3	1983:4 - 2005:2	5	Moving and storage
118	P1FIPG3	1983:4 - 2005:2	5	Household insurance premiums
119	P1FIBG3	1983:4 - 2005:2	5	Less: Household insurance benefits paid
120	P1RCLG3	1983:4 - 2005:2	5	Rug and furniture cleaning
121	P1EREG3	1983:4 - 2005:2	5	Electrical repair
122	P1FREG3	1983:4 - 2005:2	5	Reupholstery and furniture repair
123	P1PSTG3	1983:4 - 2005:2	5	Postage
124	P1MHOG3	1983:4 - 2005:2	5	Household operation services, n.e.c.
125	P1ARPG3	1983:4 - 2005:2	5	Motor vehicle repair
126	P1RLOG3	1983:4 - 2005:2	5	Motor vehicle rental, leasing, and other
127	P1TOLG3	1983:4 - 2005:2	5	Bridge, tunnel, ferry, and road tolls
128	P1AING3	1983:4 - 2005:2	5	Insurance premiums for user-operated transportation
129	P1IMTG3	1983:4 - 2005:2	5	Local transportation: Mass transit systems
130	P1TAXG3	1983:4 - 2005:2	5	Taxicab
131	P1IRRG3	1983:4 - 2005:2	5	Railway
132	P1IBUG3	1983:4 - 2005:2	5	Bus
133	P1IAIG3	1983:4 - 2005:2	5	Airline

134	P1TROG3	1983:4 - 2005:2	5	Other
135	P1PHYG3	1983:4 - 2005:2	5	Physicians
136	P1DENG3	1983:4 - 2005:2	5	Dentists
137	P1OPSG3	1983:4 - 2005:2	5	Other professional services
138	P1NPHG3	1983:4 - 2005:2	5	Hospitals: Nonprofit
139	P1FPHG3	1983:4 - 2005:2	5	Hospitals: Proprietary
140	P1GVHG3	1983:4 - 2005:2	5	Hospitals: Government
141	P1NRSG3	1983:4 - 2005:2	5	Nursing homes
142	P1MING3	1983:4 - 2005:2	5	Health insurance: Medical care and hospitalization
143	P1IING3	1983:4 - 2005:2	5	Health insurance: Income loss
144	P1PWCG3	1983:4 - 2005:2	5	Health insurance: Workers' compensation
145	P1MOVG3	1983:4 - 2005:2	5	Admissions to motion picture theaters
146	P1LEGG3	1983:4 - 2005:2	5	Admissions to theaters and opera, and entertainments of nonprofit instit. (except athletics)
147	P1SPEG3	1983:4 - 2005:2	5	Admissions to spectator sports
148	P1RTVG3	1983:4 - 2005:2	5	Radio and television repair
149	P1CLUG3	1983:4 - 2005:2	5	Clubs and fraternal organizations
150	P1SIGG3	1983:4 - 2005:2	5	Sightseeing
151	P1FLYG3	1983:4 - 2005:2	5	Private flying
152	P1BILG3	1983:4 - 2005:2	5	Bowling and billiards
153	P1CASG3	1983:4 - 2005:2	5	Casino gambling
154	P1OPAG3	1983:4 - 2005:2	5	Other commercial participant amusements
155	P1PARG3	1983:4 - 2005:2	5	Pari-mutuel net receipts
156	P1REOG3	1983:4 - 2005:2	5	Other recreation
157	P1SCLG3	1983:4 - 2005:2	5	Shoe repair
158	P1DRYG3	1983:4 - 2005:2	5	Drycleaning
159	P1LGRG3	1983:4 - 2005:2	5	Laundry and garment repair
160	P1BEAG3	1983:4 - 2005:2	5	Beauty shops, including combination
161	P1BARG3	1983:4 - 2005:2	5	Barber shops
162	P1WCRG3	1983:4 - 2005:2	5	Watch, clock, and jewelry repair
163	P1CRPG3	1983:4 - 2005:2	5	Miscellaneous personal services
164	P1BROG3	1983:4 - 2005:2	5	Brokerage charges and investment counseling
165	P1BNKG3	1983:4 - 2005:2	5	Bank service charges, trust services, and safe deposit box rental
166	P1IMCG3	1983:4 - 2005:2	5	Commercial banks
167	P1IMNG3	1983:4 - 2005:2	5	Other financial institutions
168	P1LIFG3	1983:4 - 2005:2	5	Expense of handling life insurance and pension plans
169	P1GALG3	1983:4 - 2005:2	5	Legal services
170	P1FUNG3	1983:4 - 2005:2	5	Funeral and burial expenses
171	P1UNSG3	1983:4 - 2005:2	5	Labor union expenses
172	P1ASSG3	1983:4 - 2005:2	5	Profession association expenses
173	P1GENG3	1983:4 - 2005:2	5	Employment agency fees
174	P1AMOG3	1983:4 - 2005:2	5	Money orders
175	P1CLAG3	1983:4 - 2005:2	5	Classified ads
176	P1ACCG3	1983:4 - 2005:2	5	Tax return preparation services
177	P1THEG3	1983:4 - 2005:2	5	Personal business services, n.e.c.
178	P1PEDG3	1983:4 - 2005:2	5	Private higher education
179	P1GEDG3	1983:4 - 2005:2	5	Public higher education
180	P1ESCG3	1983:4 - 2005:2	5	Elementary and secondary schools
181	P1NSCG3	1983:4 - 2005:2	5	Nursery schools
182	P1VEDG3	1983:4 - 2005:2	5	Commercial and vocational schools
183	P1REDG3	1983:4 - 2005:2	5	Foundations and nonprofit research
184	P1POLG3	1983:4 - 2005:2	5	Political organizations
185	P1MUSG3	1983:4 - 2005:2	5	Museums and libraries
186	P1FOUG3	1983:4 - 2005:2	5	Foundations to religion and welfare
187	P1WELG3	1983:4 - 2005:2	5	Social welfare
188	P1RELG3	1983:4 - 2005:2	5	Religion
189	P1FTRG3	1983:4 - 2005:2	5	Foreign travel by U.S. residents (110)
190	P1EXFG3	1983:4 - 2005:2	5	Less: Expenditures in the United States by nonresidents (112)
191	P1TDGG3	1983:4 - 2005:2	5	Durable goods
192	P1TNDG3	1983:4 - 2005:2	5	Nondurable goods
193	P1TSSG3	1983:4 - 2005:2	5	Services
194	PPCE	1983:4 - 2005:2	5	Personal Consumption Expenditures (all items)

3 – US Producer Price Indices

Format is above: series number; series mnemonic (NAICS code); data span (in quarters); transformation code and series description as appears in the database. Quarterly averages were taken of all series. The transformation for all data was first difference of logarithms, which is coded as 5. This data set contains 154 monthly series with no missing observations. All series are downloaded from the website of BLS.

1	311119	1983:4 - 2005:2	5	Other animal food manufacturing
2	311119p	1983:4 - 2005:2	5	Other animal food manufacturing (primary products)
3	311211	1983:4 - 2005:2	5	Flour Milling
4	311212	1983:4 - 2005:2	5	Rice milling
5	311213	1983:4 - 2005:2	5	Malt mfg
6	311223a	1983:4 - 2005:2	5	Other oilseed processing (cottonseed cake and meal and other byproducts)
7	311225p	1983:4 - 2005:2	5	Fats and oils refining and blending (primary products)
8	311311	1983:4 - 2005:2	5	Sugarcane mills
9	311313	1983:4 - 2005:2	5	Beet sugar manufacturing
10	311412	1983:4 - 2005:2	5	Frozen specialty food manufacturing
11	311520	1983:4 - 2005:2	5	Ice cream and frozen dessert mfg
12	311920	1983:4 - 2005:2	5	Coffee and tea manufacturing
13	312140	1983:4 - 2005:2	5	Distilleries
14	32211-	1983:4 - 2005:2	5	Pulp mills
15	32213-	1983:4 - 2005:2	5	Paperboard mills
16	325620p	1983:4 - 2005:2	5	Toilet preparation mfg (primary products)
17	325920	1983:4 - 2005:2	5	Explosives manufacturing
18	32731-	1983:4 - 2005:2	5	Cement mfg
19	327320	1983:4 - 2005:2	5	Ready mixed concrete mfg and dist
20	327410	1983:4 - 2005:2	5	Lime
21	327420	1983:4 - 2005:2	5	Gypsum building products manufacturing
22	327910	1983:4 - 2005:2	5	Abrasive product manufacturing
23	331210	1983:4 - 2005:2	5	Iron steel pipe & tube mfg from purch steel
24	333210	1983:4 - 2005:2	5	Sawmill & woodworking machinery mfg
25	334310	1983:4 - 2005:2	5	Audio & video equipment mfg
26	335110	1983:4 - 2005:2	5	Electric lamp bulb & part mfg
27	336370	1983:4 - 2005:2	5	Motor vehicle metal stamping
28	337910	1983:4 - 2005:2	5	Mattress mfg
29	311421	1983:4 - 2005:2	5	Fruit and vegetable canning
30	311423	1983:4 - 2005:2	5	Dried and dehydrated food manufacturing
31	311513	1983:4 - 2005:2	5	Cheese manufacturing
32	311611	1983:4 - 2005:2	5	Animal except poultry slaughtering
33	311612	1983:4 - 2005:2	5	Meat processed from carcasses
34	311613	1983:4 - 2005:2	5	Rendering and meat byproduct processing
35	311711	1983:4 - 2005:2	5	Seafood canning
36	311712	1983:4 - 2005:2	5	Fresh & frozen seafood processing
37	311813p	1983:4 - 2005:2	5	Frozen cakes pies & other pastries mfg (Primary products)
38	3118233	1983:4 - 2005:2	5	Dry pasta manufacturing (macaroni spaghetti vermicelli and noodles)
39	312111p	1983:4 - 2005:2	5	Soft drinks manufacturing (primary products)
40	312221	1983:4 - 2005:2	5	Cigarettes
41	3122291	1983:4 - 2005:2	5	Other tobacco product mfg (cigars)
42	313111	1983:4 - 2005:2	5	Yarn spinning mills
43	3133111	1983:4 - 2005:2	5	Broadwoven fabric finishing mills (finished cotton broadwoven fabrics not finished in weaving mills)
44	315111	1983:4 - 2005:2	5	Sheer hosiery mills
45	315191	1983:4 - 2005:2	5	Outerwear knitting mills
46	315223	1983:4 - 2005:2	5	Men's boy's cut & sew shirt excl work mfg
47	315224	1983:4 - 2005:2	5	Men's boy's cut & sew trouser slack jean mfg
48	315993	1983:4 - 2005:2	5	Men's and boys' neckwear mfg
49	316211	1983:4 - 2005:2	5	Rubber and plastic footwear manufacturing
50	316213	1983:4 - 2005:2	5	Men's footwear excl athletic mfg
51	316214	1983:4 - 2005:2	5	Women's footwear excl athletic mfg
52	316992	1983:4 - 2005:2	5	Women's handbag & purse mfg
53	321212	1983:4 - 2005:2	5	Softwood veneer or plywood mfg
54	3212191	1983:4 - 2005:2	5	Reconstituted wood product mfg (particleboard produced at this location)
55	3219181	1983:4 - 2005:2	5	Other millwork including flooring (wood moldings except prefinished moldings made from purchased moldings)
56	321991	1983:4 - 2005:2	5	Manufactured homes mobile homes mfg
57	3221211	1983:4 - 2005:2	5	Paper except newsprint mills (clay coated printing and converting paper)
58	322214	1983:4 - 2005:2	5	Fiber can tube drum & other products mfg
59	324121	1983:4 - 2005:2	5	Asphalt paving mixture & block mfg
60	324122	1983:4 - 2005:2	5	Asphalt shingle & coating materials mfg
61	324191p	1983:4 - 2005:2	5	Petroleum lubricating oils and greases (primary products)
62	325181	1983:4 - 2005:2	5	Alkalies and chlorine
63	3251881	1983:4 - 2005:2	5	All other basic inorganic chemical manufacturing (sulfuric acid gross new and fortified)

64	3251921	1983:4 - 2005:2	5	Cyclic crude and intermediate manufacturing (cyclic coal tar intermediates)
65	325212	1983:4 - 2005:2	5	Synthetic rubber manufacturing
66	325222	1983:4 - 2005:2	5	Manufactured noncellulosic fibers
67	325314	1983:4 - 2005:2	5	Fertilizer mixing only manufacturing
68	3254111	1983:4 - 2005:2	5	Medicinal & botanical mfg (synthetic organic medicinal chemicals in bulk)
69	3261131	1983:4 - 2005:2	5	Unsupported plastics film sheet excluding packaging manufacturing
70	326192	1983:4 - 2005:2	5	Resilient floor covering manufacturing
71	326211	1983:4 - 2005:2	5	Tire manufacturing except retreading
72	327111	1983:4 - 2005:2	5	Vitreous plumbing fixtures access ftg mfg
73	327121	1983:4 - 2005:2	5	Brick and structural clay tile
74	327122	1983:4 - 2005:2	5	Ceramic wall and floor tile
75	327124	1983:4 - 2005:2	5	Clay refractories
76	327125	1983:4 - 2005:2	5	Nonclay refractory manufacturing
77	327211	1983:4 - 2005:2	5	Flat glass manufacturing
78	327213	1983:4 - 2005:2	5	Glass container manufacturing
79	327331	1983:4 - 2005:2	5	Concrete block and brick manufacturing
80	3279931	1983:4 - 2005:2	5	Mineral wool manufacturing
81	331111	1983:4 - 2005:2	5	Iron and steel mills
82	331112	1983:4 - 2005:2	5	Electrometallurgical ferroalloy product mfg
83	331221	1983:4 - 2005:2	5	Rolled steel shape manufacturing
84	331312	1983:4 - 2005:2	5	Primary aluminum production
85	331315	1983:4 - 2005:2	5	Aluminum sheet plate & foil mfg
86	331316	1983:4 - 2005:2	5	Aluminum extruded products
87	331421	1983:4 - 2005:2	5	Copper rolling drawing & extruding
88	3314913	1983:4 - 2005:2	5	Other nonferrous metal roll draw extruding (titanium and titanium base alloy mill shapes excluding wire)
89	3314923	1983:4 - 2005:2	5	Other nonferrous secondary smelt refine alloying (secondary lead)
90	331511	1983:4 - 2005:2	5	Iron foundries
91	3322121	1983:4 - 2005:2	5	Hand and edge tools except machine tools and handsaws (mechanics' hand service tools)
92	332213	1983:4 - 2005:2	5	Saw blade & handsaw mfg
93	3323111	1983:4 - 2005:2	5	Prefabricated metal building and component manufacturing (prefabricated metal building systems excluding farm service bldgs & residential buildings)
94	332321	1983:4 - 2005:2	5	Metal window and door manufacturing
95	332431	1983:4 - 2005:2	5	Metal can mfg
96	324393	1983:4 - 2005:2	5	Other metal container manufacturing (steel shipping barrels & drums excl beer barrels more than 12 gallon capacity)
97	332611	1983:4 - 2005:2	5	Spring heavy gauge mfg
98	3326122	1983:4 - 2005:2	5	Spring light gauge mfg (precision mechanical springs)
99	3327224	1983:4 - 2005:2	5	Bolt nut screw rivet & washer mfg (externally threaded metal fasteners except aircraft)
100	332913	1983:4 - 2005:2	5	Plumbing fixture fitting & trim mfg
101	332991	1983:4 - 2005:2	5	Ball and roller bearings
102	332992	1983:4 - 2005:2	5	Small arms ammunition mfg
103	332996	1983:4 - 2005:2	5	Fabricated pipe & pipe fitting mfg
104	332998	1983:4 - 2005:2	5	Enameled iron & metal sanitary ware mfg
105	333111	1983:4 - 2005:2	5	Farm machinery & equipment mfg
106	333131	1983:4 - 2005:2	5	Mining machinery & equipment mfg
107	333132	1983:4 - 2005:2	5	Oil and gas field machinery and equipment mfg
108	333292	1983:4 - 2005:2	5	Textile machinery
109	333293	1983:4 - 2005:2	5	Printing machinery & equipment mfg
110	3332941	1983:4 - 2005:2	5	Food products machinery mfg (dairy and milk products plant machinery)
111	3332981	1983:4 - 2005:2	5	All other industrial machinery mfg (chemical manufacturing machinery equip. and parts)
112	3333111	1983:4 - 2005:2	5	Automatic vending machine mfg (automatic merchandising machines coin operated excluding parts)
113	333512	1983:4 - 2005:2	5	Machine tool metal cutting types mfg
114	333513	1983:4 - 2005:2	5	Machine tool metal forming types mfg
115	3335151	1983:4 - 2005:2	5	Cutting tool & machine tool accessory mfg (small cutting tools for machine tools and metalworking machinery)
116	333612	1983:4 - 2005:2	5	Speed changer industrial high speed drive & gear mfg
117	333618	1983:4 - 2005:2	5	Other engine equipment mfg
118	3339111	1983:4 - 2005:2	5	Pump & pumping equipment mfg (indus. pumps except hydraulic fluid power pumps)
119	333922	1983:4 - 2005:2	5	Conveyor & conveying equipment mfg
120	3339233	1983:4 - 2005:2	5	Overhead crane hoist & monorail system mfg (overhead traveling cranes and monorail systems)
121	3339241	1983:4 - 2005:2	5	Industrial truck tractor trailer stacker machinery mfg (industrial trucks and tractors motorized and hand powered)
122	333992	1983:4 - 2005:2	5	Welding & soldering equipment mfg (welding & soldering equipment mfg)
123	333997	1983:4 - 2005:2	5	Scale & balance except laboratory mfg
124	334411	1983:4 - 2005:2	5	Electron tube mfg
125	334414	1983:4 - 2005:2	5	Electronic capacitor mfg
126	334415	1983:4 - 2005:2	5	Electronic resistor mfg
127	334417	1983:4 - 2005:2	5	Electronic connector mfg
128	3345153	1983:4 - 2005:2	5	Electricity measuring testing instrument mfg (test equipment for testing electrical radio & communication circuits & motors)
129	334517p	1983:4 - 2005:2	5	Irradiation apparatus manufacturing (primary products)
130	3351211	1983:4 - 2005:2	5	Residential electric lighting fixture mfg (residential electric lighting fixtures except portable & parts)

131	335122	1983:4 - 2005:2	5	Commercial electric lighting fixture mfg
132	335129	1983:4 - 2005:2	5	Other lighting equipment mfg
133	335212	1983:4 - 2005:2	5	Household vacuum cleaner mfg
134	335221	1983:4 - 2005:2	5	Household cooking appliance mfg
135	335311	1983:4 - 2005:2	5	Power distribution specialty transformer mfg
136	335312	1983:4 - 2005:2	5	Motor & generator mfg
137	335314p	1983:4 - 2005:2	5	Relay & industrial control mfg (primary products)
138	335911	1983:4 - 2005:2	5	Storage battery mfg
139	3359291	1983:4 - 2005:2	5	Other communication and energy wire mfg (power wire and cable made in plants that draw wire)
140	335932	1983:4 - 2005:2	5	Noncurrent carrying wiring device mfg
141	335991p	1983:4 - 2005:2	5	Carbon & graphite product mfg (primary products)
142	336321p	1983:4 - 2005:2	5	Vehicular lighting equipment mfg (primary products)
143	337121	1983:4 - 2005:2	5	Upholstered household furniture mfg
144	337122	1983:4 - 2005:2	5	Wood household furniture except upholstered
145	337124	1983:4 - 2005:2	5	Metal household furniture
146	337211	1983:4 - 2005:2	5	Wood office furniture mfg
147	3372141	1983:4 - 2005:2	5	Nonwood office furniture (office seating including upholstered nonwood)
148	3399111	1983:4 - 2005:2	5	Jewelry except costume mfg (jewelry made of solid platinum metals and solid karat gold)
149	3399123	1983:4 - 2005:2	5	Silverware & hollowware mfg (Flatware and carving sets made wholly of metal)
150	339931	1983:4 - 2005:2	5	Doll & stuffed toy mfg
151	339932	1983:4 - 2005:2	5	Game toy & children's vehicle mfg
152	339944	1983:4 - 2005:2	5	Carbon paper & inked ribbon mfg
153	3399931	1983:4 - 2005:2	5	Fastener button needle & pin mfg (Buttons and parts except for precious or semiprecious metals and stones)
154	3399945	1983:4 - 2005:2	5	Broom brush & mop mfg (other brushes)

4 – International Data

Format is as above: contains series number; series mnemonic; data span (in quarters); transformation code and series description as appears in the database. The transformation codes are: 1 – no transformation; 2 – first difference; 4 – logarithm; 5 – first difference of logarithm. Our international data set contains 50 quarterly series. The series were taken mainly from Data Insight's IMF (International Financial Statistics, IFS), OECD (Main Economic Indictators, MEI) databases. Some series were obtained from national statistics agencies (NatS), Global Insight (GI), and the European Central Bank (ECB).

America					
Brazil					
1	NatS	SCN4_PIBPMAS4	1983:4-2005:2	5	Real Gross Domestic Product, SA (average 1990 = 100)
2	IFS	L64A@C223.M	1983:4-2005:2	5	Consumer Price Index
3	IFS	L60B@C223.Q	1983:4-2005:2	1	Interest Rate, Money Market Rate
Canada					
4	GI	CANSIM 3800002	1983:4-2005:2	5	Real Gross Domestic Product (GDP), Chained $1997, SAAR
5	IFS	L64@C156.M	1983:4-2005:2	5	Consumer Price Index
6	IFS	L60C@C156.Q	1983:4-2005:2	1	Interest Rate, Treasury Bill Rate
7	IFS	L61@C156.Q	1983:4-2005:2	1	Interest Rate, Govt. Bond Yield, Long Term > 10 years
Mexico					
8	NatS		1983:4-2005:2	5	Real Gross Domestic Product, MIL. 1993 Mexican Pesos
9	IFS	L64@C273.M	1983:4-2005:2	5	Consumer Price Index
10	IFS	L60C@C273.Q	1983:4-2005:2	1	Interest Rate, Treasury Bill Rate
Europe					
France					
		ESA.Q.FR.Y.0000.B1QG0			
11	ECB	0.1000.TTTT.Q.N.A	1983:4-2005:2	5	Real Gross Domestic Product
12	IFS	L64@C132.M	1983:4-2005:2	5	Consumer Price Index
13	IFS	L60C@C132.Q	1983:4-2005:2	1	Interest Rate, Treasury Bill Rate, 3 months
14	IFS	L61@C132.Q	1983:4-2005:2	1	Interest Rate, Govt. Bond Yield, Long Term
Germany					
15	GI	L99BV&R@C134.Q	1983:4-2005:2	5	Real Gross Domestic Product, Index (2000=100)
16	IFS	L64D@C134.M	1983:4-2005:2	5	Consumer Price Index (combined with L64@C134.M)
17	IFS	L60C@C134.Q	1983:4-2005:2	1	Interest Rate, Treasury Bill Rate
18	IFS	L61@C134.Q	1983:4-2005:2	1	Interest Rate, Govt. Bond Yield, Long Term

Italy					
		ESA.Q.IT.Y.0000.B1QG0			
19	ECB	0.1000.TTTT.L.N.A	1983:4-2005:2	5	Real Gross Domestic Product, chain linked
20	IFS	L64@C136.M	1983:4-2005:2	5	Consumer Price Index
21	IFS	L60C@C136.Q	1983:4-2005:2	1	Interest Rate, Treasury Bill Rate
22	IFS	L61@C136.Q	1983:4-2005:2	1	Interest Rate, Govt. Bond Yield, Long Term
Netherland					
		ESA.Q.NL.Y.0000.B1QG0			
23	ECB	0.1000.TTTT.Q.N.A	1983:4-2005:2	5	Real Gross Domestic Product, constant prices
24	IFS	L64@C138.M	1983:4-2005:2	5	Consumer Price Index
25	IFS	L61@C138.Q	1983:4-2005:2	1	Interest Rate, Govt. Bond Yield
United Kingdom					
		ESA.Q.GB.Y.0000.B1QG			
26	ECB	00.1000.TTTT.Q.N.A	1983:4-2005:2	5	Real Gross Domestic Product, constant prices
27	IFS	L64@C112.M	1983:4-2005:2	5	Consumer Price Index
28	IFS	L60C@C112.Q	1983:4-2005:2	1	Interest Rate, Treasury Bill Rate
29	IFS	L61@C112.Q	1983:4-2005:2	1	Interest Rate, Govt. Bond Yield, Long Term
Asia					
China (see *)					
30	DRI	JGDPRZNS@CH.Q		*	Real Gross Domestic Product, constant prices
31	IFS	L60L@C924.Q	1983:4-2005:2	1	Interest Rate, Deposit Rate
Hong Kong					
32	IFS	L99B&P&W@C532.Q	1983:4-2005:2	5	Real Gross Domestic Product, 2000 prices
33	IFS	L64@C532.M	1983:4-2005:2	5	Consumer Price Index
34	DRI	RMIB3S@HK.M	1983:4-2005:2	1	Interest Rate, Interbank Offered Rate
Japan					
35	IFS	L99BV&R@C158.Q	1983:4-2005:2	5	Real Gross Domestic Product, 2000 prices
36	IFS	L64@C158.M	1983:4-2005:2	5	Consumer Price Index
37	MEI	JPN.IR3TCD01.ST	1983:4-2005:2	1	Interest Rate, 3-months rates on CDs
38	IFS	L61@C158.Q	1983:4-2005:2	1	Interest Rate, Govt. Bond Yield, Long Term
Korea					
39	GI	GDPR@KO.Q	1983:4-2005:2	5	Real Gross Domestic Product, 2000 prices
40	IFS	L64@C542.M	1983:4-2005:2	5	Consumer Price Index
41	IFS	L61@C542.Q	1983:4-2005:2	1	Interest Rate Yield on National Housing Bond
Malaysia					
42	IFS	L99BV&P@C548.Q	1983:4-2005:2	5	Real Gross Domestic Product, 2000 prices
43	IFS	L60C@C548.Q	1983:4-2005:2	1	Interest Rate, Treasury Bill Rate, 3 months
Singapore					
44	GI	GDPR@SI.Q	1983:4-2005:2	5	Real Gross Domestic Product, 2000 prices
45	IFS	L64@C576.M	1983:4-2005:2	5	Consumer Price Index
46	IFS	L60C@C576.Q	1983:4-2005:2	1	Interest Rate, Treasury Bill Rate
Taiwan					
47	NatS		1983:4-2005:2	5	Real Gross Domestic Product, 2001 prices
48	DRI	CPI@TA.M	1983:4-2005:2	5	Consumer Price Index
49	DRI	RMCP180S@TA.Q	1983:4-2005:2	1	Interest Rate, Commercial Papers, 3-6 months, sec. mkt.

* For China, real GDP numbers are based on GDP growth numbers from DRI database and estimates of the level of GDP from Abeysinghe and Gulasekaran (2004). Consumer Price Index: no series starting in 1984 found.