Tracking Greenspan: systematic and unsystematic monetary policy

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January 21, 2002

Abstract

This paper

JEL subject classification : ....
Key words and phrases : Monetary policy, Taylor rules, monetary shocks, signal extraction, dynamic factor models.

1 Introduction

There are two ways in which the literature has modeled the transmission of monetary policy. A large set of studies has analysed the effect of unanticipated monetary policy shocks estimated and identified from small VAR models. Those studies implicitely assume that the agents' information set contains the present and past observations of the variables considered in the VAR and that policy affect the economy by surprising consumers and business. Recently, the focus on policy shocks rather than to the systematic part of monetary policy has been questioned (eg Mc Callum, 1999). The criticism is based on the fact that the percentage of output variance due to monetary policy shocks in VARs is typically very low and that the bulk of variation in the federal fund rate is explained by observable macroeconomic variables rather than exogenous policy action. A smaller set of studies, on the other hand, has focus on the estimation of structural policy equations (this literature is based on Taylor, 1993) and analysed monetary policy as systematic response to variation in observable variables, typically ouput and inflation (Clarida, Gali and Gertler, 1998). Christiano, Eichenbaum and Evans, 1999, suggest that the policy shock view and the systematic view can in principle be analysed within the same VAR framework. These authors interpret the unexpected component of policy, the shocks, as errors, by policy makers, in measuring the state of the economy. The latters are identified shocks estimated from a VAR while the systematic part of the policy function is reflected in the coefficients of the federal fund rate equation, i.e. in the impulse response functions of the federal fund to shocks other than money in the same VAR model.

Our paper broadly takes the same view on shocks and systematic policy, but proposes a new framework for empirical analysis which is more coherent with that view than VAR analysis. Our framework differs from the VAR model in three crucial aspects. First, we will explicitely model monetary shocks as those shocks arising from the Fed missperception of the current value of target variables. Second, we will take into account that monetary authorities use all information available (many time series, possibly in the order of the hundreds) to extract information on current economic activity (on this point, see Bernanke and Boivin, 2001 and Evans, 2001). Third, we will identify the number (as well as the origin) of macroeconomic shocks with respect to which monetary policy react systematically. In our model, although monetary authorities use a large set of variables to assess current economic activity, they condition their behavior on a small number of key shocks driving the observable target variables. Within the same framework we can identify the money shock interpreted as error and its effect throughout the economy as well as identifying the other relevant shocks and the monetary policy reaction to them. The degree of optimality of policy will be judged conditionally to the shocks driving the economy generalizing Gali, Lopez-Salido and Valles (2000). This will allow us to track Greenspan from 1983 to today and reassess the consensus view on historical performance of the Fed.

To identify the number of key macroeconomic shocks as well as their economic origin, we will follow Forni, Lippi and Reichlin (2001). In our model, each variable is driven by those few macroeconomic shocks, common to the whole economy and idiosyncratic dynamics which could be interpreted as measurement error (see Forni et al. 2000). To extract information on the common shocks we will use an estimation method based on Forni et al. (2001) and Stock and Watson (1999). The method provides a parsimonious way to take into account the large information set assumption when estimating shocks and propagation mechanisms. The goal will then be the identification of few shocks from many variables by imposing a minimal set of economically motivated restrictions. Since the shocks to be identified are less numerous than the variables we are conditioning on, with a set of minimal restrictions we easily obtain overidentification which we can then test (testing procedure in this context have been developed by Giannone, 2001).

A byproduct of our analysis, is that we can use statistical criteria to identify the number of the aggregate shocks which are relevant for macroeconomic analysis and therefore define a criterion for chosing the relevant "size" of the model. In the monetary literature results based on VAR are not robust with respect to the size of the model (on this point, see for example, Faust (1998). In our approach, we start from a model wich can contain all variables potentially informative, but statistical criteria will guide us on the identification of the stochastic size of the model therefore eliminating a dimension of arbitrariness typically present in structural VARs.

The paper is organized as follows ....

2 Some stylized facts

2.1 Fact 1: Comovements

Let us look at some descriptive features of a panel of quarterly time series for the US economy. To be precise, we will analyze 453 time series. Let us call the $n \times 1$ vector of these variables suitably transformed to obtain stationarity, y_t (see appendix 1 for details)

Although our data set contains variables of different nature: real, nominal, financial and sectoral as well as aggregate data, one fact that emerges from the analysis of the covariance structure is that there is strong collinearity indicating that, indeed, macro time series comove, particularly at business cycle frequencies.

One way to estimate the degree of collinearity between elements of a panel of time series is to look at the eigenvalues of the covariance matrix and see how many we need to capture the bulk of the variance. Table 1 below shows results for our panel. In the first column we have the variance captured by the first $j = 1, ..., n$ eigenvalues (cumulated) in percentage of the total variance. In column 2 and 3 we have, respectively, the same ratio for frequencies higher than $\theta = \frac{\pi}{2}$, corresponding to cycles longer than 1 years, and $\theta = \frac{\pi}{4}$, corresponding to cycles longer than 2 years. We can see that, overall, the first three eigenvalues capture 67% of total variance on average and 75% at business cycle frequencies.

Table 1. Variance explained by the first 10 DPCs

no. of DPC	all freq.	> 1 year	> 2 years
1	0.3390	0.33752	0.3949
2	0.5437	0.5901	0.6258
3	0.6660	0.7075	0.7438
4	0.7566	0.7929	0.8262
5	0.8244	0.8558	0.8865
6	0.8699	0.8950	0.9218
7	0.9018	0.9225	0.9449
8	0.9245	0.9420	0.9610
9	0.9405	0.9562	0.9724
10	0.9518	0.9658	0.9795

Let us define the first 3 dynamic principal components as

$$z_{ht} = p_h(L)y_t, \qquad h = 1, \ldots, 3,$$

where L is the lag operator and $p_h(L)$ is a $(1 \times n)$ row vector of two-sided linear filters[1].

In order to understand how strongly key variables of interest are correlated with the rest of the panel, let us project the latters on the span of the first three principal components. We have:

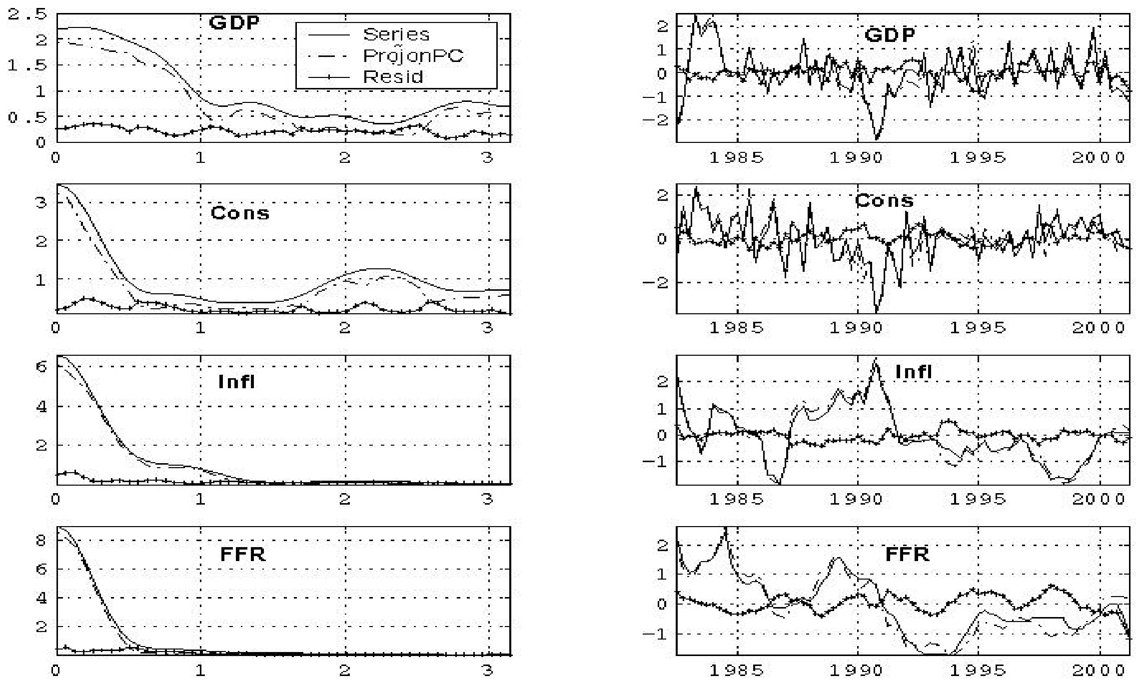
[1] z_{ht} and z_{kt} are mutually orthogonal at any lead and lag for $h \neq k$ and the filters are normalized in such as to guarantee orthogonality $h \neq k$ and unitary variance. For more details, see Brillinger (1981) and Appendix 2.

$$y_{it} = \gamma_{it} + \zeta_{it}$$

where $\gamma_{it} = c_i(L)z_t$ with $z_t = (z_{1t} \ \cdots \ z_{3t})'$ and ζ_{it} is the residual vector.

Figure 1 below shows γ_{it} and ζit plotted over time and their spectral densities over the frequency domain for four variables of interest: the growth rate of GDP and consumption, inflation and the federal funds rate.

Figure 1



Three features are worth noticing. First, the projection component (the γ's) capture the bulk of the variance in all cases. This suggests that three linear combinations of our large panel capture most of the variance of the variables of interest. Second, the residuals have flat spectral shape, indicating that they can be modeled as white noise components, while all interesting dynamics is captured by the projection. This suggests that the residual can be considered as measurement error of not much economic interest. Third, in the case of the federal fund rate, the residual is almost nil (5% of the variance at all frequencies). We will see the implication of this 'fact' later.

2.2 Facts 2: Current economic conditions are known with error

There are two major sources of uncertainty about the current state of real economic activity. First, GDP data and, to a less extent, industrial production and price data, are released with delay. Second, real variables are subject to statistical revisions. The length of publication delay and the size of revision errors vary by country (see Faust et al, 2001 for an interesting cross-country comparison), but they are generally recognized to be substantial. This fact is often misregarded in the literature where it is current practice to fit policy functions assuming that the values of the time series published at time $T+h$ are the same as those known at T. Recently, starting with the work of Orphanides (cite), standard results has been reconsidered using data prior to revisions, i.e. data available at the time of policy decisions. A different literature has dealt with the delay in data publications by suggesting techniques to exploit information on data published with no delay to estimate recent data points in GDP (Altissimo et al., 2001). The two problems, delay and revision errors, are mostly treated separately, but they can be analyzed jointly, just considering that GDP or other variables of interest, are not population quantities, but statistical models. The goal of the econometrician and the policy maker is that of extracting a signal from noisy data (this way of looking at the problem is, for example, suggested by Evans, 2001). The signal, if successfully measured, will show higher correlation with revised data than the raw variable.

Obviously, measurement error is larger in real quantities and price data than financial data. In particular, the federal fund rate has basically zero measurement error. Moreover, certain variables such as asset prices, survey based indicators on business and consumer expectations area available with minimal delay and are often used formally or informally to assess current economic conditions. Although it is not clear what information policy makers exactly use, it is reasonable to conjecture that their judgement on the state of the economy is based on information coming from a large variety of sources and variable definitions. Below we will model this assumption explicitely.

3 Modeling strategy

Our modeling strategy is based on the stylized facts documented above and rests on two pillars.

3.1 Pillar 1: The large information set conjecture

Recent literature (Bernanke and Boivin, 2001, Evans, 2001, Favero and Marcellino, 2001) has suggested that monetary policy makers, when setting the level of the instrument, do not just look at few key variables, but instead exploit knowledge coming from rich data sets containing sectoral as well as aggregate variables, asset prices and key variables used to detect demand and supply conditions.

3.2 Pillar 2: Signal extraction

We assume that variables in the panel are measured with error and that they can be decomposed into the sum of two orthogonal components, the signal y^*_{it} and the measurement error e_{it}:

$$y_{it} = y^*_{it} + e_{it}. \tag{3.1}$$

The vector y_t is composed of the vector of target variables τ_t, the monetary policy instrument, r_t and other macroeconomic variables z_t conveying information on the state of the economy

$$y_t = \begin{pmatrix} z_t & \tau_t & r_t \end{pmatrix}'$$

The problem for monetary policy makers is to extract the signal τ_t^* from τ_t, and set r_t according to some policy rule.

Given the large information set conjecture, we assume that the signal from τ_t is extracted using all information potentially available, i.e. by projecting τ_t onto the span of y_t and its past. We have:

$$\tau_t^* = \text{Proj}[\tau_t \mid \overline{\text{span}}(y_{t-k}, k \geq 0)] \tag{3.2}$$

Obviously, if the number of elements of y_t is large (in our case $n = 453$), this projection is unfeasible since there are too many parameters to estimate. However, the collinearity of the panel can be exploited to extract relevant information from the large cross-section within a parsimonious framework.

Under suitable conditions on the variance-covariance of the y's which, roughly speaking, are satisfied when there is high collinearity (see Forni, Hallin, Lippi and Reichlin, 2000 for precise conditions), we can assume that y_t follows a dynamic factor model:

$$y_{it} = \chi_{it} + \xi_{it} \tag{3.3}$$

where

$$\chi_{it} = b_i(L)u_t = \sum_{h=1}^{q} b_{ih}(L)u_{ht}$$

is the common component, $u_t = (u_{1t}, \dots, u_{qt})'$ is the q-dimensional vector of the common shocks, which are unit variance white noises mutually orthogonal at all leads and lags, $b_i(L) = b_{i1}(L), \dots, b_{iq}(L)$ is a row vector of polynomials in the lag operator of possibly infinite order and the idiosyncratic component ξ_{it} is orthogonal to u_{t-k} for any k and i.

The common component, which is identified under the conditions given in Forni et al. (2000), captures that part of the series which is correlated with the rest of the panel while the idiosyncratic component contains measurement error and locally cross-correlated components.

Abstracting for the moment from estimation issues, we assume that by extracting the common component from each time series, we clean it from measurement error. We have:

$$y_{it}^* = \chi_{it}$$

Under these assumptions, τ_t^* can be recovered by projecting on the span of the common components of y_t rather than y_t itself. Since the latter is of reduced rank q, this projection is feasible. Under our assumptions, τ^* is equal to its common component $\chi_{\tau t}$. We have:

$$\tau_t^* = \chi_{\tau t} = \text{Proj}[\tau_t \mid \overline{\text{span}}(\chi_{t-k}, k \geq 0)] \tag{3.4}$$

3.3 Pillar 3: Policy function

The policy function is an equation linking the policy instrument r_t, which we assume to be the federal funds rate, and a vector of target variables τ_t^* which, for the moment, we assume to be inflation and output. Given the argument above, τ_t^* is not known and has to be estimated. The estimate is obtained from (**??**) as $\chi_{\tau t}$. The policy function can then be written in three alternative forms:

$$r_t = \phi(L)\tau_t^* + \eta_t = \phi(L)\chi_{\tau t} + \eta_t = \phi(L)b_\tau(L)u_t + \eta_t \tag{3.5}$$

In the first two forms the federal fund rate is expressed as a function of the signal extracted from observable target variables while in the third we obtain it as a function of unobservable exogenous macroeconomic shocks. The number of these shocks is not necessarily the same as the number of target variables and it can be inferred from the behavior of the eigenvalues of the covariances of the y's (see, Forni et al., 2000 on this point). Moreover, they have to be structurally identified as technology, demand or other factors. Notice that the unanticipated part of monetary policy, the money shock, should also be identified as one of the common shocks since it is reasonable to believe that the latter has a widespread effect on the whole economy. This implies that r_t must have virtually no idiosyncratic component. If the monetary policy is conducted by targeting key variables systematically, the money shock can only arise from errors (see Christiano and Eichenbaum and Evans, 1998, for a discussion of this point). In our framework, we should expect to find that one of the common shocks, money, arises from errors in estimating τ^*.

To estimate the monetary transmission mechanism we have two goals: (i) estimate $\chi_{\tau t}$ and the coefficients of the filter $\phi(L)$ which will provide information on the systematic reaction of the Fed to changes in target variables; (ii) identify the coefficients b_τ's and the common shocks which will give us information of the systematic response of the Fed to demand and technology shocks; (iii) identify the money shock and evaluate the impulse responses of output, inflation and other key variables.

Two remarks in order.

First, $\chi_{\tau t}$ has to be estimated. A consistent estimate can be obtained by projecting y_{it} on the appropriate number of static principal components as in Stock and Watson, 1999 or as the projection on the appropriate number of dynamic principal components as in Forni, Hallin, Lippi and Reichlin, 2000. If $q = 3$ the estimated common component (the signal) of the target variables GDP and inflation is exactly what we have illustrated in Figure 1 in Section 2. Notice that the measurement error captured by the residual idiosyncratic component exhibits a flat spectrum while the business cycle dynamics is entirely captured by the estimated common component. This should persuade the reader that by extracting the common component we are indeed extracting the signal. Moreover, the estimated common component of the federal fund rate captures almost 100% of the variance at all frequencies, indicating that, as conjectured above, the federal funds rate has almost no idiosyncratic.

Second, the task of the structural identification of the u's requires to impose identification restrictions as it is usually done in the VAR literature. We turn to this point in the next Section.

4 Shocks

Having identified the number of common shocks equal to three, we now have to identify them. Identification requires two steps. First, we need to obtain a representation of the u's on the past of the χ's. This allows us to recover the common shocks from a reduced rank regression on the common components. Second, we need to impose restrictions to reach identification. Notice that in the factor model framework, we need to identify q shocks from n observable time series unlike in VAR's where the number of shocks is the same as the number of series. The consequence, as it has been pointed out by Forni, Lippi and Reichlin (2001), is that we can easily obtained over-identifying restrictions which can then be tested using the framework developed by Giannone (2001).

Let us discuss the first point first. We will assume a restricted version of (**??**) which is in line with Stock and Watson (1999) and Forni et al. (2001):

$$y_{it} = c_i(L)f_t + \xi_{it} \tag{4.6}$$

and

$$a(L)f_t = Bu_t \tag{4.7}$$

We assume that $c_i(L)$ is of finite order s and that the $q \times 1$ vector of the factors has an autoregressive structure of order p.

Under the assumptions above, the model can be written in its stacked form:

$$y_{it} = C_i F_t + \xi_{it} \tag{4.8}$$

where y_{it} is of dimension $n \times 1$, C_i of dimension $n \times r = q(s+1)$ and F_t :

$$F_t = [f_t' \ \ f_{t-1}' \ \ \cdots f_{t-s}']'$$

of dimension $r = q(s+1) \times 1$.

Written in this form, the F_t can be estimated consistently using the first r static principal components of the y_it's (Stock and Watson, 1999):

$$\hat{F}_t = V'Y_t \tag{4.9}$$

where V is the $(n \times r) \times r$ matrix of the eigenvectors of the Y's and:

$$Y_t = [y_{1t}' \ \ y_{2t}' \ \ \cdots y_{nt}']'.$$

Having obtained the F's, the q common shocks can be derived from a VAR on the F's. Identification can be obtained by fixing a static rotation of these shocks.

Let us explore this point further. If the length of the filter $a(L)$ is $p \leq s+1$, we can write F_t in VAR(1) form:

We have:

$$\hat{F}_t = A\hat{F}_{t-1} + Du_t$$

where

$$A = \begin{pmatrix} a_1 & a_2 & \cdots & a_p & \cdots & & 0 \\ 0 & I & \cdots & 0 & \cdots & & 0 \\ & & \ddots & & & & \\ & & & & \ddots & & \\ 0 & 0 & \cdots & 0 & \cdots & I & 0 \end{pmatrix}$$

and

$$D = \begin{pmatrix} B \\ 0 \\ \vdots \\ 0 \end{pmatrix}$$

Once the VAR form for $\hat{F}_t$ is obtained, we can obtain the residual $v_t = Du_t$. Notice that the dimension of F_t, r and the dimension of u_t, q, are unknown. Once r is specified, however, q can be identified from the rank of the variance-covariance matrix of v_t, $\Sigma = DD'$. The latter can be expressed in terms of the matrix P of its eigenvectors and the matrix M of its eigenvalues as $\Sigma = PMP'$. The q-vector of common shocks can be estimated as the q non-zero static principal components of the e residuals, i.e. as:

$$\omega_t = P'e_t.$$

The latter obviously spans the same space spanned by the u_t.

We are now ready for the second step. Identification of the u's consists in identifying an orthonormal matrix R which rotates ω_t. Since the rotation matrix is of dimension $q \times q$ and the u's are orthonormal, just-identification is obtained with q restrictions.

The impulse response functions of Y, at horizon h, associated with the common shocks ω's are given by:

$$V'A^h\omega_t = V'B^h u_t$$

where $u_t = R'\omega_t$, $B^h = A^h R$ and R is orthonormal matrix and can be parameterized as:

$$R = \begin{pmatrix} \cos(a) & \sin(a) & 0 \\ -\sin(a) & \cos(a) & 0 \\ 0 & 0 & 1 \end{pmatrix} \begin{pmatrix} \cos(b) & 0 & \sin(b) \\ 0 & 1 & 0 \\ -\sin(b) & 0 & \cos(b) \end{pmatrix} \begin{pmatrix} 1 & 0 & 0 \\ 0 & \cos(c) & \sin(c) \\ 0 & -\sin(c) & \cos(c) \end{pmatrix}$$

with $(a, b, c) \in [0, 2\pi]$.

Structural identification consists in the selection of a particular matrix R. Given the orthonormality of the u's this implies that we have to choose three parameters in order to reach just-identification. Appendix 4 details the procedure.

Our identification is based on the long-run multipliers $\Phi(1) = \sum_{h=0}^{+\infty} V'B^h$. A broad class of theoretical models suggests that the identified shocks should satisfy the following restrictions:

i) demand and monetary shocks do not have permanent effects on productivity and real wages;

ii) technology shocks do not permanently affect labor supply;

iii) monetary shocks do not have permanent effects on real variables such as consumption, investment, output, labor supply;

iv) monetary shocks do not have permanent effects on relative prices.

Denote by z_t a vector process consisting of labor productivity, real wage, hours per capita, GDP, consumption, investment, aggregate price and service's price. The restrictions i)-iv) imply that the long run multipliers of Δz, $\Phi_{\Delta z}(1)$ should be constrained as follows, where the first column is relative to technology shocks, the second to demand shocks and the third to monetary shocks:

$$\Phi_{\Delta z}(1) = \begin{pmatrix} 0 & k_{1,1} & 0 \\ 0 & k_{2,1} & 0 \\ k_{3,2} & 0 & 0 \\ k_{4,1} & k_{4,2} & 0 \\ k_{4,1} & k_{5,2} & 0 \\ k_{6,1} & k_{6,2} & 0 \\ k_{7,1} & k_{7,2} & \alpha \\ k_{8,1} & k_{8,2} & \alpha \end{pmatrix} \tag{4.10}$$

or equivalently $G\text{vec}(\Phi_{\Delta z}(1)) = 0$, for an opportune G. Restrictions i), ii) and iii) are standard in the literature, (see Francis and Ramey, 2001 for a review). The number of constraints imposed is much larger than the number of restrictions needed for exact identification. As a consequence, we have overidentifying restrictions that can be empirically verified.

The test for overidentifying restrictions is similar to the Hansen J-statistics (see appendix 5 for details) and is distributed as a chi-squared with degrees of fredom equal to the number of overidentifying restrictions. Applied to our database, we obtain a test statistics with a p-value of 0.57. Hence, there is no evidence against the restrictions[2].

[2] Notice that in order to be sure that our restrictions are sufficient to disentangle between the aggregate demand and monetary shocks we need to check that the additional restriction that demand shocks are neutral in the long run on real variables and relative prices is rejected. We perform it and the restrictions are indeed rejected.

Figure 2

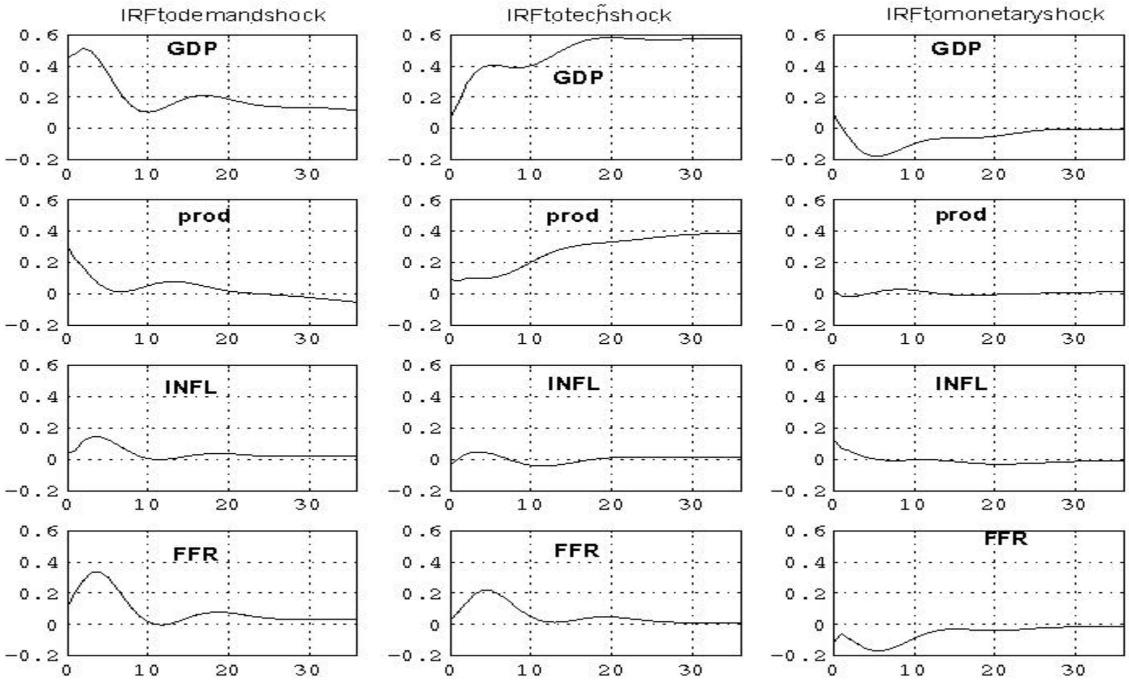
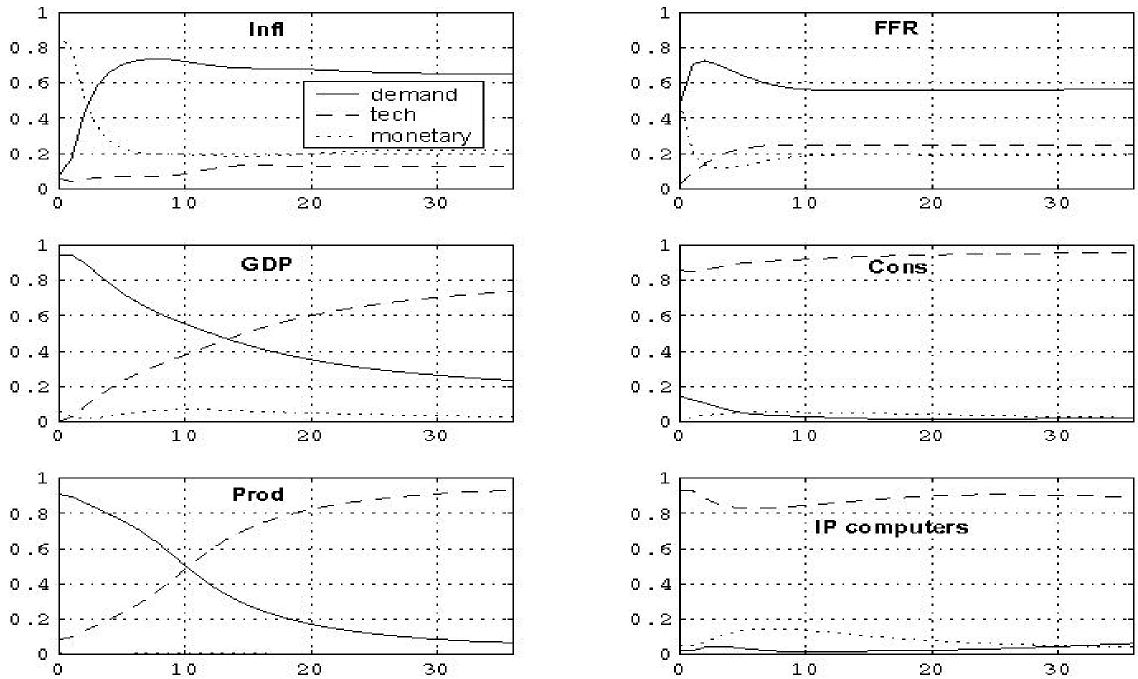


Figure 2 above illustrates the impulse response functions of GDP labor productivity, inflation and the federal fund rate associated with $R = I_q$. It is worth recalling that with this choice of R the three shocks are automatically ordered in decreasing magnitude with respect to the explained variance in the panel.

Such a rotation seems to be in line with the long-run restrictions in (4.10) and the response satisfy the sign restrictions usually required. In particular, the first shock, demand, is long-run neutral on productivity and the effect on output and nominal variables has the same sign. The second, techhnology, is not neutral on productivity and has zero effect on inflation. The third shock, unlike the first is not only neutral but also solves the price puzzle.

Further insight can be obtained by looking at the graphs of the variance decomposition for some key variables (Figure 3).

Figure 3



The technology shock explains almost all the variance of consumption and production of technological sector at all horizons.It also has no effect on inflation as found by Gali, Lopez-Salido and Valles, 2000. Finally, while the first shock explains mainly the short run variance of GDP, technology becomes the main driving force in the long run. Finally, the third shock has a negligible effect on output (as showed in Faust, 1998, the larger the dimension of the model, the smaller the percentage of the variance of GDP explained by the monetary shock) and has a sizeable, but temporary effect on nominal variables only.

5 Monetary policy empirics

5.1 Systematic monetary policy reaction to inflation and output

To be completed

5.2 Systematic monetary policy reaction to demand and technology

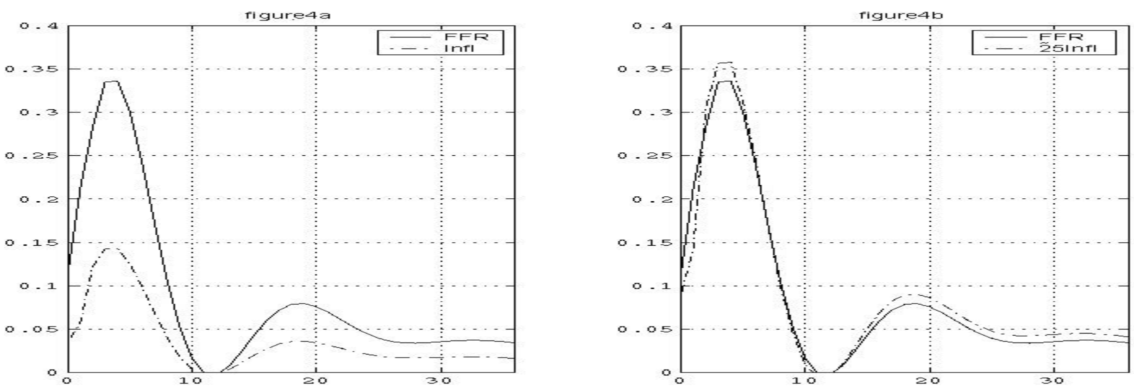
An optimal monetary policy, designed to fully stabilize prices, should call for a differentiated response of the policy instrument conditional to the origin of the shock. The policy rule in this case will be richer than the classical Taylor rule as the systematic response to, say, inflation, will be splitted in the response to the component of inflation generated by a technological shock, the component of inflation generated by a demand shock, and so on.

Our framework allow us to investigate this point in detail.

Let us start with the response to a demand shock. Figure 4a shows the endogenous response of the FFR and of inflation to a demand shock. In figure 4b the response of inflation is multiplied by 2.5. The similarity between the rescaled version of the inflation's response and that of FFR is striking. These results are fully compatible with a "conditional" Taylor rule, linking the FFR to the component of inflation generated by a demand shock.

Moving to the technological shock, the response of inflation appears to be zero, both looking at IRFs and variance decomposition. This fact is fully compatible with the implementation by the Fed of an optimal policy rule. This result is in line with the results in Gali-Lopez-Salido and Valles (2000).

Figure 4



5.3 Unanticipated monetary policy

To be added

6 Conclusions

To be added

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Appendix 1: Data and data treatment

Appendix 2: Dynamic eigenvalues

We start by estimating the spectral-density matrix of $\mathbf{x}_t = \begin{pmatrix} x_{1t} & \cdots & x_{nt} \end{pmatrix}'$. Let us denote the theoretical matrix by $\mathbf{\Sigma}(\theta)$ and its estimate by $\hat{\mathbf{\Sigma}}(\theta)$. The estimation is accomplished by using a Bartlett lag-window of size $M = 18$, i.e. by computing the sample auto-covariance matrices $\hat{\mathbf{\Gamma}}_k$, multiplying them by the weights $w_k = 1 - \frac{|k|}{M+1}$ and applying the discrete Fourier transform:

$$\hat{\mathbf{\Sigma}}_x(\theta) = \frac{1}{2\pi} \sum_{k=-M}^{M} w_k \cdot \hat{\Gamma}_k \cdot e^{-i\theta k}.$$

The spectra were evaluated at 101 equally spaced frequencies in the interval $[-\pi, \pi]$, i.e. at the frequencies $\theta_h = \frac{2\pi h}{100}$, $h = -50, \ldots, 50$.
Then we performed the dynamic principal component decomposition (see Brillinger, 1981). For each frequency of the grid, we computed the eigenvalues and eigenvectors of $\hat{\mathbf{\Sigma}}(\theta)$. By ordering the eigenvalues in descending order for each frequency and collecting values cosrresponding to different frequencies, the eigenvalue and eigenvector functions $\lambda_j(\theta)$ and $U_j(\theta)$, $j = 1, \ldots, n$, are obtained. The function $\lambda_j(\theta)$ can be interpreted as the (sample) spectral density of the j-th principal component series and, in analogy with the standard static principal component analysis, the ratio

$$p_j = \int_{-\pi}^{\pi} \lambda_j(\theta) d\theta / \sum_{j=1}^{n} \int_{-\pi}^{\pi} \lambda_j(\theta) d\theta$$

represents the contribution of the j-th principal component series to the total variance in the system.

Appendix 3: Estimation

We estimate the static factors f_t as linear combinations of (the present of) the observable variables y_{it}, $i = 1, \dots, n$. We need only a set of $r = q(s+1)$ variables forming a basis for the linear space spanned by the u_{ht}'s and their lags. We can then obtain $\hat{\chi}_{jt}$ by projecting χ_{jt} on such factors. Two strategies have been used in the literature, Sock and Watson, 1999 and Forni et al., 2001. Forni et al., 2000 propose a method based on frequency domain which is what we used in Section 2.

Otherwise we have followed Stock and watson and estimated F_t as the first r static principal components of the y's as explained in the text.

Stock and Watson (1998) show that $\hat{F}_t \to F_t$. It is easily shown that the static projection

$$\hat{\chi}_t = \Lambda \hat{F}_t$$

converges to χ_t and that ωu_t converges to u_t (SHOW).

Appendix 4: Choice of r

Choice of r ...

Appendix 5: Testing

Consider a vector process Δz_t consisting a set of difference stationary series in x_t and write $\Phi_{\Delta z}(1)$ for the relative long run multiplier. We consider the following hipothesis testing problem:

$$H_0 : G\mathrm{vec}(\Phi_{\Delta \mathrm{z}}(1)) = 0 \tag{6.11}$$

Denote by $\hat{\Phi}(1) = \hat{U}_q(\hat{\Lambda}_q)^{1/2}$, where $\hat{\Lambda}_q = \mathrm{diag}(\hat{\lambda}_1(1), \dots \hat{\lambda}_{\mathrm{q}}(1))$ and $\hat{V}_q = (\hat{U}_1, \dots, \hat{U}_1)$. It can be shown that there exist a unitary $(q \times q)$ matrix, Q, such that

$$\sqrt{(B_T T)}[\mathrm{vec}(\hat{\Phi}(1)\mathrm{Q} - \Phi(1))] \xrightarrow{\mathrm{d}} \mathrm{N}(0, \boldsymbol{\Theta}(\mathrm{Q}))$$

as both the cross-sectional and the time dimensions tend to infinity at appropriate rate.

Write $\hat{\Phi}_z(1)$ the matrix formed by taking the rows of $\hat{\Phi}(1)$ relative to the variable in $\boldsymbol{z}$. Then it can be shown that if(**??**) holds then:

$$\hat{J} = B_T T \min_{Q|QQ'=I_q} \{G\mathrm{vec}(\hat{\Phi}_{\mathrm{z}}(1)\mathrm{Q}))'(\boldsymbol{\Theta}(\mathrm{Q}))^{-1}(\mathrm{Gvec}(\hat{\Phi}_{\mathrm{z}}(1)\mathrm{Q})\} \xrightarrow{\mathrm{d}} \chi^2_{(\mathrm{v})} \tag{6.12}$$

where v is equal to the number of overidentifying restriction.

Appendix 6: data description

0: no transf. - 1: logarithm - 2: diff(log) - 3: fourth diff(log)

	Mnemonic:	Description:	transformation
1	C$.US	NIPA: Personal consumption expenditures, (Bil. Chained$, SAAR)	2
2	CD$.US	NIPA: Durable goods, (Bil. Chained$, SAAR)	2
3	CDMVP$.US	NIPA: Motor vehicles and parts, (Bil. Chained$, SAAR)	2
4	CDFHE$.US	NIPA: Furniture and household equipment, (Bil. Chained$, SAAR)	2
5	CDOTH$.US	NIPA: Other, (Bil. Chained$, SAAR)	2
6	CN$.US	NIPA: Nondurable goods, (Bil. Chained$, SAAR)	2
7	CNFAB$.US	NIPA: Food, (Bil. Chained$, SAAR)	2
8	CNCAS$.US	NIPA: Clothing and shoes, (Bil. Chained$, SAAR)	2
9	CNGAS$.US	NIPA: Gasoline and oil, (Bil. Chained$, SAAR)	2
10	CNFOC$.US	NIPA: Fuel oil and coal, (Bil. Chained$, SAAR)	2
11	CNOTH$.US	NIPA: Other, (Bil. Chained$, SAAR)	2
12	CSHOU$.US	NIPA: Housing, (Bil. Chained$, SAAR)	2
13	CSHHO$.US	NIPA: Household operation, (Bil. Chained$, SAAR)	2
14	CSUTI$.US	NIPA: Electricity and gas, (Bil. Chained$, SAAR)	2
15	CSHHOOTH$.US	NIPA: Other household operation, (Bil. Chained$, SAAR)	2
16	CSTAR$.US	NIPA: Transportation, (Bil. Chained$, SAAR)	2
17	CSMED$.US	NIPA: Medical care, (Bil. Chained$, SAAR)	2
18	CSOTH$.US	NIPA: Other, (Bil. Chained$, SAAR)	2
19	GDP$.US	NIPA: Gross domestic product, (Bil. Chained$, SAAR)	2
20	C$.US	NIPA: Personal consumption expenditures, (Bil. Chained$, SAAR)	2
21	I$.US	NIPA: Gross private domestic investment, (Bil. Chained$, SAAR)	2
22	EX$.US	NIPA: Less: Exports of goods and services, (Bil. Chained$, SAAR)	2
23	IM$.US	NIPA: Plus: Imports of goods and services, (Bil. Chained$, SAAR)	2
24	G$.US	NIPA: Government consumption expenditures and gross investment, (Bil. Chained$, SAAR)	2
25	IFNS$.US	NIPA: Structures, (Bil. Chained$, SAAR)	2
26	IFNSFR$.US	NIPA: Nonresidential buildings including farm, (Bil. Chained$, SAAR)	2
27	IFNSUT$.US	NIPA: Utilities, (Bil. Chained$, SAAR)	2
28	IFNSMI$.US	NIPA: Mining exploration shafts and wells, (Bil. Chained$, SAAR)	2
29	IFNSOT$.US	NIPA: Other structures, (Bil. Chained$, SAAR)	2
30	IFNES$.US	NIPA: Equipment and software, (Bil. Chained$, SAAR)	2
31	IFNESIP$.US	NIPA: Information processing equipment and software, (Bil. Chained$, SAAR)	2
32	IFNESIPC$.US	NIPA: Computers and peripheral equipment, (Bil. Chained$, SAAR)	2
33	IFNESIPS$.US	NIPA: Software, (Bil. Chained$, SAAR)	2
34	IFNESI$.US	NIPA: Industrial equipment, (Bil. Chained$, SAAR)	2
35	IFNESTR$.US	NIPA: Transportation equipment, (Bil. Chained$, SAAR)	2
36	IFRS$.US	NIPA: Structures, (Bil. Chained$, SAAR)	2
37	IFRS1$.US	NIPA: Single family, (Bil. Chained$, SAAR)	2
38	IFRSMF$.US	NIPA: Multifamily, (Bil. Chained$, SAAR)	2
39	IFRSOT$.US	NIPA: Other structures, (Bil. Chained$, SAAR)	2
40	IFRE$.US	NIPA: Equipment, (Bil. Chained$, SAAR)	2
41	YNX.US	NIPA: National income without capital consumption adjustment, (Bil. $, SAAR)	2
42	YNXD.US	NIPA: Domestic industries, (Bil. $, SAAR)	2
43	YNXP.US	NIPA: Private industries, (Bil. $, SAAR)	2
44	YNXPAG.US	NIPA: Agriculture forestry and fishing, (Bil. $, SAAR)	2
45	YNXPMI.US	NIPA: Mining, (Bil. $, SAAR)	2
46	YNXPCN.US	NIPA: Construction, (Bil. $, SAAR)	2
47	YNXPMF.US	NIPA: Manufacturing, (Bil. $, SAAR)	2
48	YNXPMFD.US	NIPA: Durable goods, (Bil. $, SAAR)	2
49	YNXPMFN.US	NIPA: Nondurable goods, (Bil. $, SAAR)	2
50	YNXPTU.US	NIPA: Transportation and public utilities, (Bil. $, SAAR)	2
51	YNXPTR.US	NIPA: Transportation, (Bil. $, SAAR)	2
52	YNXP48.US	NIPA: Communications, (Bil. $, SAAR)	2
53	YNXP49.US	NIPA: Electric gas and sanitary services, (Bil. $, SAAR)	2
54	YNXWT.US	NIPA: Wholesale trade, (Bil. $, SAAR)	2
55	YNXRT.US	NIPA: Retail trade, (Bil. $, SAAR)	2
56	YNXFI.US	NIPA: Finance insurance and real estate, (Bil. $, SAAR)	2
57	YNXSV.US	NIPA: Services, (Bil. $, SAAR)	2
58	YNXGV.US	NIPA: Government, (Bil. $, SAAR)	2
59	II$.US	NIPA: Change in private inventories, (Bil. Chained$, SAAR)	2
60	IIFR$.US	NIPA: Farm, (Bil. Chained$, SAAR)	2
61	IINFWTNND$.US	NIPA: Durable goods, (Bil. Chained$, SAAR)	2
62	IINFWTNNN$.US	NIPA: Nondurable goods, (Bil. Chained$, SAAR)	2
63	IINFRTD$.US	NIPA: Durable goods, (Bil. Chained$, SAAR)	2
64	IINFRTDO$.US	NIPA: Other, (Bil. Chained$, SAAR)	2
65	IINFRTN$.US	NIPA: Nondurable goods, (Bil. Chained$, SAAR)	2
66	IINFOTD$.US	NIPA: Durable goods, (Bil. Chained$, SAAR)	2
67	IINFOTN$.US	NIPA: Nondurable goods, (Bil. Chained$, SAAR)	2
68	SV.US	NIPA: Gross saving, (Bil. $, SAAR)	2
69	SVP.US	NIPA: Gross private saving, (Bil. $, SAAR)	2

70	YPSV.US	NIPA: Personal saving, (Bil. $, SAAR)	2
71	SVPU.US	NIPA: Undistributed corporate profits with inventory valuation and capital consumption adjus	2
72	SVPUC.US	NIPA: Undistributed profits, (Bil. $, SAAR)	2
73	SVPCC.US	NIPA: Corporate consumption of fixed capital, (Bil. $, SAAR)	2
74	SVPNC.US	NIPA: Noncorporate consumption of fixed capital, (Bil. $, SAAR)	2
75	SVGFC.US	NIPA: Consumption of fixed capital, (Bil. $, SAAR)	2
76	SVN.US	NIPA: State and local, (Bil. $, SAAR)	2
77	SVNC.US	NIPA: Consumption of fixed capital, (Bil. $, SAAR)	2
78	ITOT.US	NIPA: Gross investment, (Bil. $, SAAR)	2
79	I.US	NIPA: Gross private domestic investment, (Bil. $, SAAR)	2
80	GI.US	NIPA: Gross government investment, (Bil. $, SAAR)	2
81	PCNBOPH.US	Productivity & Costs: Nonfarm Business - Output Per Hour All persons, (Index 1992 = 100)	1
82	PCNBPER.US	Productivity & Costs: Nonfarm Business - Output Per Person All persons, (Index 1992 = 100	1
83	PCNBHR.US	Productivity & Costs: Nonfarm Business - Hours All persons, (Index 1992 = 100)	2
84	PCNBOUT.US	Productivity & Costs: Nonfarm Business - Output All persons, (Index 1992 = 100)	2
85	CU.US	Capacity Utilization: Total Index, (% Capacity, SA)	0
86	CUMF.US	Capacity Utilitzation: Manufacturing, (% Capacity, SA)	0
87	CUPRI.US	Capacity Utilitzation: Primary Processing, (% Capacity, SA)	0
88	CUADV.US	Capacity Utilitzation: Advanced Processing, (% Capacity, SA)	0
89	CUMDU.US	Capacity Utilitzation: Durable Manufacturing, (% Capacity, SA)	0
90	CU24.US	Capacity Utilitzation: Lumber And Products SIC=24, (% Capacity, SA)	0
91	CU25.US	Capacity Utilitzation: Furniture And Fixtures SIC=25, (% Capacity, SA)	0
92	CU32.US	Capacity Utilitzation: Stone Clay And Glass Products SIC=32, (% Capacity, SA)	0
93	CU33.US	Capacity Utilitzation: Primary Metals SIC=33, (% Capacity, SA)	0
94	CUIRN.US	Capacity Utilitzation: Iron And Steel SIC=3312, (% Capacity, SA)	0
95	CURAW.US	Capacity Utilitzation: Raw Steel SIC=331PT, (% Capacity, SA)	0
96	CUNFM.US	Capacity Utilitzation: Nonferrous Metals SIC=333-69, (% Capacity, SA)	0
97	CUCOP.US	Capacity Utilization: Copper SIC=3331, (% Capacity, SA)	0
98	CU3334.US	Capacity Utilitzation: Aluminum SIC=3334, (% Capacity, SA)	0
99	CU34.US	Capacity Utilitzation: Fabricated Metal Products SIC=34, (% Capacity, SA)	0
100	CU35.US	Capacity Utilitzation: Industrial Machinery And Equipment SIC=35, (% Capacity, SA)	0
101	CU357.US	Capacity Utilitzation: Computer And Office Equipment SIC=357, (% Capacity, SA)	0
102	CU36.US	Capacity Utilitzation: Electrical Machinery SIC=36, (% Capacity, SA)	0
103	CU37.US	Capacity Utilitzation: Transportation Equipment SIC=37, (% Capacity, SA)	0
104	CU371.US	Capacity Utilitzation: Motor Vehicles And Parts SIC=371, (% Capacity, SA)	0
105	CUARE.US	Capacity Utilitzation: Aerospace And Misc. Transp. Equipment SIC=372-69, (% Capacity, SA	0
106	CU38.US	Capacity Utilitzation: Instruments SIC=38, (% Capacity, SA)	0
107	CU39.US	Capacity Utilitzation: Miscellaneous Manufactures SIC=39, (% Capacity, SA)	0
108	CUMND.US	Capacity Utilitzation: Nondurable Manufacturing, (% Capacity, SA)	0
109	CU20.US	Capacity Utilitzation: Foods SIC=20, (% Capacity, SA)	0
110	CU22.US	Capacity Utilitzation: Textile Mill Products SIC=22, (% Capacity, SA)	0
111	CU23.US	Capacity Utilitzation: Apparel Products SIC=23, (% Capacity, SA)	0
112	CU26.US	Capacity Utilitzation: Paper And Products SIC=26, (% Capacity, SA)	0
113	CUPUP.US	Capacity Utilitzation: Pulp And Paper SIC=261-3, (% Capacity, SA)	0
114	CU27.US	Capacity Utilitzation: Printing And Publishing SIC=27, (% Capacity, SA)	0
115	CU28.US	Capacity Utilitzation: Chemicals And Products SIC=28, (% Capacity, SA)	0
116	CU2821.US	Capacity Utilitzation: Plastics Materials SIC=2821, (% Capacity, SA)	0
117	CU2825.US	Capacity Utilitzation: Synthetic Fibers SIC=28234, (% Capacity, SA)	0
118	CU29.US	Capacity Utilitzation: Petroleum Products SIC=29, (% Capacity, SA)	0
119	CU30.US	Capacity Utilitzation: Rubber And Plastics Products SIC=30, (% Capacity, SA)	0
120	CU31.US	Capacity Utilitzation: Leather And Products SIC=31, (% Capacity, SA)	0
121	CUMI.US	Capacity Utilitzation: Mining, (% Capacity, SA)	0
122	CU10.US	Capacity Utilitzation: Metal Mining SIC=10, (% Capacity, SA)	0
123	CU12.US	Capacity Utilitzation: Coal Mining SIC=12, (% Capacity, SA)	0
124	CU13.US	Capacity Utilitzation: Oil And Gas Extraction SIC=13, (% Capacity, SA)	0
125	CU138.US	Capacity Utilitzation: Oil And Gas Well Drilling SIC=138, (% Capacity, SA)	0
126	CU14.US	Capacity Utilitzation: Stone And Earth Minerals SIC=14, (% Capacity, SA)	0
127	CUUT.US	Capacity Utilitzation: Utilities, (% Capacity, SA)	0
128	CU491.US	Capacity Utilitzation: Electric Utilities SIC=491493PT, (% Capacity, SA)	0
129	CU492.US	Capacity Utilitzation: Gas Utilities SIC=492493PT, (% Capacity, SA)	0
130	CCALL.US	Consumer Installment Credit: Total Outstanding, (Bil. $, SA)	2
131	CCNREV.US	Consumer Installment Credit: Nonrevolving, (Bil. $, SA)	2
132	XCCALL.US	Consumer Installment Credit: Total, (Bil. $, NSA)	2
133	XCCBNK.US	Consumer Installment Credit: CommercialBanks, (Bil. $, NSA)	2
134	XCCFIN.US	Consumer Installment Credit: Finance Companies, (Bil. $, NSA)	2
135	XCCCRE.US	Consumer Installment Credit: Credit Unions, (Bil. $, NSA)	2
136	XCCSAV.US	Consumer Installment Credit: Savings Institutions, (Bil. $, NSA)	2
137	XCCNFN.US	Consumer Installment Credit: Nonfinancial Business, (Bil. $, NSA)	2
138	XCCNREV.US	Consumer Installment Credit: Nonrevolving, (Bil. $, NSA)	2
139	XCCNREVB.US	Nonrevolving Credit: Commercial Banks, (Bil. $, NSA)	2
140	XCCNREVF.US	Nonrevolving Credit: Finance Companies, (Bil. $, NSA)	2
141	XCCNREVC.US	Nonrevolving Credit: Credit Unions, (Bil. $, NSA)	2
142	XCCNREVS.US	Nonrevolving Credit: Savings Institutions, (Bil. $, NSA)	2
143	XCCNREVN.US	Nonrevolving Credit: Nonfinancial Business, (Bil. $, NSA)	2
144	CPIU.US	CPI: Urban Consumer - All items, (1982-84=100, SA)	3
145	CPIUAF.US	CPI: Urban Consumer - Food and beverages, (1982-84=100, SA)	3
146	CPIUAF1.US	CPI: Urban Consumer - Food, (1982-84=100, SA)	3
147	CPIUAF11.US	CPI: Urban Consumer - Food at home, (1982-84=100, SA)	3
148	CPIUAF112.US	CPI: Urban Consumer - Meats, poultry, fish, and eggs, (1982-84=100, SA)	3
149	CPIUAF113.US	CPI: Urban Consumer - Fruits and vegetables, (1982-84=100, SA)	3
150	CPIUAF114.US	CPI: Urban Consumer - Nonalcoholic beverages and beverage materials, (1982-84=100, SA	3
151	CPIUAF115.US	CPI: Urban Consumer - Other food at home, (1982-84=100, SA)	3

152	CPIUEFV.US	CPI: Urban Consumer - Food away from home, (1982-84=100, SA)	3
153	CPIUAF116.US	CPI: Urban Consumer - Alcoholic beverages, (1982-84=100, SA)	3
154	CPIUAH.US	CPI: Urban Consumer - Housing, (1982-84=100, SA)	3
155	CPIUAH1.US	CPI: Urban Consumer - Shelter, (1982-84=100, SA)	3
156	CPIUAH2.US	CPI: Urban Consumer - Fuels and utilities, (1982-84=100, SA)	3
157	CPIUAH21.US	CPI: Urban Consumer - Fuels, (1982-84=100, SA)	3
158	CPIUEHE.US	CPI: Urban Consumer - Fuel oil and other fuels, (1982-84=100, SA)	3
159	CPIUEHF.US	CPI: Urban Consumer - Gas (piped) and electricity, (1982-84=100, SA)	3
160	CPIUAH3.US	CPI: Urban Consumer - Household furnishings and operations, (1982-84=100, SA)	3
161	CPIUAA.US	CPI: Urban Consumer - Apparel, (1982-84=100, SA)	3
162	CPIUAA1.US	CPI: Urban Consumer - Men's and boys' apparel, (1982-84=100, SA)	3
163	CPIUAA2.US	CPI: Urban Consumer - Women's and girls' apparel, (1982-84=100, SA)	3
164	CPIUEAE.US	CPI: Urban Consumer - Footwear, (1982-84=100, SA)	3
165	CPIUAT.US	CPI: Urban Consumer - Transportation, (1982-84=100, SA)	3
166	CPIUAT1.US	CPI: Urban Consumer - Private transportation, (1982-84=100, SA)	3
167	CPIUETA01.US	CPI: Urban Consumer - New vehicles, (1982-84=100, SA)	3
168	CPIUETA02.US	CPI: Urban Consumer - Used cars and trucks, (1982-84=100, SA)	3
169	CPIUETB.US	CPI: Urban Consumer - Motor fuel, (1982-84=100, SA)	3
170	CPIUETB01.US	CPI: Urban Consumer - Gasoline (all types), (1982-84=100, SA)	3
171	CPIUETD.US	CPI: Urban Consumer - Motor vehicle maintenance and repair, (1982-84=100, SA)	3
172	CPIUAM.US	CPI: Urban Consumer - Medical care, (1982-84=100, SA)	3
173	CPIUAM1.US	CPI: Urban Consumer - Medical care commodities, (1982-84=100, SA)	3
174	CPIUAM2.US	CPI: Urban Consumer - Medical care services, (1982-84=100, SA)	3
175	CPIUEEA.US	CPI: Urban Consumer - Educational books and supplies, (1982-84=100, SA)	3
176	CPIUAG.US	CPI: Urban Consumer - Other goods and services, (1982-84=100, SA)	3
177	CPIUAF.US	CPI: Urban Consumer - Food and beverages, (1982-84=100, SA)	3
178	CPIUACL11.US	CPI: Urban Consumer - Commodities less food and beverages, (1982-84=100, SA)	3
179	CPIUAA.US	CPI: Urban Consumer - Apparel, (1982-84=100, SA)	3
180	CPIUAD.US	CPI: Urban Consumer - Durables, (1982-84=100, SA)	3
181	CPIUAC.US	CPI: Urban Consumer - Commodities, (1982-84=100, SA)	3
182	CPIUAS.US	CPI: Urban Consumer - Services, (1982-84=100, SA)	3
183	CPIUEHF.US	CPI: Urban Consumer - Gas (piped) and electricity, (1982-84=100, SA)	3
184	CPIUAS4.US	CPI: Urban Consumer - Transportation services, (1982-84=100, SA)	3
185	CPIUAM2.US	CPI: Urban Consumer - Medical care services, (1982-84=100, SA)	3
186	CPIUAS367.US	CPI: Urban Consumer - Other services, (1982-84=100, SA)	3
187	CPIUL1.US	CPI: Urban Consumer - All items less food, (1982-84=100, SA)	3
188	CPIUL2.US	CPI: Urban Consumer - All items less shelter, (1982-84=100, SA)	3
189	CPIUL5.US	CPI: Urban Consumer - All items less medical care, (1982-84=100, SA)	3
190	CPIUACL1.US	CPI: Urban Consumer - Commodities less food, (1982-84=100, SA)	3
191	CPIUAN.US	CPI: Urban Consumer - Nondurables, (1982-84=100, SA)	3
192	CPIUE.US	CPI: Urban Consumer - Energy, (1982-84=100, SA)	3
193	CPIULE.US	CPI: Urban Consumer - All items less energy, (1982-84=100, SA)	3
194	CPIUL1E.US	CPI: Urban Consumer - All items less food and energy, (1982-84=100, SA)	3
195	CPIUACL1E.US	CPI: Urban Consumer - Commodities less food and energy commodities, (1982-84=100, SA	3
196	CPIUACE.US	CPI: Urban Consumer - Energy commodities, (1982-84=100, SA)	3
197	CPIUASLE.US	CPI: Urban Consumer - Services less energy services, (1982-84=100, SA)	3
198	ET.US	Employment: Total Non-Agricultural, (Ths., SA)	2
199	ETP.US	Employment: Total private, (Ths., SA)	2
200	EGOOD.US	Employment: Goods-producing, (Ths., SA)	2
201	EMI.US	Employment: Mining, (Ths., SA)	2
202	E10.US	Employment: Metal mining, (Ths., SA)	2
203	E12.US	Employment: Coal mining, (Ths., SA)	2
204	E14.US	Employment: Nonmetallic minerals except fuels, (Ths., SA)	2
205	ECN.US	Employment: Construction, (Ths., SA)	2
206	E15.US	Employment: General building contractors, (Ths., SA)	2
207	EMF.US	Employment: Manufacturing, (Ths., SA)	2
208	EMFD.US	Employment: Durable goods, (Ths., SA)	2
209	E20.US	Employment: Food and kindred products, (Ths., SA)	2
210	E21.US	Employment: Tobacco products, (Ths., SA)	2
211	E22.US	Employment: Textile mill products, (Ths., SA)	2
212	E23.US	Employment: Apparel and other textile products, (Ths., SA)	2
213	E24.US	Employment: Lumber and wood products, (Ths., SA)	2
214	E25.US	Employment: Furniture and fixtures, (Ths., SA)	2
215	E26.US	Employment: Paper and allied products, (Ths., SA)	2
216	E29.US	Employment: Petroleum and coal products, (Ths., SA)	2
217	E27.US	Employment: Printing and publishing, (Ths., SA)	2
218	E28.US	Employment: Chemicals and allied products, (Ths., SA)	2
219	E30.US	Employment: Rubber and miscellaneous plastics products, (Ths., SA)	2
220	E31.US	Employment: Leather and leather products, (Ths., SA)	2
221	E32.US	Employment: Stone clay and glass products, (Ths., SA)	2
222	E33.US	Employment: Primary metal industries, (Ths., SA)	2
223	E34.US	Employment: Fabricated metal products, (Ths., SA)	2
224	E35.US	Employment: Industrial machinery and equipment, (Ths., SA)	2
225	E357.US	Employment: Computer and office equipment, (Ths., SA)	2
226	E36.US	Employment: Electronic and other electrical equipment, (Ths., SA)	2
227	E367.US	Employment: Electronic components and accessories, (Ths., SA)	2
228	E37.US	Employment: Transportation equipment, (Ths., SA)	2
229	E371.US	Employment: Motor vehicles and equipment, (Ths., SA)	2
230	E372.US	Employment: Aircraft and parts, (Ths., SA)	2
231	E38.US	Employment: Instruments and related products, (Ths., SA)	2
232	E39.US	Employment: Miscellaneous manufacturing industries, (Ths., SA)	2
233	ETU.US	Employment: Transportation and public utilities, (Ths., SA)	2
234	ETR.US	Employment: Transportation, (Ths., SA)	2

235	E40.US	Employment: Railroad transportation, (Ths., SA)	2
236	E41.US	Employment: Local and interurban passenger transit, (Ths., SA)	2
237	E48.US	Employment: Communications, (Ths., SA)	2
238	E49.US	Employment: Electric gas and sanitary services, (Ths., SA)	2
239	ETT.US	Employment: Wholesale and retail trade, (Ths., SA)	2
240	EWT.US	Employment: Wholesale trade, (Ths., SA)	2
241	ERT.US	Employment: Retail trade, (Ths., SA)	2
242	E531.US	Employment: Department stores, (Ths., SA)	2
243	E54.US	Employment: Food stores, (Ths., SA)	2
244	E55.US	Employment: Automotive dealers and service stations, (Ths., SA)	2
245	E56.US	Employment: Apparel and accessory stores, (Ths., SA)	2
246	E57.US	Employment: Furniture and home furnishings stores, (Ths., SA)	2
247	E58.US	Employment: Eating and drinking places, (Ths., SA)	2
248	EFI.US	Employment: Finance insurance and real estate, (Ths., SA)	2
249	E62.US	Employment: Security and commodity brokers, (Ths., SA)	2
250	E63.US	Employment: Insurance carriers, (Ths., SA)	2
251	ESV.US	Employment: Services, (Ths., SA)	2
252	E72.US	Employment: Personal services, (Ths., SA)	2
253	E73.US	Employment: Business services, (Ths., SA)	2
254	E734.US	Employment: Services to buildings, (Ths., SA)	2
255	E76.US	Employment: Miscellaneous repair services, (Ths., SA)	2
256	E80.US	Employment: Health services, (Ths., SA)	2
257	E806.US	Employment: Hospitals, (Ths., SA)	2
258	E82.US	Employment: Educational services, (Ths., SA)	2
259	E871.US	Employment: Engineering and architectural services, (Ths., SA)	2
260	EGV.US	Employment: Government, (Ths., SA)	2
261	TFXI134.US	Foreign Exchange Rate: Germany, (Deutsche Mark Per U.S.$)	2
262	TFXI158.US	Foreign Exchange Rate: Japan, (Yen Per U.S.$)	2
263	AHETP.US	Avg. Hrly Earnings: Total private, ($ Per Hrs., SA)	2
264	AHEGOOD.US	Avg. Hrly Earnings: Goods-producing, ($ Per Hrs., SA)	2
265	AHEMI.US	Avg. Hrly Earnings: Mining, ($ Per Hrs., SA)	2
266	AHECN.US	Avg. Hrly Earnings: Construction, ($ Per Hrs., SA)	2
267	AHEMF.US	Avg. Hrly Earnings: Manufacturing, ($ Per Hrs., SA)	2
268	AHEXOMF.US	Avg. Hrly Earnings X-Overtime: Manufacturing, (Index, SA)	2
269	AHEPSERV.US	Avg. Hrly Earnings: Private service-producing, ($ Per Hrs., SA)	2
270	AHETU.US	Avg. Hrly Earnings: Transportation and public utilities, ($ Per Hrs., SA)	2
271	AHETT.US	Avg. Hrly Earnings: Wholesale and retail trade, ($ Per Hrs., SA)	2
272	AHEWT.US	Avg. Hrly Earnings: Wholesale trade, ($ Per Hrs., SA)	2
273	AHERT.US	Avg. Hrly Earnings: Retail trade, ($ Per Hrs., SA)	2
274	AHEFI.US	Avg. Hrly Earnings: Finance insurance and real estate, ($ Per Hrs., SA)	2
275	AHESV.US	Avg. Hrly Earnings: Services, ($ Per Hrs., SA)	2
276	HST.US	Housing Starts: Total privately owned, (Ths., SAAR)	2
277	HPR.US	Total Authorized Building Permits, (SAAR, Ths.)	2
278	HN1.US	New Home Sales: New single-family houses sold, (Ths., SAAR)	2
279	HN1SALE.US	New Home Sales: Single-Family Houses for Sale, (Ths., SA)	2
280	CP$96.US	Construction put in place: Total, (Bil. 96$, SAAR)	2
281	CPP$96.US	Construction put in place: Private - Total, (Bil. 96$, SAAR)	2
282	CPPR$96.US	Construction put in place: Private residential - Total, (Bil. 96$, SAAR)	2
283	CPPRN$96.US	Construction put in place: Private residential - New housing units, (Bil. 96$, SAAR)	2
284	CPPRN1$96.US	Construction put in place: Private residential - New housing 1 unit, (Bil. 96$, SAAR)	2
285	CPPRNM$96.US	Construction put in place: Private residential - New housing 2 units or more, (Bil. 96$, SAAR)	2
286	CPPN$96.US	Construction put in place: Private nonresidential - Total, (Bil. 96$, SAAR)	2
287	CPPNID$96.US	Construction put in place: Private nonresidential - Industrial, (Bil. 96$, SAAR)	2
288	CPPNCM$96.US	Construction put in place: Private nonresidential - Other commercial, (Bil. 96$, SAAR)	2
289	CPPNHT$96.US	Construction put in place: Private nonresidential - Hotels and motels, (Bil. 96$, SAAR)	2
290	CPPNRL$96.US	Construction put in place: Private nonresidential - Religious, (Bil. 96$, SAAR)	2
291	CPPNED$96.US	Construction put in place: Private nonresidential - Educational, (Bil. 96$, SAAR)	2
292	CPPNHO$96.US	Construction put in place: Private nonresidential - Hospital, (Bil. 96$, SAAR)	2
293	CPPNMS$96.US	Construction put in place: Private nonresidential - Miscellaneous, (Bil. 96$, SAAR)	2
294	CPPUT$96.US	Construction put in place: Private public utilities - Telecommunications, (Bil. 96$, SAAR)	2
295	CPPO$96.US	Construction put in place: Private - Other, (Bil. 96$, SAAR)	2
296	CPU$96.US	Construction put in place: Public - Total, (Bil. 96$, SAAR)	2
297	CPUB$96.US	Construction put in place: Public buildings - Total, (Bil. 96$, SAAR)	2
298	CPUBHS$96.US	Construction put in place: Public buildings - Housing and redevelopment, (Bil. 96$, SAAR)	2
299	CPUBID$96.US	Construction put in place: Public buildings - Industrial, (Bil. 96$, SAAR)	2
300	CPUBED$96.US	Construction put in place: Public buildings - Educational, (Bil. 96$, SAAR)	2
301	CPUBHO$96.US	Construction put in place: Public buildings - Hospital, (Bil. 96$, SAAR)	2
302	CPUBOT$96.US	Construction put in place: Public buildings - Other, (Bil. 96$, SAAR)	2
303	CPUHI$96.US	Construction put in place: Public - Highways and streets, (Bil. 96$, SAAR)	2
304	CPUSCN$96.US	Construction Put in Place: Public Construction - State and local - Conservation and Develop	2
305	CPUSWE$96.US	Construction Put in Place: Public Construction - State and local - Sewer Systems, (Bil. 96$,	2
306	CPUSWA$96.US	Construction Put in Place: Public Construction - State and local - Water supply facilities, (Bil.	2
307	CPUSMS$96.US	Construction Put in Place: Public Construction - State and local - Miscellaneous Non-building	2
308	CPUF$96.US	Construction Put in Place: Public Construction - Federal - Total, (Bil. 96$, SAAR)	2
309	CPUFB$96.US	Construction Put in Place: Public Construction - Federal Buildings, (Bil. 96$, SAAR)	2
310	CPUFBHS$96.US	Construction Put in Place: Public Construction - Federal Buildings - Housing, (Bil. 96$, SAAF	2
311	CPUFBID$96.US	Construction Put in Place: Public Construction - Federal Buildings - Industrial, (Bil. 96$, SAA	2
312	CPUFBED$96.US	Construction Put in Place: Public Construction - Federal Buildings - Educational, (Bil. 96$, S	2
313	CPUFBHO$96.US	Construction Put in Place: Public Construction - Federal Buildings - Hospital, (Bil. 96$, SAAF	2
314	CPUFBOT$96.US	Construction Put in Place: Public Construction - Federal Buildings - Other, (Bil. 96$, SAAR)	2
315	CPUFML$96.US	Construction Put in Place: Public Construction - Federal - Military Facilities, (Bil. 96$, SAAR)	2
316	CPUFCN$96.US	Construction Put in Place: Public Construction - Federal - Conservation and Development, (E	2
317	CPUFMS$96.US	Construction Put in Place: Public Construction - Federal - Miscellaneous Non-building, (Bil. 9	2

318 RILIBOR1M.US	LIBOR Rates: 1-Month US Dollar Deposits, (%, NSA)	0
319 RILIBOR3M.US	LIBOR Rates: 3-Month US Dollar Deposits, (%, NSA)	0
320 RILIBOR6M.US	LIBOR Rates: 6-Month US Dollar Deposits, (%, NSA)	0
321 RFED.US	Interest Rates: Federal Funds Rate, (%,P.A.)	0
322 RCD1M.US	Interest Rates: CDs secondary Market -1 Month, (% P.A.)	0
323 RCD3M.US	Interest Rates: CDs secondary Market -3 Month, (% P.A.)	0
324 RCD6M.US	Interest Rates: CDs secondary Market -6 Month, (% P.A.)	0
325 RED1M.US	Interest Rates: Eurodollar Deposits ; London - 1 Month, (% P.A.)	0
326 RED3M.US	Interest Rates: Eurodollar Deposits ; London - 3 Month, (% P.A.)	0
327 RED6M.US	Interest Rates: Eurodollar Deposits ; London - 6 Month, (% P.A.)	0
328 RPRIME.US	Interest Rates: Bank Prime Rate, (% P.A.)	0
329 RDISC.US	Interest Rates: Discount Window Borrowing, (% p.a.)	0
330 RATB3.US	Interest Rates: 3-Month T-Bill AuctionAverage, (%)	0
331 RATB6.US	Interest Rates: 6-Month T-Bill AuctionAverage, (%)	0
332 RTB3M.US	Interest Rates: 3-Month Treasury Bills - Secondary Market, (% P.A.)	0
333 RTB6M.US	Interest Rates: 6-Month Treasury Bills - Secondary Market, (% P.A.)	0
334 RTB12M.US	Interest Rates: 12-Month Treasury Bills - Secondary Market, (% P.A.)	0
335 RGT1Y.US	Interest Rates: 1-Year Constant Maturity Securities, (% P.A.)	0
336 RGT3Y.US	Interest Rates: 3-Year Constant Maturity Securities, (% P.A.)	0
337 RGT5Y.US	Interest Rates: 5-Year Constant Maturity Securities, (% P.A.)	0
338 RGT10Y.US	Interest Rates: 10-Year Constant Maturity Securities, (% P.A.)	0
339 RBB20.US	Bond Buyer Index: General Obligation 20-Years to Maturity, (%)	0
340 RMAAA.US	Interest Rates: Moodys AAA Seasoned, (%)	0
341 RMBAA.US	Interest Rates: Moodys BAA Seasoned, (%)	0
342 IP.US	Industrial Production: Total Index, (Index 1992=100, SA)	2
343 IPMF.US	Industrial Production: Manufacturing, (Index 1992=100, SA)	2
344 IPPRI.US	Industrial Production: Primary Processing, (Index 1992=100, SA)	2
345 IPADV.US	Industrial Production: Advanced Processing, (Index 1992=100, SA)	2
346 IPMDU.US	Industrial Production: Durable Manufacturing, (Index 1992=100, SA)	2
347 IP24.US	Industrial Production: Lumber And Products SIC=24, (Index 1992=100, SA)	2
348 IP25.US	Industrial Production: Furniture And Fixtures SIC=25, (Index 1992=100, SA)	2
349 IP32.US	Industrial Production: Stone Clay And Glass Products SIC=32, (Index 1992=100, SA)	2
350 IP33.US	Industrial Production: Primary Metals SIC=33, (Index 1992=100, SA)	2
351 IPIRN.US	Industrial Production: Iron And Steel SIC=3312, (Index 1992=100, SA)	2
352 IPRAW.US	Industrial Production: Raw Steel SIC=331PT, (Index 1992=100, SA)	2
353 IPNFM.US	Industrial Production: Nonferrous Metals SIC=333-69, (Index 1992=100, SA)	2
354 IP34.US	Industrial Production: Fabricated Metal Products SIC=34, (Index 1992=100, SA)	2
355 IP35.US	Industrial Production: Industrial Machinery And Equipment SIC=35, (Index 1992=100, SA)	2
356 IP357.US	Industrial Production: Computer And Office Equipment SIC=357, (Index 1992=100, SA)	2
357 IP36.US	Industrial Production: Electrical Machinery SIC=36, (Index 1992=100, SA)	2
358 IP37.US	Industrial Production: Transportation Equipment SIC=37, (Index 1992=100, SA)	2
359 IP371.US	Industrial Production: Motor Vehicles And Parts SIC=371, (Index 1992=100, SA)	2
360 IPARE.US	Industrial Production: Aerospace And Misc. Transp. Equipment SIC=372-69, (Index 1992=1(	2
361 IP38.US	Industrial Production: Instruments SIC=38, (Index 1992=100, SA)	2
362 IP39.US	Industrial Production: Miscellaneous Manufactures SIC=39, (Index 1992=100, SA)	2
363 IPMND.US	Industrial Production: Nondurable Manufacturing, (Index 1992=100, SA)	2
364 IP20.US	Industrial Production: Foods SIC=20, (Index 1992=100, SA)	2
365 IP21.US	Industrial Production: Tobacco Products SIC=21, (Index 1992=100, SA)	2
366 IP22.US	Industrial Production: Textile Mill Products SIC=22, (Index 1992=100, SA)	2
367 IP23.US	Industrial Production: Apparel Products SIC=23, (Index 1992=100, SA)	2
368 IP26.US	Industrial Production: Paper And Products SIC=26, (Index 1992=100, SA)	2
369 IP27.US	Industrial Production: Printing And Publishing SIC=27, (Index 1992=100, SA)	2
370 IP28.US	Industrial Production: Chemicals And Products SIC=28, (Index 1992=100, SA)	2
371 IP29.US	Industrial Production: Petroleum Products SIC=29, (Index 1992=100, SA)	2
372 IP30.US	Industrial Production: Rubber And Plastics Products SIC=30, (Index 1992=100, SA)	2
373 IP31.US	Industrial Production: Leather And Products SIC=31, (Index 1992=100, SA)	2
374 IPMI.US	Industrial Production: Mining, (Index 1992=100, SA)	2
375 IP10.US	Industrial Production: Metal Mining SIC=10, (Index 1992=100, SA)	2
376 IP12.US	Industrial Production: Coal Mining SIC=12, (Index 1992=100, SA)	2
377 IP13.US	Industrial Production: Oil And Gas Extraction SIC=13, (Index 1992=100, SA)	2
378 IP14.US	Industrial Production: Stone And Earth Minerals SIC=14, (Index 1992=100, SA)	2
379 IPUT.US	Industrial Production: Utilities, (Index 1992=100, SA)	2
380 IP491.US	Industrial Production: Electric Utilities SIC=491493PT, (Index 1992=100, SA)	2
381 IP492.US	Industrial Production: Gas Utilities SIC=492493PT, (Index 1992=100, SA)	2
382 IPMXM.US	Industrial Production: Manufacturing Ex. Motor Vehicles And Parts, (Index 1992=100, SA)	2
383 IPMXC.US	Industrial Production: Manufacturing Ex. Computer And Office Equipment, (Index 1992=100,	2
384 IPMXP.US	Industrial production: Total X-Computers and semiconducters, (Index 1992=100, SA.US)	2
385 IPTOTASS.US	Industrial Production: Total Motor Vehicle Assemblies, (Index 1992=100, SA)	2
386 IPAUTOASM.US	Industrial Production: Auto Assemblies, (Index 1992=100, SA)	2
387 IPTRUCKS.US	Industrial Production: Total Truck Assemblies, (Index 1992=100, SA)	2
388 MR.US	Reserves: Total reserves adjusted for changes in reserve requirements, (Mil. $, SA)	2
389 MRN.US	Reserves: Nonborrowed reserves adjusted for changes in reserve requirements, (Mil. $, SA)	2
390 MRNT.US	Reserves: Nonborrowed reserves plus Extended Credit adjusted for changes in reserve requ	2
391 MRR.US	Reserves: Required reserves adjusted for changes in reserve requirements, (Mil. $, SA)	2
392 XMRE.US	Reserves: Excess reserves adjusted for changes in reserve requirements, (Mil. $, NSA)	2
393 MRBASE.US	Reserves: Monetary base adjusted for changes in reserve requirements, (Mil. $, SA)	2
394 M1.US	Money Stock; M1, (SA Billions $)	2
395 M2.US	Money Stock; M2, (SA Billions $)	2
396 M3.US	Money Stock; M3, (SA Billions $)	2
397 EURO.US	Money Stock: Overnight and Term Eurodollars, (SA Billions $)	2
398 DEBT.US	Money stock: Debt of domestic non-financial sectors, (Bil. $, SA)	2
399 DEBTF.US	Money stock: Federal debt, (Bil. $, NSA)	2
400 DEBTN.US	Money stock: Nonfederal debt, (Bil. $, SA)	2

401	PPISP3000.US	PPI: Finished goods, (1982=100, SA)	3
402	PPISP3100.US	PPI: Finished consumer goods, (1982=100, SA)	3
403	PPISP3110.US	PPI: Finished consumer foods, (1982=100, SA)	3
404	PPISP3300.US	PPI: Finished consumer goods excluding foods, (1982=100, SA)	3
405	PPISP3120.US	PPI: Consumer nondurable goods less food, (1982=100, SA)	3
406	PPISP3130.US	PPI: Consumer durable goods, (1982=100, SA)	3
407	PPISP3200.US	PPI: Capital equipment, (1982=100, SA)	3
408	PPISP2000.US	PPI: Intermediate materials supplies and components, (1982=100, SA)	3
409	PPISP3400.US	PPI: Finished goods; excluding foods, (1982=100, SA)	3
410	PPISP2700.US	PPI: Intermediate materials less foods and feeds, (1982=100, SA)	3
411	PPISP2800.US	PPI: Intermediate foods and feeds, (1982=100, SA)	3
412	PPISP1400.US	PPI: Crude materials less agricultural products, (1982=100, SA)	3
413	SP500.US	S&P Stock Price Index: 500 Composite, (Index 1941-43=10, Monthly Average)	2
414	SP500DY.US	S&P Composite Common Stock: Dividend Yield, (%, NSA)	2
415	SP500PE.US	S&P Composite Common Stock: Price Earnings Ratio, (%, NSA)	2
416	DJIA.US	Dow Jones Industrials: 30 Industries, (Index 1920=100, Monthly End)	2
417	LBR.US	Household survey: Unemployment rate, (% SA)	0
418	LBRM20G.US	Household survey: Unemployment rate - 20 yrs. & over Male, (% SA)	0
419	LBRF20G.US	Household survey: Unemployment rate - 20 yrs. & over Female, (% SA)	0
420	LBR1619.US	Household survey: Unemployment rate - 16-19 yrs., (% SA)	0
421	LBRW.US	Household survey: Unemployment rate - White, (% SA)	0
422	AWH20.US	Avg. Weekly Hours: Food and kindred products, (# of Hrs., SA)	2
423	AWH21.US	Avg. Weekly Hours: Tobacco products, (# of Hrs., SA)	2
424	AWH331.US	Avg. Weekly Hours: Blast furnaces and basic steel products, (# of Hrs., SA)	2
425	AWH34.US	Avg. Weekly Hours: Fabricated metal products, (# of Hrs., SA)	2
426	AWH35.US	Avg. Weekly Hours: Industrial machinery and equipment, (# of Hrs., SA)	2
427	AWH37.US	Avg. Weekly Hours: Transportation equipment, (# of Hrs., SA)	2
428	AWH371.US	Avg. Weekly Hours: Motor vehicles and equipment, (# of Hrs., SA)	2
429	AWHCN.US	Avg. Weekly Hours: Construction, (# of Hrs., SA)	2
430	AWH39.US	Avg. Weekly Hours: Miscellaneous manufacturing industries, (# of Hrs., SA)	2
431	AWHGOOD.US	Avg. Weekly Hours: Goods-producing, (# of Hrs., SA)	2
432	AWHMF.US	Avg. Weekly Hours: Manufacturing, (# of Hrs., SA)	2
433	AWHMFD.US	Avg. Weekly Hours: Durable goods, (# of Hrs., SA)	2
434	AWHMFN.US	Avg. Weekly Hours: Nondurable goods, (# of Hrs., SA)	2
435	AWHMI.US	Avg. Weekly Hours: Mining, (# of Hrs., SA)	2
436	AWHPSERV.US	Avg. Weekly Hours: Private service-producing, (# of Hrs., SA)	2
437	AWHTP.US	Avg. Weekly Hours: Total private, (# of Hrs., SA)	2
438	AWHRT.US	Avg. Weekly Hours: Retail trade, (# of Hrs., SA)	2
439	AWHTT.US	Avg. Weekly Hours: Wholesale and retail trade, (# of Hrs., SA)	2
440	AWHTU.US	Avg. Weekly Hours: Transportation and public utilities, (# of Hrs., SA)	2
441	AWHSV.US	Avg. Weekly Hours: Services, (# of Hrs., SA)	2
442	AWHWT.US	Avg. Weekly Hours: Wholesale trade, (# of Hrs., SA)	2
443	AWH27.US	Avg. Weekly Hours: Printing and publishing, (# of Hrs., SA)	2
444	AWH26.US	Avg. Weekly Hours: Paper and allied products, (# of Hrs., SA)	2
445	AWH22.US	Avg. Weekly Hours: Textile mill products, (# of Hrs., SA)	2
446	AWH24.US	Avg. Weekly Hours: Lumber and wood products, (# of Hrs., SA)	2
447	AWH28.US	Avg. Weekly Hours: Chemicals and allied products, (# of Hrs., SA)	2
448	AWH23.US	Avg. Weekly Hours: Apparel and other textile products, (# of Hrs., SA)	2
449	AWH25.US	Avg. Weekly Hours: Furniture and fixtures, (# of Hrs., SA)	2
450	AWH30.US	Avg. Weekly Hours: Rubber and miscellaneous plastics products, (# of Hrs., SA)	2
451	AWH32.US	Avg. Weekly Hours: Stone clay and glass products, (# of Hrs., SA)	2
452	AWH31.US	Avg. Weekly Hours: Leather and leather products, (# of Hrs., SA)	2
453	AWH33.US	Avg. Weekly Hours: Primary metal industries, (# of Hrs., SA)	2