Credit, the Stock Market and Oil: Forecasting U.S. GDP

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June 12, 2001

***** This research was supported by the Economic and Social Research Council, under grant number R000237500. We are grateful to Cara Lown for help in extracting historical data from the Federal Reserve Survey of Senior Loan Officers and to Janine Aron, Spencer Dale, David Hendry, Nick Oulton, Adrian Pagan, Neil Shephard, Simon Ward and seminar participants in Oxford and the Bank of England for helpful comments.

Abstract:

We derive a comprehensive one-year ahead forecasting model of U.S. per capita GDP for 1955-2000, examining collectively variables usually considered singly, e.g. interest rates, credit conditions, the stock market, oil prices and the yield gap, of which all, except the last, are found to matter. The credit conditions index is measured in the Federal Reserve's Survey of Senior Loan Officers and its importance is consistent with a 'financial accelerator' view. The balance of payments, exchange rate and fiscal policy also play a role. We address the Lucas critique, investigating consequences of monetary policy regime shifts in 1980, and fiscal policy regime shifts at the end of the 1980's. The model forecasts the most severe growth reversal in 2001 since 1974.

JEL codes: E63. E32, E37

Keywords: macroeconomic forecasts, monetary policy transmission, the credit channel, the financial accelerator, Lucas critique, the U.S. recession, oil prices.

1. Introduction

There has been a remarkable shift in perceptions of the U.S. economic outlook between the summer of 2000 and the beginning of 2001. The business cycle has returned with a vengeance when some believed that the ‘new economy’ based on the internet and other new technologies had abolished it permanently. Though there is evidence of a regime shift in the period 1989-92, we find little evidence of shifts since then in relationships governing the cyclical pattern in U.S. GDP. However, the nature of these relationships should be more widely appreciated, particularly as they now point to one of the sharpest downturns in the U.S. business cycle in the post-war period.

There is extensive published research on forecasting U.S. GDP growth. Much of this literature has been concerned with an interest in a specific hypothesis such as the influence of monetary policy, credit conditions or the financial accelerator, stock market prices, oil prices, yield spreads and the yield curve on growth. Typically, these questions have been examined in the context of a narrow, often bivariate VAR. To be fair, much of this work has been less concerned with practical forecasting than with finding evidence for or against some hypothesis.

Another strand of literature is concerned with shifts in the underlying process governing the business cycle, following the work of Hamilton (1989) on Markov switching models. In two-state versions of these models, it is argued that there is a parameter shift in the dynamics between ‘recession’ and ‘recovery’ phases of the business cycle. The bulk of this work, while econometrically sophisticated, has been in a univariate context, though, more recently, Hamilton and Lin (1996) have examined the joint behaviour of stock returns and growth, and Krolzig and Toro (2000) have examined models incorporating information on oil prices and unemployment, where the stochastic process for GDP shifts.

In this paper, we derive a more comprehensive forecasting model for 1955-2000 examining the above influences, but in a wider macroeconomic context where the balance of payments, the exchange rate and fiscal policy also play a role. Moreover, we take seriously the Lucas critique and explore possible consequences of shifts in the monetary policy regime around 1980, see Clarida, Gali and Gertler (1998) and of the fiscal policy regime around 1989, see Muellbauer (1996). We show that, in a range of models, an index of credit conditions as measured in the

Federal Reserve's Survey of Senior Loan Officers, a real stock market price index, an index of real oil prices and/or the rise of inflation over recent levels, have important predictive power, in addition to the short-term interest rate, reflecting monetary policy, and the three macro variables mentioned above. We find that an important shift in behaviour occurred around 1989, consistent with the Lucas critique.

The model is for annual GDP growth but incorporates higher frequency information available in early January as well as information in the form of annual averages. Though the form of the model is a single forecasting equation, a conventional quarterly econometric model or VAR would need at least a dozen behavioural equations to produce comparable four-quarter ahead forecasts. Stability tests suggest that, despite the rich specification, parameter stability in the last two decades has been remarkably good, once the influence of the regime shift in fiscal policy is incorporated.

Section 2 briefly reviews some of the previous literature and provides some theoretical background for our more comprehensive model. The Federal Reserve's Senior Loan Officer Survey was carried out quarterly between 1967 and 1983 and from 1990 to the present. The Appendix derives quarterly econometric models for interpolating the missing observations. Section 3 presents evidence for a range of one-year ahead forecasting model using data in the form of annual averages for the period 1955-1999 plus information from the last quarter or month of each year. In some of these models, only linear trends appear, but we also investigate alternatives which incorporate stochastic trends estimated via Koopman et al's (2000) STAMP package to capture the long-run evolution of the economy and check further robustness issues. Section 4 discusses some of the economic context of 2001 further and concludes.

2. The Economic Background

Important results on output forecasting arise in the context of empirical work on the monetary transmission mechanism. Economic theory suggests higher interest rates curtail consumer and investment spending impacting both directly and via their indirect effects on asset values and income expectations. Many studies use VAR's to examine effects of short-term interest rates or other monetary policy indicators on subsequent output growth, see Sims (1980, 1987, 1996), Todd (1990), and Bernanke (1990). More recently, attention has been given to the 'credit channel', Bernanke and Blinder (1992), Bernanke and Gertler (1995) or the ‘financial accelerator’, Bernanke, Gertler and Gilchrist (1996, 1999). In this framework, the credit terms available to firms depend on the source of finance (e.g inside vs. outside finance) and the terms of such finance can vary with economic conditions. For example, a fall in a firm’s net worth reduces the effective collateral a bank may be able to access in the event of a loan default. Changes in asset prices are thus likely to influence credit terms. More generally, increased uncertainty, a downturn in the economic outlook or a fall in the net worth of banks themselves can all influence the cost of outside finance available to firms by altering the willingness or ability of banks to provide such finance. Some empirical research has proxied credit conditions using spreads between corporate and government bonds as one proxy for such credit terms, see Gertler and Lown (1999), though others have interpreted such spreads instead as a proxy for uncertainty. In what follows, we examine the impact both of short-term interest rates and credit conditions, as measured by the Federal Reserve survey.

Asset prices obviously play an important role in the transmission mechanism, whether one takes a ‘conventional’ asset markets view, see Taylor (1999), or the credit channel view. Research has examined the effects of asset prices and asset price volatility on GDP growth, see Hamilton and Lin (1996) and Estrella and Mishkin (1998). Another financial variable, which has received much attention as a predictor of cyclical activity (as well as of inflation), is the yield curve or the yield gap between short-term and long-term bonds, see Campbell (1995), Estrella and Mishkin (1998), Bernard and Gerlach (1998), and Peel and Taylor (1997).

Finally, the effects of oil prices on the economy have been much studied, see Hamilton (1983), Mork (1989), Hooker (1996), Ferderer (1996), Raymond and Rich (1997), and Clements and Krolzig (2001). Considerable attention has been given to possible asymmetries in these effects, where increases in oil prices damage growth more than decreases in prices benefit growth.

We will embody the above credit, monetary transmission, asset and oil price variables in a more general macroeconomic framework. Following Muellbauer (1996), output growth is captured in a dual adjustment process: firstly, of output to equilibrium output given by an income - expenditure model and secondly, of output to trend output. Trend output is determined, in principle, by the state of technology and physical and human capital stocks. The adjustment process involves spontaneously occurring recovery forces operating in recessions. These might include real wages and real raw material prices falling far enough relative to productivity trends to make production, employment and investment more profitable again, as well as rising replacement demand and low interest rates resulting from the low investment rates associated with recession. The reverse mechanisms operate in booms, together with the high marginal costs associated with overtime hour premia and, in the limit, sheer capacity or labour supply constraints. Large macroeconometric models articulate many elements of these processes. In what follows they will be summarized by a single adjustment equation.

In this equation, three variables capture the self-correcting tendency of growth to fall after final expenditure has overshot capacity and to recover when output is below capacity. The first of these is the deviation of output from trend (though we have also examined specifications in which this is replaced by the unemployment rate). The second is the trade balance to GDP ratio, since excess demand spills over into higher imports. And the third is the deviation of inflation from average inflation in recent years. Empirical research on U.S. inflation, see Stock and Watson (1999), emphasizes the role of the output gap in explaining inflation. It makes sense therefore to investigate this kind of inflation effect as another symptom of over- or undershooting of GDP.

In what follows, we consider the rich set of variables discussed above to capture influences on autonomous demand, including real and nominal interest rates, the government bond yield gap, an index of credit conditions, real stock market prices and the real exchange rate.

A distinction can be made between the structural adjustment process with policy in neutral, and the solved out adjustment process incorporating policy feedback rules. These reflect policymakers' dislike of inflation shocks and of too high unemployment, as well as their possible concerns for balancing government budget and trade accounts. Because the actually observed solved out adjustment process is a mixture of the process that would hold for the private sector with inactive policy and the policy feedback rules of the policymakers, it is likely to shift when policymakers' preferences shift. In other words, the forecasting equation will implicitly incorporate monetary and fiscal policy feedback rules and, in principle, is therefore subject to the Lucas critique.

The dual adjustment process mentioned above can be articulated as follows. When goods markets are in equilibrium GDP (Y) equals total expenditure, consumption (C) + investment (I) + government expenditure on goods and services (G) + exports (X) - imports (M). Suppose private expenditure depends linearly on GDP minus taxes plus an autonomous element A which reflects, for example, interest rates, wealth, the real exchange rate, uncertainty and growth expectations. Then, in goods market equilibrium, equilibrium GDP, denoted by Y* is given by:

$$Y^* = a(Y^* - T) + A + G + X - M \qquad (1)$$

so that

$$Y^* = \frac{1}{1-a}[A + G - aT + X - M] \qquad (2)$$

$$\approx \frac{1}{1-a}[A + G - T + X - M]$$

if a is of the order of 0.8 or more.

There is also some process of adaptation of GDP to trend income (TY), depending on the level of *technology, human and physical capital.

Suppose there is an adjustment mechanism linking actual Y both with Y* and with trend Y:

$$\Delta Y_t = b_1(Y_t^* - Y_{t-1}) + b_2(Y_{t-1}^* - Y_{t-1}) + b_3(TY_{t-1} - Y_{t-1}) \qquad (3)$$

Note that $b_2 > 0$ captures the idea that the adjustment process could be drawn out enough so that last period's deviation of output from the equilibrium level continues to exert some influence this period. Deflating by Y_{t-1} gives the log approximation:

$$\Delta \ln Y_t \approx b_0^* + b_1^* \left(\frac{Y_t^*}{Y_{t-1}}\right) + b_2^* \left(\frac{Y^*}{Y}\right)_{t-1} + b_3^*(\ln TY_{t-1} - \ln Y_{t-1}) \qquad (4)$$

where $\ln TY_{t-1} - \ln Y_{t-1}$ corresponds to the usual concept of an output gap.

Let -(G-T)/Y be denoted GSUR, ie., the government surplus to GDP ratio and -(X-M)/Y be denoted TDEF, ie., the trade deficit to GDP ratio. Then (4) becomes

$$\Delta \ln Y_t \approx b_0^* + \frac{b_1^*}{1-a}[\frac{A_t}{Y_{t-1}} - GSUR_t - TDEF_t] + \frac{b_2^*}{1-a}[(\frac{A_{t-1}}{Y_{t-1}}) - GSUR_{t-1} - TDEF_{t-1}]$$

$$+ b_3^*(\ln TY_{t-1} - \ln Y_{t-1}) \qquad (5)$$

Equation (5) is the economy's approximate structural adjustment equation and becomes a forecasting equation when $[\frac{A_t}{Y_{t-1}} - GSUR_t - TDEF_t]$ is replaced by variables dated t-1 which forecast this term. This forecast will implicitly incorporate monetary and fiscal policy feedback rules and, in principle, is therefore subject to the Lucas critique. In what follows, we consider a rich set of variables to capture influences on autonomous demand including real and nominal interest rates, the government bond yield gap, an index of credit conditions, real stock market prices and the real exchange rate.

As noted above, the output gap $\ln TY_{t-1}$ - $\ln Y_{t-1}$ may not be well measured as the deviation of log GDP from a linear trend. The deviation of inflation from levels in recent years and the trade deficit to GDP ratio, TDEF, are likely to provide additional information on the output gap. Lags in TDEF may therefore reflect persistence in $TDEF_{t-1}$ which helps forecast $TDEF_t$, the direct role of $TDEF_{t-1}$ envisaged in eq(5) and an indirect role via its contribution to measuring the output gap.

The 1980's saw increasing international concern among macroeconomists and latterly policy makers about the long-run sustainability of fiscal policy, see Federal Reserve Bank of Kansas City (1995) and Bryant et al (1993). Correspondingly, in the US, there was a shift in the attitude of policymakers to the federal government's budget deficit. This was signalled by the passing in late 1985 of the first of the Gramm-Rudman Amendments. However, most observers, e.g. White and Wildavsky (1991), see especially the Postscript, agree that the Budget Enforcement Act of 1990 was the most important milestone. This appears to be the key shift in the fiscal policy feedback rule since the 1950's and also coincides with the end of the Cold War, and the decline in defense spending which followed.

As far as shifts in the monetary policy feedback rule are concerned, Clarida, Gertler and Gali (1998) argue that 1980 marks the key shift. Under Federal Reserve chairmen Volcker and Greenspan, the Federal Reserve became more committed to fighting inflation. Estimates of extended Taylor rules suggest that, from 1980, a rise in inflation was followed by an even greater rise in nominal interest rates so that real interest rates rose, while this was not so before 1980. Below, we test for both of these regime shifts.

3. An Annual Model of Per Capita U.S. GDP Growth

At the beginning of each year, the media and stockbrokers' reports predict the economic outlook for the coming year. It is reasonable to want to forecast the annual average of GDP relative to last year's annual average. One can consider several different information sets for forecasting. One consists just of annual average data, which gives the broad picture of business cycle dynamics for the last 45 years. If last year's annual average of data drawn from the national accounts is in the information set, this strictly speaking, means that forecasts cannot be made until end-January, when the 4th quarter data from the national accounts are published – unless the 4th quarter data are themselves forecast. Confining oneself to data in annual average form, however, is unnecessarily restrictive. A wider information set therefore supplements these data with information available at the beginning of each year about the last month or quarter of each year. We therefore consider the deviation of available monthly or quarterly data from the annual average.

Our dependent variable is DLGDP(t+1), the annual growth rate of U.S. real GDP minus DLWAPOP(t), the growth rate of the working age population one year earlier. The reason for this form of the dependent variable is that this year's growth rate of the working age population is the best simple forecast of next year's. All regressors in the model are dated t or earlier, reflecting an information set up to January of year t+1. An important feature of our model is the tendency of output growth to correct recent supply-demand imbalances. As noted earlier, we include three measures of such imbalances. The first is an output gap. One measure of the output gap is the deviation from trend of real log GDP scaled by working age population.[1] Our model therefore includes LGDPW (log per capita GDP) and the trend. The second measure of supply-demand imbalances is the trade deficit-to-GDP ratio, TDEF. The final measure is the deviation of inflation in year t from recent average inflation rates, INFLD, where we take average inflation in the previous four years, t-1 to t-5, as the relevant indicator. Research on U.S. inflation, e.g. by Stock and Watson (1999), has emphasized the importance of supply-demand imbalances on the inflation deviation, so it seems useful to take the deviation of inflation as an additional indicator of such imbalances.

As well as the tendency towards correcting such imbalances, a kind of trend reversion or 'equilibrium correction', it seems likely that GDP also has short-term momentum or persistence. Thus end-of-year news about the cyclical position of the economy is likely to make a useful contribution to forecasting the annual average of GDP.[2] We find the deviation of weekly hours of work in the last quarter from the annual average, WHDLQ, to be very informative in this respect and this measure is available on the first Friday of January, and is not usually subject to significant revision.

Our other regressors include a range of financial and credit variables likely to influence autonomous demand (i.e. separately from the effects of current income on demand). These are the change in the nominal 3-month Treasury bill rate, DIR, the level of the real short-term interest rate, RIR defined as the T-bill rate minus current CPI inflation, the index of tighter loan standards from the Federal Reserve's quarterly Survey of Senior Loan Officers of around eighty major banks, TLS, the log S&P stock price index deflated by the CPI, LSP, a measure of stock market volatility, STOVOL, and the yield gap defined as the yield on one-year Treasury bonds minus the yield on ten-year treasury bonds. The other variables are the log real oil price index, LOILP or its deviation from its lagged 5-year moving average, DEVOIL, the log real exchange rate, LREER, the primary federal government budget surplus to GDP ratio, GSUR, and the federal government debt to GDP ratio, GDEBT. The reason for including the nominal interest rate in difference form lies in the fact that in a potential high inflation period, when nominal rates are high, one would not necessarily expect growth to be low for that reason.[3]

End-of-year news about some of these variables might be expected to contribute to forecasting annual GDP in the following year. So we check whether the difference between the December

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[1] For the U.S., (minus) the unemployment rate is a good alternative proxy for this. It also has the advantage of being available by the second week of January, while GDP data only come in later and are subject to considerable revision. We therefore present alternative versions of our models, which use the unemployment rate as the output gap proxy.

[2] As is well known, GDP is very persistent in quarterly data. The persistence of LGDPC as measured in a simple ARI process will be considerably higher at a one-quarter gap than at a four-quarter gap. If the regression coefficient of Y_t as Y_{t-1} is b on quarterly data, it should be about b^4 in the regression of Y_t on T_{t-4} or in the analogous regression on annual data.

[3] Hendry (1995) uses the term 'congruent' to describe this type of constraint on a feasible model.

value and the annual average of the T-bill rate, the index of tighter loan standards, the stock price index and the oil price have any forecasting potential.

Two regime shifts were discussed in the previous section. To handle the possible shift in the monetary policy regime in 1980, we define a step-dummy D80 to be zero up to 1979 and one from 1980. We then interact it with current and lagged values of our interest rate variables. To handle the fiscal policy regime shift in 1989, we use the dummy variable used for a similar purpose[4] in Muellbauer (1996). To phase the shift in gradually, we define D89 to be zero up to 1988, 0.25 in 1989, 0.5 in 1990, 0.75 in 1991 and 1 from 1992 onwards. We then interact this with current and lagged values of GSUR and with GDEBT[5]. We might expect GSUR to have the conventional Keynesian effect on output growth up to 1988: the larger the surplus, the less short-term growth, implying a negative coefficient on GSUR. From 1989, we expect this effect to weaken or reverse as surpluses are increasingly seen as a signal for lower taxes or greater spending in the future, making consumers and businesses more optimistic. Similarly, once the private sector realized that the federal government was seriously concerned about the government debt to income ratio, one would expect high levels of this debt to have a negative influence on future growth. The Data Appendix summarizes the terminology and data sources.

Even with only two lags, i.e. information dated t and t-1, the general model is very rich, at least by typical North American econometric practice. However, recent literature on ‘general to specific’ model selection procedures, see Hoover and Perez (1999), Hendry (2000) and Hendry and Krolzig (1999), suggests that sensible model selection procedures, using a variety of criteria, including fit, lack of residual autocorrelation and parameter stability, can select parsimonious reductions which are surprisingly free of ‘pre-test bias’ problems[6]. Moreover, we have plausible priors for all the signs of the explanatory variables, given the theoretical framework and standard economics, which predicts that higher interest rates, tighter loan conditions, a more overvalued real exchange rate, a fall in the stock market and higher oil prices all reduce next period’s growth.

Our reduction procedure operates in two steps. First, we check that in the general model there are no significant effects contradicting these sign priors. This turns out to be true. Then we eliminate

[4] But to forecast personal non-property income per head.
[5] Since GSUR is closely related to changes in GDEBT, we only include the t-dated value of GDEBT in the general equation.

insignificant 'wrong-signed' effects. To protect against the possibility of omitting t-2 dated effects, we look for significant t-1 dated effects. Whenever we find one, we add the t-2 effect for that variable. With this temporarily expanded model, we now follow again a 'general to specific' model selection strategy. Log GDPW appears as a two-year moving average LGDPWMA. The trade deficit to GDP ratio appears as a lagged two year moving average. This is the only variable where a t-2 dated effect appears. One interpretation of the lack of significance of a t-dated effect is that the two other indicators of supply-demand imbalances, the deviation from trend of output and the deviation of inflation from levels in recent years, mop up the t-dated supply-demand imbalance. It is also likely that switching costs imply considerable hysteresis in trade patterns.

The yield gap is always insignificant. The real interest rate effect appears as a first difference and the difference of the nominal interest rate is insignificant. The index of tighter loan standards, the real stock market index and the real oil price are significant as current levels though its deviation from its five-year moving average, DEVOIL, fits best as a two-year moving average, DEVOILMA. Stock market volatility, using monthly data, appears to enter as a two-year moving average. The December deviation of the real stock market index from the annual average, LSPD is also quite important. It is most significant in the form of an annual difference, DLSPD.

Regarding potential policy shifts, we find slight evidence, but not statistically significant, that before 1980, changes in nominal rates had somewhat stronger negative effects, while from 1980, changes in real rates had somewhat stronger negative effects.[7] The fiscal policy shift, however, in 1989 is strongly significant and can be simply represented by interacting our D89 dummy with government debt/GDP, represented as GDEBT*D89. The government surplus to GDP ratio, GSUR does have a negative coefficient before 1989 and a positive one from the early 1990's, but neither effect is significant. The effect of GDEBT*D89 implies a significant slowing of economic growth from 1989, though as government debt is reduced in later years, this negative effect tends to wear off. We cannot rule out the possibility that other factors might be contributing to this effect, for example, over-investment in the late 1980's in commercial real estate, which led to a long

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[6] In which the investigator mis-states the size of the test, so increasing the risk of choosing to include variables not in the data generation process, which happen to have a sample correlation with the dependent variable.

[7] However, note that in the Appendix, we find evidence of a shift in the determinants of the index of tighter loan standards, TLS. Indeed, there is evidence that from 1980, a higher *level* of real interest rates raises TLS.

slump in this market and contributed to low rates of investment in the early 1990's, see further discussion later.[8]

Some results are shown in Table 1 and the last row shows the implied forecast growth rate of GDP (NOT in per capita form). Column 1 of Table 1 shows one of our best-fitting parsimonious specifications estimating for 1955-88. Column 2 shows estimates for 1955-95 and column 3 for 1955-99. Parameter stability looks satisfactory. The growth forecast for 2001 is for a 0.6% contraction. Compared with 4.8% growth in 2000, this is a striking change.

We know that the American economy has become more open in the last 35 years: the ratio of non-oil imports to GDP has risen steadily from under 3% in 1965 to over 11% in 2000. This suggests that the responsiveness of output growth to the real exchange rate has increased over time. Recursive estimates of the parameters suggest that the real exchange rate coefficient has indeed become more negative. In column 4, we therefore display a specification in which the deviation of LREER from its 1965 value is interacted with a split trend which is zero up to 1965, 1 in 1966, 2 in 1967 etc., giving the variable denoted LREER*. LREER then has a coefficient of effectively zero ($t \approx 0.3$) and can be omitted. This specification fits a little better than that of column 3.

Lagrange multiplier tests for residual autocorrelation at lags up to two years are shown in the penultimate row of Table 1 and are satisfactory. Tests for heteroscedasticity and normality of the residuals are always satisfactory.

The assumption that the deviation of output from a *linear* trend is a good representation of the output gap seems a strong one and is worth checking for non-linearities. We therefore re-estimated these equations using the STAMP software of Koopman et al (2000), which uses Kalman filtering to estimate a stochastic trend. This, however, confirms the linear trend.

Perhaps the most controversial aspect of our model arises through the GDEBT*D89 term, which as noted above, implies a strong growth slowdown from 1989 into the 1990's. If we omit this term and re-estimate the model in STAMP, we obtain the results shown in Table 1, column 6. The

8 Incidentally, if we include a 'capital deepening measure' defined as the log of the real capital stock relative to working age population, this typically has a negative but insignificant coefficient. One interpretation is that overinvestment has demand consequences that, on average, overcome the contribution of the capital stock to trend output, given that a linear time trend is included in the equation.

stochastic trend now estimated by STAMP is specified as an I(1) stochastic intercept and shows a sharp slow-down in growth after 1989, followed by the resumption of trend growth at broadly similar rates several years later, see Figure 3. The stochastic trend can be thought of as a slightly smoothed estimate of the effect of omitted I(1) variables which therefore ‘robustifies’ the forecasting procedure: the one year ahead forecast assumes that the I(1) component remains the same at t+1 as at t. With the exception of the coefficient on LTDEFMA(t-1), the parameter estimates are similar to those shown in columns 1 to 4. The forecast growth rate in 2001 is –1.0% %, marginally worse than the other columns, despite the lower coefficient on LTDEFMA(-1). However, if we estimate up to 1988 using STAMP, the coefficient on TDEFMA(t-1) rises to the levels found in columns 1 to 4, see column 5. In other words, parameter stability is better for the specifications incorporating GDEBT*D89 than for those omitting it.

We show recursive estimates, computed in Doornik and Hendry’s (1998) PCGIVE, of the beta coefficients and the recursive Chow test for a structural break for the column 3 specification in Figure 1. The Chow test tests the hypothesis of a structural break between the point in the sample at t and the end of the sample. Parameter stability looks satisfactory once the shift in the fiscal policy reaction function in 1989 is allowed for. Omission of the inflation effect results in a worse fit but a much more significant oil price effect before and after 1979.

Let us now consider the orders of integration of the data. Augmented Dickey-Fuller tests suggest that the I(0) variables in the data set are per capita output growth, the interest rate changes and the last month deviation in the stock price index and in weekly average hours of work. The remainder, the output gap, the debt to GDP ratio, the trade deficit to GDP ratio, the real exchange rate, the real stock market price index and the index of tightening loan standards all appear to be I(1). The model suggests at least one co-integrating relationship between these variables. Given the structural break in 1989, applying formal procedures such as the Johansen procedure to investigate cointegration for the full sample is difficult. On the other hand, applying it to the period 1955-88 with such a rich set of variables is likely to result in tests that lack power.

An indication of the contribution of each of the regressors to the change in U.S. log GDP is found in Figures 2a, 2b and 2c, which weight each variable by its estimated coefficient using Table 1, column 3. This provides interesting historical decompositions of U.S. business cycle fluctuations. The contribution of the rising stock market and the falling government debt to GDP ratio in the second half of the 1990's is notable. Note that the recursive estimates shown in Chart 1, for the two stock market effects, LSP and DLSPD, suggest that the estimated coefficients have been stable for 20 years[9] and are not merely picking up some chance correlation between the stock market and growth in the late 1990's. However, this conclusion may depend on the interpretation of the 1990-91 recession.

We have also investigated the use of a broader measure of wealth than the stock market index using the Federal Reserve's household balance sheets for the end of each year. The models always fit less well but give broadly similar forecasts.

In Table 2, we show comparable specifications, which use the unemployment rate UR instead of LGDPWMA. Shimer(1998) argues that the average unemployment rate is distorted as a measure of supply-demand imbalances by variations in the age composition of the labour force. As is well known, unemployment rates for recent entrants to the labour market tend to be higher. We therefore included the proportion of the labour force aged 16-24, LFYT, which peaks in the early 1980's, to correct for this. Indeed, its lagged value has a significant negative coefficient and the goodness of fit of these equations is comparable to those in Table 1, though both the oil price and stock market volatility have weaker effects. Kalman filter estimates using the STAMP package and an I(1) specification of a stochastic level effect give the results shown in columns 5 and 6. As in the comparable column in Table 1, GDEBT*D89 is omitted in column 6 with comparable results. The forecasts for 2001, shown in the last row of Table 2, are for 0.1% or zero growth in columns 3 and 4 and for -0.2% growth in column 6.

The 1990-91 Recession and Its Aftermath

One of the puzzles in U.S. post-war business cycle history is the 1990-91 recession and the relatively slow recovery, which followed it. Blanchard (1993) suggests a proximate cause in the decline of consumption and non-residential investment but offers little explanation for why these occurred, aside from the observations that consumer confidence remained low for two years after the invasion of Kuwait in August 1990. Hall (1993) considers a wide range of possibilities including a rise in marginal tax rates, a negative productivity shock, a credit crunch afforced by

[9] Note that since LSP and DLSPD have similar coefficients, these two effects can be reparameterized as the two year moving average of the log real S&P index and its annual December to December change.

tighter bank regulation and a spontaneous decline in consumption, reflecting lower income expectations. Walsh (1993) also put a large weight on a shift in the IS curve using evidence from a quarterly VAR of output, inflation, the T-bill rate and M2 but without, in turn, explaining this. Bernanke and Lown (1991) investigate the credit crunch hypothesis in some depth, providing evidence that it played a significant role in the 1989-90 downturn. Hansen and Prescott (1993) raise the possibility of a downturn in the growth of productivity.

Perhaps the most suggestive interpretations emerge in a series of papers by Runkle (1990, 1991, 1992). He provides evidence from the Bayesian vector autoregression (BVAR) model at the Minnesota Federal Reserve developed by Doan, Litterman and Sims (1984), see also Litterman (1984). Runkle also draws heavily on ancillary information. In his 1991 paper he notes that the period since 1989 had seen the second weakest consumption growth since 1948. Among factors he cites are the government budget constraint - the fiscal plight of state and local as well as the Federal government, and the possibility that with the rise of labour participation and hours in the 1980's, households were now anticipating a slower rise in permanent income. He suggests that the weakness of the residential property market also helps explain weak consumption growth, though he finds no evidence for a forecasting role for house prices in the Minnesota Fed's forecasting model. Like Bernanke and Lown (1991), he notes the decline in the commercial real estate market which was holding back non-residential investment.

Our models shown in Table 1, columns 2 to 4, place a large weight on the regime switch in fiscal policy between 1989 and 1992. Figure 2a makes clear that the trough in growth occurred in 1991. While tighter loan standards (TLS) reflecting the credit crunch in 1990, see Figure 2b, and the decline in the stock market at the end of 1990 (DLSPD), see Figure 2c, help explain the down-turn, there are also important offsetting factors, particularly the improvement in the trade deficit relative to GDP, TDEFMA(-1), see Figure 2a.[10] In our model, the fall in GDEBT*D89, thus contributes an important missing link. Furthermore, the continued decline in this term to 1992 helps explain why the pick-up in GDP growth from 1991 to 1993 was not more dramatic given the positive contribution of the output gap, the improved trade deficit relative to GDP, lower inflation, easier loan standards, lower oil prices, a rising stock market and even the rise in weekly hours at the end of 1991. The GDEBT*D89 term provides one explanation for the decline in consumption noted by

[10] To which both the fall in the real exchange rate from 1986 and the tightening of fiscal policy in 1989, will have contributed.

all observers of the 1990-91 recession since the new fiscal policy regime associated lower future after tax income growth with a high level of government debt (debt levels peaked in 1994).

Figure 2c suggests that the weighted GDEBT*D89 term tended to depress growth even after 1992, especially compared with the period before 1988. From the early 1990's, there were strong positive contributions to growth from higher real stock market prices and lower real oil prices. To explain the realized growth outcomes, offsetting negative factors were required. Some of these came from the deteriorating trade deficit, a higher real exchange rate and after 1994, tighter loan standards. It seems, however, that these were insufficient to offset the positive forces and the GDEBT*D89 term can be seen as supplying the missing negative ingredient.

The sheer size of the effect, however, remains problematic and it seems too large to represent only the effect of a shift in the fiscal policy feedback rule. We attempted to investigate one aspect of the shift in the fiscal policy feedback rule by estimating a separate forecasting model for GSUR, the ratio of the primary federal surplus to GDP. Figure 4 graphs GSUR and the ratio to GDP of the debt of the federal government. The graph makes clear the extent of the regime change in the behaviour of GSUR. From 1992 to 1999, there was a massive contraction in net expenditure from this source, which should have had a corresponding negative effect on GDP. However, although the fitted GSUR(t+1) typically has a negative coefficient, we typically do not find these effects to be significant.

As noted above, another contributing factor to the 1990-91 recession and subdued growth in the early 1990's was the aftermath of the commercial property boom and the associated overbuilding in the late 1980's. This left low property prices and high vacancy rates into the mid 1990's and low rates of gross investment by businesses in buildings for this period. In Figure 5 we display data on the rate of return in commercial property and the ratio to GDP of investment in non-residential building. However, by the second half of the 1990's, this negative factor should have largely disappeared. Yet, as Figure 2c reveals, the negative effect of the GDEBT*D89 term moderated only a little in the second half of the 1990's.

The housing market also suffered what appears to have been the first sustained falls in nominal prices since the 1950's. At the broad regional level, the North-East after 1989 and the West after 1991 were the regions in which median house prices fell, while median prices for the Mid-West and the South continued to rise. It seems likely that the experience of negative net housing equity and higher rates of foreclosure would have dampened both the supply of credit and the willingness of households to spend, particularly in these regions. A very crude proxy for negative equity can be obtained by taking the negative deviation from the previous peak median price. Multiply by the number of units in the affected regions and divide by total US personal disposable income. This peaks at 9% in 1983, see Figure 6. At one level, this indicator, NEGEQ, overstates negative equity since it implicitly assumes 100% loan to value ratios for all house owners. One the other hand, the median house price data disguise local and individual variations and so greatly understate the prevalence of negative equity. It seems likely that NEGEQ is strongly correlated with the correct concept.

We have argued that the Table 1 and 2 specifications may be exaggerating the effect of GDEBT89. We now investigate whether a mixture of calibration and estimation, which makes a rough allowance for negative equity in the housing market and for high vacancy rates and early scrapping in the commercial property market, produces plausible results. A simple proxy for the underutilization and early scrapping of part of the stock of buildings in this period is to assume that a temporary reduction occurred in the growth rate of underlying capacity. A negative effect from a split trend, T8995, from 1989 to 1995, i.e. zero up to 1988 and rising from 1 in 1989 to 7 in 1995, then remaining at 7 could be regarded as a proxy for such an effect. A coefficient of -0.04 on GDEBT89 seems entirely plausible as a proxy for the shift in fiscal policy, instead of the freely estimated coefficient, which is three or more times as large. If we impose such value, and include NEGEQ and T8995 in the Table 1 specification, we obtain the results shown in Table 3. While the fit is a little worse than Table 1, column 3, the other parameters are quite stable in comparison with the 1955-88 sample. This model implies a longer drawn-out growth slowdown from 1989 to 1995, in addition to the assumed effect of the shift in the fiscal policy reaction function on spending.

Another robustness issue concerns the presence of ‘bubble’ elements in the rise in the stock market, particularly in the second half of the 1990’s. If this had been so, the real stock market index may have become a less successful predictor of GDP growth. There are two main reasons why the real S&P index in year t should help explain GDP growth in year t+1. One is that higher stock prices increase spending: wealthier consumers spend more and firms with access to cheaper finance invest more. The other is that higher stock prices forecast longer term increases in the growth rate since they are supposed to represent the discounted present value of future earnings streams of companies. However, in the presence of a financial bubble, this second factor would weaken and one might then expect a drop in the coefficient on the log real S&P index in the second half of the 1990's. However, conditional upon the inclusion of GDEBT*D89, nothing in the recursive estimates in Figure 1 is consistent with this view. As noted above, if we omit GDEBT*D89 and introduce an I(1) stochastic trend estimated using the Kalman filter, we obtain the estimates shown in Table 1, column 5. These also show no symptom of a drop in the influence of the stock market terms. Instead, they suggest a drop in the coefficient on TDEFMA(-1), the trade deficit relative to GDP, with a compensating rise in the coefficient on LGDPWMA, compared with estimates up to 1988.

There are theoretical reasons why the trade deficit relative to GDP might be imposing less of a constraint on growth over time. For example, after the break-up of the Bretton Woods international payments system in 1971 and the move to flexible exchange rates, one might have expected a reduced role for this constraint. Point estimates of such a shift confirm the direction but the size of the shift is statistically insignificant. The increased international capital mobility of the 1980's could be taken as another reason for such a shift, but the recursive estimates in Figure 1 given no indication of such an effect. One rather speculative argument for such a shift in the 1990's concerns the changes in U.S. corporate financial structures in this period. Holmstrom and Kaplan (2001) argue that, with the spread of stock options for managers, maximizing share-holder value received much more emphasis in corporate decision taking. This may have made the U.S. equity market more attractive to foreign investors so that capital inflows were readily available as the counterpart to higher trade deficits, but without a depreciation of the Dollar against other currencies.

A simple test of this hypothesis is to interact TDEFMA(-1) with D89. Added to the Table 1, column 3 specification, this variable has a coefficient of 0.6 (t=0.9). However, if D89 is also included in the equation, this coefficient rises to 1.5 (t=2.2), leaving a net coefficient on TDEFMA(-1) after 1992 of –0.6, a considerable reduction from values close to –2 estimated in earlier samples. In fact, this specification has current implications very similar to those of the Table 1, column 6 estimates which include a stochastic level and the same point forecast as Table 1, column 3. Remarkably enough, these specification changes have little implications for the one-year ahead forecasts: weakening the role of the trade deficit appears not to result in less negative forecasts.

Implications for 2001

The fall in the stock market at the end of 2000, higher oil prices, tighter loan standards, the rise in interest rates between 1999 and 2000, the high level of the trade deficit, the above trend level of per capita GDP and the high level of the real exchange rate all have negative implications for growth in 2001. The forecasts for U.S. GDP growth (not per capita) in 2001 were shown in the last row of Tables 1 to 3 and range from 0 percent to –1.5 percent. A visual impression of the contribution of each variable to the forecast of –0.6 percent growth from column 3 of Table 1, which is in the middle of this spread, can be obtained by examining the year 2000 plots of each variable in Figure 2, where each variable is weighted by its coefficient estimate from column 1. To see these more precisely, we can decompose the reversal of 5.5 percent from 4.9 percent growth in 2000 to our central forecast of a 0.6 percent decline in GDP in 2001, into the factors shown in Table 4.[11]

The margin of uncertainty around this forecast of -0.6 percent growth is that growth will fall in the range +0.4 to –1.6 percent with a 95 percent probability.

Using the unemployment rate as the output gap measure - see the Table 2 results - gives the forecasts shown in the last row of Table 2. Though the fit of these specifications is marginally inferior to those in Table 1, which use the deviation from trend of GDP per head, the forecasts are uniformly less negative by between 0.7 to 0.8 percent.

Pointers for 2002

While our model forecasts only one year ahead, there are nevertheless some implications for 2002. First, note that the trade deficit-to-GDP ratio only reached its all-time peak in 2000. Its maximum impact on GDP growth is likely to occur in 2002.[12] Second, note that a further drag on the economy in 2002 is almost certain to come from a lower level of real stock prices in 2001. Third, note that the tightness of loan standards in January 2001 was far worse than the average for 2000,

[11] Since the model predicts a 5.2 percent growth rate in 2000 instead of the 4.9% realized, and so a 5.8 percent reversal of predicted rates in 2001, we have scaled the contribution of each estimated factor by 5.5/5.8 to make the figures add to 5.5 percent.

though there has been a little improvement in March and May, see Figure 7. It is certainly a possibility that the annual average of the tightness index in 2001 could be as bad as in 2000. Finally, little relief has come so far from a fall in the Dollar, probably because of the markets' perceptions of the policy agenda pursued by the European Central Bank as well as the still fragile state of banking systems in much of Asia and especially Japan. This suggests that considerable uplift will have to come from the other factors if positive growth is to be restored in 2002. Paradoxically, one of these will be a fall in output from its above trend level, but lower real interest rates and the tax cuts recently passed by Congress will obviously be the key, particularly if they have a positive enough impact on asset values and credit conditions.

4. Conclusions

Our range of comprehensive forecasting models for annual growth of U.S. GDP encompass most of the important variables investigated in econometric research in recent years – and more, because they also incorporate the wider macro context: fiscal policy, the trade balance and the real exchange rate. The models offer an integrated perspective on the U.S. business cycle since the mid-1950's, illuminating such major questions as the effect of monetary policy, changes in credit market conditions, the stock market and oil prices on the business cycle. The models offer strong evidence for the 'financial accelerator' or 'credit channel' views of monetary policy transmission. Our estimates also suggest that the Lucas critique is relevant for forecasting U.S. growth: we find evidence of an important shift in the fiscal policy feedback rule from 1989, consistent with claims by Muellbauer (1996). Increased concerns by policy makers with the federal government deficit and debt, appears to have caused an important shift in the effect of the debt on subsequent growth. However, it is likely that the other factors contributed to the 1990-91 recession and the sluggishness of the subsequent recovery. Conditional on the index of tighter loan standards, we find little evidence of a shift in response to the shift in the monetary policy rule around 1980. However, our investigation of the determinants of this index itself shows clear evidence of a break around 1980.

[12] However, since our discussion has indicated that there is some uncertainty about the current size of the impact of the trade deficit on the growth forecast, this increases the uncertainty about the outlook for 2002.

Whether our comprehensive models exhibit the asymmetries in the business cycle and regime switches in the stochastic process intensively investigated by Hamilton and others remains to be investigated on quarterly data. What is clear is that the models offer some fascinating perspectives on the U.S. economic outlook. For example, the models find little evidence of any speed-up in the underlying growth rate of the economy in the latter half of the 1990's, *given* the real stock market index, the government debt to GDP ratio and the other variables. One obvious interpretation is that the recorded improvements in multi-factor productivity growth have been capitalized in the stock market, the high real exchange rate and perhaps reflected in the decline in the government debt to GDP ratio. The contribution to growth of the rising stock market and the falling government debt to GDP ratio in the second half of the 1990's is notable. However, the fact that demand growth has outstripped supply is indicated in the trade deficit to GDP ratio. More recently, the fall in the stock market at the end of 2000, higher oil prices, higher inflation, tighter loan standards, the rise in interest rates between 1999 and 2000, the high level of the trade deficit, the high level of the output gap and the high level of the real exchange rate all have negative implications for growth in 2001. Indeed, our estimated lags suggest that the record trade deficit to GDP ratio is likely to dampen growth for several years to come.

It is worth spelling out the negative feedback mechanisms operating in the years 2000-2001 via equity and credit markets. Lower share prices have the effect of reducing consumer spending. The consensus view is that, in the U.S., 3.5 to 5 cents of every dollar of stock market wealth is spent by consumers each year, with spending lagging behind share price movements. The longest lags arise from the part of wealth tied up in pension funds lying outside the direct control of households: these tend to adjust contribution rates very slowly in response to changes in asset values.

Business investment too is affected by equity prices, since lower equity prices raise the cost of capital. A sustained fall in share prices, therefore, leads to lower spending and lower income growth, which in turn, by lowering growth expectations can further lower share prices.

The other key ingredient in the negative feedbacks operating in 2001 is the financial accelerator. The notion of the 'financial accelerator' has been used by economists , see Bernanke et al (1996) (though the ideas go back, at least, to Irving Fisher, writing in the 1930's), to describe the process of credit contraction when asset prices fall. Much of the borrowing from banks and other financial institutions is backed by collateral, with both the amount of borrowing and credit terms such as interest rates or duration of loans depending on collateral values. When asset prices fall, collateral backing is reduced, tending to diminish credit availability and raise the effective interest rates at which finance can be obtained. In the last year, the 'spreads' between corporate bond yields and safe government bond yields have risen sharply, signalling that investors have become more concerned about corporate default risks and that credit lines from banks have contracted with the fall in asset values and lower growth expectations. The quarterly U.S. Federal Reserve Senior Loan Officer Surveys show credit conditions tightening in the U.S. throughout 2000 and into 2001, see Figure 7. Spending and therefore growth falls with credit contraction, providing an important aspect of the feedback.

U.S. consumers have a particularly high debt exposure, with household debt to income ratios at the highest levels and the ratio of liquid assets minus debt to personal disposable income at the lowest for 70 years, see Figures 8 and 9. Spending has recently exceeded income because asset values were so high and consumers were confident about future income growth. Many consumers have been financing part of their spending by increasing borrowing. Indeed, default rates on consumer credit have been running at historically high levels, even in these years of record growth and low unemployment. Lower growth and lower collateral values are bound to result in a substantial rise in default rates from current levels, making banks more wary about lending. Lower share prices of banks are likely both to signal the rising proportion of bad loans, and, by limiting the capital-raising opportunities of banks, restrict credit supplies further, see Bernanke and Lown (1991).

In the absence of policy intervention, this analysis points to a downward spiral, such as seen in the collapse of the 'bubble economy' in Japan in the early 1990s and the financial crisis in Thailand in 1997. However, the U.S. Federal Reserve has already lowered the federal funds rate by 2.5 percentage points since January to arrest the process. This appears to be a speedier response than in the 1990 recession. The U.S. economy is much more sensitive to interest rates than the Japanese.[13] Furthermore, fiscal policy has been loosened with exceptional speed. Thus, it is highly improbable that the U.S. could suffer a decade long recession Japanese style.

Practical forecasters almost always add 'judgement' to their forecasts. Indeed, there are some reasons to think that the U.S. GDP outcome for 2001 is likely to be at the positive end of the 95% forecast interval, which is 0.4 to –1.6% for the typical Table 1 model and 0.9 to –1.1% for the

[13] Research with Keiko Murata on Japanese consumer spending makes this clear.

typical Table 2 model. The reasons are as follows: while stabilizing monetary and fiscal responses are implicit in our forecasting model, it can be argued that the speed and scale of the fiscal response were larger than in past down-turns. It was fortuitous that the newly elected President was committed to tax cuts irrespective of the economic environment and then found it easy to obtain moral support from the Federal Reserve and quick approval from Congress in the light of the threat of recession. While the scale of the monetary response has been similar, for example, to that in 1990-1, it can be argued that the speed has been greater. The third positive factor is that the lifetime of IT equipment, where much of investment in recent years has been concentrated is much shorter than for typical investment in past investment booms. The replacement cycle is therefore likely to begin sooner. While this is unlikely to be relevant for the 2001 forecast except insofar as the high import content of this investment means that the pain of the contraction will be shared with the rest of the world, it is relevant for the outlook into 2002.

However, not all the news or additional factors by which one might wish to adjust our central forecasts are positive. There are three negative factors. One is the California power crisis, the result of faulty deregulation of the electricity market and the lack of investment in generating capacity. The second is the scale of the Japanese recession and the associated banking problems not only in Japan but in much of Asia, not yet fully recovered from the 1998 financial crisis. And the third is a double problem in Europe. Here the policy agenda of the European Central Bank threatens to stifle growth. Furthermore, the German economy still suffers handicaps from the attempt to integrate the former German Democratic Republic. These are revealing themselves in the property market slump in the East, associated bad debt problems, the continued high unemployment rate and the fiscal problems generated by more than a decade of high subsidies for the East. Just as the European Central Bank was mistaken in its belief that the Eurozone would be largely insulated from the U.S. downturn, so it would be wrong to believe that the U.S. is completely immune from the rest of the global economy.

However some of these specific factors work out, it is clear that the U.S. economy is undergoing a massive adjustment. Behind the record trade deficit and the government surplus lies a record private sector financial deficit of 7 percent of GDP, see Wolf (2000), and private sector debt relative to GDP at the highest levels since the 1930’s. The asset price levels, which supported these deficits and debt levels, are now seen as having had a serious ‘bubble’ aspect and the deflation of the bubble is well under way. After the high levels of investment in recent years, it is clear that U.S. firms and households will not soon be spending as freely in the new economic environment. Our models suggest that the scale of the short-term GDP adjustment will be dramatic despite the swift response of monetary and fiscal policy.

Table 1: US Growth Forecasting Models

	M 1			M2	M3	
	(1)	(2)	(3)	(4)	(5)	(6)
	55-88	55-95	55-99	55-99	55-88	55-99
LGDPMAW	-0.359	-0.368	-0.34	-0.335	-0.359	-0.457
	[7.3]	[8.3]	[7.7]	[8.0]	[7.3]	[3.3]
INFLD	-0.252	-0.268	-0.287	-0.288	-0.252	-0.241
	[3.7]	[4.6]	[4.5]	[4.8]	[3.7]	[2.3]
D. RIR3	-0.444	-0.442	-0.47	-0.507	-0.444	-0.396
	[5.6]	[6.3]	[6.6]	[7.2]	[5.6]	[4.6]
L. TDEFMA	-2.255	-2.041	-1.926	-2.077	-2.255	-0.739
	[6.2]	[7.5]	[7.6]	[8.5]	[6.2]	[1.6]
LSP	0.055	0.061	0.054	0.054	0.055	0.047
	[5.6]	[8.1]	[11.0]	[11.7]	[5.6]	[3.2]
TLS	-0.03	-0.029	-0.031	-0.031	-0.030	-0.027
	[2.8]	[3.4]	[3.3]	[3.5]	[2.8]	[2.3]
LREER	-0.062	-0.063	-0.074		-0.062	-0.045
	[4.3]	[4.8]	[5.3]		[4.3]	[1.6]
WHDLQ	0.022	0.021	0.021	0.022	0.022	0.023
	[6.5]	[6.9]	[6.5]	[7.2]	[6.5]	[5.8]
D. LSPD	0.07	0.073	0.071	0.069	0.070	0.067
	[8.2]	[9.7]	[8.9]	[9.1]	[8.2]	[6.8]
TREND	0.854	0.854	0.786	0.791	0.854	0.801
	[8.1]	[8.8]	[7.8]	[8.3]	[8.1]	[2.8]
DV73	-0.025	-0.025	-0.026	-0.02	-0.025	-0.022
	[4.2]	[4.7]	[4.6]	[3.7]	[4.2]	[3.2]
DEVOILMA	-0.024	-0.018	-0.017	-0.014	-0.024	-0.019
	[2.4]	[2.5]	[3.0]	[2.6]	[2.4]	[1.7]
STOVOLMA	-0.16	-0.131	-0.264	-0.235	-0.160	-0.154
	[1.3]	[1.3]	[2.6]	[2.4]	[1.3]	[1.0]
GDEBT*D89		-0.138	-0.136	-0.16		
		[12.7]	[11.6]	[11.9]		
LREER*				-0.004		
				[5.9]		
Constant	-15.67	-15.66	-14.327	-14.796	Stoch. level	Stoch. level
	[8.0]	[8.7]	[7.7]	[8.4]		
Observations	34	41	45	45	34	45
Adjusted R-squared	0.9598	0.9599	0.9496	0.9542	0.9861	0.9360
RMSE	0.0048	0.0045	0.0049	0.0047	0.0037	0.0072
DW	2.5868	2.4548	2.0343	2.1733	2.4004	1.8230
LM 2	.0532	.0239	.1743	.2490		
f			-0.006	-0.008		-0.010

Absolute value of t statistics in brackets
LM 2 refers to p-values of Lagrange multiplier tests for second order residual autocorrelation

Table 2: US Growth Forecasting Models with Unemployment Rate

	M 4			M5	M6	
	(1)	(2)	(3)	(4)	(5)	(6)
	55-88	55-95	55-99	55-99	55-88	55-99
URMA	0.955	0.851	0.811	0.901	0.955	1.152
	[5.6]	[5.2]	[4.9]	[5.9]	[5.6]	[3.1]
INFLD	-0.189	-0.245	-0.274	-0.259	-0.189	-0.190
	[2.3]	[3.2]	[3.7]	[3.7]	[2.3]	[1.6]
D. RIR3	-0.404	-0.416	-0.476	-0.492	-0.404	-0.401
	[4.4]	[4.9]	[6.0]	[6.3]	[4.4]	[4.5]
L. TDEFMA	-1.934	-1.762	-1.592	-1.463	-1.934	-0.454
	[4.8]	[4.7]	[4.3]	[4.2]	[4.8]	[0.9]
LSP	0.04	0.048	0.053	0.054	0.040	0.047
	[4.1]	[6.1]	[9.2]	[9.7]	[4.1]	[3.1]
TLS	-0.032	-0.033	-0.037	-0.035	-0.032	-0.029
	[2.9]	[3.2]	[3.7]	[3.7]	[2.9]	[2.4]
LREER	-0.052	-0.064	-0.074		-0.052	-0.042
	[2.6]	[3.5]	[4.2]		[2.6]	[1.5]
WHDLQ	0.022	0.02	0.02	0.021	0.022	0.022
	[6.2]	[5.7]	[5.8]	[6.1]	[6.2]	[5.4]
D. LSPD	0.07	0.075	0.071	0.071	0.070	0.070
	[7.7]	[8.5]	[8.2]	[8.4]	[7.7]	[6.7]
TREND	0.084	0.096	0.093	0.06	0.084	-0.125
	[1.5]	[1.8]	[1.7]	[1.2]	[1.5]	[0.8]
DV73	-0.024	-0.024	-0.024	-0.02	-0.024	-0.024
	[3.9]	[3.8]	[3.8]	[3.3]	[3.9]	[3.5]
DEVOILMA	-0.028	-0.016	-0.005	-0.004	-0.028	-0.014
	[2.1]	[1.7]	[0.9]	[0.6]	[2.1]	[1.3]
STOVOLMA	-0.112	-0.073	-0.118	-0.091	-0.112	-0.067
	[0.9]	[0.6]	[1.1]	[0.9]	[0.9]	[0.4]
LFYT	-0.173	-0.251	-0.294	-0.213	-0.173	0.018
	[1.5]	[2.9]	[3.5]	[2.9]	[1.5]	[0.1]
GDEBT*D89		-0.124	-0.129	-0.132		
		[5.6]	[5.9]	[6.2]		
LREER*				-0.004		
				[4.6]		
Constant	-1.619	-1.816	-1.728	-1.467		
	[1.5]	[1.8]	[1.7]	[1.6]		
Observations	34	41	45	45	34	45
Adjusted R-squared	0.9555	0.9467	0.9419	0.9454	0.9742	0.8864
RMSE	0.0051	0.0052	0.0052	0.0051	0.0038	0.0072
DW	2.5536	2.1673	1.8887	1.973	2.4270	2.0122
LM 2	.0625	.0694	.3543	.3543		
f			0.001	0.000		-0.002

Absolute value of t statistics in brackets
LM 2 refers to p-values of Lagrange multiplier tests for second order residual autocorrelation

Table 3: U.S. Growth Forecasting Models with GDEBT*D89 coefficient set at –0.04

	M 7			M8
	(1)	(2)	(3)	(4)
	55-88	55-95	55-99	55-99
LGDPWMA	-0.359	-0.342	-0.301	-0.291
	[7.3]	[6.4]	[5.4]	[5.1]
INFLD	-0.252	-0.272	-0.284	-0.275
	[3.7]	[3.7]	[3.6]	[3.5]
DRIR3	-0.444	-0.439	-0.436	-0.455
	[5.6]	[5.0]	[4.9]	[5.0]
TDEFMA (-1)	-2.255	-1.987	-1.827	-1.986
	[6.2]	[5.9]	[5.3]	[5.6]
LSP	0.055	0.056	0.047	0.044
	[5.6]	[6.1]	[5.6]	[5.3]
TLS	-0.03	-0.029	-0.031	-0.031
	[2.8]	[2.7]	[2.7]	[2.7]
LREER	-0.062	-0.056	-0.063	
	[4.3]	[3.5]	[3.7]	
WHDLQ	0.022	0.021	0.021	0.022
	[6.5]	[5.6]	[5.2]	[5.5]
DLSPD	0.07	0.071	0.072	0.071
	[8.2]	[7.5]	[7.2]	[7.0]
NEGEQR		0.435	0.244	0.312
		[3.6]	[2.7]	[3.2]
TREND	0.854	0.795	0.696	0.693
	[8.1]	[6.7]	[5.6]	[5.5]
DV73	-0.025	-0.024	-0.025	-0.019
	[4.2]	[3.7]	[3.4]	[2.7]
DEVOILMA	-0.024	-0.019	-0.019	-0.018
	[2.4]	[2.0]	[2.2]	[2.1]
STOVOLMA	-0.16	-0.148	-0.279	-0.274
	[1.3]	[1.1]	[2.1]	[2.0]
T89-T95		-0.512	-0.679	-0.812
		[3.0]	[4.6]	[5.0]
GDEBT*D89	-0.04	-0.04	-0.04	-0.04
	(fixed)	(fixed)	(fixed)	(fixed)
LREER*				-0.003
				[3.6]
Constant	-15.67	-14.578	-12.689	-12.946
	[8.0]	[6.7]	[5.5]	[5.6]
Observations	34	41	45	45
Adjusted R-squared	0.9598	0.9472	0.9406	0.94
RMSE	0.0048	0.0055	0.0061	0.0061
DW	2.5868	2.3777	1.7333	1.751
LM 2	.0532	.2757	.3202	.4878
F 2001			-0.011	-0.015

Absolute value of t statistics in brackets
LM 2 refers to p-values of Lagrange multiplier tests for second order residual autocorrelation

Table 4: decomposing the 2000-2001 growth reversal

Factor	Contribution (%)
Rise in GDP overshoot relative to trend	-0.3
Rise in the balance of payments deficit/ GDP	-1.5
Rise in inflation	-0.4
Fall in last quarter weekly hours of work	-1.1
Rise in annual real S&P index	0.2
Fall in December/annual real S&P index	-1.0
Rise in real T-bill rate	-0.4
Tighter loan standards	-0.4
Higher real oil prices	-0.9
Higher real exchange rate index	-0.2
Lower government debt/GDP	0.5
Lower stochastic volatility	0.0
TOTAL	-5.5

Figure 1: Recursive Estimations, Table 1 Column 3 Model

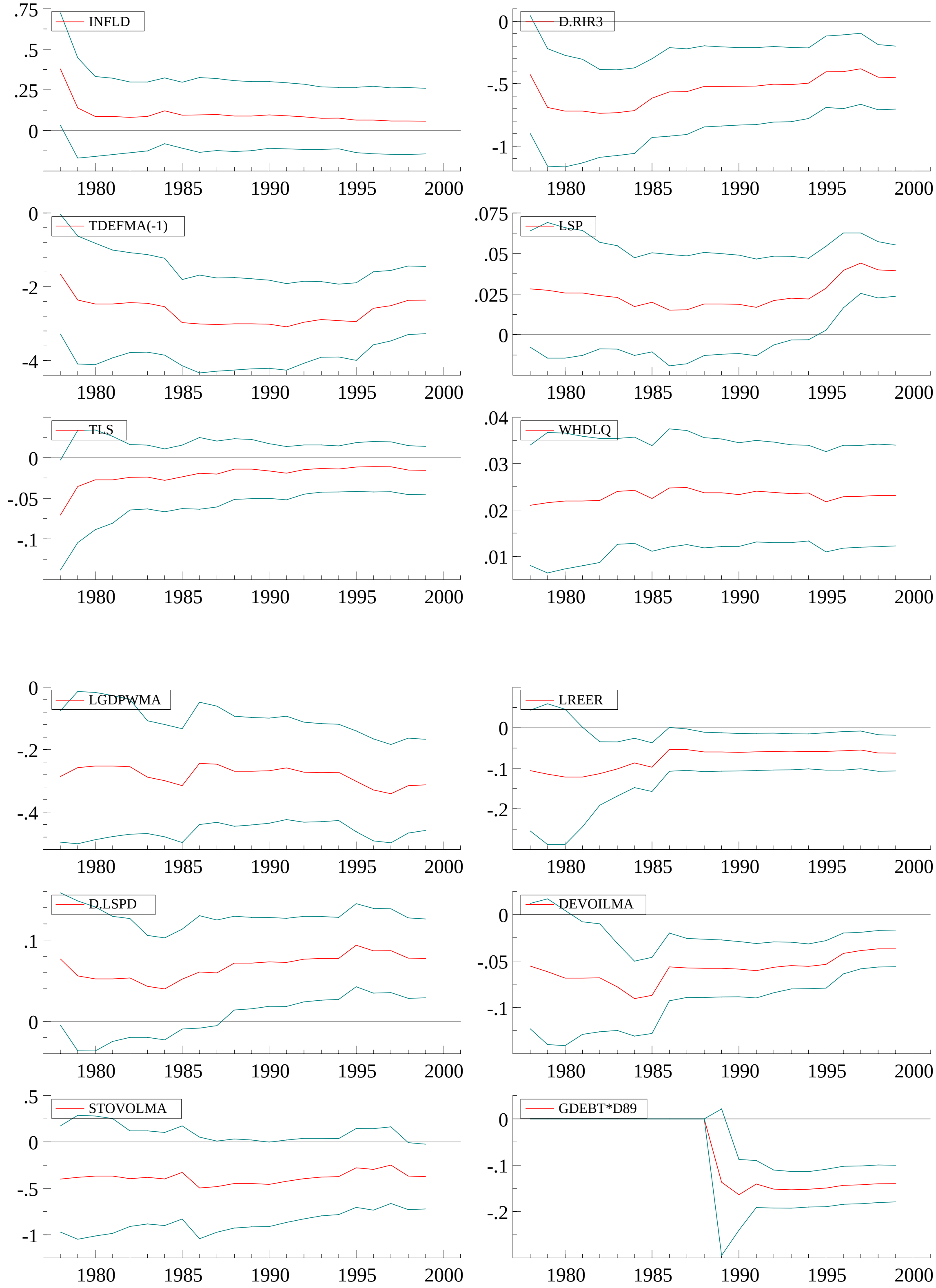


Figure 2a: Regressors Contribution to the Dependent Variable, Table 1 Column 1 Model

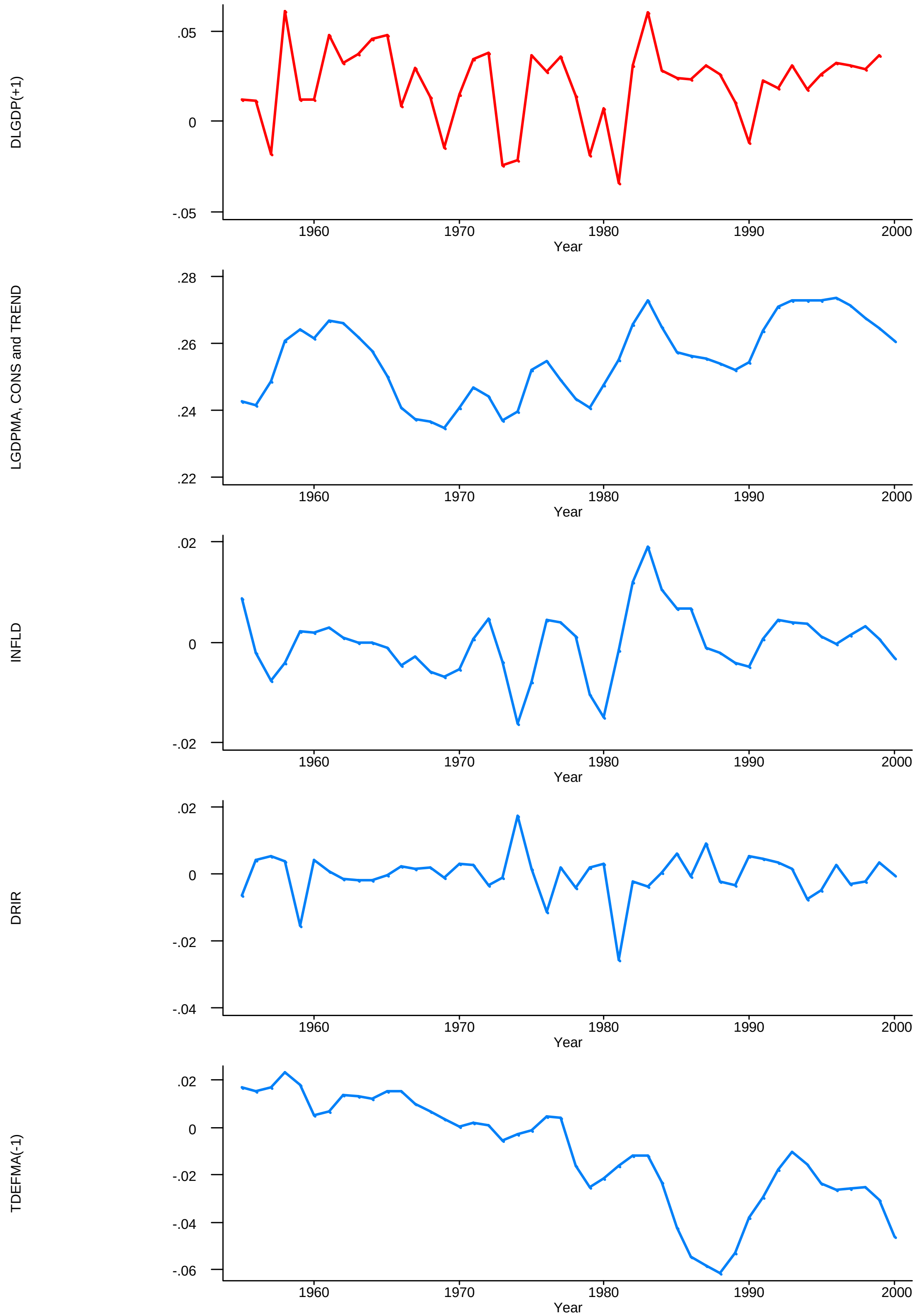


Figure 2b: Regressors Contribution to the Dependent Variable, Table 1 Column 1 Model

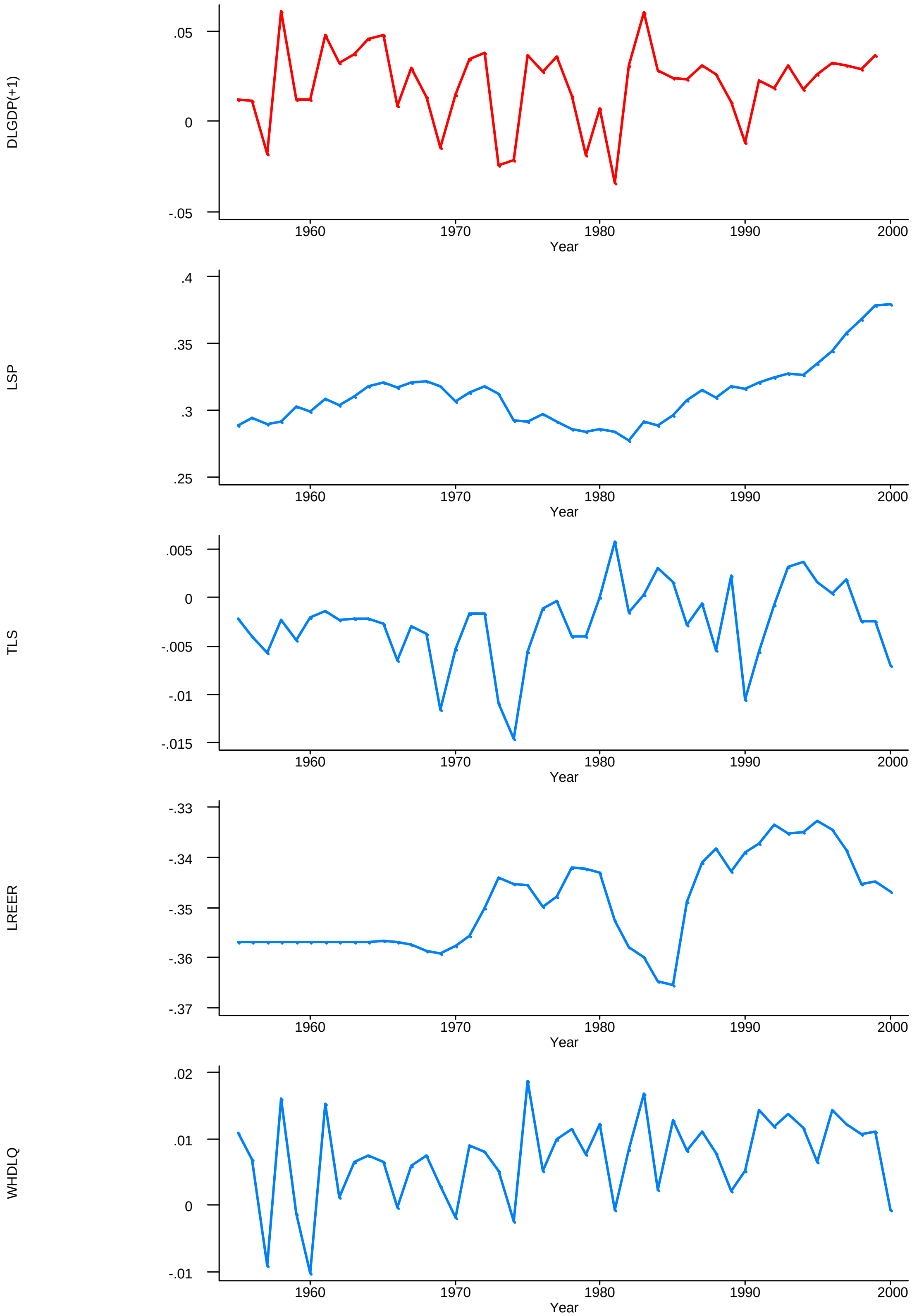


Figure 2c: Regressors Contribution to the Dependent Variable, Table 1 Column 1 Model

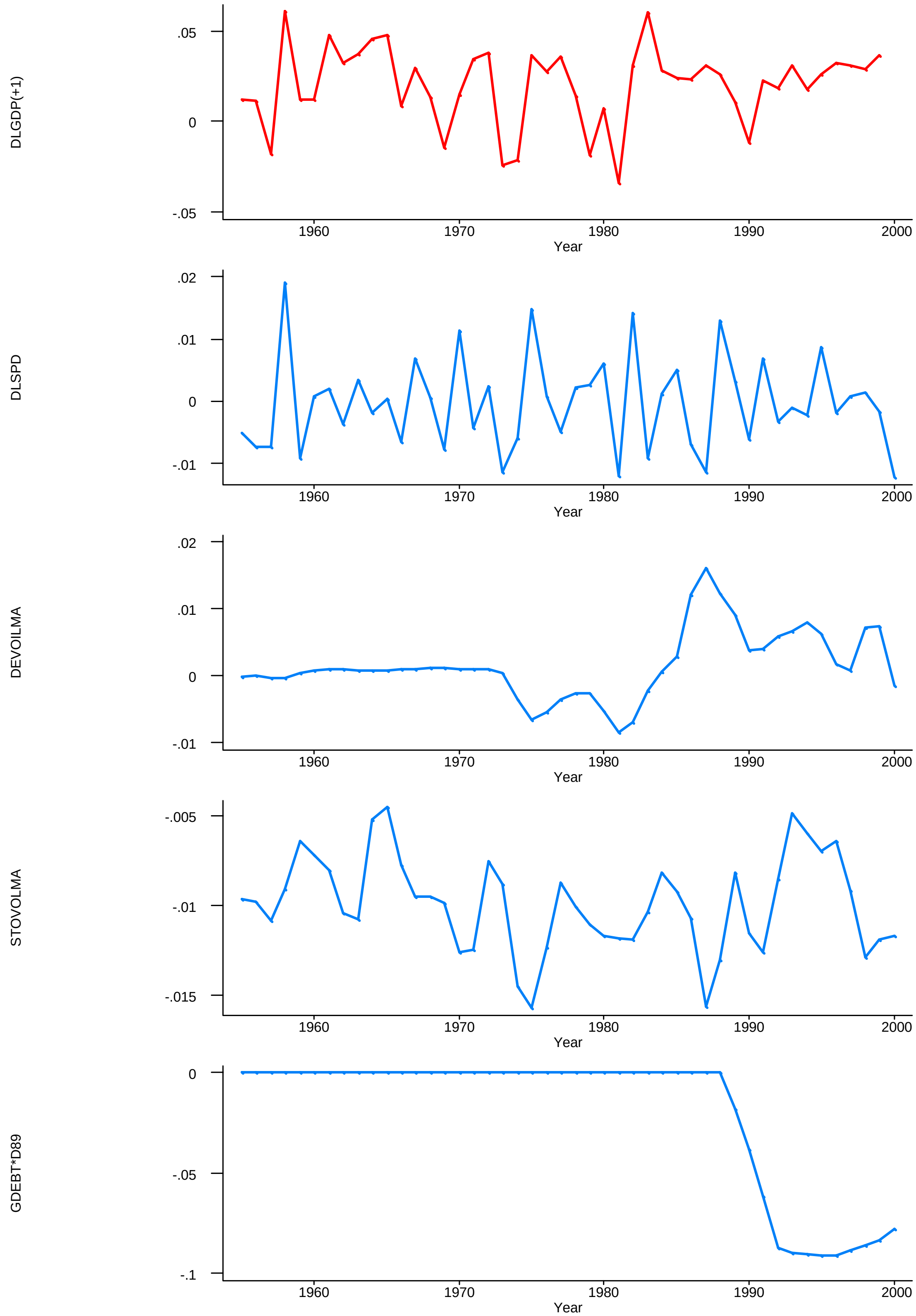


Figure 3: Trend and Stochastic Level, Table 1 Column 3 Model

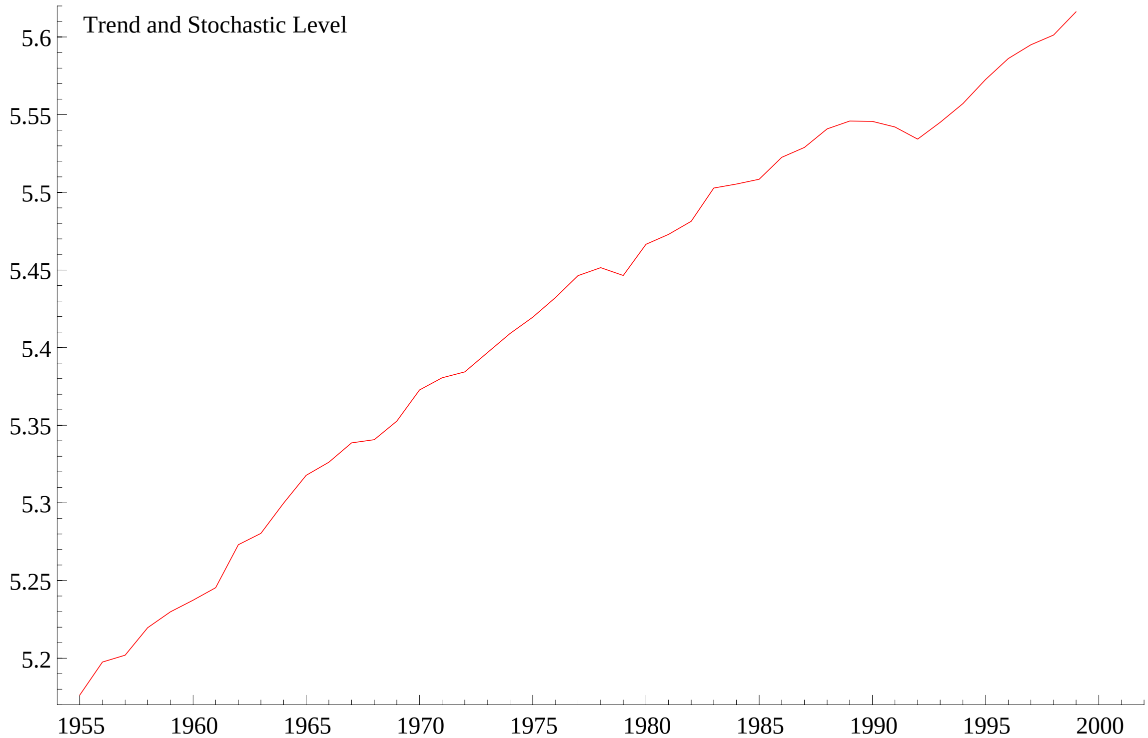
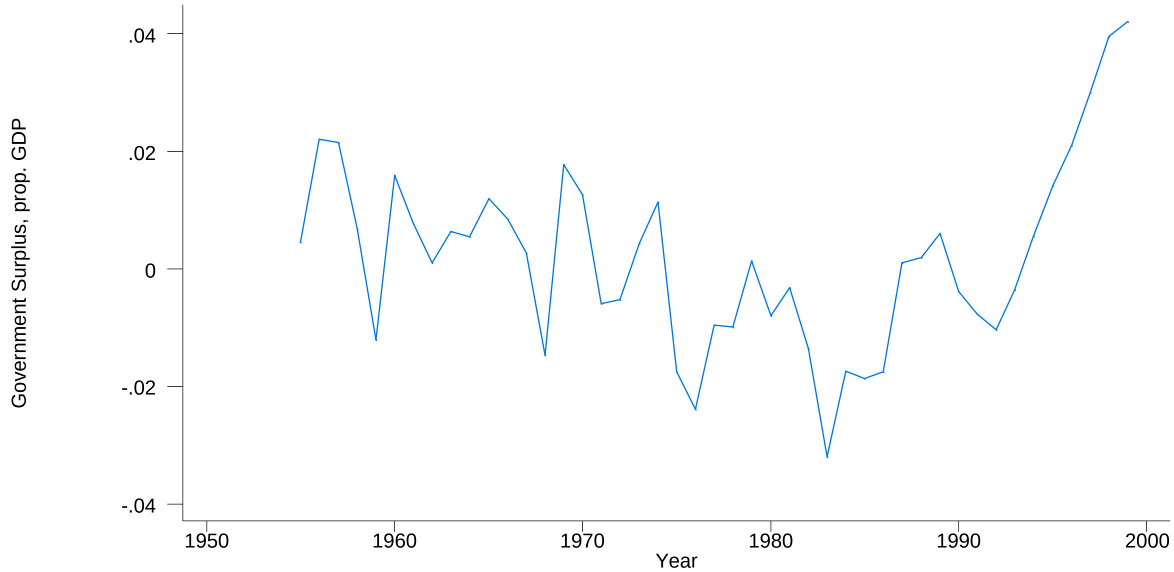


Figure 4: Ratios to GDP of Primary Surplus of Federal Government and Government debt



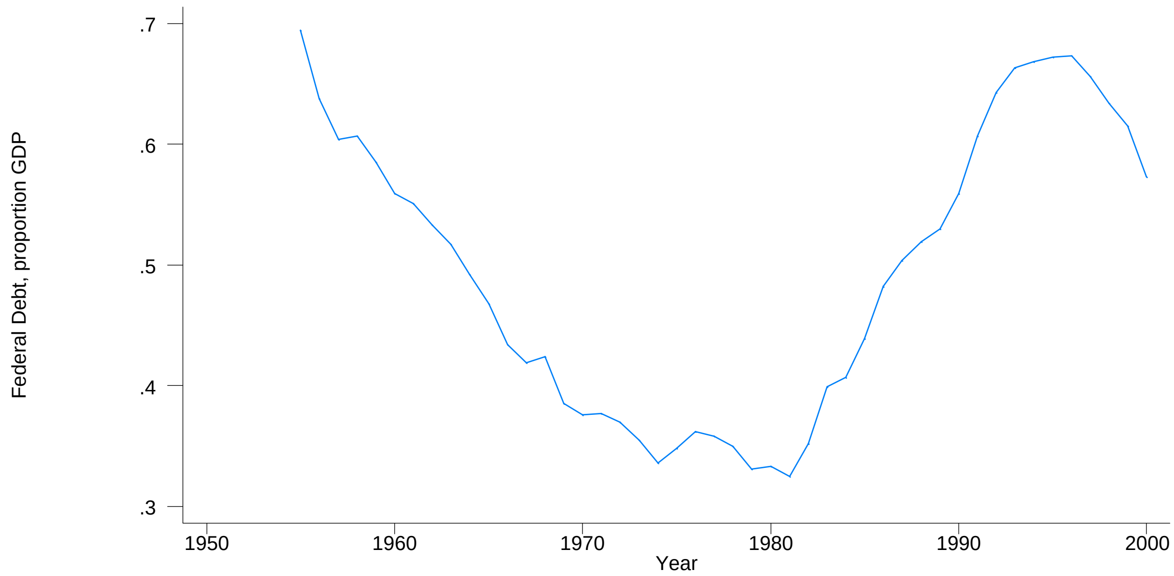


Figure 5: Rate of Return in Commercial Property and Ratio to GDP of Investment in Non-Residential Buildings.

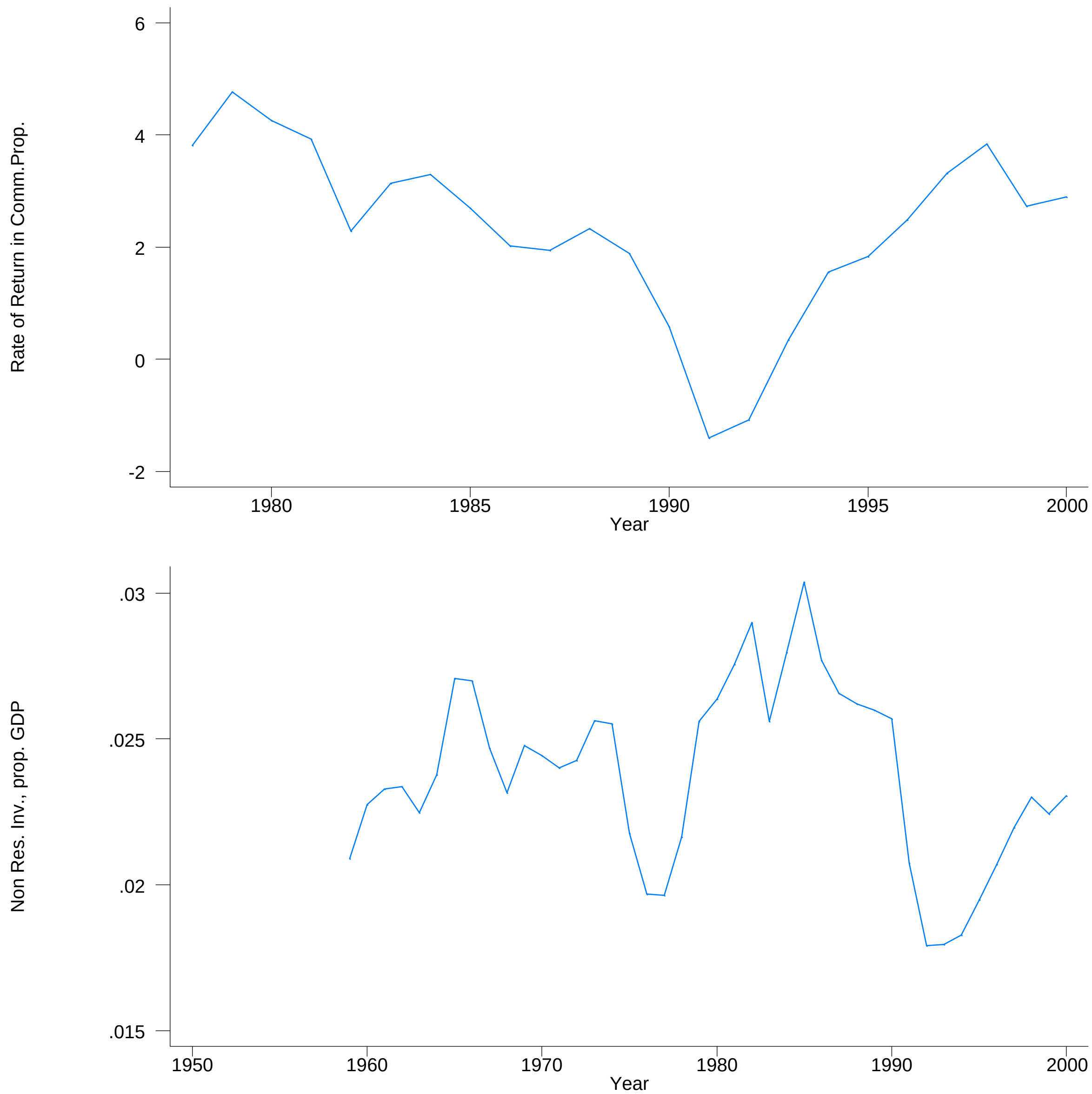


Figure 6: Proxy for Negative Housing Equity

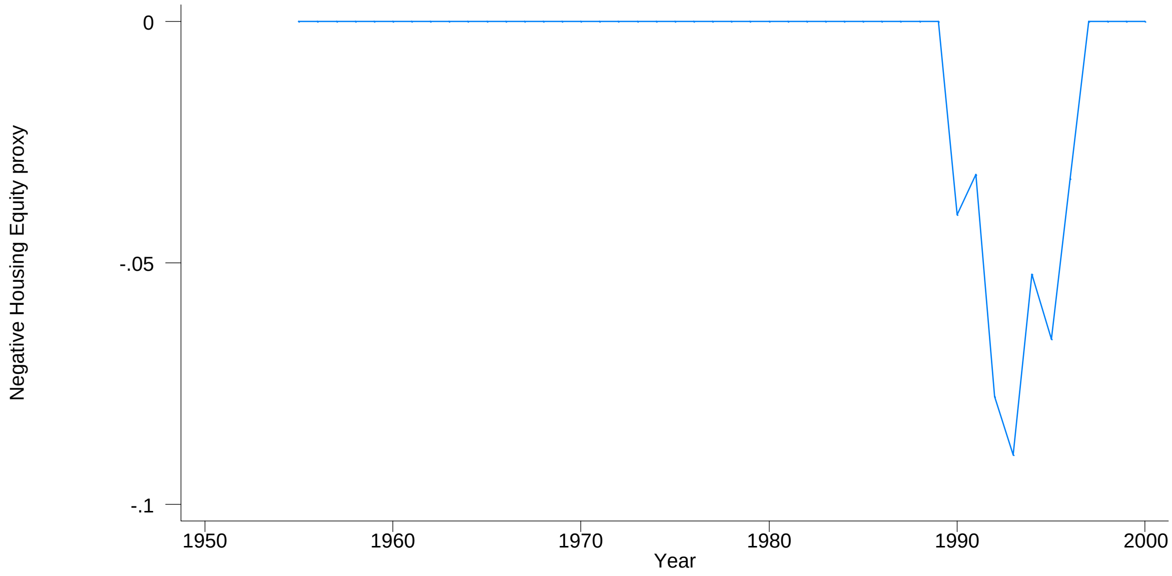


Figure 7: Measures of Supply and Demand for C&I Loans, by size of firms seeking loans

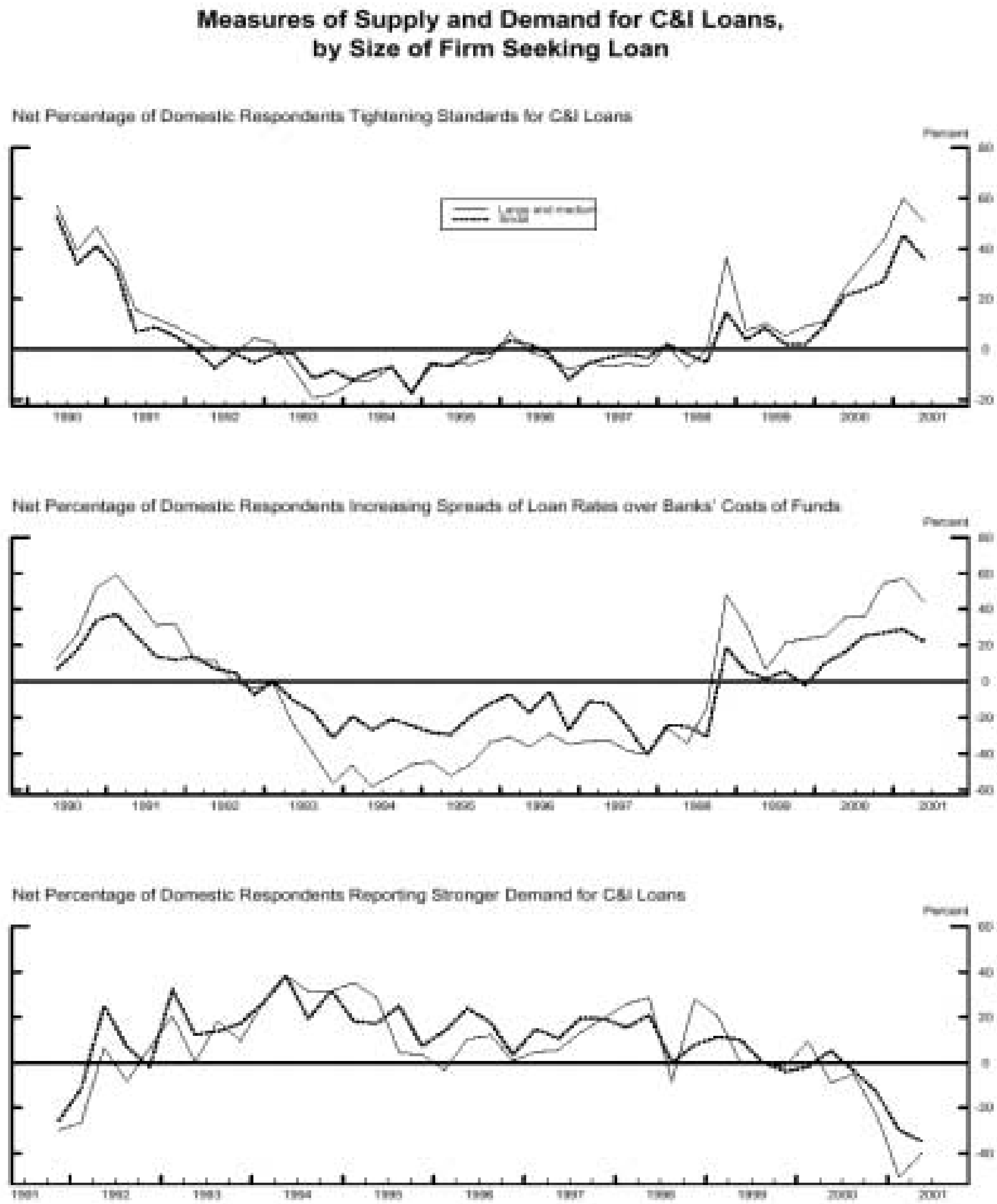


Figure 8: Household Ratio of Debt to PDI

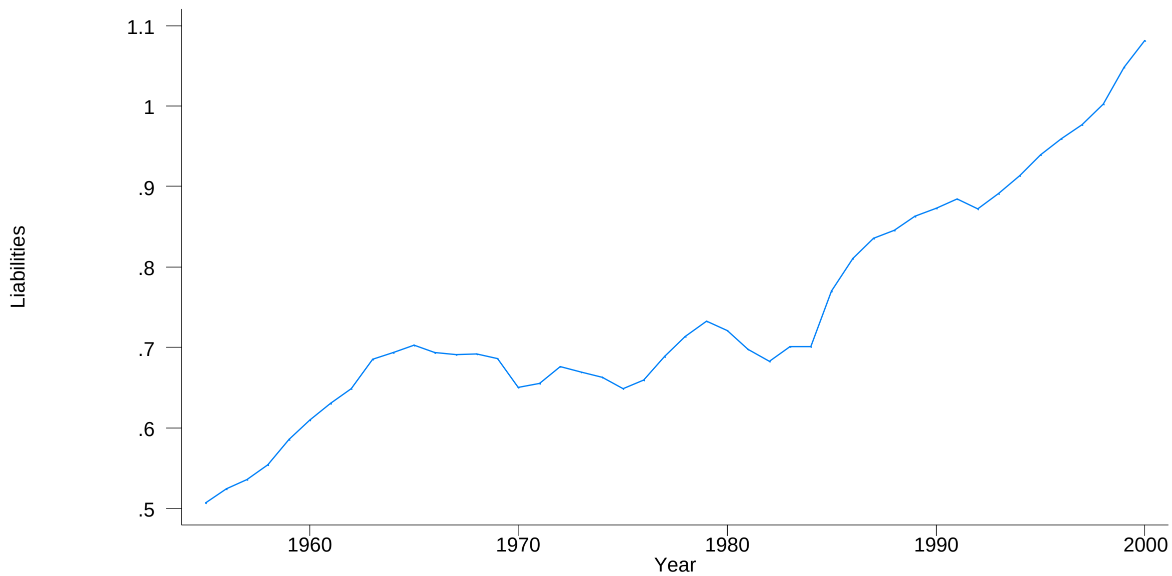
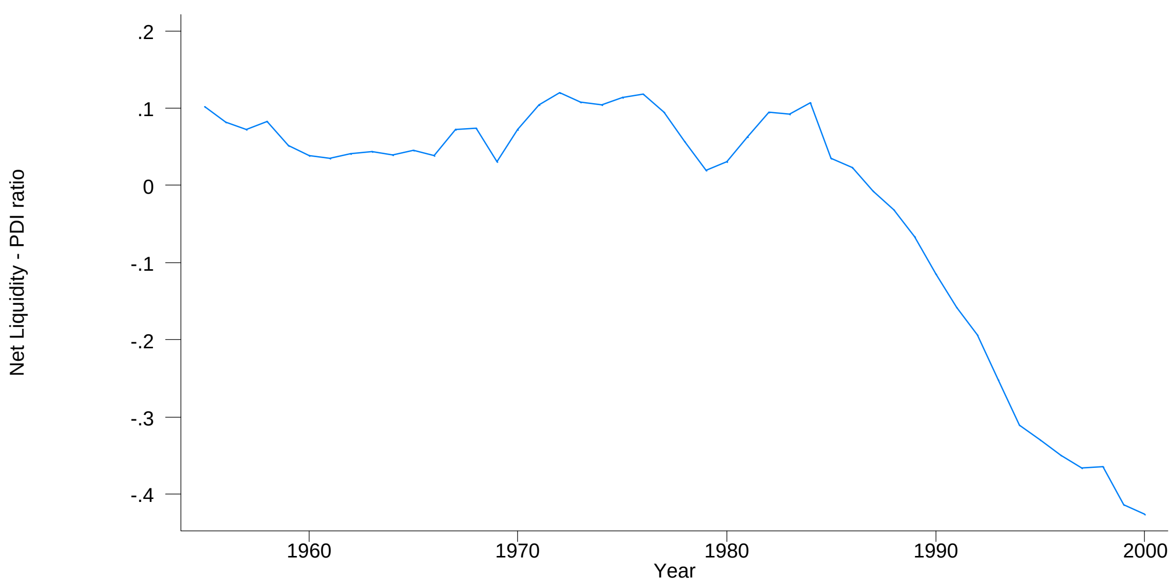


Figure 9: Household Ratio of Liquid Assets Minus Debt to PDI



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Appendix 1: THE DATA

DEFINITION AND SOURCES

DLGDP
Annual growth rate of U.S. real GDP minus the growth rate of the working age population one year earlier. GDP from Department of Commerce (Bureau of the Census and Bureau of Economic Analysis), working age population from Department of Labor, Bureau of Labor Statistics.

LGDPWMA
Two years moving average of log GDP scaled by working age population.

INFLD
INFL-{INFL (-1)+ INFL (-2) +INFL (-3) +INFL (-4)}/4, where INFL is Δ log Consumer Price Index from Department of Labor, Bureau of Labor Statistics.

DRIR
Δ 3-Month Treasury Bill Rate, from Federal Reserve Board of Governors.

TDEFMA
Trade Deficit, proportion of GDP, where trade deficit = - balance goods and services, from Department of Commerce (Bureau of the Census and Bureau of Economic Analysis). Two-year moving average.

LSP
log (SP/CPI), where SP is Standard and Poor's S&P500 Stock Index, and CPI is Consumer Price Index.

TLS
Tighter Loan Standards Index , annual average of quarterly data from Federal Reserve's Survey of Senior Loan Officers (available for the periods 1967:1-1984:1 and 1990:2-2000:3) whose missing values have been estimated by authors.

LREER
log Real Effective Exchange Rate, series constructed chaining data on trade-weighted value of the U.S. dollar from Muellbauer (1996) and Board of Governors of the Federal Reserve System (Broad Index).

GDEBT*D89
Federal debt (end of period), proportion of GDP, from Department of the Treasury and Office of Management and Budget, interacted with the dummy D89. The latter is zero up to 1988, 0.25 in 1989, 0.5 in 1990, 0.75 in 1991 and 1 from 1992 onwards.

WHDLQ
Last quarter value of average weekly hours of production workers in manufacturing minus the annual average value. The hours series is from Department of Labor, Bureau of Labor Statistics.

DLSPD

Δ {December value of log real S&P500 - annual average log real S&P500}.

TREND
Year /100.

DEVOILMA
Two years moving average of lnOILP-{ lnOILP(-1)+lnOILP(-2) + lnOILP(-3) + lnOILP(-4) + lnOILP (-5) }/5, where OILP is an annual average of a quarterly Real Oil Price Index (1990:1=100), constructed using real oil price data from J.D. Hamilton web site at the University of California, San Diego (http://weber.ucsd.edu/~jhamilto/software.htm).

STOVOLMA
Two years moving average of annual average of STOVOLQ, that is a quarterly measure of Volatility in Share Prices taken as the deviation of the log-change in the real share price index from the average change in the previous 36 months , i.e.

$$\text{STOVOLQ}=\sqrt{\text{quarterly average of } \{\Delta sp - 1/36\cdot[sp(-1) - sp(-37)]\}^2}$$

sp being monthly log real S&P 500 index.

LFYT
Proportion of the labour force aged 16-24, from Department of Labor, Bureau of Labor Statistics.

LREER*
Deviation of LREER from its 1965 value, interacted with a split trend which is zero up to 1965 and increasing by one every following year.

DV73
Dummy variable equal to 1 in 1973, zero otherwise.

SUMMARY STATISTICS

Variable	Obs	Mean	Std. Dev.	Min	Max
DLGDWAP	45	0.02	0.02	-0.03	0.06
LGDPWMA	46	3.33	0.26	2.87	3.79
INFLD	46	0	0.02	-0.07	0.06
DRIR	46	0	0.01	-0.04	0.05
TDEFMA	46	0.01	0.01	-0.01	0.03
LSP	46	5.73	0.44	5.09	6.98
TLS	46	0.09	0.13	-0.19	0.48
LREER	46	4.75	0.12	4.52	4.97
GDEBT*D89	46	0.14	0.26	0	0.67
WHDLQ	46	0.34	0.3	-0.48	0.88
DLSPD	46	-0.01	0.11	-0.17	0.27
TREND	46	19.77	0.13	19.55	20
DEVOILMA	46	-0.09	0.3	-0.94	0.49
STOVOLMA	46	0.04	0.01	0.02	0.06
LREER*	46	-2.4	3.34	-9.94	2.32

Appendix 2: THE AUXILIARY TLS REGRESSION

The Federal Reserve publishes a quarterly survey of Senior Loan Officers at the 80 or so main banks lending to U.S. commercial and industrial companies. There are three main questions which have been asked throughout. The first asks whether loan standards or credit terms have tightened over the previous three months. The second asks whether spreads between rates charged and the cost of funds has widened over the same period. And the third asks whether demand for loans from commercial and industrial companies has risen in the last three months. The survey results reporting the percentages of respondents replying 'yes' to these questions from 1990 to February 2001 are shown in Figure A1. We concentrate on the first question. Thus, we have quarterly data on Net Percentage of Senior Loan Officers reporting tighter loan standards, from now on TLS. The series stems only from 1967:1 to 2000:3, with missing values from 1984:1 to 1990:2 (included). We perform an auxiliary regression of TLS on a set of interest rates and other financial variables in order to estimate the missing values in the series both pre-1967 and between 1984-1990. From original monthly data, we calculate the following quarterly series that we use in the auxiliary regression:

1. **raaaq**: Moody's Seasoned Aaa Corporate Bond Yield, Averages of Business Days, Percent, from Moody's Investors Service;
2. **rbaaq**: Moody's Seasoned Baa Corporate Bond Yield, Averages of Business Days, Percent, from Moody's Investors Service;
3. **ir3fedq**: 3-Month Treasury Bill Rate, Secondary Market, Averages of Business Days, Discount Basis, Percent, Source: H.15 Release -- Federal Reserve Board of Governors;
4. **spq**: S&P 500 index, close values;
5. **rtcm1q**: 1-Year Treasury Constant Maturity Rate, Averages of Business Days, Percent, from H.15 Release -- Federal Reserve Board of Governors;
6. **r10tq**: 10-Year Treasury Constant Maturity Rate, Percent, from H.15 Release -- Federal Reserve Board of Governors;
7. **cpi**: Consumer Price Index, for All Urban Consumers, All Items, 1982-84=100, from U.S. Department of Labor, Bureau of Labor Statistics.
8. **infl**: Inflation Rate, in annual terms, with infl=Δln(cpi)·400;
9. **stovolq**: Volatility in Share Prices taken as the deviation of the log-change in the real share price index from the average change in the previous 36 months , with

$$\text{stovolq}=\sqrt{\text{quarterly average of } \{\Delta \text{sp} - 1/36\cdot[sp(-1)-sp(-37)]\}^2}$$

sp being monthly log real S&P 500 index;

10. **spread**: Spread between Baa Corporate Bond Yield and 10-Year Treasury Constant Maturity Rate, i.e. spread=rbaaq-r10tq;
11. **spreada**: Spread between Aaa Corporate Bond Yield and 10-Year Treasury Constant Maturity Rate, i.e. spreada=raaaq-r10tq;
12. **rrtcm**: Real 1-Year Treasury Constant Maturity Rate, i.e. rrtcm=rtcm1q-Linfl, where inflation is lagged one quarter to account for lags in agents information about price changes.

We follow a modelling procedure from general to specific, and estimate the following equation over the whole sample and over pre-1980Q1 and post 1980Q1 sub-samples:

$$\begin{aligned}\text{tls(t)}= {} & \beta_0 + \beta_1 \text{tls(t-1)} + \beta_2 \text{ spreada(t)} + \beta_3 \text{spreada(t-1)} + \beta_4 \text{ rrtcm(t)} + \\ & + \beta_5 \text{ } (\Delta \text{spq})\text{ (t-1)} + \beta_6 \text{ stovolq(t)} + \beta_7 \text{ stovolq(t-1)} + \\ & + \beta_8 \text{ spread(t)} + \beta_9 \text{ spread(t-1)} + \beta_{10} \text{ } \Delta\text{ir3fedq(t)} + \beta_{11} \text{ } \Delta\text{rtcm1q(t)}\end{aligned}$$

In order to test for structural breaks due to likely changes in monetary policy regimes, we perform a Chow test, splitting the sample in the two subperiods 1967:1-1979:4 and 1980:1-2000:3. The test statistics F(11,86)=7.06, with P-value$\cong$0.00, rejects the null hypothesis of homogeneous coefficients along the whole sample period. We therefore estimate two different parsimonious models over the two subsamples:

MODEL 1, 1967:1-1979:4

$$tls(t)=\alpha_0+\alpha_1 tls(t-1)+\alpha_2 spread(t)+\alpha_3 spread(t-1)+\alpha_4 \Delta ir3fedq(t)+\alpha_5 \Delta rtcm1q(t)+\alpha_6 (\Delta spq)(t-1)$$

MODEL 2, 1980:1-2000:3

$$tls(t)=\delta_0+\delta_1 tls(t-1)+\delta_2 spreada(t)+\delta_3 spreada(t-1)+\delta_4 rrtcm(t)+\delta_5 (\Delta spq)(t-1)+\delta_6 stovolq(t-1)$$

The estimations are presented in Table A1, while Figure A2 shows the TLS quarterly series containing the estimated values for the missing gaps. It is interesting to notice that in the first period the relevant spread regressor is calculated using rbaa while in the second period it is raaa that seems to matter. From both specifications we note a positive Δspread effect on TLS, possibly reinforced in the second period by a level effect of current spread. Moreover increasing stock prices lower TLS in both periods, while the volatility in stock prices has a positive significant effect in the second period only. Finally, we have a positive significant effect of the yield gap between the 1-Year Treasury Constant Maturity Rate and the 3-Month Treasury Bill Rate in the first period. This effect is not confirmed in the second period, where the real 1-Year Treasury Constant Maturity Rate has instead a positive significant impact in tightening loan standards.

Table A1: Auxiliary TLS Regressions

	(A1) TLS	(A2) TLS
TLS(-1)	0.601	0.657
	[6.09]	[10.18]
spread	0.177	
	[2.05]	
spread(-1)	-0.166	
	[2.00]	
spreada		0.228
		[3.7]
spreada(-1)		-0.097
		[1.53]
rrtcm		0.011
		[2.83]
Dspq(-1)	-0.404	-0.592
	[1.61]	[2.95]
stovolq(-1)		1.444
		[2.25]
Dir3fed	-0.14	
	[2.40]	
Drtcm1q	0.264	
	[4.52]	
Constant	0.028	-0.203
	[0.49]	[4.99]
Observations	51	57
Adj R-squared	0.69	0.77
RMSE	0.0981	0.074
DW P-val	1.814	2.356
BG LM 4 P-val	0.5503	0.1435
White het P-val	0.577	0.65

Absolute value of t statistics in brackets

Figure A1: Estimated Quarterly TLS series