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ABSTRACT

The stabilization of economic activity in the mid 1980s has received considerable attention. Research has focused primarily on the role played by milder economic shocks, improved inventory management, and better monetary policy. This paper explores another potential explanation: financial innovation. Examples of such innovation include developments in lending practices and loan markets that have enhanced the ability of households and firms to borrow and changes in government policy such as the demise of Regulation Q. We employ a variety of simple empirical techniques to identify links between the observed moderation in economic activity and the influence of financial innovation on consumer spending, housing investment, and business fixed investment. Our results suggest that financial innovation should be added to the list of likely contributors to the mid-1980s stabilization.

KEYWORDS: Economic fluctuations, volatility, financial innovation, financial deregulation

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1. Introduction

A wave of recent research shows that the U.S. economy has been markedly more stable since the mid-1980s than it had been in the preceding couple of decades. The reduction in volatility has been widespread, showing up in real GDP and most of its components as well as other measures of economic activity.

The source of this moderation is not clear. Changes in data construction do not appear to be responsible, nor has fiscal policy become appreciably more countercyclical, and the shift in the composition of output toward services has played only a small role. Instead, various papers have argued that volatility has fallen principally because of milder economic shocks, improved inventory management, or better monetary policy.

One possible cause of the reduction in volatility that has received little attention is financial innovation. Improved assessment and pricing of risk, expanded lending to households without strong collateral, more widespread securitization of loans, and the development of markets for riskier corporate debt have enhanced the ability of households and businesses to borrow funds. Moreover, these developments have been complemented by changes in government policy, including the demise of Regulation Q, which had restrained bank lending whenever market interest rates increased. Shifting social attitudes seem to have increased the willingness to borrow as well.

Greater use of credit could foster a reduction in economic volatility by lessening the sensitivity of household and business spending to downturns in income and cash flow. In this way, the traditional "multiplier" response to negative shocks would be diminished. However, greater borrowing could also boost volatility by giving households and businesses the wherewithal to purchase capital goods more quickly when their target stocks of those goods increase. In other words, the traditional "accelerator" response to positive shocks would be exacerbated. Whether, on balance, financial innovation has exacerbated or diminished economic volatility is therefore an empirical question.

In addressing this question, we do not attempt to develop and test a formal model of the interaction between the financial system and household and business spending. That approach seems too ambitious to us at this stage of research on the topic. Instead,

we employ a variety of simple empirical techniques to examine some possible links between financial innovation and the observed moderation in economic activity.

In the next section of the paper, we use a very stylized model and a brief review of key changes in financial markets and institutions to catalog the channels through which financial innovation might have affected the volatility of output. Then we document the declining volatility of income over time—an important backdrop for the rest of our empirical analysis, in which the changing response of households and businesses to variation in income and cash flow figure prominently. The following three sections of the paper study, in turn, consumer spending, housing investment, and business fixed investment. We show that consumer spending has become less sensitive to contemporaneous income and that housing investment has become less responsive to interest rates—two changes that are consistent with financial innovation having stabilized economic activity. Business fixed investment also appears to have become less sensitive to financial frictions, but our evidence on this point is not as strong as in the other cases.

All told, our results suggest that financial innovation has indeed contributed to the long-term decline in economic volatility. However, we would not argue that financial innovation is the only source of this moderation; we suspect that a number of factors emphasized in previous research have played some role. Distinguishing between alternative explanations will remain a challenge: Feedback relationships among sectors of the economy make it difficult to separate impulse from propagation; in addition, the falloff in volatility constitutes essentially one episode, which makes it difficult to determine which factors are causal and which are correlated because of a coincidence in timing. Given our results, we believe that future research should continue to explore the effect of financial innovation on economic volatility.

2. Links between Financial Innovation and Economic Volatility

In this section we use a simple model of the economy and some background about the evolution of the financial system to describe the links between financial innovation and the volatility of economic activity.

A Simple Model

We draw on the previous literature (for example, Rudebusch, 2001, and McCallum and Nelson, 2004) and describe the economy with these equations:[1]

$$Y = C(Y,r) + H(Y,r) + B(Y,r)\ , \tag{1}$$

$$\pi = \mathrm{p}_0^* + \mathrm{p}_1(Y - \overline{Y}) + \upsilon\ , \text{ and} \tag{2}$$

$$i = \mathrm{m}_0^* + \mathrm{m}_1(\pi - \overline{\pi}) + \mathrm{m}_2(Y - \overline{Y}) + \mu\ . \tag{3}$$

Equation (1) is an IS curve, in which total output or income (Y) is the sum of consumer spending (C), housing investment (H), and business investment (B). The components of spending depend on Y, the real interest rate r (which equals the nominal interest rate, i, less inflation, π), and a stochastic shock. Specifying this dependence as a linear function for convenience, we rewrite equation (1) as:

$$Y = \Theta_0 + \Theta_1 Y - \Theta_2(i - \pi) + \varepsilon\ . \tag{4}$$

Equation (2) is a price-adjustment equation, in which $\overline{Y}$ is potential output and inflation depends on the output gap. Assuming that potential output is fixed yields:

$$\pi = \mathrm{p}_0 + \mathrm{p}_1 Y + \upsilon\ . \tag{5}$$

Equation (3) is a monetary policy reaction function in the form of a Taylor rule. The nominal interest rate depends on the difference between inflation and the target inflation rate ($\overline{\pi}$), the output gap, and a stochastic shock (μ). With target inflation fixed:

$$i = \mathrm{m}_0 + \mathrm{m}_1\pi + \mathrm{m}_2 Y + \mu\ . \tag{6}$$

Putting together the price adjustment equation and policy reaction function gives:

$$i - \pi = \Phi_0 + \Phi_1 Y + \Phi_2\upsilon + \mu\ . \tag{7}$$

[1] As we discuss below, we suppress the dynamic aspects of the models in these papers.

Combining equations (4) and (7) shows that:

$$Y = \frac{\Theta_0 - \Theta_2\Phi_0}{1-\Theta_1+\Theta_2\Phi_1} - \frac{\Theta_2\Phi_2}{1-\Theta_1+\Theta_2\Phi_1}\upsilon - \frac{\Theta_2}{1-\Theta_1+\Theta_2\Phi_1}\mu + \frac{1}{1-\Theta_1+\Theta_2\Phi_1}\varepsilon . \tag{8}$$

If the stochastic shocks are uncorrelated, the variance of output is described by:

$$\begin{aligned}\text{var}(Y) = &\left[\frac{\Theta_2\Phi_2}{1-\Theta_1+\Theta_2\Phi_1}\right]^2 \text{var}(\upsilon) + \left[\frac{\Theta_2}{1-\Theta_1+\Theta_2\Phi_1}\right]^2 \text{var}(\mu) \\ &+ \left[\frac{1}{1-\Theta_1+\Theta_2\Phi_1}\right]^2 \text{var}(\varepsilon) .\end{aligned} \tag{9}$$

As we describe shortly, financial innovation has likely affected the marginal propensity to spend out of income by households and businesses Θ_1, the interest sensitivity of spending Θ_2, and the magnitude of the shocks to spending.[2] Examination of equation (9) reveals that

$$\frac{\partial \text{var}(Y)}{\partial \Theta_1} > 0 . \tag{10}$$

Intuitively, a larger marginal propensity to spend out of income generates larger multiplier effects in response to shocks. Manipulation of equation (9) and the assumption of reasonable parameter values ($\Theta_1 < 1$, $\Theta_2 > 0$, $p_1 > 0$, $m_1 > 0$, and $m_2 > 0$) yields:

$$\frac{\partial \text{var}(Y)}{\partial \Theta_2} = \Omega_1 \text{var}(\upsilon) + \Omega_2 \text{var}(\mu) - \Omega_3 \text{var}(\varepsilon) , \tag{11}$$

$$\text{with } \Omega_1 > 0, \Omega_2 > 0, \Omega_3 > 0 .$$

[2] This third effect is an example of the point made in previous papers that shocks in a reduced form model may incorporate structural features of the economy.

Thus, the net effect of Θ_2 on the variance of output is ambiguous and depends on the magnitude of various coefficients and variances of shocks. Greater interest sensitivity of spending accentuates the effect on output of shocks to inflation and monetary policy, but it dampens the effect of exogenous shifts in spending because such shifts are offset to a larger extent by the induced increase in interest rates.

Of course, this model is highly stylized, and two caveats to the preceding interpretations are needed. First, the model omits the lags and expectational terms that generate the dynamic behavior often studied in the literature. Although such dynamic features are clearly important for implementing such a model empirically and for evaluating many economic hypotheses, the simplicity of a single-period model is useful for our illustrative purposes. Second, we do not consider how the monetary policy reaction function might respond to changes in the structure of the economy. If we had described policy as a function of *expected* inflation and output, then the coefficients on those terms would likely depend only on the social welfare function. However, in our single-period formulation, a central bank aiming to reduce economic volatility would adjust m_1 and m_2 when other aspects of the economy changed. For example, an increase in the interest sensitivity of spending might reduce the response of interest rates to contemporaneous movements in inflation and output. We think that such endogeneity has likely mattered for the effect of financial innovation on the variance of output. However, analysis of this issue lies beyond the scope of this paper.

Financial Innovation

The financial system has evolved in myriad ways over the past forty years. An ever-growing literature has catalogued these developments and explored their causes and implications; see Frame and White (2004) for a useful recent overview. Here we simply summarize some broad trends that are relevant for aggregate economic volatility.

Market-driven changes. One key change in financial intermediation has been improved assessment and pricing of risk. Technological advances have made it easier for lenders to collect and disseminate information on the creditworthiness of prospective

borrowers.[3] Lenders have also developed new techniques for using this information in determining underwriting standards, setting interest rates, and managing their risks. One example is the increased use in the mid-1990s of risk-based pricing for consumer loans, which is discussed by Edelberg (2003).

The financial landscape has also changed dramatically through the greater use of markets rather than institutions to intermediate between borrowers and lenders. This change can be seen in the development of extensive secondary markets for loans, which means that a large fraction of mortgages—and a growing fraction of other household loans and business loans—is now securitized (for example, see Johnson, 2002). This change can also be seen in a widening of direct access to financial markets for businesses. Over the past thirty years, the development of an active market for high-risk debt (sometimes known as "junk bonds") has allowed lesser-known and financially weaker firms to raise funds in the bond market (see Altman, 1992). New issuance of junk bonds was essentially nil in the mid-1970s but accounted for more than 25 percent of total nonfinancial bond issuance by 1984 and 42 percent in 2004.[4] In addition, the share of capital expenditures undertaken by junk-rated firms climbed from a presumably low value in the mid-1970s to 5 percent in 1984 and 17 percent in 2004.[5]

These and other market-driven changes have increased the fraction of households and firms that have ready access to credit—an evolution that has been termed the "democratization" of credit. Moreover, households and firms that previously had some access to credit have likely gained improved access in terms of both the amount of credit and the consistency of its availability under different macroeconomic conditions.

Government policy changes. Over the past several decades, new legislation and changes in the regulatory environment have had a powerful effect on the financial system. One crucial change was the phasing-out in the early 1980s of Federal Reserve Regulation Q, which had set ceilings on interest rates that banks paid on deposits.[6] When

[3] Technological changes have also reduced the transactions costs of obtaining loans, resulting, for example, in an increased amount of home equity extracted through refinancings.
[4] We thank our colleague Paul Harrison for providing the 1984 figure; the 2004 figure is based on data from the Securities Data Company.
[5] These figures are based on Compustat data including both fixed investment and inventory investment.
[6] See Litan (1994) for a discussion of financial regulation in the 1980s and Mahoney et al (1987) for a detailed chronology of the elimination of deposit-rate ceilings.

the regulation was in force, increases in market interest rates above the ceilings generated an outflow of funds from banks; this disintermediation greatly restricted the funds available for lending. Without this regulation, increases in market rates push up the cost of funds but do not suddenly curtail their supply. Other policy changes have improved financial institutions' ability to offer new products and expand across geographic boundaries. The resulting diversification has insulated institutions from shocks specific to a given region or type of customer and thereby fostered a steadier supply of credit.

Government policy changes have interacted with market-driven changes in various ways. For example, wider access to financial markets put competitive pressure on banks, which led the government to relax regulatory restrictions on banks' activities (see Litan, 1984). The development of money market mutual funds was partly a response to deposit-rate ceilings, and it spurred the elimination of those ceilings by exacerbating the process of disintermediation. Government policies aimed at increasing the provision of mortgage credit to low-income households, such as the Community Reinvestment Act and the "housing goals" that must be met by Fannie Mae and Freddie Mac, encouraged the financial community to improve its assessment and pricing of risk.

Changes in willingness to borrow. Household and business attitudes toward the use of credit also seem to have evolved over time. The ratio of household debt to disposable personal income rose from 0.57 in 1960 to 0.64 in 1984 and 1.14 in 2004; personal bankruptcy filings per 100,000 people climbed from 68 in 1960 to 120 in 1984 and 531 in 2004. These trends likely stem both from the increase in credit supply discussed above and from an increased willingness to borrow—arising perhaps from a greater familiarity with the process of obtaining credit and reduced stigma of being in debt (for example, see Gross and Souleles, 1999). The aggregate debt-equity ratio for firms has trended up as well, and shifting demand again appears to have played a role. For example, Jensen and Meckling (1976) and Jensen (1986) advocated heavy use of debt financing in order to constrain managers' discretion and ensure that managers are working in the best interest of shareholders.

A subtlety. The link between financial innovation and economic volatility depends not on the *average* amount of borrowing but on *marginal* borrowing that

smoothes spending in the face of income fluctuations. Financial innovation appears to have increased the marginal availability and use of debt in addition to the average availability and use. For example, risk-based pricing and the more active market for risky corporate debt have likely fostered a more stable supply of credit when economic conditions deteriorate. In addition, the demise of Regulation Q has greatly reduced the disintermediation that used to choke off the supply of bank credit when interest rates were high. An important caveat, though, is that if households or firms are carrying a lot of debt under good economic conditions, they might be unable or unwilling to increase their indebtedness when conditions deteriorate. Indeed, Carroll and Dunn (1997) argued that precautionary motives make the spending of households with high debt levels more sensitive to uncertainty about labor income than households with less debt—and therefore more likely to pull back their spending in the face of an adverse shock.

Implications for Spending

Now we turn to the way in which these changes in financial markets and institutions could have affected the volatility of household and business spending.

Consumer spending. Consider households that wish to borrow (perhaps because they are at an early stage of their lifecycle and their lifetime income path slopes up) but cannot; their spending equals their income and is equally volatile. An improved ability to borrow has two opposing effects on the volatility of spending: It allows households to better maintain their spending when their income experiences a transitory slump, but it also allows them to boost their spending more sharply when their perceived permanent income increases.[7] In our simple model, the first effect corresponds to a decline in the marginal propensity to consume (MPC), while the second effect corresponds to an increase in the variance of the consumption shock, or, to the extent that expected income is correlated with current income, to an apparent increase in the MPC.[8] Thus, whether financial innovation raises or lowers the MPC is unclear theoretically. Ludvigson (1999)

[7] We ignore increases in transitory income and decreases in perceived permanent income because financial innovation seems to have had a bigger effect on households' ability to borrow than to save, notwithstanding the development of the mutual fund industry, expansion of tax-favored savings accounts, and so on.

[8] The second effect might be especially pronounced for durable goods, because a given increase in consumption requires a larger rise in spending. Focusing on this accelerator effect, Blanchard and Simon (2001) and Campbell and Hercowitz (2005) asserted that more efficient financial markets would increase the volatility of durable goods purchases. However, they did not allow for the first effect we describe.

discussed conditions under which the MPC would fall, and some cross-country evidence suggests that the MPC is smaller when households can borrow more easily. For example, Japelli and Pagano (1989) found that the excess sensitivity of consumption to current income is lower in countries with more developed capital markets, and Bacchetta and Gerlach (1997) argued that the United States has experienced a larger decline in excess sensitivity than other countries because financial deregulation has proceeded the furthest here.

For the interest elasticity of consumer spending, we again see two opposing effects.[9] First, the democratization of credit increases the share of the spending that responds to changes in borrowing rates, boosting the interest sensitivity of spending; second, the tempering of disintermediation when market interest rates rise makes spending less sensitive to changes in rates. Ludvigson (1998) estimated that the share of bank lending relative to total lending for automobile loans—a proxy for the extent of disintermediation—had only a small (though statistically significant) effect on aggregate consumption; this finding suggests that the first effect may be dominant.

Housing investment. Because a large share of owner-occupied housing is purchased with borrowed funds, the "marginal propensity to buy housing out of current income" is probably not a useful concept. Still, empirical estimates of housing demand show that investment responds to current income, probably because expected permanent income is correlated with current income and because the supply of credit is correlated with macroeconomic conditions. As with consumer spending, greater access to credit is likely to reduce the response of housing investment to transitory income decreases but to boost the response to permanent income increases. However, we are not aware of any studies that have estimated the relative importance of these effects.

For the interest elasticity of housing demand, the two effects discussed for consumer spending are again relevant. But, given that disintermediation had pronounced effects on housing investment when Regulation Q was in force (see Ryding, 1990, Duca, 1996, and McCarthy and Peach, 2002), one would expect housing investment to be less responsive to movements in market interest rates now than it was before. Indeed, Estrella

[9] Sellon (2002) analyzed the effect of changes in the financial system on the interest-rate channel of monetary policy.

(2002) estimated that securitization (as measured by the ratio of the values of securitized home mortgages to all home mortgages) has reduced the interest sensitivity of the output gap.

Business investment. When firms experience transitory downturns in sales, the ability to borrow enables them to maintain their investment spending; when firms revise up their expectations of long-run sales, the ability to borrow enables them to raise their investment spending more quickly. Thus, we see again that financial innovation smoothes spending in the face of transitory shocks but has the opposite effect for permanent shocks. Firms' desired investment is also affected by technological progress or other changes in production processes. For example, the high-tech investment boom of the late 1990s arose not only from an increase in expected sales but also from a growing perception that information technology would enable firms to produce a given amount of output in a more efficient way (see Doms, 2004). Analogous shocks to households' desired spending—such as a shift in the utility gain expected from a new product—seem less important, suggesting that permanent shocks may be more important to firms than households. If so, financial innovation would not moderate business investment as much as household spending.

Changes in the market for bank loans and the end of Regulation Q likely reduced the interest sensitivity of investment. English (2004) argued that, before the 1970s, bank lending was determined by implicit contracts between banks and borrowers: When market rates rose above Regulation Q ceilings, banks would lend to favored customers at below-market rates and ration credit to new or risky customers. These contracts broke down during the 1970s as banks gained access to market-priced funding sources and became less reliant on retail deposits, and as businesses gained better access to short-term capital markets. In addition, Regulation Q was phased out starting in the early 1980s. As a result, changes in market rates now seem likely to have less effect on the supply of business loans.

Finally, note that although the same broad forces altered the availability of funds to both households and businesses, the effect on the volatility of their spending might have been quite different. For example, financial innovation might have increased

households' access to credit to a greater extent than businesses' access. Or, household spending might have been more restricted by credit constraints during the earlier period so that a given increase in credit access would reduce the volatility of their outlays more.

3. Reduced Volatility of Output and Income

In this section we review the evidence on the changing volatility of output and present new evidence on the volatility of income.

Basic Issues

McConnell and Perez-Quiros (2000) and Kim and Nelson (1999) estimated that a break in the quarterly growth rate of real GDP occurred in the first quarter of 1984. Similarly, Stock and Watson (2002) argued that the volatility of the four-quarter growth rate of real GDP experienced a break in 1984. In contrast, Blanchard and Simon (2001) argued instead that underlying volatility has fallen gradually over many decades, but that volatile inflation in the 1970s and early 1980s obscured this trend. Although the empirical evidence is not definitive, we find the conclusion of a sharp drop in volatility puzzling because most explanations for the moderation in economic activity—such as improved inventory management or many aspects of financial innovation—would seem to imply a gradual evolution. Even if a structural change—say, in monetary policy—occurred all at once, households' and firms' expectations might need to adjust before the new dynamics would be fully in place.

Nevertheless, to present statistics on declining volatility, choosing some date as a dividing line is useful. The standard deviation of the quarterly growth rate of real GDP was 4.5 between 1960:Q1 and 1983:Q4, but just 2.1 between 1984:Q1 and 2004:Q4. The standard deviation of nominal GDP growth displays a very similar decline across these periods, but the volatility of nominal gross domestic income (GDI) falls by just over one-third.[10] GDI is conceptually equal to GDP but is constructed from separate data, and notable differences between their measured growth rates are not uncommon. This problem is especially acute with a dividing line at 1984:Q1; if we shift the dividing line

[10] We focus on nominal income because the appropriate price indexes for deflating GDI and national income (to which we turn shortly) are unclear.

one or two years later, the variability of both GDI and GDP decline by about one-half. Thus, we will use a dividing line of 1985:Q1.

Our analysis uses four-quarter growth rates as well as quarterly growth rates. Volatility at a very high frequency may be less relevant for decision-making and well-being than volatility at a slightly lower frequency. For example, an increase in tax rates scheduled for the beginning of 1994 caused a shift of bonus payments into late 1993; the resulting month-to-month volatility of income growth mattered less for households less than the year-to-year volatility during recessions. In addition, some of the quarterly data presented in the national accounts are interpolated from underlying source data that are available only on an annual basis, so measured quarterly variability may not correspond to true quarterly variability. Looking at four-quarter changes also suggests a dividing line of 1985:Q1 rather than 1984:Q1: The variability of four-quarter real GDP growth declines less than the variability of quarterly growth when splitting the sample at the earlier date, but not the later one.

Composition of the Step-Down in Output Volatility

As shown in table 1, the volatility of real GDP growth fell in half between the 1960-1984 and 1985-2004 periods, measured on either a quarterly or four-quarter basis. [11] Volatility also declined for every major component of GDP, although the decline was much larger proportionally for consumption expenditures and residential investment than for business fixed investment—which seems surprising because more-stable household demand should itself have smoothed investment. Table 2 presents contributions to the declining variability of GDP. About a third of the reduction in quarterly variability can be attributed to spending by the household sector and hardly any to business fixed investment; half of the reduction owes to inventory investment, which became both less variable and negatively correlated with final sales. Of the decline in four-quarter variability, household spending is the single largest contributor, and again business fixed investment plays almost no role.

[11] The National Income and Product Accounts (NIPA) data used in the paper incorporate the summer 2005 Annual Revision.

Reduced Volatility of National Income, Corporate Income, and Personal Income

Turning to the income side of the national accounts, figure 1 compares the evolving volatility of real and nominal GDP, nominal GDI, and nominal national income (which equals GDI less depreciation and net income paid to the rest of the world).[12] The thin lines show four-quarter growth rates, and the thick lines show five-year moving averages of the standard deviation of the quarterly growth rates. For real GDP, the dominant feature is the step-down in volatility in the mid-1980s. For nominal GDP, nominal GDI, and nominal national income—three alternative measures of aggregate economic activity—pronounced upward spikes in volatility in the late 1970s and early 1980s are apparent; still, all of these series look less volatile since the mid-1980s than they were before those spikes. The figure also shows nominal and real disposable personal income (DPI, the portion of national income received by households), to which we return later.

Table 3 shows that the variability of nominal national income growth fell about 40 percent between the 1960-1984 and 1985-2004 periods—a sizable drop, albeit not as large as for GDP. Variability also declined for nearly every major component of national income, although to differing degrees; figure 2 provides a graphical display of these patterns. The memo line of the table shows the variability of cash flow available to firms for investment, which we measure as profits plus depreciation less taxes and the inventory valuation adjustment. The variability of this series also diminished considerably.

Table 4 documents the declining volatility of nominal disposable personal income and its components. The volatility of DPI fell 40 percent on a four-quarter basis but only 13 percent on a quarterly basis—a striking divergence that stems from very different behavior of wage disbursements when measured over shorter and longer horizons. Quarterly volatility in wages was boosted in the early 1990s by a shifting of bonus payments in anticipation of tax-rate increases, but this shifting had relatively little effect

[12] Thus, GDI is gross income earned by factors of production located in the United States, while national income is net income earned by U.S. residents.

on wages measured over several quarters.[13] The variability of capital income received by households fell only a little, and by less than the variability of capital income in the economy as a whole, because dividend income became more variable even as corporate profits became less so. Government transfer payments and contributions for social insurance became markedly less variable over time, but income taxes became only a little less variable.

4. Consumer Spending

We now turn directly to the question of whether financial innovation has helped to reduce the volatility of consumer spending. To begin, we note that the correlation between movements in income and movements in saving increased considerably between the earlier and later periods. Specifically, the correlation between the change in real DPI and the change in real personal saving rose from 0.69 to 0.86 on a quarterly basis and from 0.45 to 0.57 on a four-quarter basis.[14] Thus, swings in income are now more likely to be reflected in saving, implying that spending is less affected—just as we would expect if households can now borrow more readily in order to smooth consumption.

Indeed, the marginal propensity to consume (MPC) out of contemporaneous income does appear to have fallen over time. Consider a model in which the growth rate of aggregate real consumer spending depends on lagged spending growth, contemporaneous real income growth, the contemporaneous real federal funds rate, the contemporaneous change in the unemployment rate, and the lagged ratios to income of wealth, transfer payments, and consumer spending.[15] Figure 3 plots the estimated coefficients on contemporaneous income in this model based on rolling 40-quarter sample periods ending between 1965:Q2 and 2004:Q4 (due to data limitations, we cannot estimate this coefficient before 1965). For consumer spending on nondurable goods and services—the top panel—the estimated MPC falls from an average of 0.23 in the 1965-

[13] This bonus shifting did not affect the volatility of national income because national income includes wage accruals—the wages earned by workers—rather than wage disbursements.
[14] Despite the increase in the correlation between real DPI and real saving, their covariance falls on a four-quarter basis because of a significant decline in their variances.
[15] We obtained quite similar results using alternative specifications, including one based on Davis and Palumbo (2001).

1984 period to an average of -0.02 in the 1985-2004 period. For total consumer spending—the bottom panel—the estimated MPC falls from an average of 0.36 to an average of 0.05.

The same conclusion arises from examining unusual changes in income and consumption. If business cycles were sufficiently common in both parts of our sample, we could explore the changing response of consumption to cyclical swings in income. However, business cycles have been infrequent in the past two decades, making this approach impractical. To generalize the idea, we calculate deviations in income growth and consumption growth from their recent norms; these data are plotted in the top panels of figure 4 for quarterly growth rates and figure 5 for four-quarter growth rates. The solid regression lines corresponding to the 1985-2004 period are much flatter than the dashed regression lines corresponding to the 1960-1984 period, confirming that consumption growth has been less sensitive to income growth in the later period.

This approach also allows us to explore any asymmetries in the response of consumption to positive and negative deviations in income. Changes in financial markets and institutions that facilitate borrowing should have more effect on the consumption response to negative income deviations than positive ones. Indeed, the flattening of the regression lines in the bottom panels of figures 4 and 5—which relate to unusually weak income growth—is more pronounced than the flattening of the lines in the middle panels—which relate to unusually strong income growth. This pattern is consistent with the hypothesis that financial innovation has had a bigger effect on households' ability to borrow than on their ability to save.

5. Housing Investment

As we noted earlier, the elimination of Regulation Q's ceilings on bank deposit rates should have greatly smoothed the supply of credit for housing by reducing the extent of disintermediation when market interest rates rise. We would expect to observe this smoothing in a reduced sensitivity of housing investment to mortgage rates, because a given increase in mortgage rates is presumably accompanied by less non-price rationing in the post-Regulation Q period. However, English's (2004) analysis of business lending

implies that non-price rationing was very extensive when Regulation Q was in force, which suggests that a lessened sensitivity to mortgage rates would not capture all the effects of eliminating the regulation; we would like to find a more direct measure of its role as well.

We begin with a model in which the log difference of aggregate real residential investment depends on four lags each of log differences of real residential investment, real disposable personal income, and the 30-year fixed mortgage rate.[16] The top panel of figure 6 plots the sum of the estimated coefficients on the mortgage rate in this model based on rolling 40-quarter sample periods ending between 1965:Q1 and 2004:Q4. The response of residential investment to movements in the mortgage rate was markedly smaller (less negative) after the mid-1980s than before—a pattern consistent with the demise of Regulation Q.[17]

To account for other channels through which Regulation Q affected housing investment, we use the time series on short-term bank loan rates developed by English. The difference between his estimate of the bank loan rate and the federal funds rate is plotted in the bottom panel of figure 6. When Regulation Q was in force and bank loan rates were sluggish compared with market rates, this spread was extremely volatile; when Regulation Q was no longer operative and bank loan rates moved more closely with market rates, the spread was more stable. Low values of the spread—when short-term bank loan rates did not rise commensurately with the federal funds rate—should correspond to periods of financial friction owing to Regulation Q. Thus, if the elimination of this regulation played an important role in reducing the variability of housing investment, one would expect this spread to have important predictive power for housing investment in the 1960-1984 period but not in the 1985-2004 period.

We test this hypothesis using a vector autoregression in the levels of the three variables described above (log of real residential investment, log of real disposable

[16] For this regression and the vector autoregressions described below, we use standard data and variable definitions. We pulled data for the vector autoregressions from the database for FRB/US, the Federal Reserve Board staff's quarterly econometric model. The mortgage rate series begins in 1971:Q2; we extend it back in time using the ten-year Treasury rate.

[17] The same reduction in the sensitivity of housing investment to interest rates can be seen clearly in scatter plots of the sort we used to examine the sensitivity of consumption to income.

personal income, and the 30-year fixed mortgage rate) and the spread between English's bank loan rate and the federal funds rate. We include four lags of each variable, estimate separate models for the earlier and later periods, and orthogonalize the innovations using a standard Choleski decomposition (with an ordering of the spread, the mortgage rate, income, and residential investment). We estimate this model for the period 1965:Q1 through 2004:Q4.[18] Figure 7 shows impulse response functions for the spread and the mortgage rate. Shocks to the bank rate spread have a large effect with the expected sign in the earlier period and virtually no effect in the later period; the mortgage rate has a much larger effect in the earlier period than in the later period. Table 5 presents a variance decomposition that reflects, of course, both changes in the coefficients and changes in the time series properties of the variables. At the two-year and three-year horizon, the spread explains 20 percent of the variance of residential investment in the 1965-1984 period but virtually none in the 1985-2004 period. Similarly, the mortgage rate explains about half of the variance of residential investment in the earlier period but much less in the later period.[19]

6. Business Fixed Investment

As we noted earlier, business fixed investment (BFI) has moderated to a lesser degree than household spending; in addition, because such investment is a much smaller share of the economy than household spending, its contribution to the declining variability of GDP is quite small. Still, the changes in financial markets and institutions that we have discussed have altered the availability of credit to firms as well as households, and we would expect to see some effect on the volatility of BFI.[20]

Our empirical strategy is to investigate whether variables that plausibly reflect financial frictions had a smaller effect on investment after 1984 than before it. One

[18] The estimation period for all of the vector autoregressions in the paper begins in 1965:Q1 because that is the earliest date for which we have data for all of the variables.

[19] An examination of household debt during recessions provides corroborating evidence that financial innovation has enabled households to better smooth their spending on consumer goods and housing. Even controlling for debt growth preceding business-cycle peaks (which should capture secular trends), debt growth following peaks has increased over time, with the fastest growth seen in the most recent recession and the second fastest growth in the preceding recession.

[20] Whether financial innovation has helped to reduce the volatility of business investment in inventories is a topic that we leave for future research.

variable we use is the spread between the short-term bank loan rate and the federal funds rate that we employed when analyzing housing investment. The other variable we use is business cash flow, which is a measure of internally generated funds that can be used for investment by firms that are unable or unwilling to access credit markets. Unfortunately, a long literature on the effect of financing constraints on business investment has failed to reach a consensus, which makes our attempt to identify an evolution of this effect over time somewhat daunting.[21]

We estimate vector autoregressions using log levels of components of real business fixed investment, real business output, the user cost of capital, and one of the financial-friction variables.[22] We include four lags of each variable and orthogonalize the innovations using a standard Choleski decomposition (with an ordering of the financial-friction variable, the user cost, business output, and investment). The estimation period is 1965:Q1 through 2004:Q4. We consider three categories of BFI separately: high-tech equipment and software (including computer hardware and software as well as communications equipment), other equipment, and nonresidential (i.e., business) structures. Between the 1965-1984 and 1985-2004 periods, the standard deviation of four-quarter log differences declined for high-tech equipment and software investment 10 percent, for other equipment investment roughly 40 percent, and for nonresidential structures investment less than 5 percent. In terms of fundamentals for business fixed investment, the standard deviation of the four-quarter log difference of real business output—a proxy for the need for capital—dropped more than 50 percent between these periods, and the volatility of the user cost of capital also decreased considerably in all three categories.[23]

[21] Hubbard (1998) surveys this literature, in which some papers find an effect of cash flow and others do not. Recent work seems more skeptical than some earlier analyses. For example, Cummins, Hassett, and Oliner (forthcoming) argue that the cash-flow investment regressions typically used in this literature are poorly identified, and Erickson and Whited (2000) find no significant effect of cash flow after controlling for measurement error in Tobin's Q.

[22] We use the log level of real cash flow and the level of the spread between the bank loan rate and the fed funds rate.

[23] The standard deviation of four-quarter log differences of the user cost declined for high-tech equipment and software about 75 percent, for non-high-tech equipment about 55 percent, and for nonresidential structures about 30 percent.

Figures 8 through 10 show impulse response functions for the spread variable and cash flow for the three categories of BFI, and table 6 presents the key elements of the variance decompositions. For high-tech equipment, cash flow plays a smaller role in the 1985-2004 period than in the 1965-1984 period, as financial innovation would predict: The impulse response function lies much closer to zero in the later period, and the share of the variance of investment explained by innovations to cash flow is much smaller. However, the spread between the bank loan rate and the federal funds rate plays a relatively minor role in both periods. For other equipment, the results are reversed: A decline over time in the importance of the interest-rate spread supports our hypothesis about the effect of financial innovation, while cash flow is more important in the later period. In the business structures sector, cash flow is less important after 1984 than before—which is consistent with a role for financial innovation—but the interest rate spread matters little in both periods.

Altogether, the results for BFI are more mixed than they were for consumer spending or housing investment. On balance, financial frictions appear to have become less important for business fixed investment over time, but the data we have examined do not speak with a clear voice on this issue.

7. Conclusion

The stabilization of economic activity in the mid-1980s has received considerable attention. Three possible explanations—milder economic shocks, improved inventory management, and better monetary policy—have been the primary focus of research, with researchers disagreeing about the relative importance of each explanation. We have argued that financial innovation should be added to the list as a likely contributor to the stabilization.

Unfortunately, our attempt to provide a fairly inclusive overview of this topic has forced us to paint in very broad strokes. One particular shortcoming, in our view, is our exclusive focus on aggregate data, and we think that an important direction for future research in this area is the study of individual households and firms. For example, with data on income and spending by individual households, one can develop sharper tests of

whether people now use borrowing more readily to cushion against temporary shortfalls in income. On the business side, Agca and Mozumdar (2004) recently concluded that investment by individual firms in the manufacturing sector has become less sensitive to cash flow over the past several decades. Such firm-level data can shed light on whether the stabilization of investment is more pronounced among firms that had been more likely to be credit-constrained and are now able to access credit markets.

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Table 1
Declining Volatility of Real GDP and its Components

Component	Standard deviation of quarterly growth			Standard deviation of four-quarter growth		
	1960:Q1 to 1984:Q4	1985:Q1 to 2004:Q4	Change	1960:Q1 to 1984:Q4	1985:Q1 to 2004:Q4	Change
GDP	4.4	2.1	-53%	2.8	1.4	-51%
Consumption expend.	3.3	2.0	-39%	2.2	1.2	-44%
Residential invest.	24.1	9.5	-60%	17.3	7.1	-59%
Business fixed invest.	10.3	8.4	-19%	7.7	6.5	-15%
Government	5.0	3.6	-29%	2.9	2.1	-29%
Exports	23.1	8.1	-65%	7.4	5.6	-24%
Imports	20.0	7.6	-62%	9.1	4.9	-47%
Memo:						
Nominal GDP	4.7	2.1	-56%	2.9	1.4	-52%
Nominal GDI	4.3	2.3	-47%	2.9	1.7	-43%

Table 2
Contributions to the Declining Volatility of Real GDP, 1960-1984 to 1985-2004

Component	Quarterly growth		Four-quarter growth	
	Change	Share	Change	Share
Variance of GDP	-15.1	100%	-5.9	100%
Household sector	-5.4	36%	-2.8	48%
Variance of personal consumption expend.	-2.5	16%	-1.2	20%
Variance of residential investment	-.9	6%	-.5	8%
Covariance of PCE, residential invest.	-2.0	13%	-1.2	20%
Variance of business fixed investment	-.5	3%	-.2	3%
Inventory investment	-7.8	51%	-2.7	45%
Variance	-5.4	35%	-.7	11%
Covariance of inventory invest., final sales	-2.4	16%	-2.0	34%
Other variances and covariances	-1.5	10%	-.3	5%

Notes. The variance of four-quarter GDP growth shown here equals the sum of the variances and covariances of the components of GDP; this figure does not precisely match the actual variance of four-quarter GDP growth owing to the nonlinearity of the calculation of four-quarter growth.

Table 3
Declining Volatility of Nominal National Income and its Components

Component	Nominal share	Standard deviation of quarterly growth			Standard deviation of four-quarter growth		
	1985:Q1 to 2004:Q4	1960:Q1 to 1984:Q4	1985:Q1 to 2004:Q4	Change	1960:Q1 to 1984:Q4	1985:Q1 to 2004:Q4	Change
National income	1.00	4.7	3.1	-36%	3.1	1.8	-41%
Compensation	.65	3.6	2.5	-30%	2.8	1.7	-37%
Wage accruals	.54	3.5	2.9	-18%	2.7	2.2	-21%
Other labor inc.	.12	7.9	3.2	-59%	3.7	2.4	-35%
Proprietors' inc.	.08	14.1	8.2	-42%	7.2	4.1	-44%
Capital income	.18	14.6	11.8	-19%	7.4	4.8	-35%
Profits	.10	24.2	21.3	-12%	13.2	9.5	-28%
Other	.08	13.0	10.5	-19%	7.6	6.5	-15%
Other income	.09	6.3	7.9	26%	3.7	3.0	-20%
Memo:							
Cash flow	n.a.	12.4	8.7	-30%	6.8	5.2	-24%

Table 4
Declining Volatility of Nominal Disposable Personal Income and its Components

Component	Nominal share	Standard deviation of quarterly growth			Standard deviation of four-quarter growth		
	1985:Q1 to 2004:Q4	1960:Q1 to 1984:Q4	1985:Q1 to 2004:Q4	Change	1960:Q1 to 1984:Q4	1985:Q1 to 2004:Q4	Change
DPI	1.00	4.1	3.6	-13%	2.6	1.5	-40%
Compensation	.78	3.6	3.5	-5%	2.8	1.8	-35%
Wage disburse.	.64	3.6	4.1	16%	2.7	2.2	-18%
Other labor inc.	.14	7.9	3.2	-59%	3.7	2.4	-35%
Proprietors' inc.	.09	14.1	8.2	-42%	7.2	4.1	-44%
Capital income	.22	8.1	7.1	-13%	5.5	4.9	-10%
Dividends	.04	8.6	17.0	99%	5.5	7.2	31%
Other	.17	9.5	7.2	-25%	6.2	5.4	-12%
Govt. transfers less taxes	-.09	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Govt. transfers	.15	14.9	5.1	-66%	7.3	3.1	-58%
Contrib. for social ins.	-.10	23.3	4.3	-81%	7.0	2.1	-71%
Personal taxes	-.14	20.6	16.6	-20%	9.1	7.5	-18%

Table 5
Variance Decomposition for Residential Investment

Quarters ahead	Percent of forecast variance explained by:			
	Spread between bank loan rate and fed funds rate	30-year fixed mortgage rate	Log (income)	Log (residential investment)
	--- 1965:Q2 to 1984:Q4 ---			
1	4	1	2	94
4	11	47	6	36
8	20	52	11	17
12	20	50	12	19
24	20	47	12	21
	--- 1985:Q1 to 2004:Q4 ---			
1	3	8	20	69
4	5	14	10	71
8	3	20	10	67
12	3	18	12	68
24	2	15	17	66

Table 6
Variance Decompositions for Components of Business Fixed Investment: Role of Cash Flow and Spread Between Bank Loan Rate and Fed Funds Rate

Quarters ahead	High-tech equipment		Other equipment		Nonresidential structures	
	Percent of forecast variance explained by:		Percent of forecast variance explained by:		Percent of forecast variance explained by:	
	Cash flow	Spread	Cash flow	Spread	Cash flow	Spread
	--- 1965:Q2 to 1984:Q4 ---					
1	2	0	0	19	2	7
4	2	4	6	17	8	5
8	25	3	9	12	22	5
12	39	6	8	17	37	4
24	39	8	7	22	50	5
	--- 1985:Q1 to 2004:Q4 ---					
1	1	1	0	0	0	2
4	0	8	7	0	0	1
8	0	10	31	0	5	3
12	0	9	49	0	14	5
24	1	9	56	1	17	6

Notes. These decompositions are based on vector autoregressions that also include the levels of investment, real business output, and the user cost of capital.

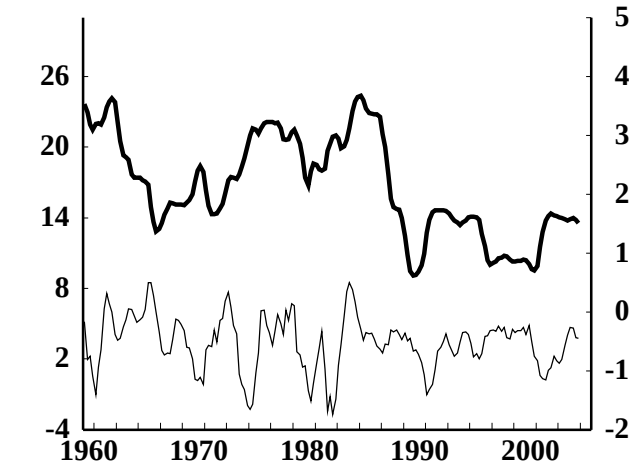
Figure 1

Volatility of Output and Income

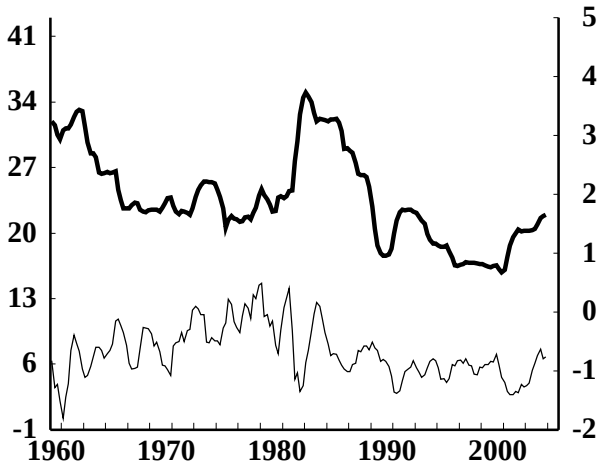
Thin line = Four-quarter growth rate (left scale)

Thick line = 5-year trailing moving average of the standard deviation (right scale)

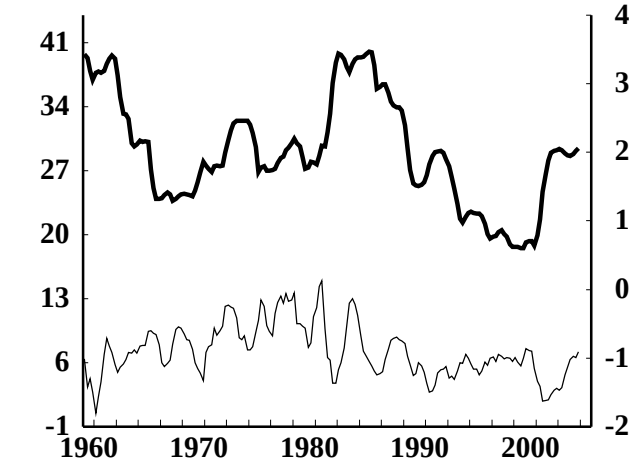
Real GDP



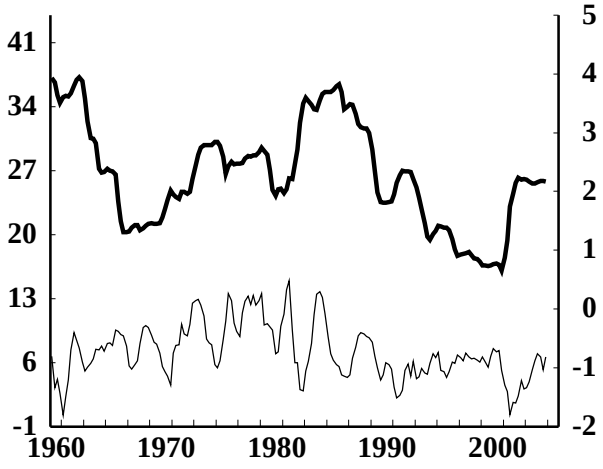
Nominal GDP



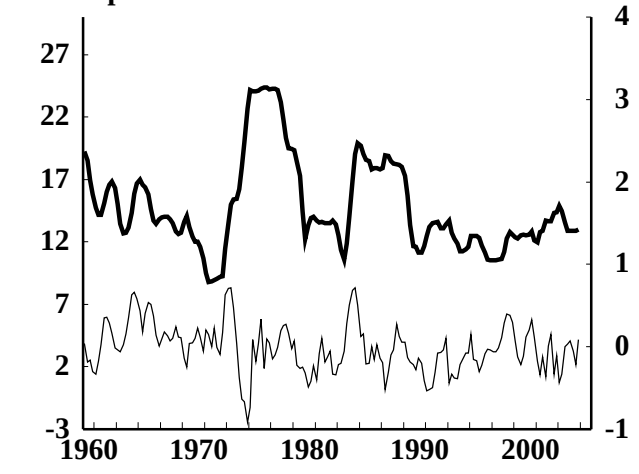
Nominal Gross Domestic Income



Nominal National Income



Real Disposable Personal Income



Nominal Disposable Personal Income

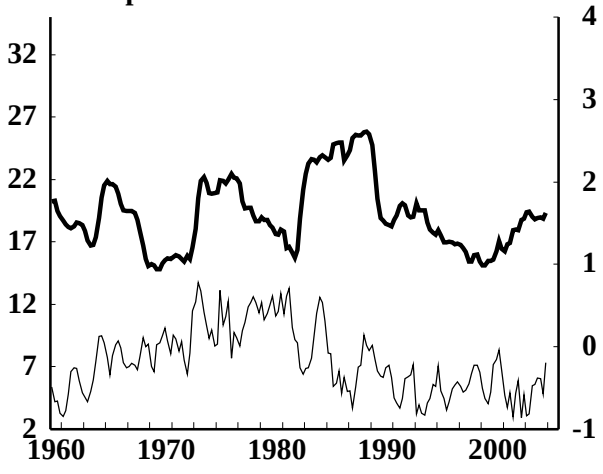
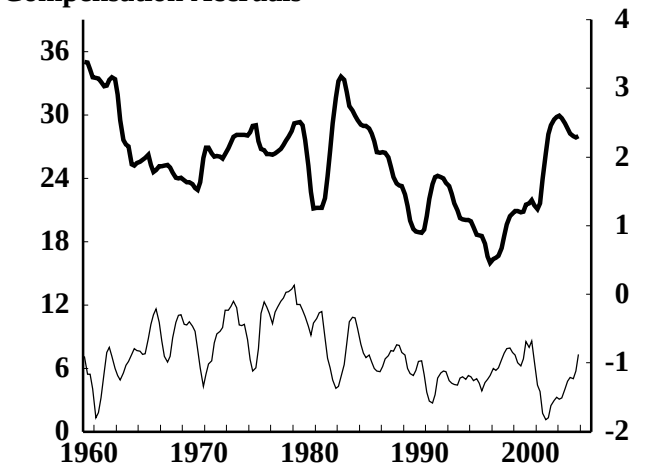


Figure 2

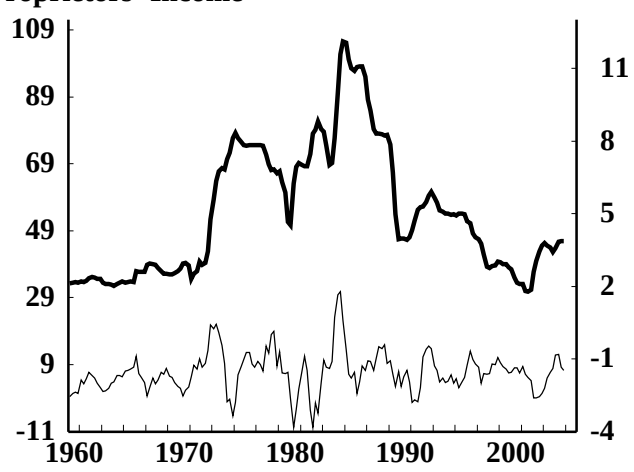
Volatility of National Income Components

Thin line = Four-quarter growth rate (left scale)
Thick line = 5-year trailing moving average of the standard deviation (right scale)

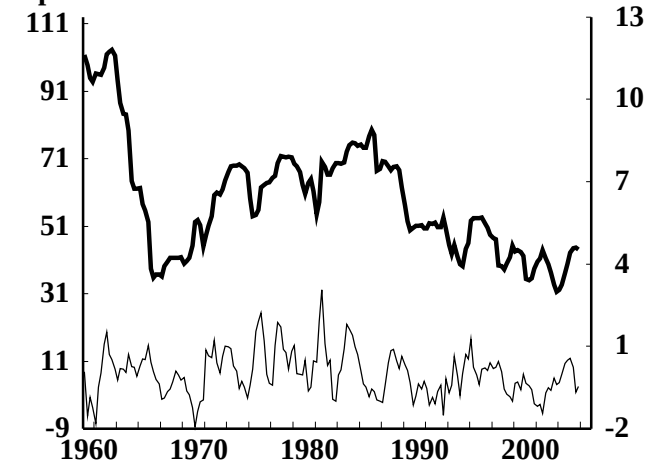
Compensation Accruals



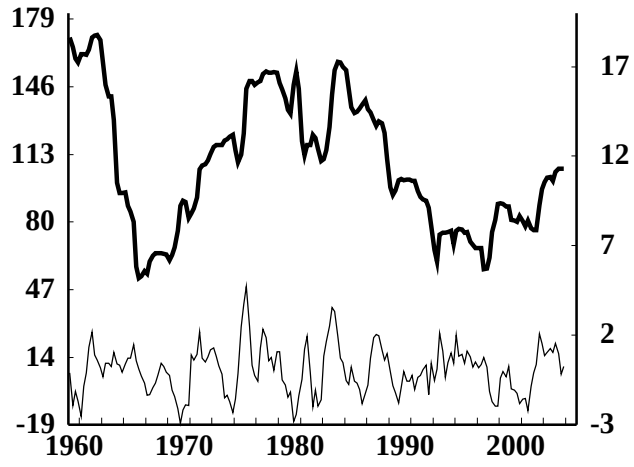
Proprietors' Income



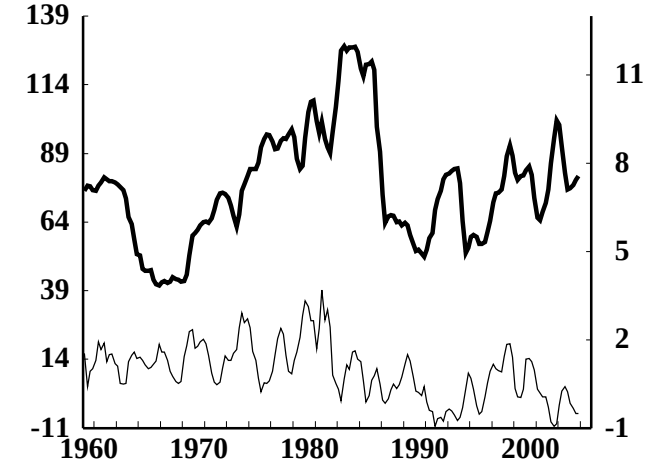
Capital Income



Profits Before Taxes



Net Interest



Other Natl Income

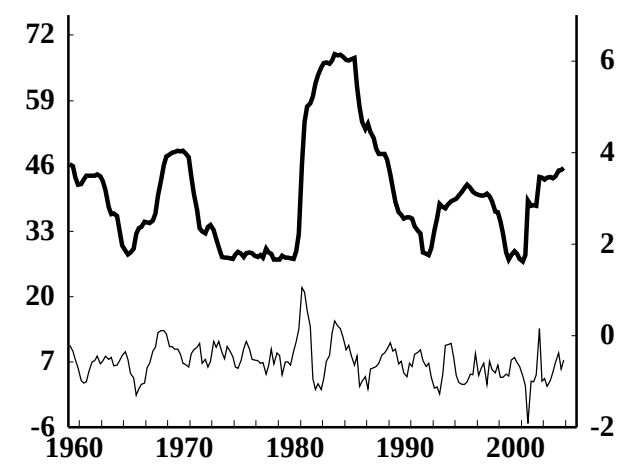
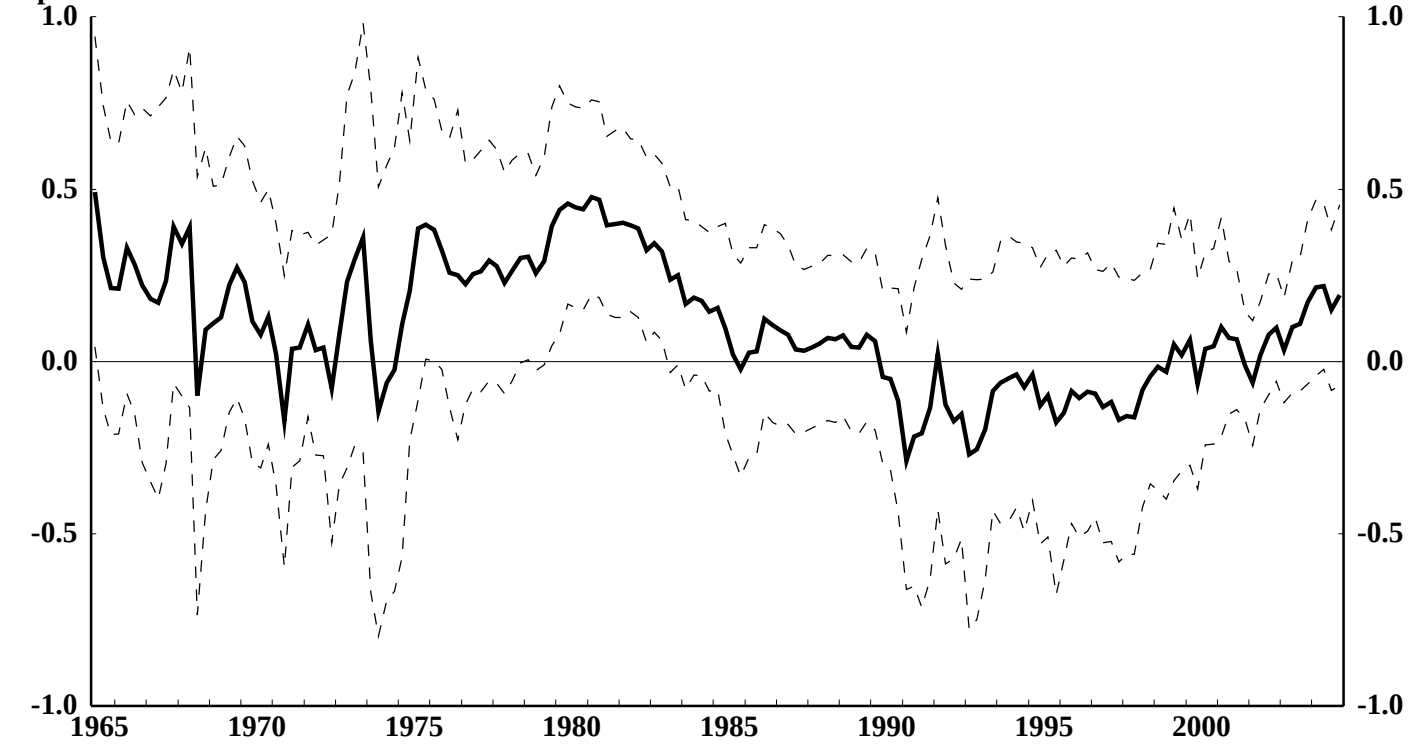


Figure 3

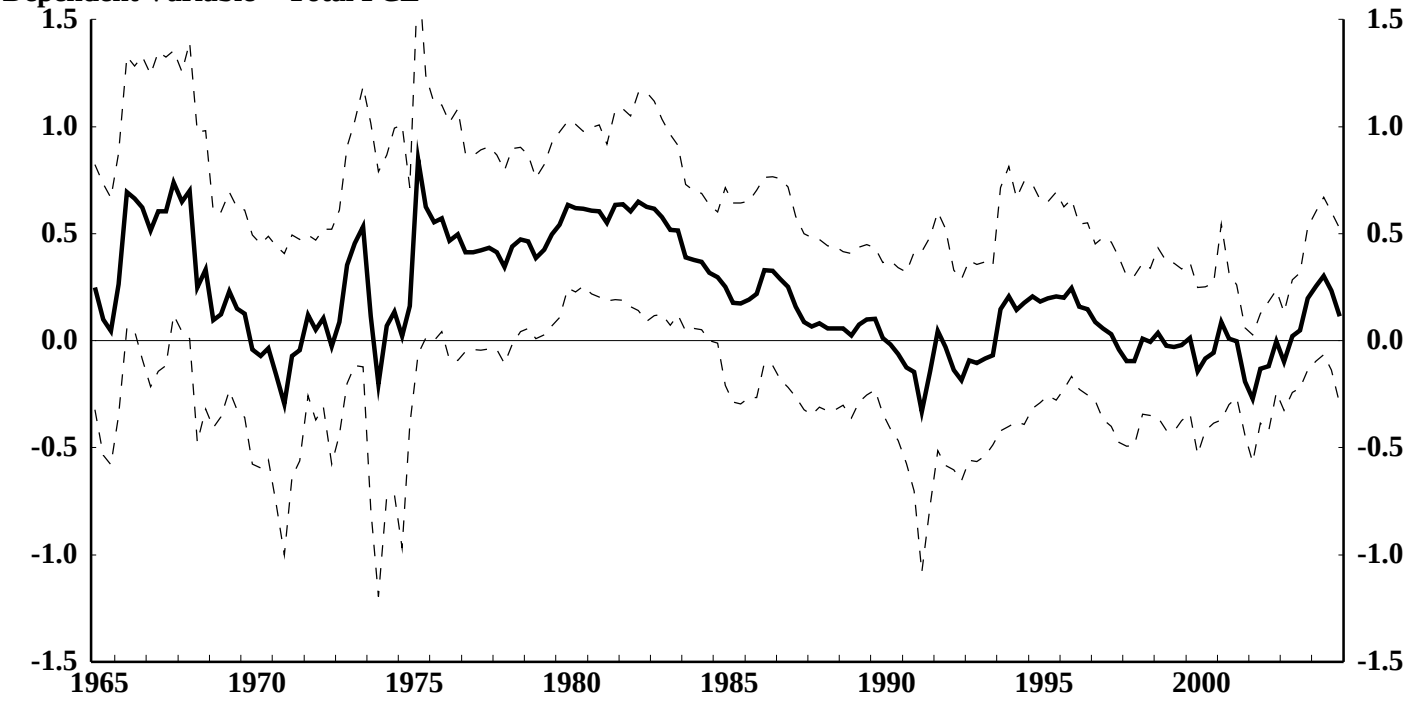
Estimated MPC out of Contemporaneous Income

Coefficients from 40-Quarter Rolling Regressions
(95% confidence intervals shown by dashed lines)

Dependent Variable = PCE Nondurables and Services



Dependent Variable = Total PCE

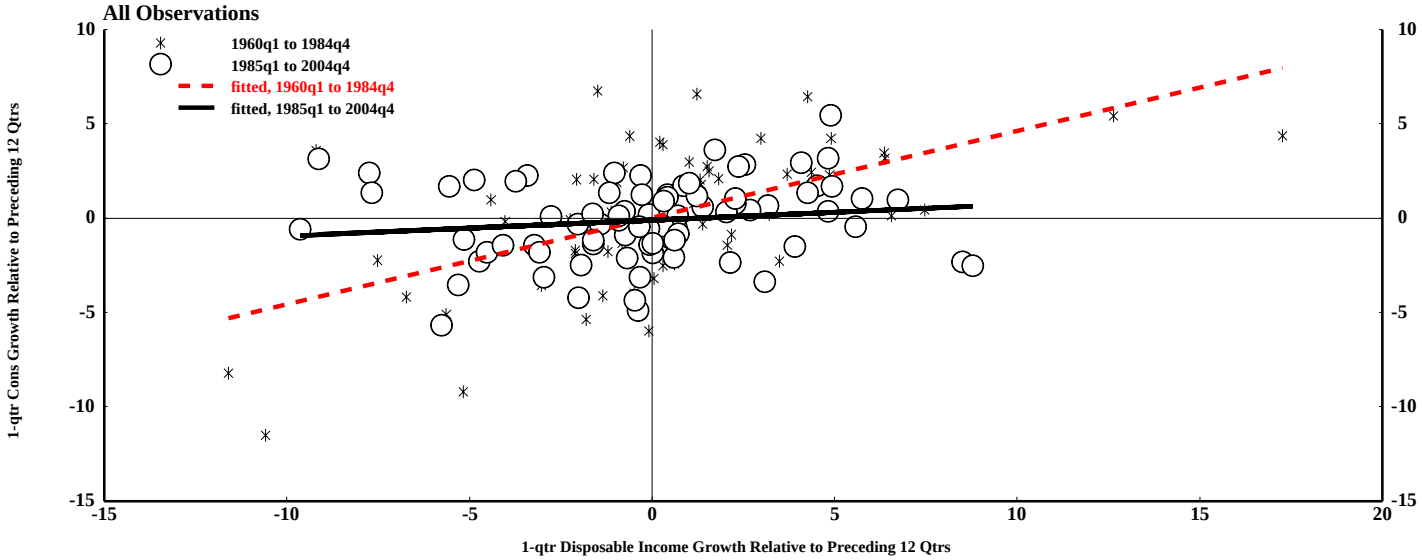


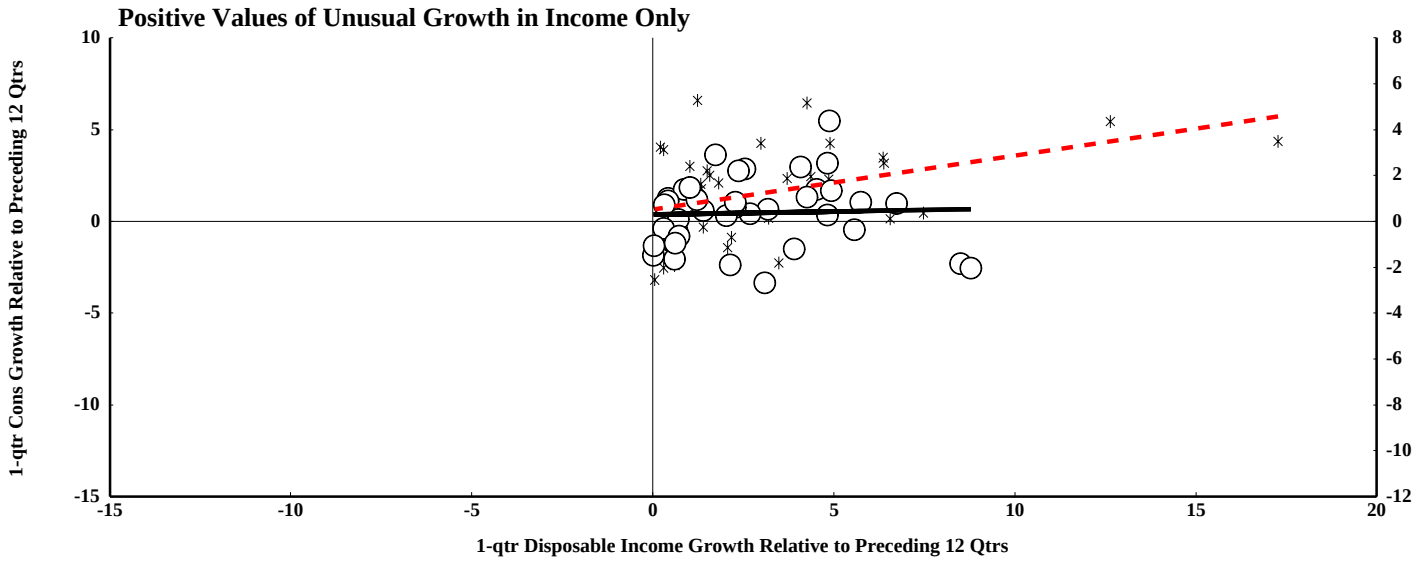
Note. The upper bound for the confidence interval in 1975:Q3 is 1.75.

Figure 4

Unusual Growth in Income vs. Unusual Growth in Consumption

Based on Annualized Quarterly Growth Rates





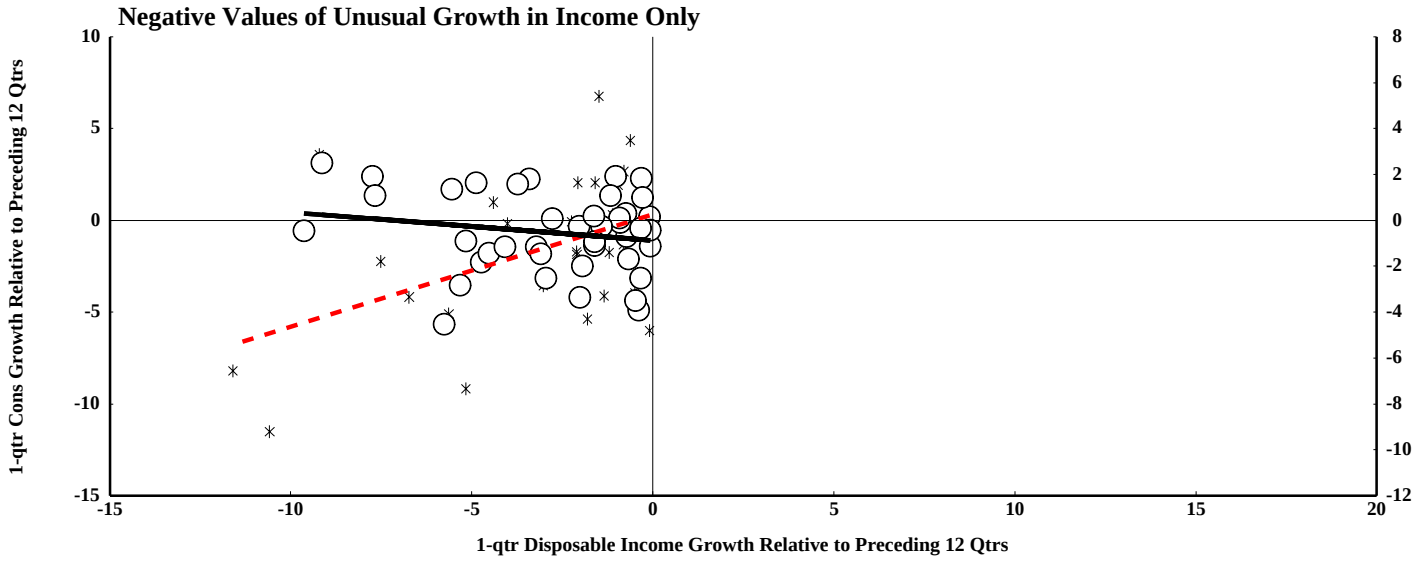
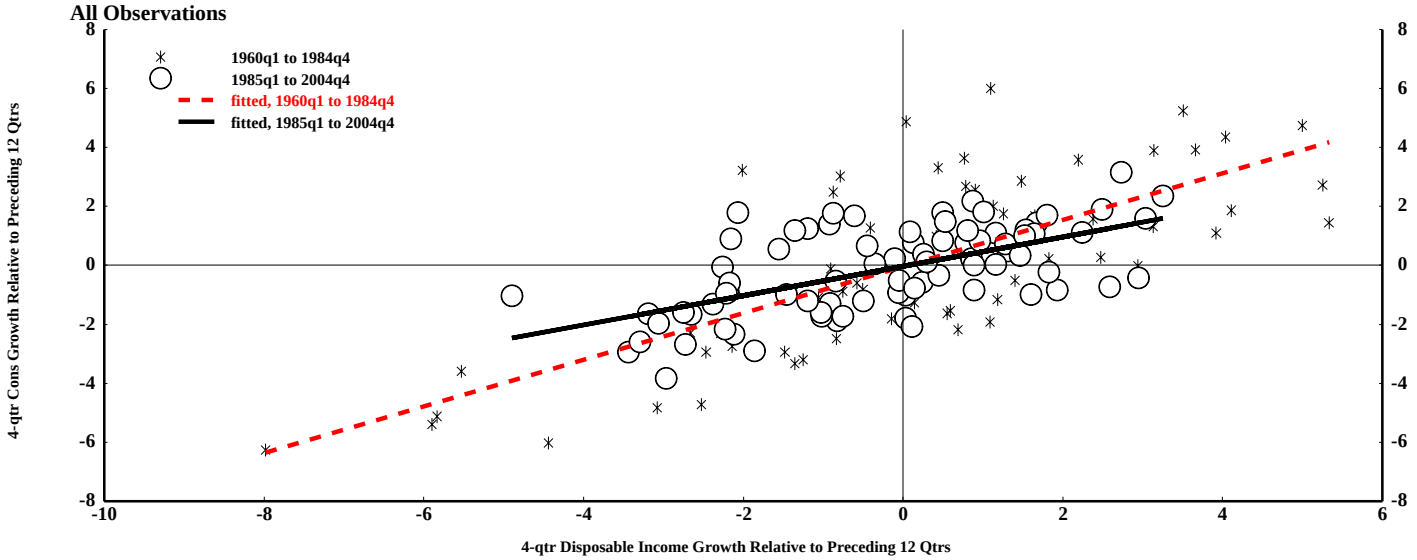
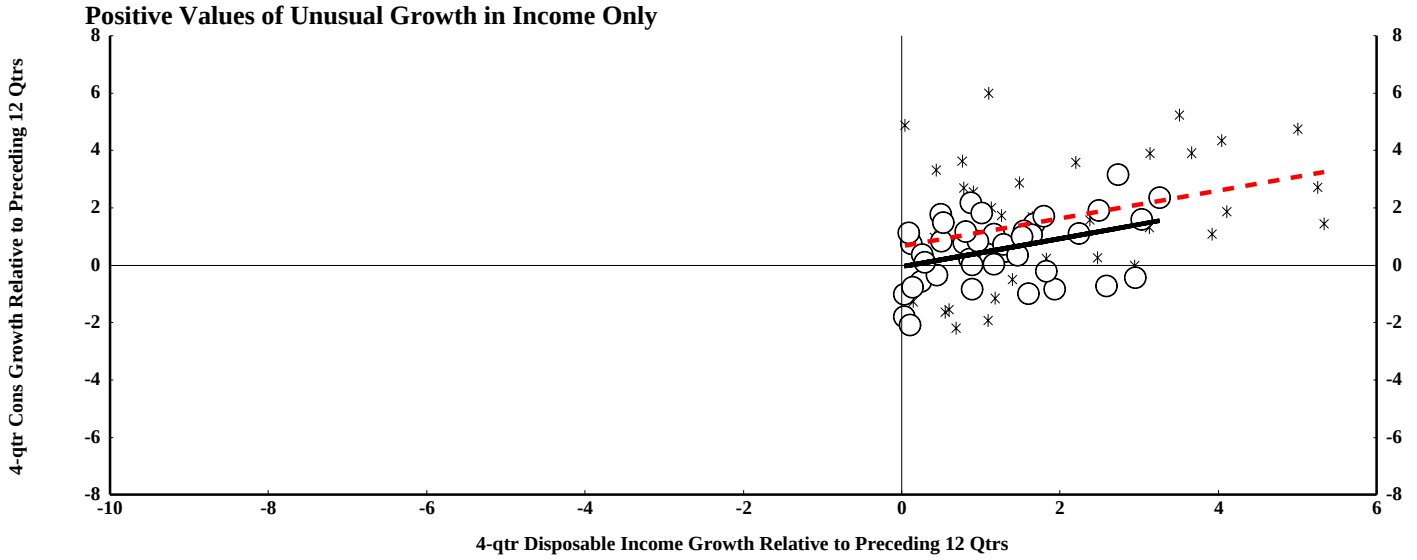


Figure 5

Unusual Growth in Income vs. Unusual Growth in Consumption

Based on 4-Quarter Growth Rates





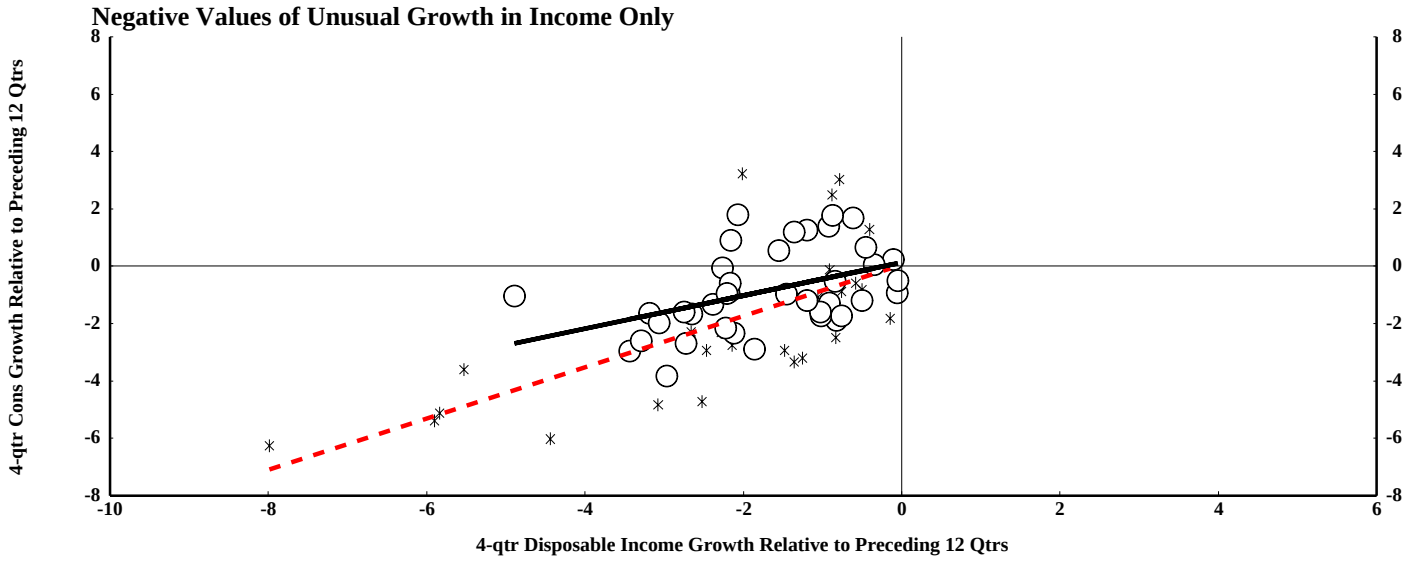
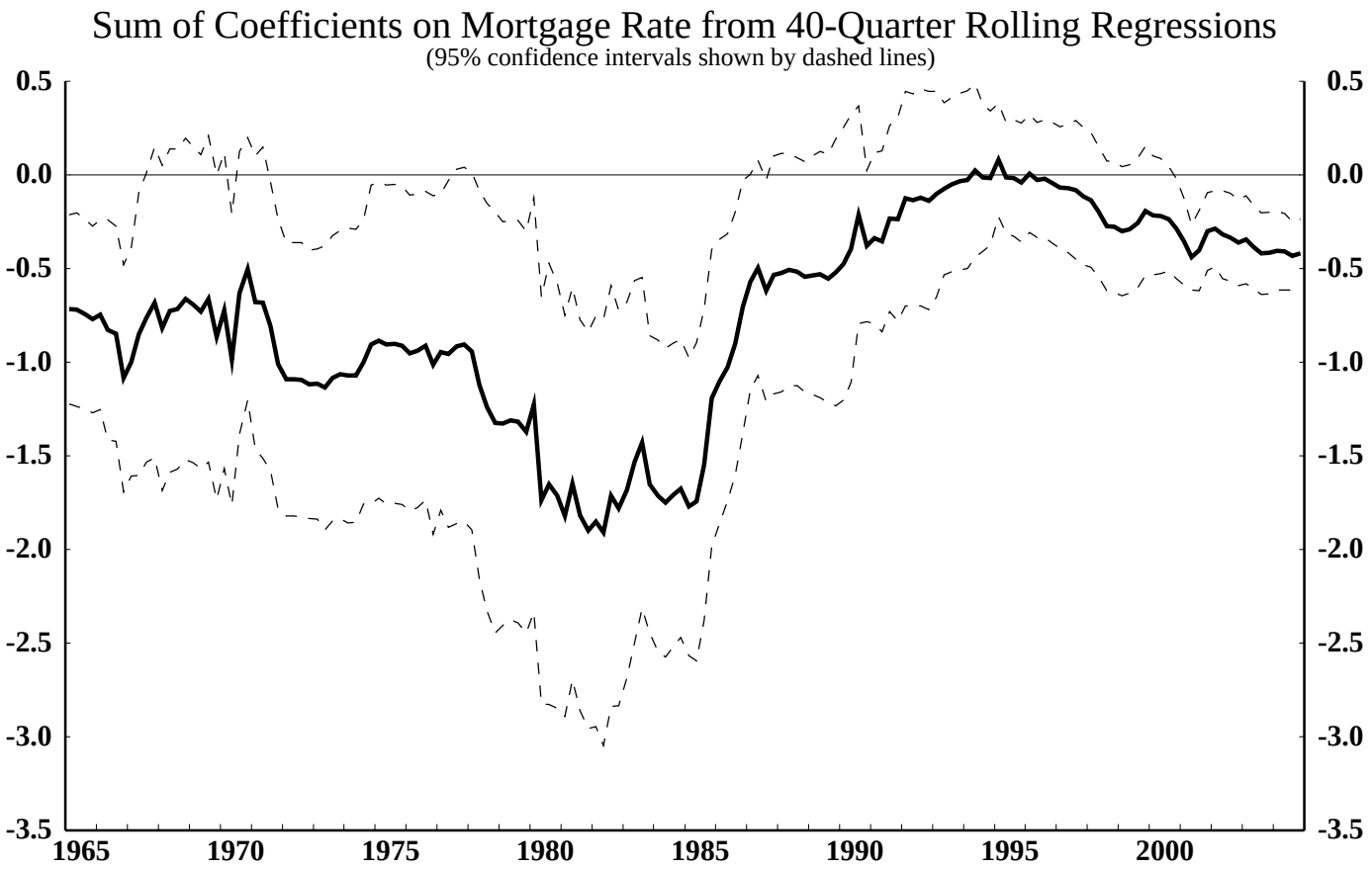


Figure 6


Sum of Coefficients on Mortgage Rate from 40-Quarter Rolling Regressions
(95% confidence intervals shown by dashed lines)
0.5
0.0
-0.5
-1.0
-1.5
-2.0
-2.5
-3.0
-3.5
1965
1970
1975
1980
1985
1990
1995
2000

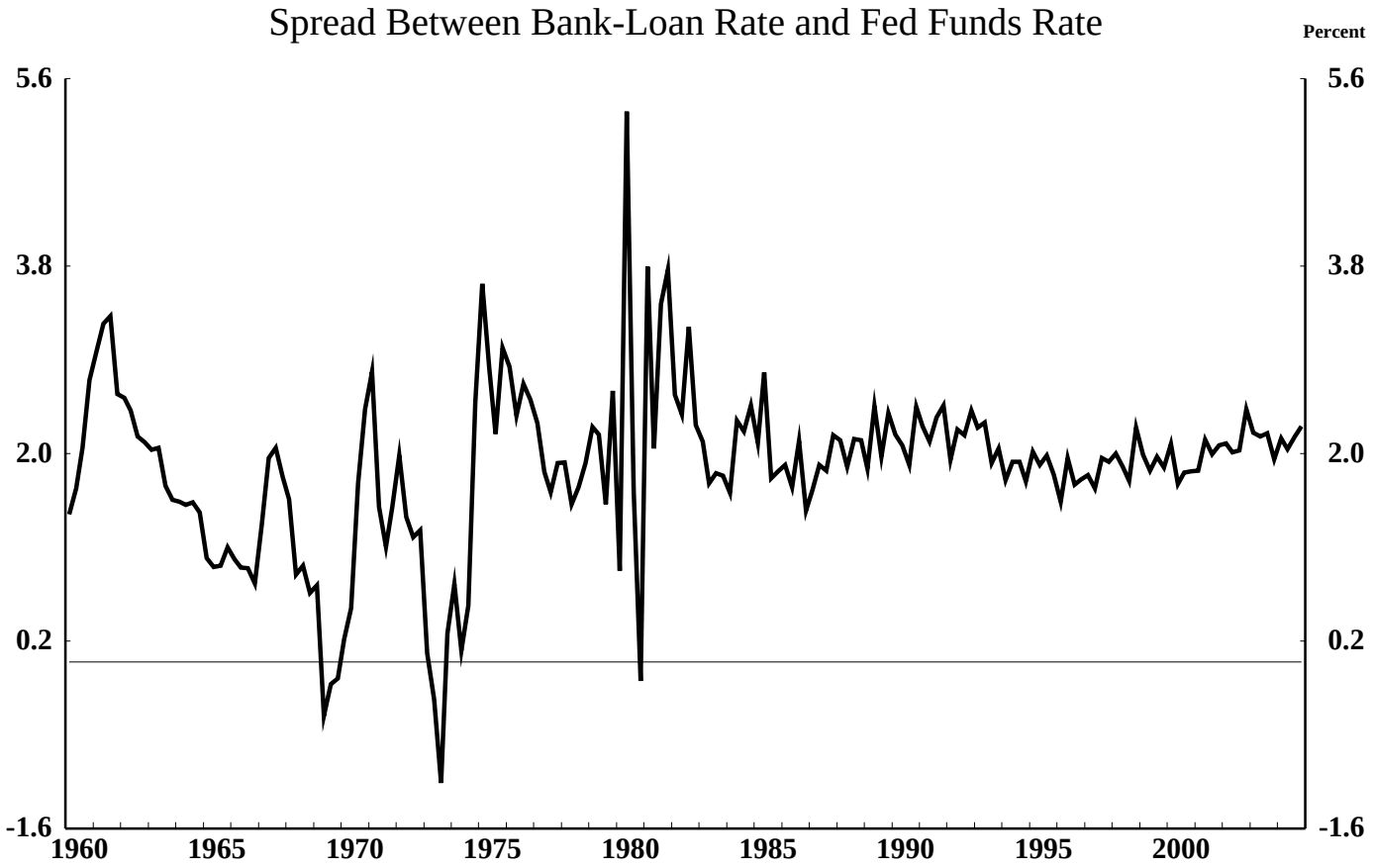
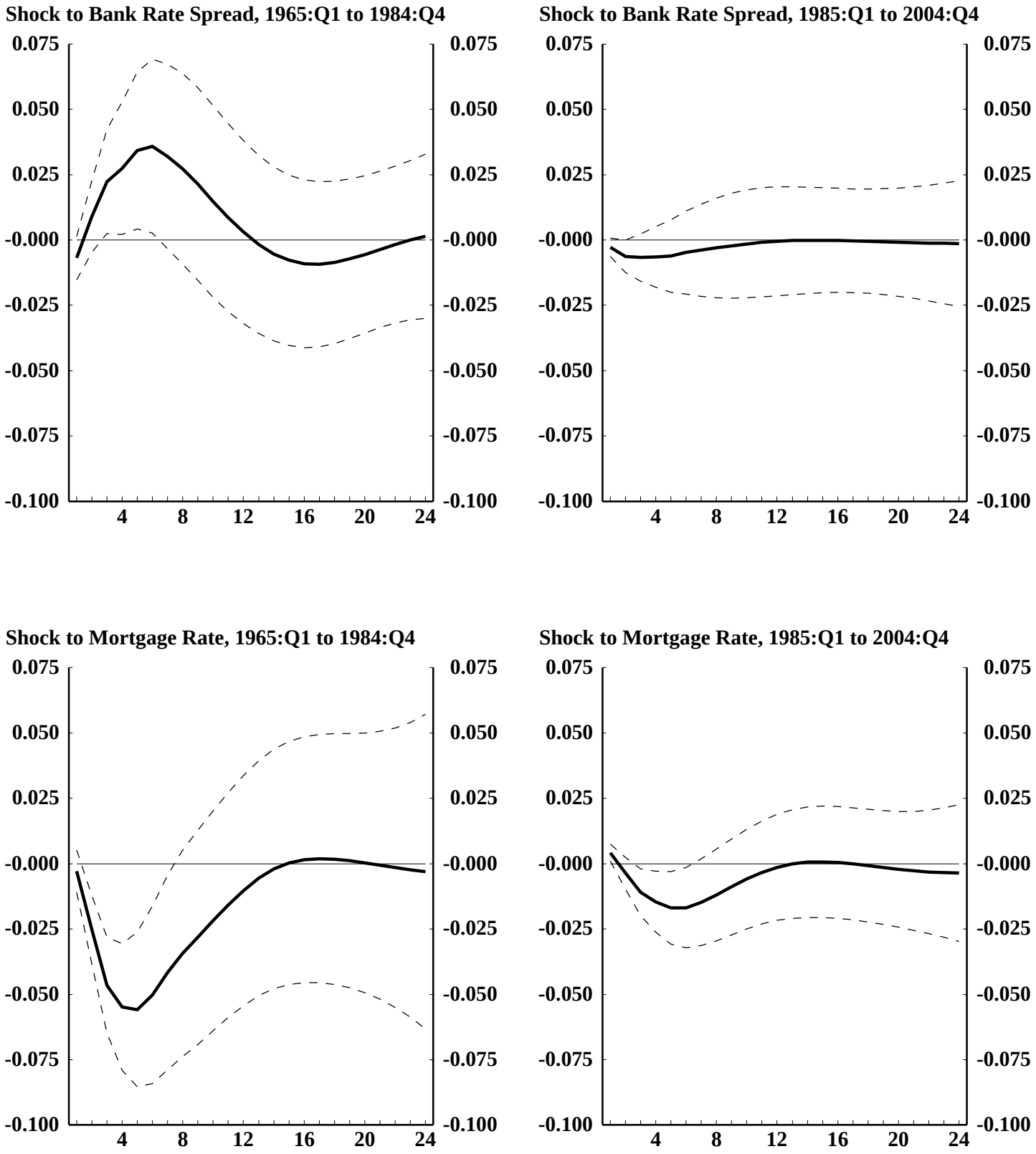
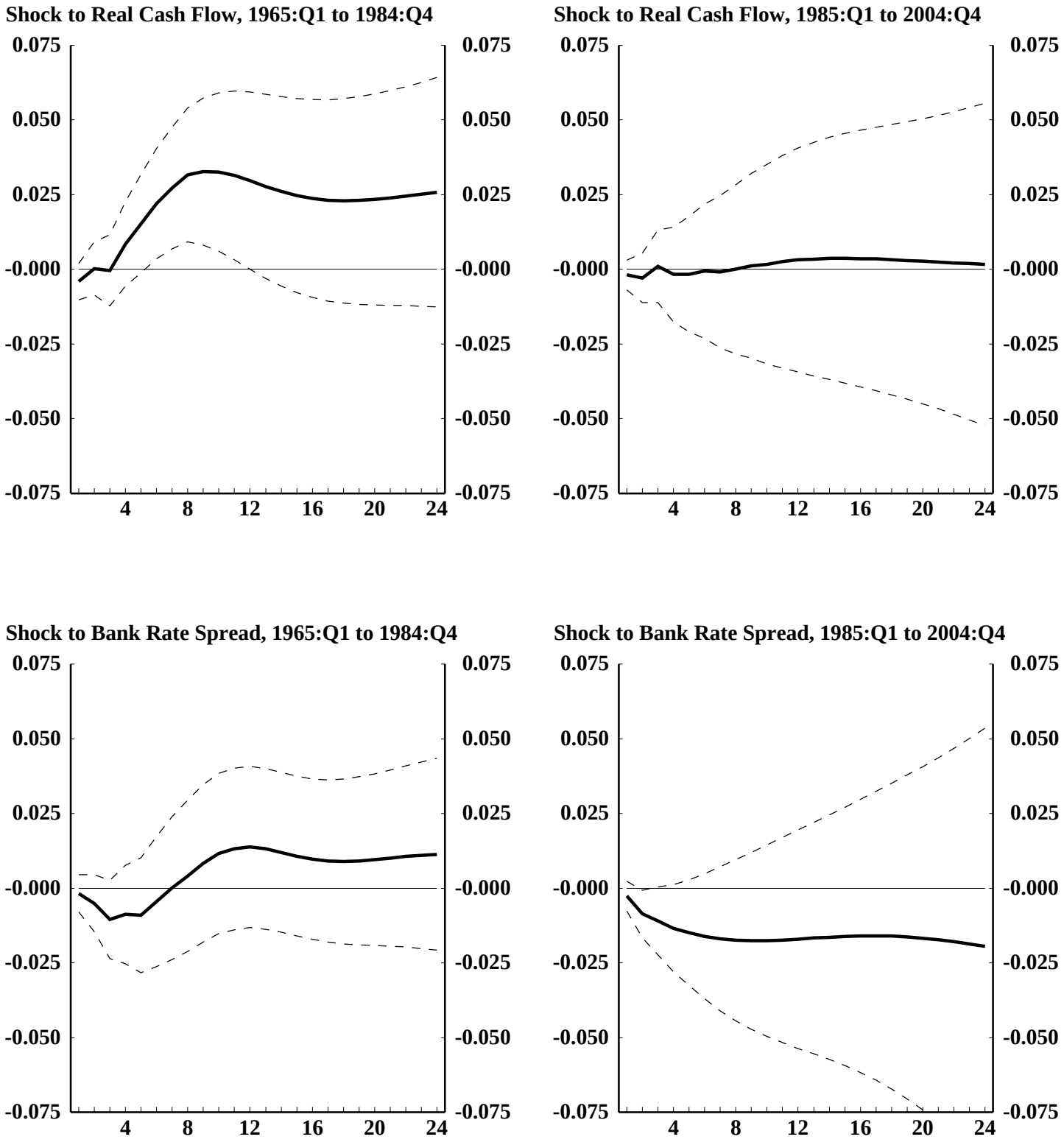

Spread Between Bank-Loan Rate and Fed Funds Rate
Percent
5.6
3.8
2.0
0.2
-1.6
1960
1965
1970
1975
1980
1985
1990
1995
2000

Figure 7
Impulse Responses of Real Residential Investment



Note. Responses shown are based on a VAR including the bank-rate spread, the mortgage rate, real disposable income, and real residential investment. Dashed lines show two-standard-error confidence bounds.

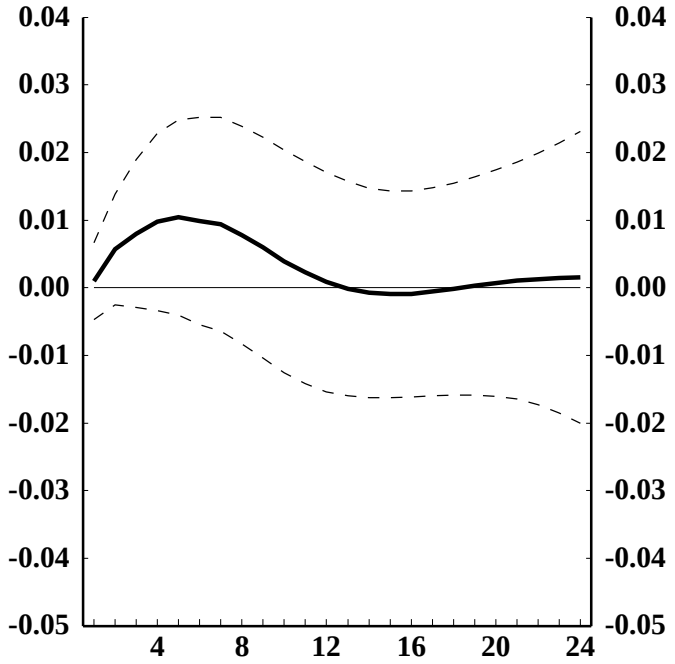
Figure 8
Impulse Responses of Real High-tech E&S



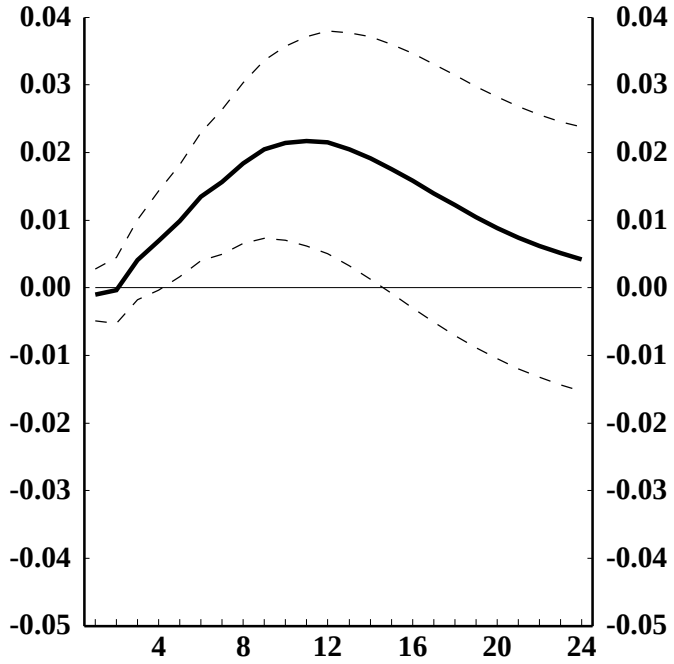
Note. Responses shown in the first row are based on a VAR including real cash flow, the user cost, real business output, and real high-tech equipment and software investment. Responses shown in the second row are based on a VAR including the bank-rate spread, the user cost, real business output, and real high-tech equipment and software investment. Dashed lines show two-standard-error confidence bounds.

Figure 9
Impulse Responses of Real Non-high-tech E&S

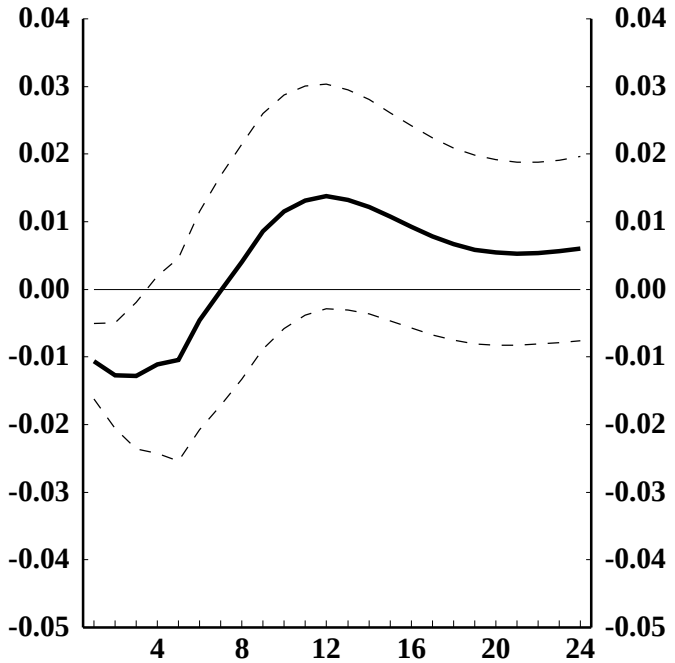
Shock to Real Cash Flow, 1965:Q1 to 1984:Q4



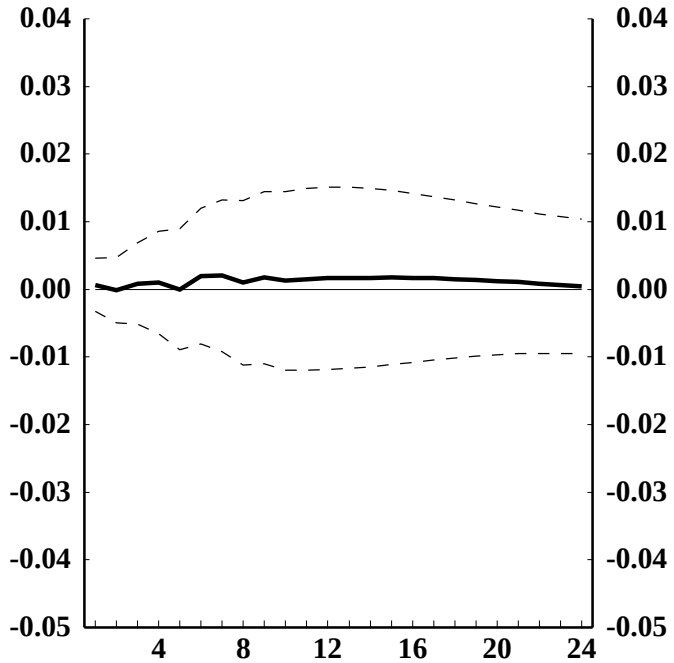
Shock to Real Cash Flow, 1985:Q1 to 2004:Q4



Shock to Bank Rate Spread, 1965:Q1 to 1984:Q4



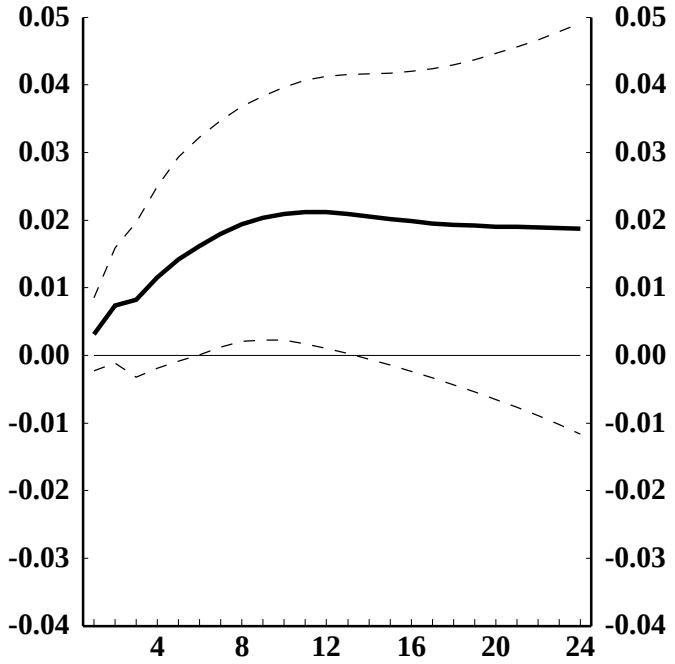
Shock to Bank Rate Spread, 1985:Q1 to 2004:Q4



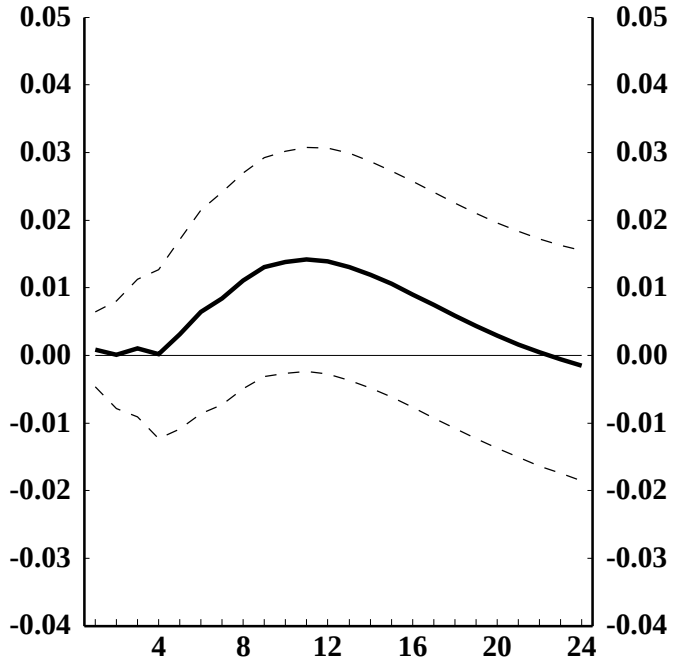
Note. Responses shown in the first row are based on a VAR including real cash flow, the user cost, real business output, and real non-high-tech equipment and software investment. Responses shown in the second row are based on a VAR including the bank-rate spread, the user cost, real business output, and real non-high-tech equipment and software investment. Dashed lines show two-standard-error confidence bounds.

Figure 10
Impulse Responses of Real Nonresidential Structures

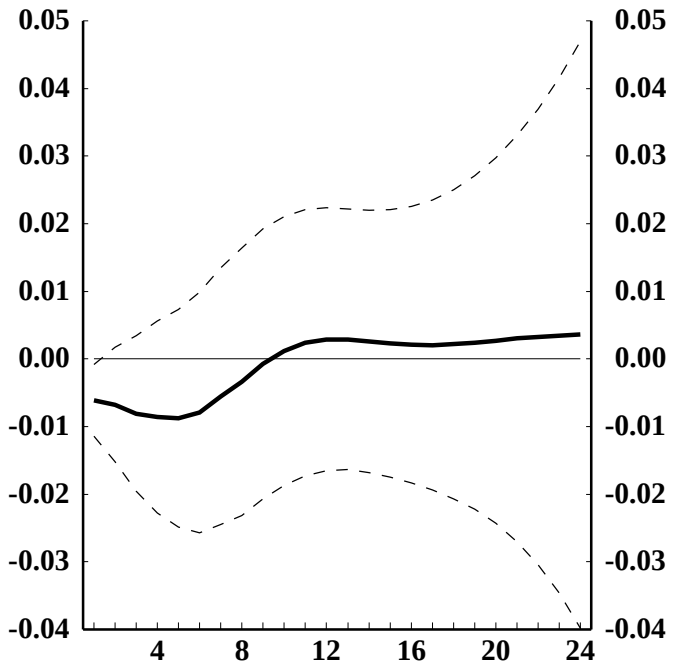
Shock to Real Cash Flow, 1965:Q1 to 1984:Q4



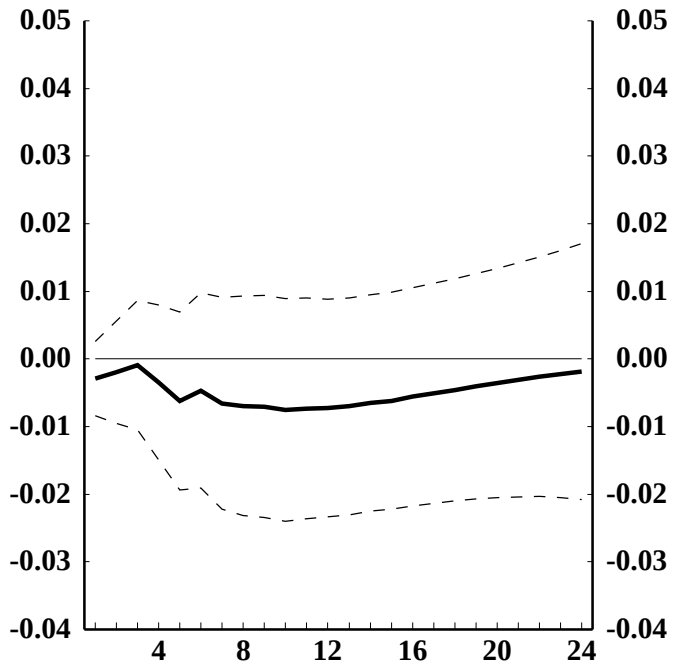
Shock to Real Cash Flow, 1985:Q1 to 2004:Q4



Shock to Bank Rate Spread, 1965:Q1 to 1984:Q4



Shock to Bank Rate Spread, 1985:Q1 to 2004:Q4



Note. Responses shown in the first row are based on a VAR including real cash flow, the user cost, real business output, and real nonresidential structures investment. Responses shown in the second row are based on a VAR including the bank-rate spread, the user cost, real business output, and real nonresidential structures investment. Dashed lines show two-standard-error confidence bounds.

Appendix: Additional Material Not Included in the Published Version of "Can Financial Innovation Help to Explain the Reduced Volatility of Economic Activity?"

Financial Innovation and the Volatility of Economic Activity

Appendix table 1 compares the drop in the volatility of different measures of aggregate output and income using alternative break dates. As noted in the text, a dividing line of 1985:Q1 produces more-consistent declines in volatility across frequencies of data and across measures of aggregate economic activity than does a dividing line of 1984:Q1.

Appendix figures 1 and 2 display the decline in volatility of the components of real GDP and nominal disposable personal income.

Appendix figure 3 plots unusual changes in interest rates against unusual changes in housing investment, analogous to the scatter plots we used to examine the evolving sensitivity of consumption to income. The figure shows clearly that residential investment growth has become much less sensitive to unusual movements in market interest rates, especially when measured on a four-quarter basis.

Appendix figure 4 shows cyclical comparisons of household debt. The top panel plots household debt relative to income around five recent business cycle peaks as dated by the NBER; we omit the 1980 peak because the subsequent recession was so short. Debt has increased faster in more-recent recessions than in earlier ones. However, this pattern could reflect either households using debt more effectively to smooth consumption when income growth stalls or simply a secular increase in debt. To abstract from the second factor, the bottom panel plots debt growth following peaks relative to the trend in the three years preceding the peaks. With this adjustment, the differences across business cycles are less stark. Still, debt growth was fastest in the most recent recession and second fastest in the preceding recession—consistent with the hypothesis that financial innovation has enabled households to better smooth consumption.

Other Explanations for the Reduced Volatility of Economic Activity

Previous authors have put forward a number of possible explanations for the moderation in economic activity.[1] In this section we briefly review the leading explanations and the evidence regarding them.

Changes in data construction: In the extended debate about whether the U.S. economy has been more stable since World War II than it had been previously, a key problem is the lack of comparability of prewar and postwar economic data. This concern does not seem to be important for the issue at hand, both because the construction of GDP data is not markedly different for the 1970s and the 1990s, and because the decline in volatility appears in other economic variables (such as employment and industrial production) that are constructed in different ways.[2]

Shift in the composition of output toward services: Over the years, many analysts have suggested that the rising share of services in total output is a stabilizing force on the economy.[3] Indeed, the production of services is much less variable than the production of goods. However, a number of papers have documented that the principal source of the reduced variability of output is a decline in the variability of goods production (for example, see McConnell and Perez-Quiros, 2000).

More-stabilizing fiscal policy: Little evidence has been put forward that fiscal policy has stabilized economic fluctuations more effectively over time. Auerbach and

[1] Comin and Mulani (2004) and Comin and Philippon (2005) showed that the growth rate of sales at individual firms in the Compustat database has become more volatile over time, even as the growth rate of aggregate sales has become less volatile. They argued that a full explanation of the reduction in aggregate volatility should also account for the increase in firm-level volatility. Stiroh (2005) highlighted the possible role of changing labor market dynamics in reducing output volatility. He showed that growth in both labor productivity and hours has been less variable after 1984 than before, and that the correlation between hours growth and labor productivity growth has fallen as well; all of these changes contribute in an arithmetic sense to a reduction in the volatility of output, although determining causality remains a challenge.

[2] See Warnock and Warnock (2000) on the variability of employment. Dynan and Elmendorf (2001) showed that the dispersion of *revisions* to estimated real GDP growth in the national income accounts is smaller after 1984 than before. Because the BEA's initial estimates are based partly on trends in preceding quarters, a reduction in actual volatility should make the initial estimates more reliable. The BEA may also have changed its methodology for generating initial estimates. However, neither of these stories implies that the BEA is using a different method for constructing its *currently published* estimates of real GDP growth during different decades.

[3] See Burns (1960), Moore (1987), and Zarnowitz and Moore (1986).

Feenberg (2000) found that the role of the tax system as an automatic stabilizer has changed little, on balance, since the early 1960s, and Cohen and Follette (2001) concluded that the tax and expenditure systems were both modestly less stabilizing of late than they had been earlier. Turning to discretionary fiscal policy, the two largest tax cuts of the past twenty years (the 1981 and 2001 tax laws) took effect during recessions. However, isolated fiscal actions cannot explain the generally lower economic volatility over the past two decades.

The view that fiscal policy has not become a stronger stabilizing force is supported by the pattern of government outlays and receipts in the national income accounts. The reduced variability of government purchases shown in table 1 explains only a few percent of the downshift in the variance of real GDP growth. Further, the changing behavior of taxes and transfer payments explains just one-tenth of the reduced variability of disposable income: Although the variance of government transfers less taxes has fallen substantially over time (which reduces the variance of disposable income), their covariance with compensation has also become considerably smaller (which works in the opposite direction).

Improved inventory management: As emphasized by Kahn, McConnell, and Perez-Quiros (2002), and documented in table 2, changes in inventory dynamics have contributed significantly to the reduced volatility of real GDP growth. Those changes are consistent with anecdotal evidence, case studies, and a downtrend in inventory-sales ratios suggesting that firms are using information technology and better practices to manage their inventories more efficiently. Indeed, Blanchard and Simon showed that the rolling correlation of the contributions to GDP growth of inventory investment and final sales has fallen, on balance, over time. This downshift suggests that firms are using inventories to smooth production in a way that they had not done earlier.

However, the reduction in the volatility of inventory investment might stem from the greater stability of final sales rather than a change in inventory behavior per se. In particular, if shocks to final sales become less persistent, one would expect a positive shock to final sales to induce a larger offset in inventory investment—because firms would see less need to build up inventories to maintain a target inventory-sales ratio, and

they could focus on smoothing production instead (see McCarthy and Zakrajsek, 2003, and Ramey and Vine, 2004).

Smaller shocks ("Good luck"): Another possible explanation for the reduction in volatility is that the shocks faced by the economy have become smaller over time. Ahmed, Levin, and Wilson (2004) argued that smaller shocks should reduce volatility at all frequencies, while better monetary policy should reduce volatility principally at the business-cycle frequency and improved inventory management should reduce volatility at relatively high frequencies. They could not reject the hypothesis that the variance of real output growth declined proportionally at all frequencies, which pointed them toward the "good luck" hypothesis. Ahmed, Levin, and Wilson also estimated time series models of output growth. They concluded that only a small share of the step-down in volatility was due to changes in coefficients—which could reflect changes in the structure of the economy—and most was attributable to a reduction in the variance of shocks. Blanchard and Simon and Stock and Watson obtained similar results.

In our view, this evidence is suggestive but not definitive. The link between the explanation for reduced volatility and the frequency at which volatility changed is not tight; for example, better monetary policy could reduce the volatility of expected economic activity and thereby smooth actual activity at higher frequencies as well as business-cycle frequencies. Moreover, innovations to output in quarterly VARs are not completely exogenous shocks to output but instead conflate those shocks with private agents' contemporaneous responses.[4] If private agents believe that monetary policy now responds more aggressively to shifts in activity, they might boost production by less in response to a positive demand shock, which would appear as a smaller estimated variance of output shocks. Further, Taylor (1999) argued that economic shocks since the mid-1980s—including the savings and loan crisis, swings in oil prices, and the Asian financial crisis—do not appear to be smaller or less frequent than shocks in the earlier period.

Better monetary policy: Improved conduct of monetary policy is another frequently cited explanation for the moderation of economic activity. There seems little doubt that the Volcker-Greenspan approach to monetary policy has led to the lower

[4] For example, Rudebusch (1998) argues that so-called monetary policy shocks in VARs do not correspond to market-based measures of unexpected movements in the federal funds rate.

average level and lower volatility of inflation observed since the mid-1980s. For example, many analysts including Taylor (1999), Clarida, Gali, and Gertler (2000), Kim, Nelson, and Piger (2001), Boivin and Giannoni (2003), Stock and Watson, and Romer and Romer (2002) have found that an increase in the inflation rate now induces a larger than one-for-one increase in the federal funds rate (instead of the less than one-for-one reaction previously).

Whether changes in monetary policy have also played an important role in stabilizing real activity is less clear. Some researchers have estimated that a shock to output induces a larger movement in the funds rate than previously.[5] In addition, Kim, Nelson, and Piger, and Stock and Watson showed that the volatility of long-term interest rates has been significantly higher since the mid-1980s, which is consistent with a more aggressive Fed response to shocks to inflation and real output.[6] Blanchard and Simon provided cross-country evidence of a positive relationship between inflation volatility and output volatility. Roberts (2004) calibrated a small dynamic model of the economy and showed that monetary policy could plausibly explain much of the stabilization of the output gap (although not so much of the stabilization of the growth rate of output itself), while Gordon's (2005) estimates of a small model pointed to both good luck and monetary policy having played important roles in the moderation of the output gap.

Still, not all of the evidence lines up with this story. As noted above, the biggest change in time series models of the economy seems to be in the shocks rather than the coefficients, where one might expect changes in economic structure to be most apparent. And, the variance of output has declined about equally at all frequencies rather than being concentrated at the business cycle frequency where the effects of monetary policy might be strongest. A different counterargument arises from Romer and Romer's case for

[5] In contrast with most of the literature, Orphanides (2001) argued that the improvement in monetary policy during the past several decades owes to a smaller response of the funds rate to perceived output gaps. Because output gaps estimated in real time are measured with significant error, an attenuated response to them transmits less of the measurement error to the economy. Orphanides, Porter, Reifschneider, Tetlow, and Finan (2000) found that the Federal Reserve has improved its real-time measurement of the output gap over time, which would lead to fewer policy mistakes and more stable output.

[6] These papers show that the federal funds rate has been slightly less volatile since the mid-1980s but substantially more persistent. Under the expectations theory of the term structure, more-persistent movements in the funds rate should have a larger effect on long-term rates.

rehabilitating the reputation of monetary policy during the 1950s. They estimated that policy in the 1950s behaved much like policy in the 1980s and 1990s—but output volatility was much higher in the 1950s than in the past two decades.

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Appendix Table 1
Declining Volatility of U.S. Output and Income: Comparison of Break Dates

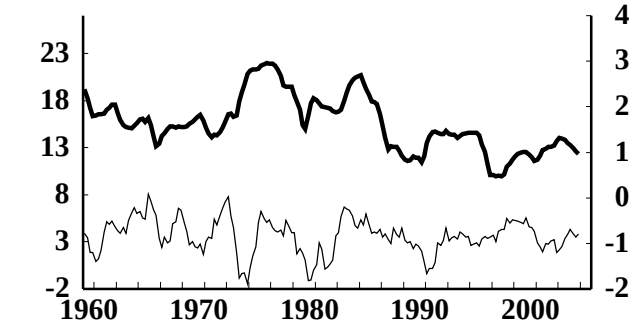
	Standard deviation of quarterly growth			Standard deviation of four-quarter growth		
	1960:Q1 to 1983:Q4	1984:Q1 to 2004:Q4	Change	1960:Q1 to 1983:Q4	1984:Q1 to 2004:Q4	Change
Real GDP	4.5	2.1	-52%	2.8	1.6	-41%
Nominal GDP	4.7	2.3	-52%	2.9	1.8	-37%
Nominal GDI	4.3	2.7	-38%	2.9	2.2	-25%
Nominal national income	4.7	3.4	-28%	3.0	2.4	-21%
	1960:Q1 to 1984:Q4	1985:Q1 to 2004:Q4	Change	1960:Q1 to 1984:Q4	1985:Q1 to 2004:Q4	Change
Real GDP	4.4	2.1	-53%	2.8	1.4	-51%
Nominal GDP	4.7	2.1	-56%	2.9	1.4	-52%
Nominal GDI	4.3	2.3	-47%	2.9	1.7	-43%
Nominal national income	4.7	3.0	-36%	3.1	1.8	-41%

Appendix Figure 1

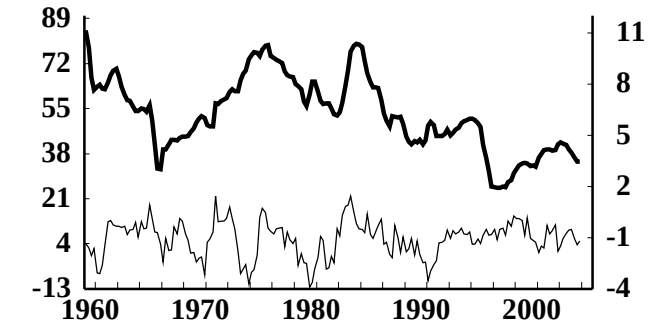
Volatility of Selected Components of Real GDP

Thin line = Four-quarter growth rate (left scale)
Thick line = 5-year trailing moving average of the standard deviation (right scale)

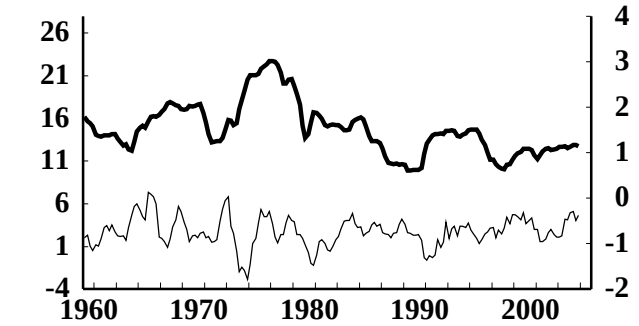
Real PCE



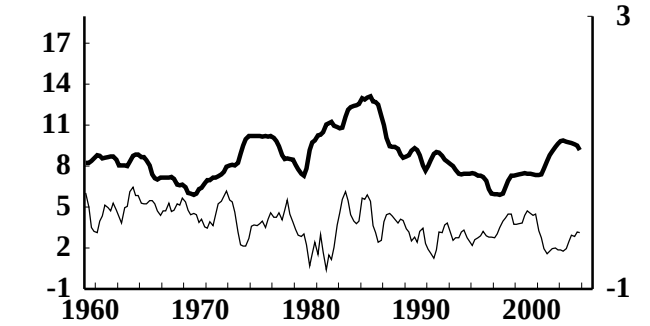
Real PCE Durables



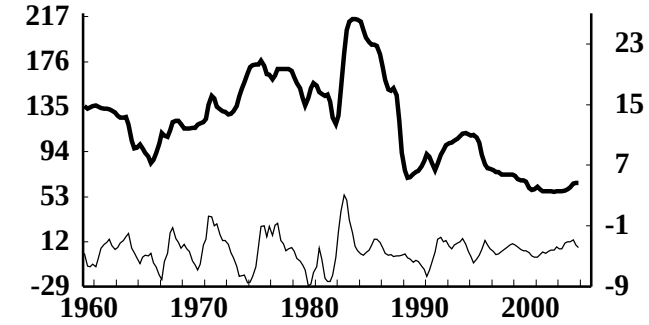
Real PCE Nondurables



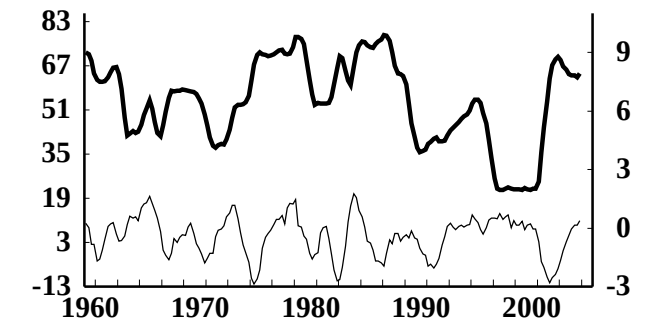
Real PCE Services



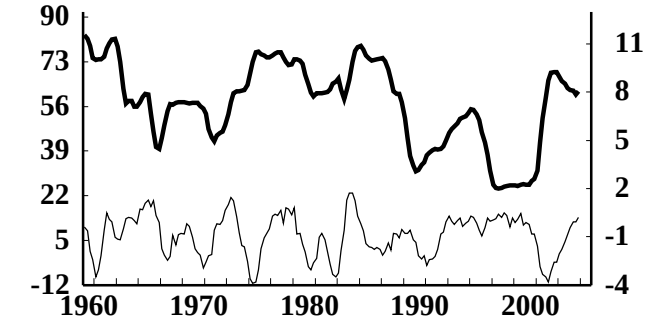
Real Residential Investment



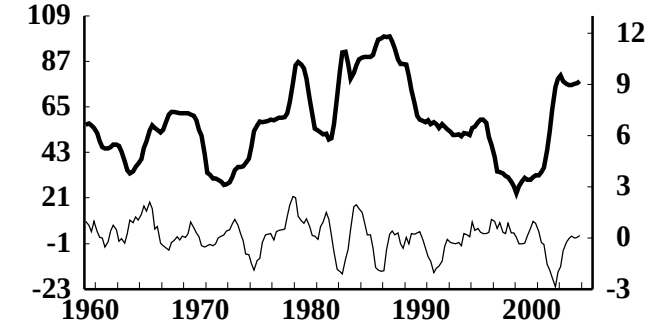
Real Business Fixed Investment



Real Equipment and Software



Real Nonresidential Structures

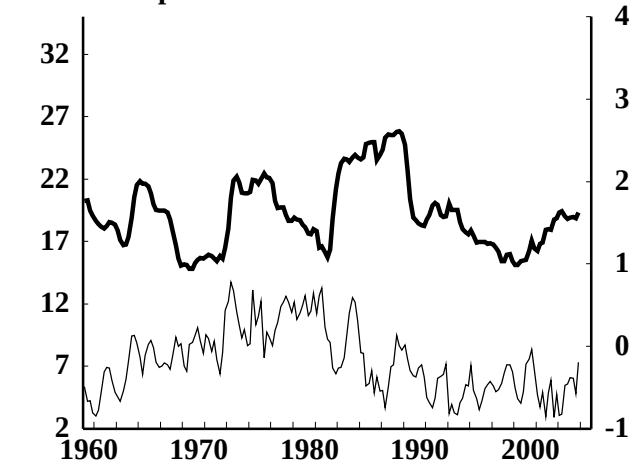


Appendix Figure 2

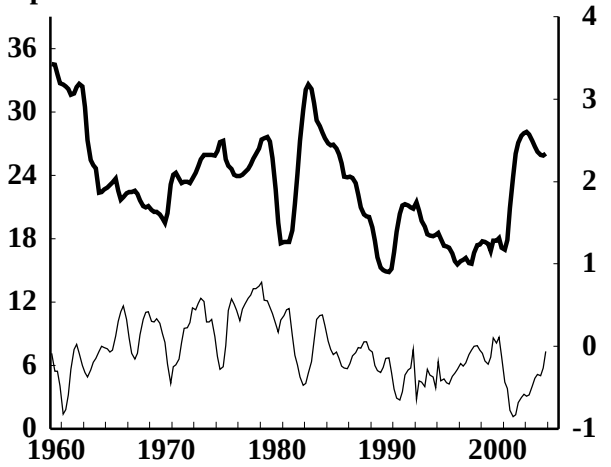
Volatility of Disposable Personal Income and Its Components

Thin line = Four-quarter growth rate (left scale)
Thick line = 5-year trailing moving average of the standard deviation (right scale)

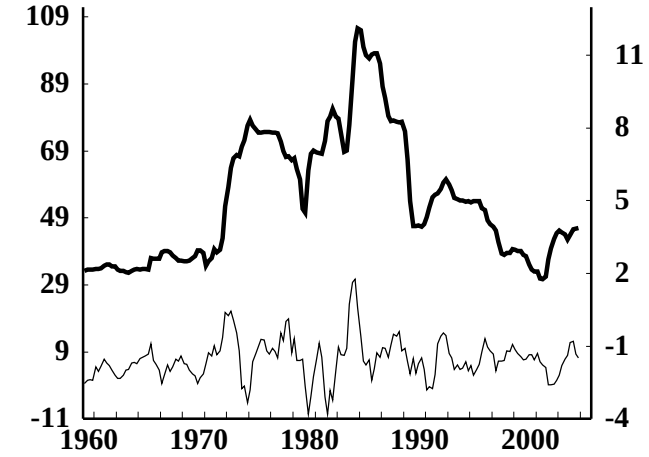
Nominal Disposable Personal Income



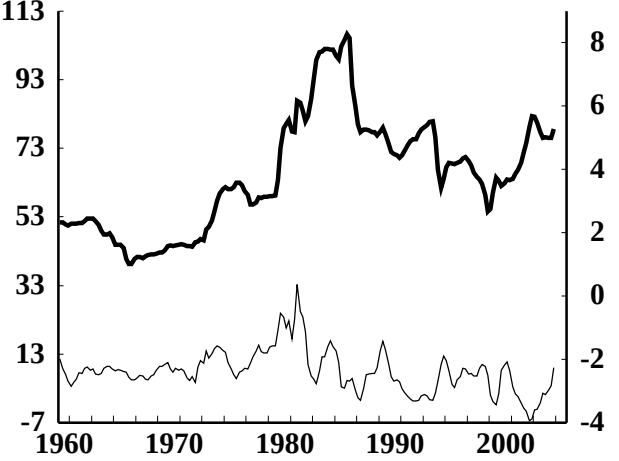
Compensation



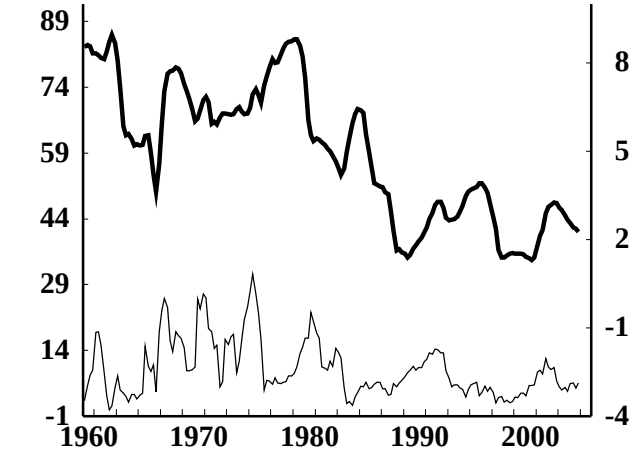
Proprietors' Income



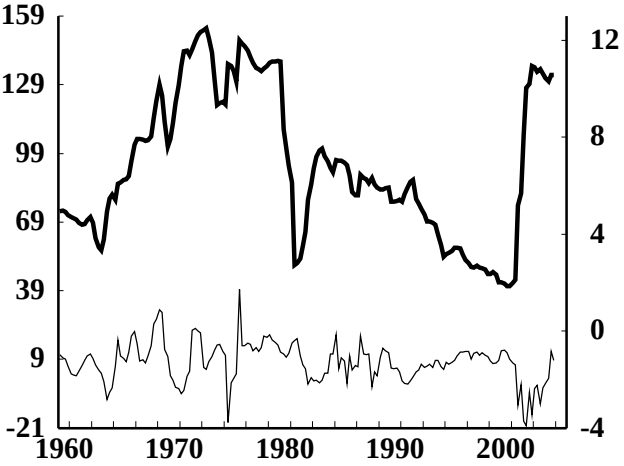
Personal Capital Income



Govt Trans to Persons

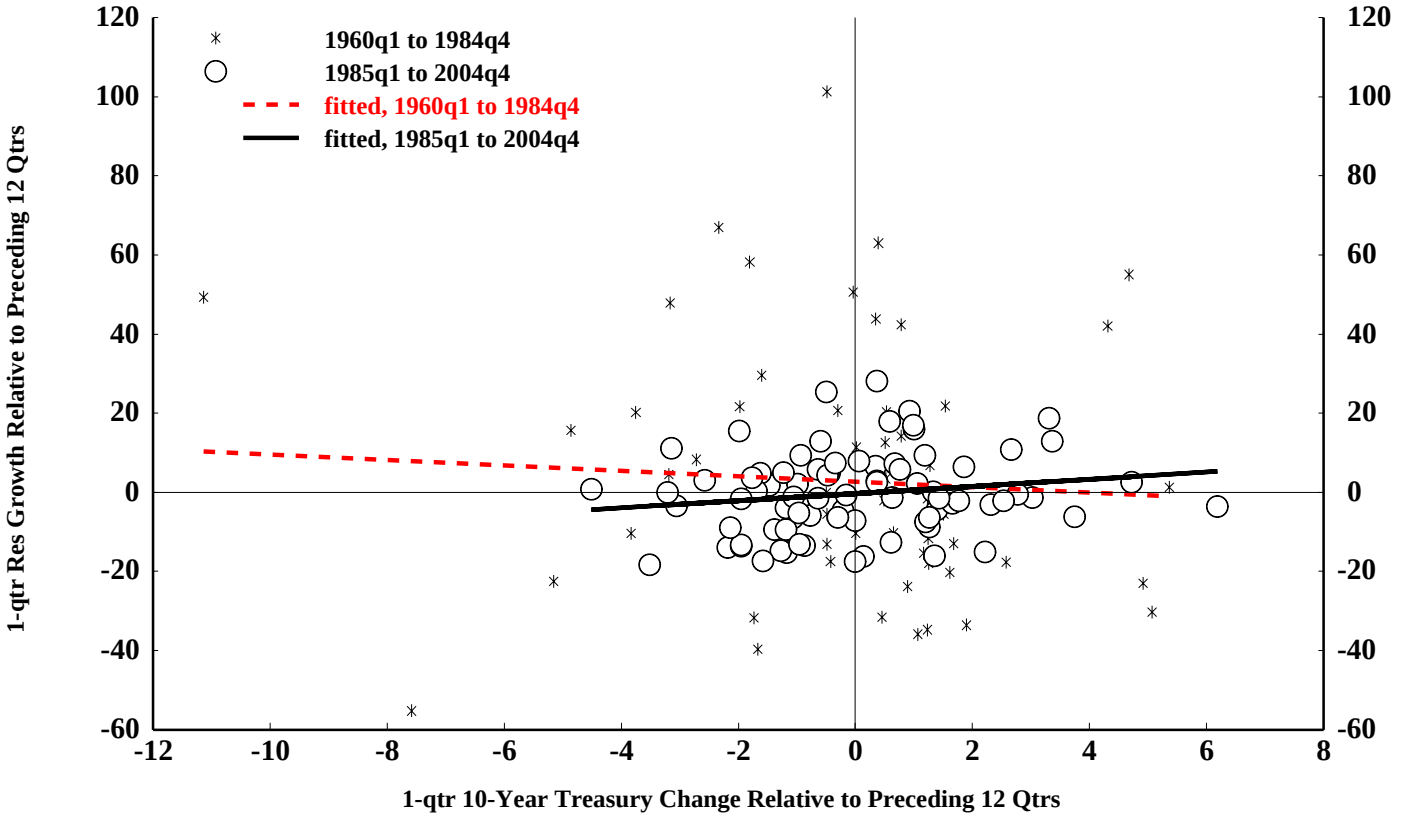


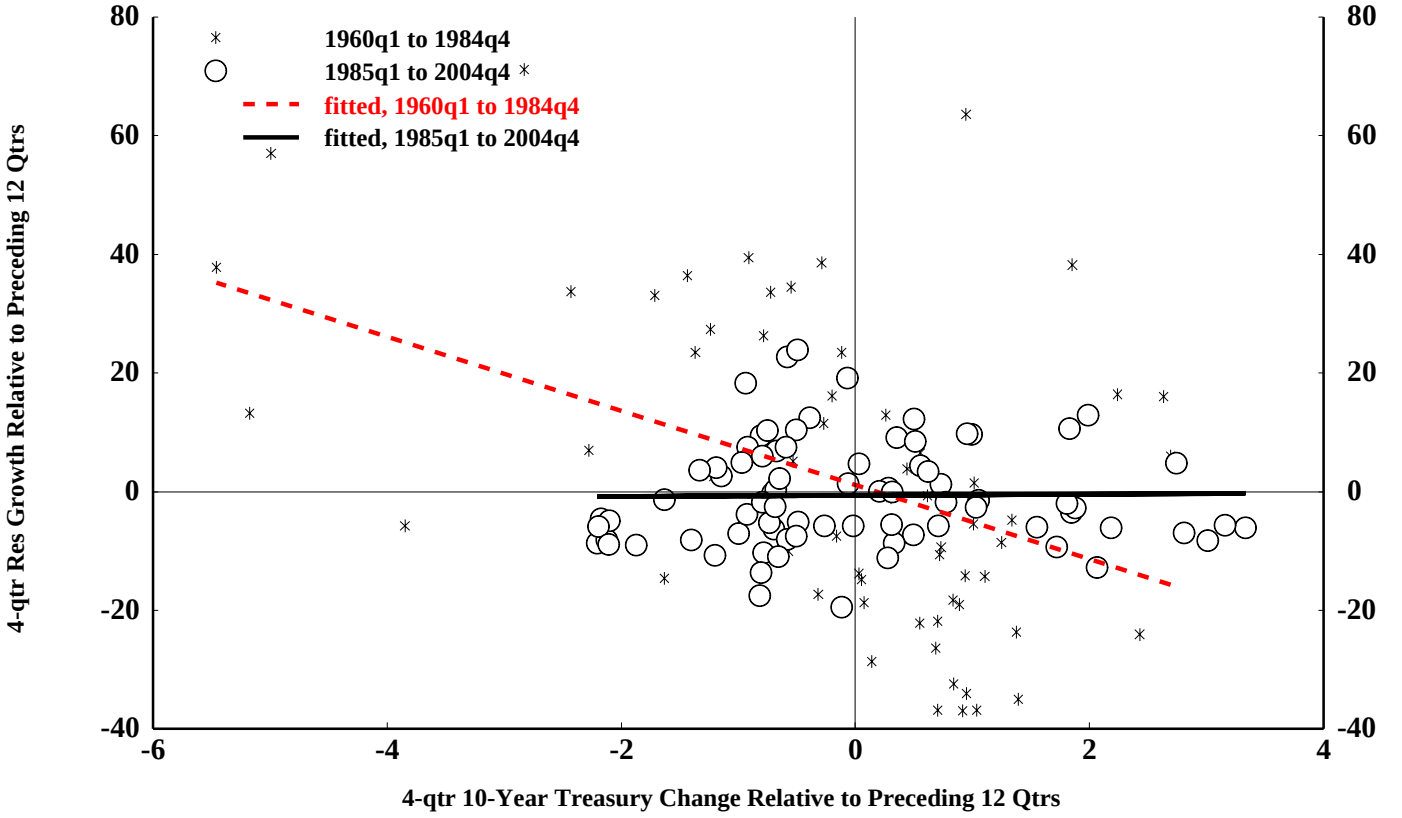
Personal Taxes



Appendix Figure 3

Unusual Growth in 10-Year Treasuries vs. Unusual Growth in Residential Investment





Appendix Figure 4

Cyclical Comparisons Of Household Debt