THE CHANNEL OF MONETARY TRANSMISSION TO DEMAND: EVIDENCE FROM THE MARKET FOR AUTOMOBILE CREDIT

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The Channel of Monetary Transmission to Demand: Evidence from the Market for Automobile Credit

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Abstract

In response to tight money, both consumer loans and consumption fall. In this paper, I ask whether there is any causality running from loans to consumption by focusing on how the composition of automobile finance between bank and nonbank sources of credit changes in response to unanticipated innovations in monetary policy. The results indicate that contractionary monetary policy reduces the supply of bank consumer loans, which in turn produces a decline in real consumption. The evidence is therefore supportive of a credit channel theory of monetary transmission to aggregate consumption. Furthermore, the nature of automobile finance is uniquely suited to identifying which of two possible sub-channels is relatively more important, and suggests the results are more likely consistent with a bank lending channel than with a pure balance sheet channel.

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1 Introduction

Is there any causal link between the availability of consumer credit and consumer demand? In bad times, does consumer credit decline simply because demand is lower, or is the downturn exacerbated by a reduction in the supply of consumer loans to credit-dependent households who would otherwise maintain consumption at higher levels?

The relation of credit market conditions to the production and investment decisions of firms has recently been a topic of extensive research (Bernanke and Blinder, 1988 and 1992, Bernanke, Gertler and Gilchrist, 1994, Gertler and Gilchrist, 1993). This research emphasizes the importance of endogenous changes in the firm's external finance premium in amplifying the effects of conventional (money) channels of monetary transmission. In particular, the credit channel theory of monetary transmission holds that recessions are worsened by the inability of credit-dependent firms to borrow at the levels they could in good times, either because banks decrease the supply of loans after a monetary tightening or because firm's credit-worthiness declines as their net worth falls.[1] If firms depend on bank loans to maintain production and investment activities and to finance inventories, a monetary contraction will have a greater impact on real activity than that predicted by the pure money view, according to which loan supply simply responds passively to changes in the demand for credit induced by variation in the cost-of-capital.

One can distinguish analogously between two possible channels of monetary transmission to demand with the following question: Does consumer credit simply passively respond to consumption demand (itself responding to variation in current income), or does a reduction in the supply of consumer credit by banks further retard consumption? This question is in fact twofold: 1) does a monetary contraction reduce the supply of consumer loans from banks, and 2) if so, does this lead to lower consumption? Although a considerable body of literature has developed to investigate the mechanism by which monetary policy shocks affect production and investment of firms, little work identifies these channels to the demand side of the economy. In this paper, I use evidence from

[1] See Bernanke and Gertler, 1995, for a general discussion of the broad credit channel.

the market for automobile credit to determine how unanticipated shifts in monetary policy affect consumption.

The main problem with discriminating between the money and credit channels from a reading of the aggregate data is that the two theories are observationally equivalent in the usual econometric analyses. For example, in either theory, loans contract after a monetary tightening, rendering it difficult to distinguish between supply-versus-demand induced movements in credit. Simple correlations between loans and various measures of real activity tell us something about the timing of events, but little about the direction of causality.

One approach to this problem is suggested by Kashyap, Stein and Wilcox (1991). They study how the ratio of business bank loans to commercial paper (a close substitute for bank credit) is influenced by a shift in monetary policy. Their insight was if a monetary contraction leads to a decline in the ratio of bank loans to the sum of commercial paper and bank loans, the *supply* of bank loans must be shrinking, since presumably the demand for both types of finance should fall in rough proportion. They found that a monetary contraction was associated with a decline in this ratio and concluded that tight money leads to a reduction in the supply of business loans from commercial banks, consistent with predictions of the credit channel theory.[2] Thus, whereas the money view makes no explicit prediction about the behavior of the composition of business finance, an implication of the credit channel theory is that a monetary contraction will shift this composition away from bank loans and toward non-intermediated credit.

This paper follows a research strategy very much in the spirit of Kayshap, Stein and Wilcox (KSW) by investigating how the composition of consumer loans between bank and nonbank sources

[2]Because Kashyap, Stein and Wilcox interpret their results as a reduction in the supply of bank loans, they find the evidence supportive of, not just a credit channel, but more specifically a bank lending channel, which is thought of as a sub-channel of the broader credit channel. Others have argued that their evidence is also consistent with an alternate sub-channel, the balance sheet channel. In the latter, banks do not necessarily decrease the supply of loans, but because there is a counter-cyclical demand for business credit, they may shift their loan portfolios from more risky to less risky borrowers in bad times. Because better borrowers have access to the commercial paper market, it is then difficult to distinguish between the two possibilities. In section 3, I argue that the evidence presented here for automobile credit is better suited to sorting out the two possibilities, and is more supportive of a bank lending channel than a pure balance sheet channel. Henceforth, I therefore view the empirical exercises as testing whether the supply of loans is affected by contractionary monetary policy.

of finance changes after an unanticipated disturbance to monetary policy. Consumer installment credit is issued by banks and by businesses and is given in aggregate time series data. Variation in the composition of consumer finance after a contractionary monetary shock provides the needed econometric identification for sorting out supply and demand movements in household credit: a fall in the ratio of bank loans to the sum of bank and nonbank loans indicates a constriction in the supply of bank credit. Before these empirical tests can be implemented, however, two issues need to be addressed.

The first implementation issue concerns the choice of household credit series. To ensure that bank and nonbank consumer installment credit is issued for the same pool of products, I focus my study on loans for a particular product – automobiles.[3] Automobile credit is extended by commercial banks or by finance companies which are usually subsidiaries of major automobile manufacturers.

A second implementation issue concerns the measurement of monetary policy. In order to track how the composition of consumer credit responds to an unanticipated shift in monetary policy, one needs some way of measuring the stance of monetary policy. A descriptive strategy for identifying exogenous monetary policy shocks is advanced by Romer and Romer (1990) who interpret minutes of the Federal Open Market Committee to identify particular episodes of tighter policy. Alternatively, Bernanke and Blinder (1991) argue that innovations in the federal funds rate are a good indicator of central bank policy because the Federal Reserve has direct leverage over this rate in the short term.

Christiano, Eichenbaum and Evans (1994) compare these two ways of measuring monetary policy. As they point out, one advantage of the Romer approach is that it requires no formal specification of the Federal Reserve's policy rule. Its primary disadvantage, however, lies with the ad-hoc identification of exogenous policy episodes (of which Romer and Romer locate six) as deliberate and large movements in policy controlled variables. Furthermore, the federal funds rate provides more information about the stance of monetary policy because there is a policy episode

[3]This strategy also eliminates certain types of consumer credit that are available to borrowers at their option (e.g. credit cards) and which make it particularly difficult to distinguish supply and demand movements when observing changes in the amount of debt outstanding.

for each data point in the sample. Finally the federal funds rate, unlike the Romer dates, furnishes a quantitative gauge of the intensity of the policy action. For these reasons, I restrict most of my calculations to those that measure monetary policy as an innovation in the federal funds rate, once a particular feedback rule, or reaction function, for monetary policy has been assumed.

The general strategy I employ is to use vector autoregressions to evaluate whether shocks to Federal Reserve policy influence the composition of automobile credit, and whether variation in this composition in turn affects automobile consumption. I test: (i) whether the composition of automobile finance changes in response to an unanticipated innovation in federal funds rate (helping to sort out supply and demand movements in credit), and (ii) whether variation in this composition affects sales of new automobiles (providing information on how substitutable these two forms of finance are). In short, the results indicate that contractionary monetary policy reduces the relative supply of bank consumer loans, which in turn produces a decline in real consumption.

The rest of this paper is organized as follows. In the next section, I briefly outline some relevant institutional details of automobile finance companies. In order to understand how finance companies (the primary source of nonbank automobile credit) alter the extension of credit in response to shifts in monetary policy, it is helpful to have some sense of their sources of funds. In Section 3.1 I discuss the empirical procedure used to evaluate the possibility that a credit channel to demand exists. Section 3.2 is devoted to documenting how the composition of consumer finance changes in response to an innovation in the federal funds rate. Section 3.3 presents evidence that changes in the composition of automobile finance affects automobile sales, and section 3.4 discusses some related issues about how to interpret the results. Section 4 concludes.

2 Some Institutional Aspects of Finance Companies

This section briefly describes some institutional aspects of finance companies' resources in order to gain a sense of what constraints they operate under in extending funds over the business cycle. Sales

finance companies purchase retail installment sales contracts from automobile dealers and collect payments directly from the consumer.[4] Finance companies also make wholesale loans to sellers in order to help them cover the costs of high inventories in times of slow demand. Historically, finance companies typically competed with each other by varying the rates charged on wholesale financing rather than on retail financing, since a lower rate on retail financing commonly just reduces the finance charges paid by the individual consumer. Today, much of the nonbank credit is extended by a few national firms which are subsidiaries of the Big Three U.S. automobile companies (GM, Ford and Chrysler).

The growth in finance companies from 1980 to 1990, at an average annual rate of 11.4 percent, was initially financed by funds raised primarily in the commercial paper market.[5] Commercial paper issuance by finance companies grew an average of 12 percent per year during this period. Corporate bond issuance subsequently surged leaving it the largest component of finance company liabilities by 1990. For sales finance companies as a whole (the largest of which are auto sales finance companies but they also include subsidiaries of major appliance manufacturers and retailers), the largest sources of funds at the end of 1982 (as a percentage of liabilities and capital combined) were long term debt (debt with original maturity of one year or more, 31.5%) and commercial paper (24.9%). Bank loans made up a much smaller percentage (7.4%).[6]

Similarly, for the major automobile finance companies, short term funding requirements are met primarily through the direct sale of commercial paper. For example, General Motor Acceptance Corporation's (GMAC) short term debt outstanding at December 31, 1983 amounted to $19.7 billion in the United States, about half of their total outstanding debt world wide. Medium and long term notes, including those marketed directly to investors in the U.S., account for slightly less than half of the total indebtedness, while bank credit represented about 3% of total indebtedness. In 1989, short term debt accounted for about 51% of total indebtedness, though by 1994 it was less

[4]The information is this section is drawn from various annual reports of General Motors Acceptance Corporation, Ford Motor Corporation, Chrysler Motor Corporation, and from Olney (1989).

[5]FRBNY (Federal Reserve board of New York) *Quarterly Review*, summer 1992, pp. 26-27. The growth of bank loans over this period averaged 8.4 percent annually.

[6]Finance Facts Yearbook, 1984, p.61.

at 33%. Similarly, Ford Credit's commercial paper debt in 1992 was about 86% of its total short term debt, itself approximately 53% of total debt.

The financial services operations of these companies, in addition to relying on loan collections and retained earnings, depend heavily on their ability to raise funds in capital markets. Stock issuance, surplus and undivided profits represented only 12.3% of all finance company funds in 1982.[7] Credit ratings are therefore a key determinant of the growth of finance company credit. When asset growth is regressed on senior debt ratings, capital ratios, parent relationships, and demand conditions, only the finance company's own credit rating significantly explains asset growth.[8]

The credit ratings of finance companies are themselves primarily determined by the capital strength of the parent company. Hence, financial ties to the parent company can lower the cost of borrowing by raising the finance company's credit rating. The parent company's senior debt ratings are found to be more important than own capital ratios, asset size, and parent relationships in determining the finance company's senior debt ratings. Rating agencies consider the capital support the parent company has provided in the past and their capacity to stand behind finance company debt in the future.[9]

The source of short-term finance is relevant because consumers do not have direct access to non-intermediated credit markets. Bernanke, Gertler and Gilchrist (1993) show that there is a flight to quality in downturns, in which credit is shifted toward high-grade borrowers with access to the commercial paper market, and away from riskier, smaller firms. Automobile finance companies are precisely this type of high-grade borrower. Thus some of their high-grade status may be indirectly imparted to automobile consumers if, when faced with a decline in the supply of bank credit, they are able to substitute into finance company credit.

[7] *Finance Facts Yearbook*, 1994, p. 67.
[8] FRBNY *Quarterly Review*, summer 1992, p. 28.
[9] FRBNY *Quarterly Review*, summer 1992, pp. 28-29.

3 Empirical Tests

3.1 *Empirical procedure*

Following the terminology used in KSW, I construct a variable called the mix of automobile finance, equal to the ratio of bank automobile credit to bank automobile credit plus finance company automobile credit, all measured as the stock of credit outstanding. I then estimate a set of vector autoregressive (VAR) models using monthly data from 1965:1 to 1994:12 and ask what the impulse responses for the mix variable and for automobile sales look like in response to innovations in monetary policy.[10] Each VAR was estimated using 12 lags of each variable.

As proposed by Bernanke and Blinder (1992), I use innovations in the federal funds rate to represent shocks to monetary policy. I make an additional assumption about the timing of information available to the Federal Reserve by placing the funds rate last in the VAR. The last equation in the VAR then represents a reaction function of the central bank, so that the innovation is the unanticipated policy shock. The typical justification for this placement of the federal funds rate in the VAR is the idea that it can affect other variables only with a one period lag, while the rate itself can respond contemporaneously given the Federal Reserve's reaction function.

The first model I estimate includes 5 variables: the log of industrial production, the log of the consumer price index (CPI), the log of the commodity price index, the financing mix, and the federal funds rate, in that order.[11] Christiano, Eichenbaum and Evans (1995) emphasize the importance of including a commodity price index in VARs designed to measure the effects of innovations in monetary policy (see also Sims, 1992). As they demonstrate, this inclusion is necessary to eliminate the price puzzle, the finding that contractionary monetary policy shifts appear to lead to a sustained increase in the price level in VARs which do not include a commodity price index. Including the commodity price index controls for episodes such as the oil price shock of 1974, in which the

[10]The data for the mix variable are obtained from the Federal Reserve Board of Governors in their G.19 and G.20 statistical releases. The other data are obtained from Citibase data bank.

[11]Even though several of these variables may be nonstationary, I do not difference them since the hypothesis tests based on the VAR in levels will have standard asymptotic distributions; see Sims, Stock, and Watson (1990).

subsequent rise in inflation was preceded by a rise in the federal funds rate.

Next, I ask how real retail passenger car sales react to an innovation in the federal funds rate or in the mix variable.[12] This model includes the log of industrial production, the log of the CPI and of the commodity price index, the log of real car sales or the inventory to sales ratio, and either the mix, or the federal funds rate, in that order.

In the next section, I discuss impulse responses using the first model, where I investigate how monetary policy affects the composition of automobile finance. Bank loans should make up less of the consumer's overall financing portfolio if depository institutions are constricting the supply of consumer credit in response to a positive innovation in the federal funds rate. The subsequent section uses the second VAR model and asks how the composition of automobile credit influences real activity. If consumers cannot perfectly substitute between the two forms of finance, then a negative shock to the mix variable should lead to a decline in automobile consumption. Finally, in section 3.3 I also add the finance composition variable to some standard automobile demand equations to see if it adds any explanatory power.

3.2 *The effect of monetary policy on the composition of automobile credit*

I begin by analyzing how the composition of automobile finance changes following periods of tight money. Figures 1 and 1A plot the financing mix (the ratio of bank automobile credit to credit issued by automobile finance companies plus bank credit) over time. Figure 1 plots the simple mix and figure 1A plots the mix detrended by a quadratic time trend. The solid vertical lines in the latter are drawn at dates Romer and Romer identify as coinciding with episodes of contractionary monetary policy.[13]

As the figures show, there appears to be relatively little trend in the variable, though there are some large low frequency movements. A particularly sharp drop in this ratio occurs in the

[12]The sales series is obtained from Citibase.

[13]These dates are: October 1947, September 1955, December 1968, April 1974, August 1978, and October 1979.

late 1970's. During the early part of that decade, depository institutions became increasingly aggressive providers of automobile finance. After 1979, however, other, higher yielding markets for commercial bank lending became available and decreased the amount of funds these institutions placed in automobile credit. This resulted in a shift back to finance companies. Finance companies' share in total automobile credit outstanding rose from 29% in 1980 to 37% by 1982.[14] This trend appears to be reversing itself in more recent years.

Figure 1A demonstrates that the detrended mix generally declines shortly after a Romer date. Thus, if the Romer dates adequately capture periods of tight money, the figure suggests contractionary shifts in monetary policy lead to a reduction in the relative supply of bank consumer credit.

Figure 2 displays the response of the composition of automobile finance to a one standard deviation increase in the federal funds rate, with two standard error bands computed using Monte Carlo simulations and assuming the errors are normally distributed. There is a significant decline in the ratio of bank loans to total automobile credit over a period of 60 months after a positive innovation in the federal funds rate. In figures 3 and 4 I document the response of each component of the mix variable to a positive innovation in the federal funds rate. The financing mix drops primarily because bank loans contract.[15]

The latter finding is in contrast to the results obtained in Gertler and Gilchrist (1993), where the composition of corporate finance between bank loans and commercial paper changes primarily because commercial paper issuance rises substantially after a federal funds rate increase; the response of bank loans is relatively flat. The usual explanation for the Gertler and Gilchrist result starts with a countercyclical demand for short-term business credit caused by a decline in the firm's cash flow and a need to finance growing inventories. This permits two possible interpretations of the change

[14] *Finance Facts Yearbook*, 1982, p. 52.

[15] Bernanke and Mihov (1995) suggest funds rate targeting as a description of Federal Reserve Policy may not be stable over various sub-samples. I split the full sample into three sub-samples consistent with Bernanke and Mihov: 65:1- 79:9, 79:10-94:3, 84:2-94:3. As is typical over such a small sample size, the standard error bands are quite wide. Nonetheless, in the pre-1979 sample, the financing mix declines slightly in response to a funds rate shock, consistent with the notion that the funds rate was a good measure of monetary policy over this period. In the other two sub-samples, the financing composition declines, but not outside of the two standard error bands. In the last sub-sample this is partly due to the relatively low variability of the funds rate and other variables that seems to be a characteristic of the post 1984 period.

in finance composition: Either firms substitute between loans and paper as banks constrict loans (as KSW suggest), or because low-grade borrowers find their balance sheet positions deteriorating, relatively more credit is supplied to high-grade borrowers who have access to the paper market (as Gertler and Gilchrist suggest). In the case of automobile finance, there is no obvious analogous need for short-term countercyclical finance of automobile consumption; therefore a more likely explanation for the behavior of the automobile finance mix is that consumers substitute between the two forms of credit, rather than lending institutions shifting their funds among consumers of varying quality. The distinction between the KSW interpretation and the Gertler and Gilchrist interpretation is often identified as two sub-channels of the broad credit channel theory; the former often termed the bank lending channel, and the latter the balance sheet channel. Which interpretation is more appropriate has not been conclusively demonstrated, though in the next section I will argue that the bank lending channel seems to better fit the facts of automobile finance.

In summary, tables 2, 3, and 4 indicate the ratio of bank auto loans to finance company obligations declines in the face of a positive shock to the federal funds rate. This suggests that the correlation between consumer loans and real activity is not simply a passive accommodation of loan supply to fluctuations in demand; instead, the evidence signifies that banks reduce the supply of loans in response to a contractionary policy shift.

3.3 *The effects of finance composition on real consumption*

The evidence presented in the last section indicates that commercial banks may decrease the supply of consumer loans in response to tight money, and that consumers may be able to substitute into alternative forms of finance in response. If the two forms of finance are not *perfect* substitutes, however, the overall supply of loans to credit-dependent individuals will decline, leading to a fall in consumption. In this section, I first investigate whether the financing composition of consumer credit significantly affects automobile consumption in a VAR controlling for income and the price level. This provides a test of how substitutable finance company contracts are for bank automobile

loans. Next I estimate a set of standard automobile demand equations to see if the composition variable adds any explanatory power.

I use monthly data on retail sales of motor vehicles, seasonally adjusted and deflated, as well as on the ratio of real passenger car sales to inventories.[16] As figure 5 shows, real automobile sales decline in response to a federal funds rate increase, confirming a positive correlation between tight money and a decline in consumption. Figure 6 plots the cumulative response of the log of automobile sales to a one standard deviation increase in the mix variable. Real retail sales rise in response to an increase in bank loans as a fraction of total credit. Approximately six months after a positive innovation to the financing mix, auto sales significantly increase. Figure 7 shows the response of the passenger car inventory to sales ratio to a one standard deviation increase in the mix variable. Though this series is much more volatile than car sales alone, sales still rise relative to inventories within 8 months after the mix rises.

In principle, another way to test whether a decline in the supply of bank loans affects real variables is to see whether the *spread* between the bank interest rate and finance company interest rate rises in response to tight money. A credit channel theory for consumption would predict that there are bank dependent borrowers who can not perfectly substitute between bank and nonbank credit, resulting in an increase in the spread. This is simply another way of asking whether the decrease in bank loan supply is an additional effect of contractionary monetary policy on real variables that exists over and above conventional channels.

In practice, using the financing mix to infer the state of bank loan supply is generally more reliable because there may be reasons why the spread does not increase even if banks do decrease the supply of loans and even when the two forms of finance are imperfect substitutes. For example, if banks respond to a decrease in reserves by lending to a less risky pool on average, the lower default probability may hold down the bank lending rate so that the spread is little affected. On the other hand, there is not much reason to think, practically or theoretically, that the spread would rise unless banks were constricting the supply of loans and unless alternative forms of outside

[16]The ratio is obtained from Data Stream International.

finance are imperfect substitutes for borrowers. Therefore, an increase in the spread in response to tight money lends at least tentative support for the credit channel theory; in contrast, if the spread remains unchanged or even falls, it is likely to be a less reliable indicator of bank loan supply and financing substitutability.

With this caveat in mind, I display how the spread responds to a one standard deviation shock in the federal funds rate in figure 8.[17] The spread significantly rises after about 2 months, lending further support to the hypothesis that banks cut the supply of consumer loans and that consumers find it more costly to use nonbank finance.[18]

Next, I consider two aggregate automobile demand equations and ask whether the financing composition adds any explanatory power. The first demand equation comes from Chow (1957). Chow assumes that individuals choose automobile consumption by maximizing utility subject to consumption being proportional to income. The desired stock of automobiles is a linear function of the relative price of new automobiles and real disposable income, suggesting the following equation for automobile demand:

$$S_t = \alpha + \beta_1 RP_t + \beta_2 Y_t + \beta_3 X_{t-1}, \tag{1}$$

where S_t is sales of new automobiles, α is a constant, RP_t is the relative price of new automobiles in terms of consumption, Y_t is real, disposable income, and X_{t-1} is the consumer's lagged stock of automobiles.

Another demand equation arises from a study by Blanchard and Melino (1986). They examine

[17]The interest rate data are obtained from the Federal Reserve statistical release G.19 and are annual percentage rates. Interest rates at commercial banks are simple unweighted averages of each bank's most common rate charged for a 48 month new car loan during the first calendar week of the middle month of each quarter. Finance company data are from the subsidiaries of the three major U.S. automobile manufacturers and are volume-weighted averages covering all loans for new cars purchased during the month. Since the data for bank rates are of quarterly frequency, I average the monthly finance company rates over the quarter for figure 8.

[18]The sample mean of the spread using these rates (bank rate minus finance company rate) is -0.84 percent using data from 1972:02 to 1995:01.

a whole market structure deriving both a demand and supply equation. Here I focus on their results for the consumer's problem and just extract a demand equation from their model. In that model, the consumer maximizes the conditional expected value of additively separable utility from now until infinity over consumption and the stock of automobiles, subject to a wealth accumulation constraint and an accumulation constraint for the stock of cars. After linearizing the first order conditions and making some assumptions about the information set of the consumer, the following demand equation arises, which is very similar to (1)[19]:

$$S_t = \alpha + \beta_1 RP_t + \beta_2 C_t + \beta_3 X_{t-1}, \tag{2}$$

where C_t is consumption, excluding automobile services.[20]

Table 1 presents the results. The table reveals a puzzling outcome with respect to the relative price, but otherwise produces some significant patterns with respect to the composition of automobile finance. The first row estimates (1) itself, and the second row adds in the current period's financing composition as an additional explanatory variable. The current financing composition is strongly significant in the demand equation, as is disposable income. The price variable which is the CPI component for new cars divided by the PCE deflator is, oddly, strongly significant with a positive coefficient. BM solved out the complete market structure model, so that price was determined simultaneously by supply and demand. They found however that the price equation was in substantial contradiction with the model and speculate that prices could be measured badly. Alternatively, if there are costs to adjusting prices, lagged prices should be state variables in the

[19]Once the first order conditions are linearized, the problem consists of solving a linear, expectational difference equation. I make similar assumptions to those of Blanchard and Melino (BM) and suppose that the consumer's information set contains only current and lagged variables and that consumption and prices are uncorrelated with current and lagged disturbances to marginal utility, and are represented by a first order autoregressive structure, making it easy to use the method of undetermined coefficients to solve for (2).

[20]Data is obtained from Citibase data bank, see table 1. I follow Blanchard and Melino and use constant dollar personal consumption expenditures as a measure of C_t, and measure RP_t as the CPI component for new cars divided by the PCE deflator. To obtain a stock for consumer durables, I assume the initial stock is the average on expenditure for first 15 months (67:1 - 68:3), dividing by the depreciation rate, and that subsequent values of the stock evolve using a depreciation rate of 2% per quarter.

model and included in the regressions. In subsequent regressions I therefore include lags of the price variables as well as for C_t in case the first order autoregressive specification for that variable is too restrictive.

The third, and other rows add in the rate on the three month treasury bill as a proxy for the consumer's user cost. Again the financing composition remains a strong predictor of automobile sales even though the t-bill adds explanatory power to the regression. When lags of the relative price are added in (fourth row), the current period's relative price no longer has a positive coefficient but is also no longer significant, and the sign on the sum of lagged price coefficients is again positive. Row 5 shows that it makes little difference whether consumption or disposable income is used, indicating that there is small distinction in practice between the specifications in (1) and (2). Finally, the last two rows add in lags of the financing mix. The sum of the coefficients on the current mix and its lags has a positive sign and is strongly significant with or without the addition of the t-bill rate, while controlling for consumption, the relative price of new cars and its lags, and the lagged stock of cars.

One obvious reason for why the relative price might appear with a negative coefficient in the structural form demand equations (1) and (2) is the potential for endogeneity problems to arise. Though the credit channel theory in this case directly applies to consumer demand, the VAR results suggest that, in equilibrium, final sales are affected. I attempt to eliminate any potential simultaneity bias by next adding the financing composition into Blanchard and Melino's reduced form equation for automobile sales:

$$S_t = \alpha + \beta_1 X_{t-1} + \beta_2 I_{t-1} + \beta_3 Z_{t-1} + \Sigma_{i=0}^{3} \beta_4 C_i + \Sigma_{i=0}^{3} \beta_8 W_i, \tag{3}$$

where I_t is the producer-dealers inventory of automobiles, Z_t is automobile production, W_t is the real wage, and the other variables are defined as before.[21] Blanchard and Melino obtain the reduced

[21] I_t and Z_t are obtained from the Citibase data bank, where the first is given as retail auto inventories of total

form equation by simultaneously solving the demand problem discussed above and a supply problem for a representative automobile firm (which makes both the production and the sales decision) that maximizes the expected present value of cash flows subject to an inventory accumulation constraint. I also follow BM and add in dummy variables for strike dates of the Big Three automobile manufacturers and a (quadratic) time trend.

Table 2 presents the results of estimating (3). The first row estimates (3) itself. The results are very similar to those obtained by BM for all variables except the real wage. Here the coefficient is significantly positive, whereas they found it to be insignificantly different from zero. The second row adds in the financing composition which again appears to be an important determinant of automobile sales. The marginal significance level is less than 0.0001. The third row adds in the financing composition and its lags; the sign of the sum of all coefficients on this variable is positive and strongly significant. Finally the last two rows add in the price of fuel as a robustness check. The price of fuel adds significant explanatory power to the regression, but the financial factors continue to influence automobile sales at very high marginal significance levels.

In summary, the analysis in this section shows that changes in the composition of consumer finance are associated with variation in real consumption not captured by aggregate income or price variables, or by lagged stocks of automobiles or some measure of the user cost. In addition the reduced form estimation indicates that financing elements influence automobile sales *in equilibrium*, consistent with the VAR results. This, along with the evidence in the previous section, suggests that consumers can not perfectly substitute into nonbank forms of automobile finance when banks reduce the supply of automobile credit after a monetary tightening. The evidence is consistent with a credit theory of monetary transmission, according to which credit market conditions exacerbate the conventional effect of depressed demand brought about by a movement toward tighter policy.

new passenger cars, and the second is measured as the Industrial Production Index for automobiles. W_t is obtained from Datastream International and is the average, hourly wage for production workers in the automotive industry.

3.4 Discussion

Two points about what the results represent are worth discussing. First, one possible interpretation of the behavior of the mix variable in response to a positive federal funds rate shock is that, rather than commercial banks cutting the supply of loans, consumers willingly switch into finance company credit because they offer better financing terms in bad times when automobile dealers are facing declining demand and growing inventories.

Several considerations shed doubt on this interpretation. One is that the autoregressions and OLS regressions preformed above have controlled for the most plausible conventional variables (output or income, and interest rates) which could impact the demand for automobiles; changes in the composition of external finance are associated with changes in automobile consumption above and beyond the component attributable to fluctuations in income. If automobile demand declines simply through conventional channels, the financing mix should have no additional explanatory power. Furthermore, the scenario begs the question of why the automobile dealers or the finance companies (the manufacturers) would choose to cut the financing cost rather than cut the list price directly. In fact, manufacturers usually offer a choice between better financing terms or a cash rebate which comes directly from the manufacturer. Offering better financing terms instead of a lower price would make sense if there was some reason to price discriminate between credit-dependent and unconstrained consumers, so that the manufacturer effectively offers a price cut just to the credit-dependent borrowers. But finance companies would price discriminate in this way only if the monetary contraction left them with a comparative advantage in furnishing credit. At the margin, there is little reason to expect manufacturers to optimally lower price only to credit-dependent consumers unless the consumer's ability to borrow from banks has diminished. Finally, figure 9 shows that the interest rates charged by finance companies *rise* in response to a positive shock in the federal funds rate (so the spread rises because bank rates increase even more). Though the interest rate does not fully capture the financing terms of a credit contract, at least to a rough approximation this evidence seems at odds with the notion that the shift in the financing mix is

a consequence of price cutting by automobile dealers (via financing costs) designed to stimulate sagging sales and deplete mounting inventories.

Another issue that arises is whether the results can help discriminate between the two sub-channels (described above) of the broader credit channel theory. Recall the two possible interpretations of why bank loans fall relative to nonbank credit in response to a monetary contraction: one is that banks cut the supply of loans to borrowers who cannot perfectly substitute into nonbank forms of credit (the bank lending channel), the other is that the quality mix of borrowers changes; because the balance sheets of borrowers deteriorates, there is a flight to quality by banks at the same time that there is a surge in the demand for credit by high-grade borrowers who have access to non-intermediated outside finance (the balance sheet channel). In this context however, the pure balance sheet channel interpretation rests crucially on the institutional assumption that only high-grade borrowers have access to non-intermediated credit. This assumption is justified in the case of firms, where commercial paper is the primary substitute for bank loans and is generally available only to companies with outstanding credit ratings.

Construing the evidence presented in this paper as a pure balance sheet effect is more problematic. I obtained data on delinquency rates for the automobile credit contracts of commercial banks and finance companies.[22] The delinquency rates on bank loans are consistently below rates on finance company loans: In monthly data from 1980:1 to 1994:12, the delinquency rate at commercial banks averaged 1.81 percent, while that of finance companies averaged 2.07 percent. This evidence does not support the balance sheet channel because the behavior of the mix cannot be explained by a shift to higher quality borrowers. The opposite appears to be true in the case of automobile credit: riskier borrowers are more likely to use finance company credit.

On the other hand it is precisely because nonbank forms of business credit are accessible almost exclusively to high grade borrowers that is has been particularly difficult to draw a distinction between the two sub-channels in existing empirical work involving the composition of firm finance.

[22]Source: Staten, Michael E., and Robert W. Johnson, Ed., 1995, *Household Credit Data Book*, fourth edition, West Lafayette: Credit Research Center. The rates are measured as the percent of auto loans thirty or more days past due, seasonally adjusted.

The institutional nature of automobile finance provides a unique instrument for distinguishing between the balance sheet and bank lending channels. Thus, at least in the case of consumer loans, the results here provide evidence of a bank lending channel of monetary policy transmission as distinct from a balance sheet channel.

4 Conclusions

The importance of consumption in cyclical fluctuations has long been emphasized as a reason to understand what determines this component of GNP in aggregate data. The goal of this paper is to identify the channels through which aggregate consumption may be affected by unanticipated shifts in monetary policy. Conventional theories explain the pro-cyclical behavior of consumer credit by assuming that loans merely passively respond to the income induced change in demand. If instead, lending institutions react to tight money by decreasing the supply of consumer loans, credit-dependent households would be forced to cut spending by more than conventional mechanisms imply. The bank loan supply channel predicts that economic downturns will be exacerbated by the decline in consumer credit available from depository institutions, helping to understand why large cyclical swings in consumption are often associated with relatively small monetary impulses.

The evidence presented in this paper is supportive of a credit channel theory of monetary transmission to aggregate consumption demand. The *composition* of automobile credit between banks and finance companies is significantly changed by unanticipated shocks to monetary policy, a finding consistent with the predictions of a credit channel theory, but not with conventional theories of monetary transmission. Furthermore, innovations in the financing mix have significant affects on automobile consumption not explained by variation in income. Finally, the results are more likely consistent with a bank lending channel than with a pure balance sheet channel, since the primary nonbank source of automobile credit – finance company contracts – is generally used by riskier borrowers. The results support the hypothesis that the correlation between consumer debt

outstanding and real activity is at least partially attributable to shifts in the supply of consumer loans.

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Figure 1

THE COMPOSITION OF AUTOMOBILE FINANCE

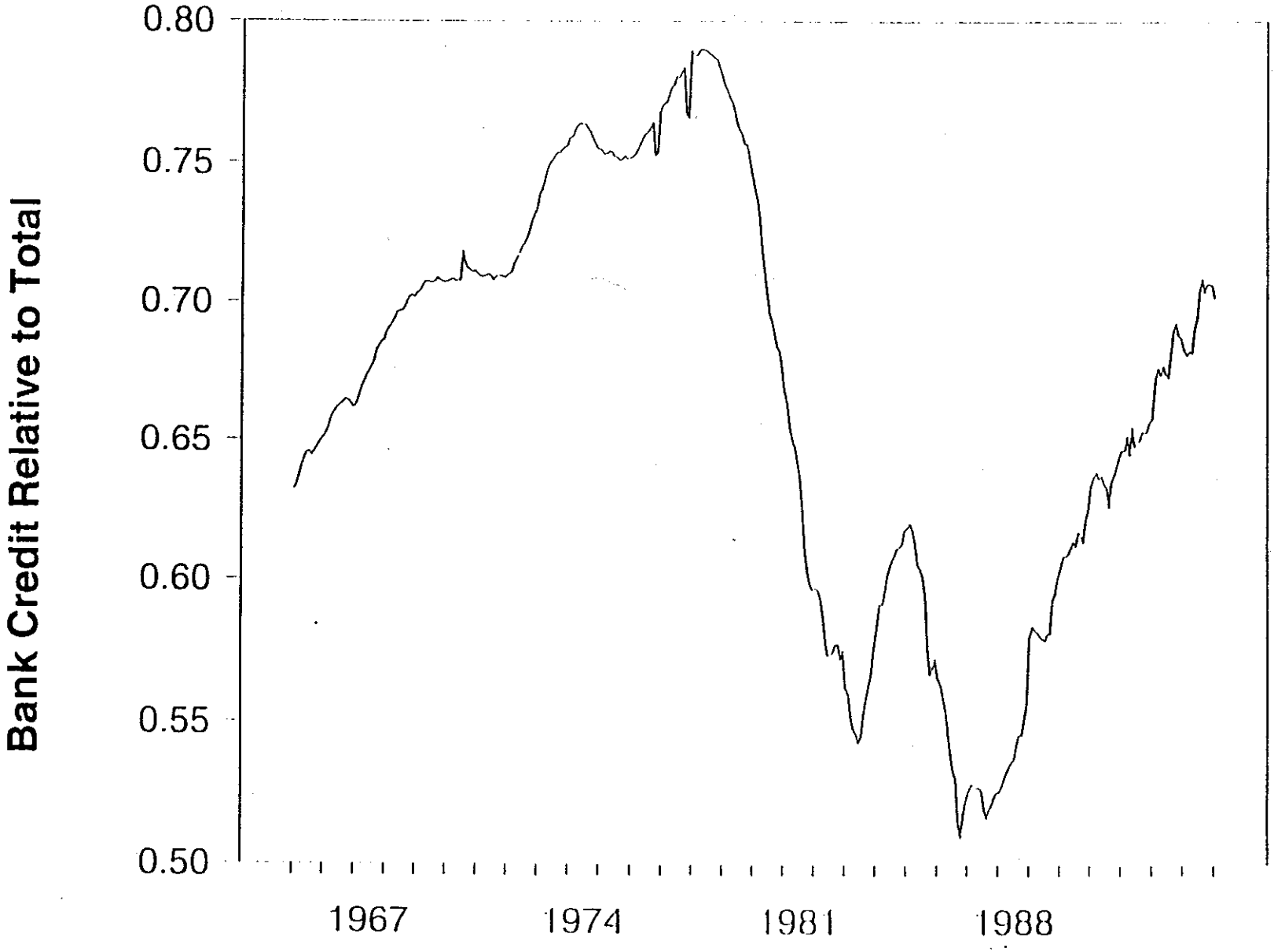

Figure 1A

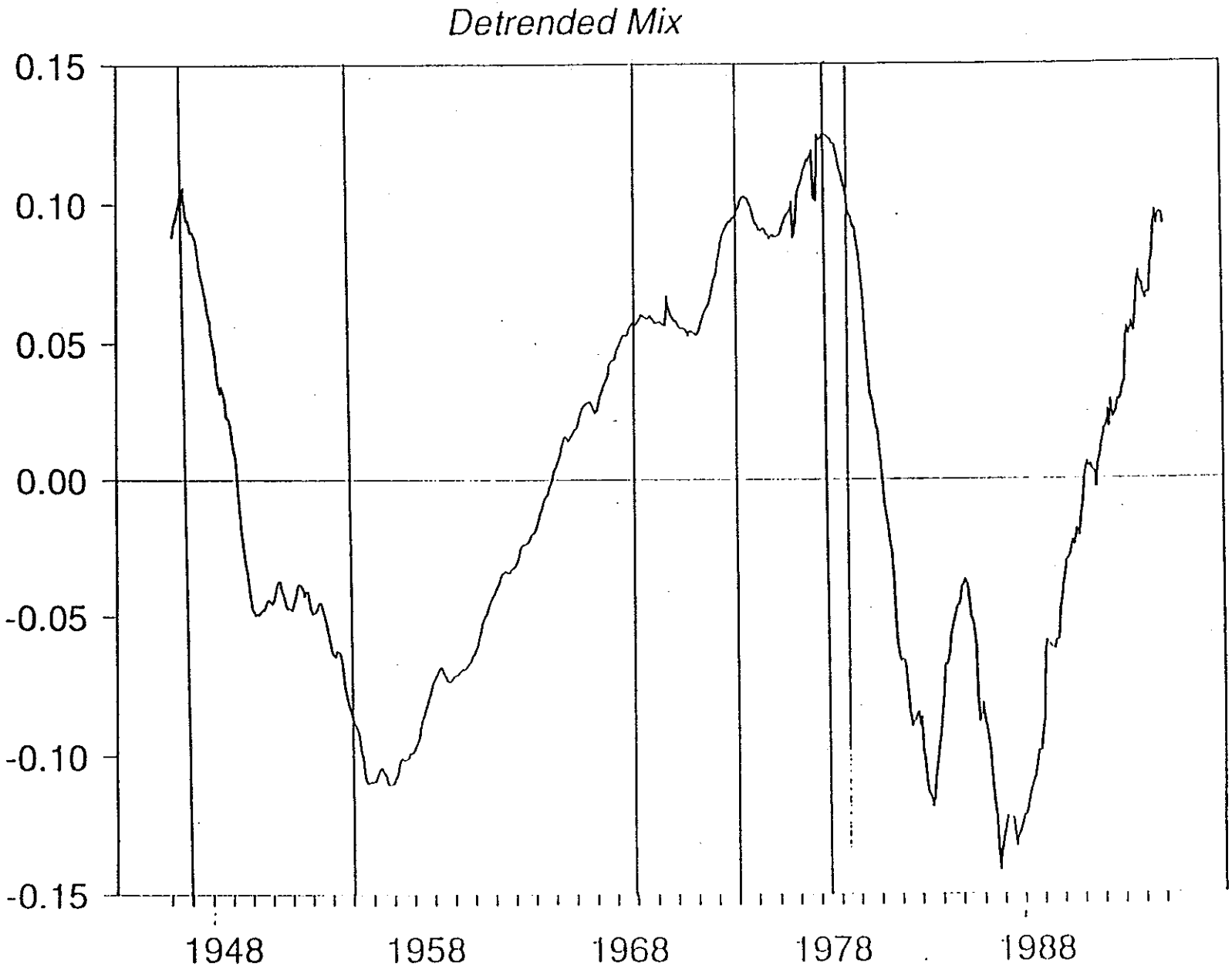
Detrended Mix
0.15
0.10
0.05
0.00
-0.05
-0.10
-0.15
1948
1958
1968
1978
1988

Figure 2

Response of Mix to Fed Funds Rate shock and Two S.E. Bands

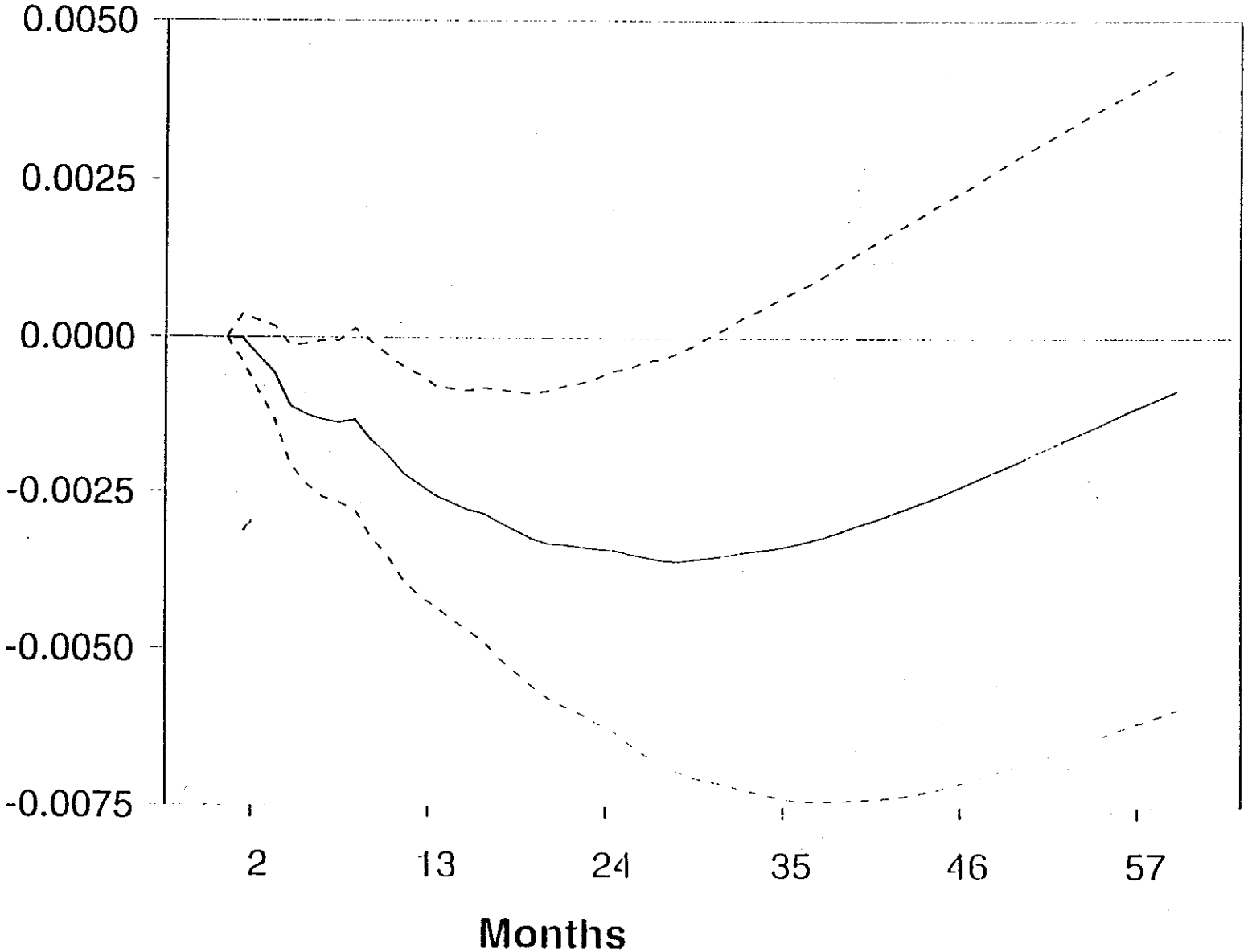

Figure 3

Response of Finance Co. Credit to Fed Funds Rate shock and Two S.E. Bands

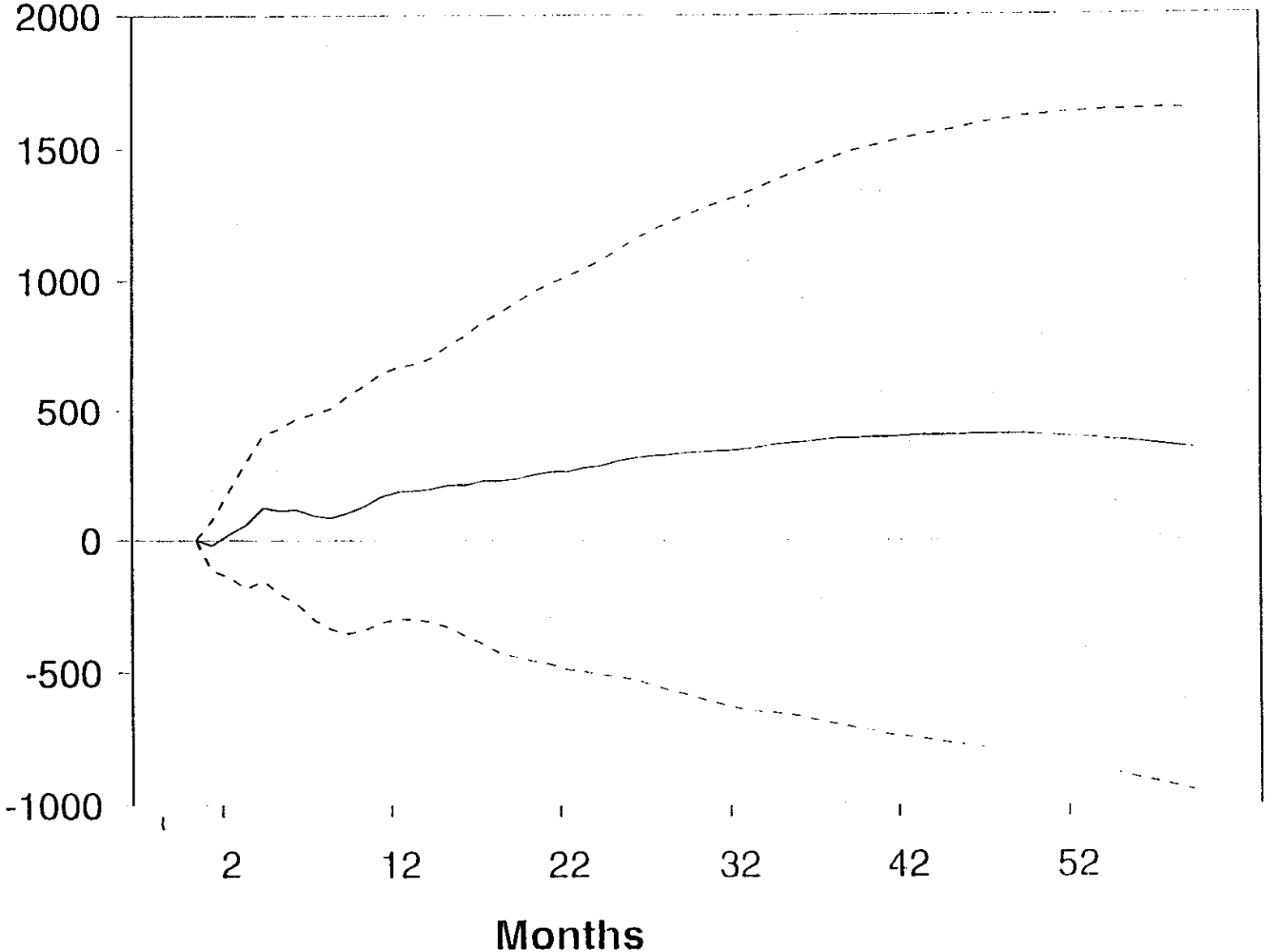

Figure 4

Response of Bank Credit to Fed Funds Rate shock and Two S.E. Bands

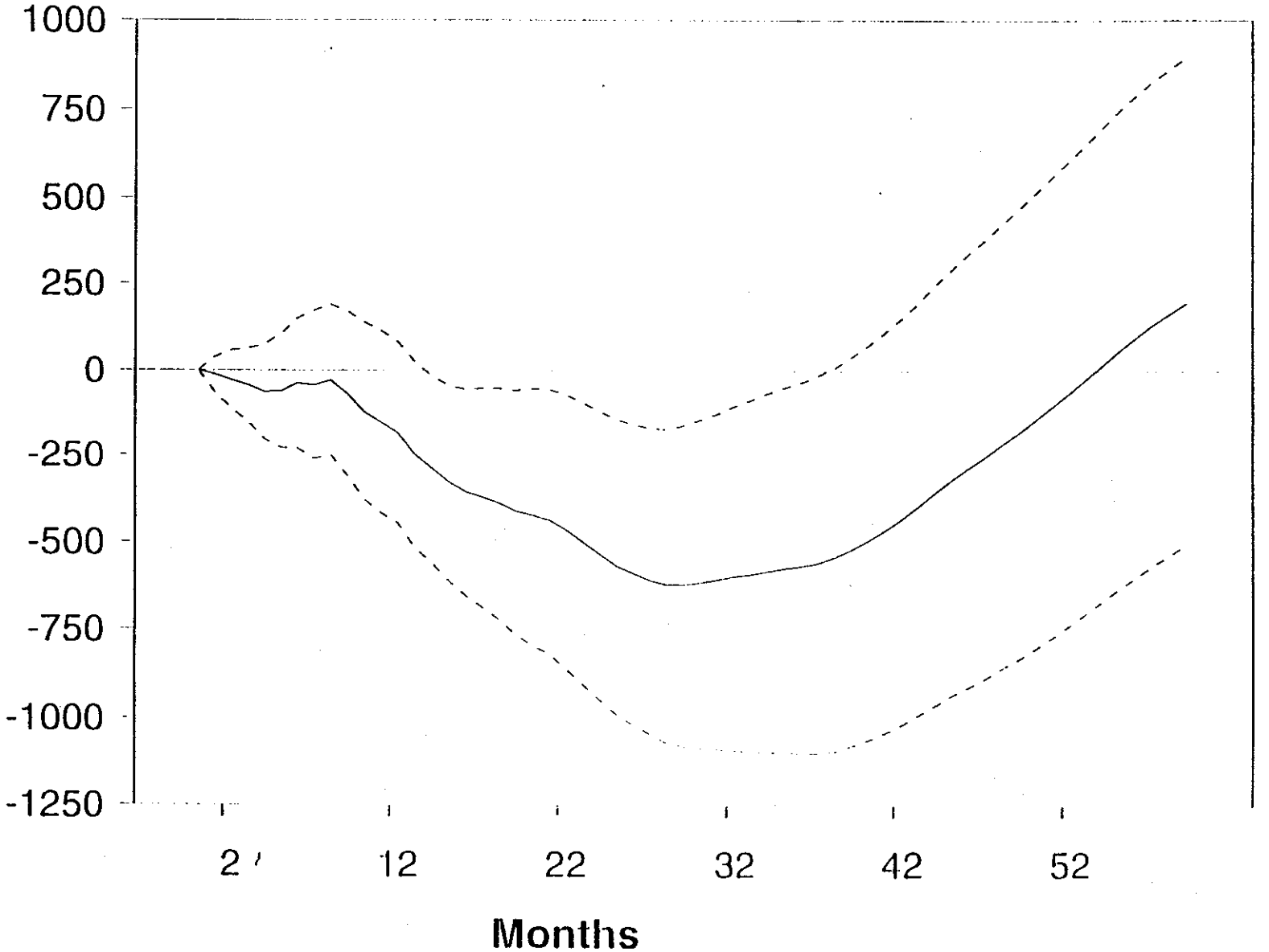

Figure 5

Response of Auto Sales to Fed Funds Rate shock and Two S.E. Bands

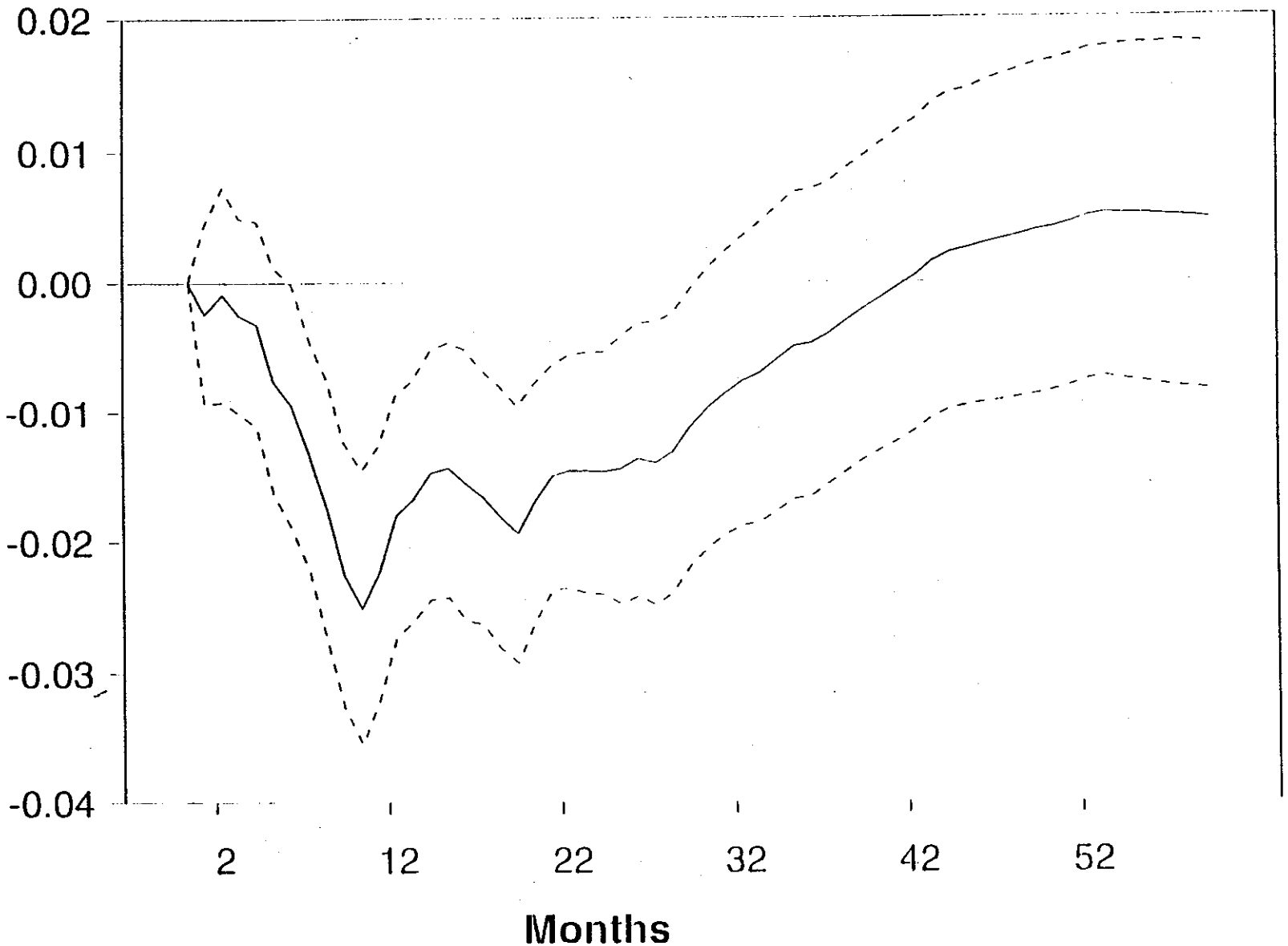

Figure 6

Response of Auto Sales to Mix shock and Two S.E. Bands

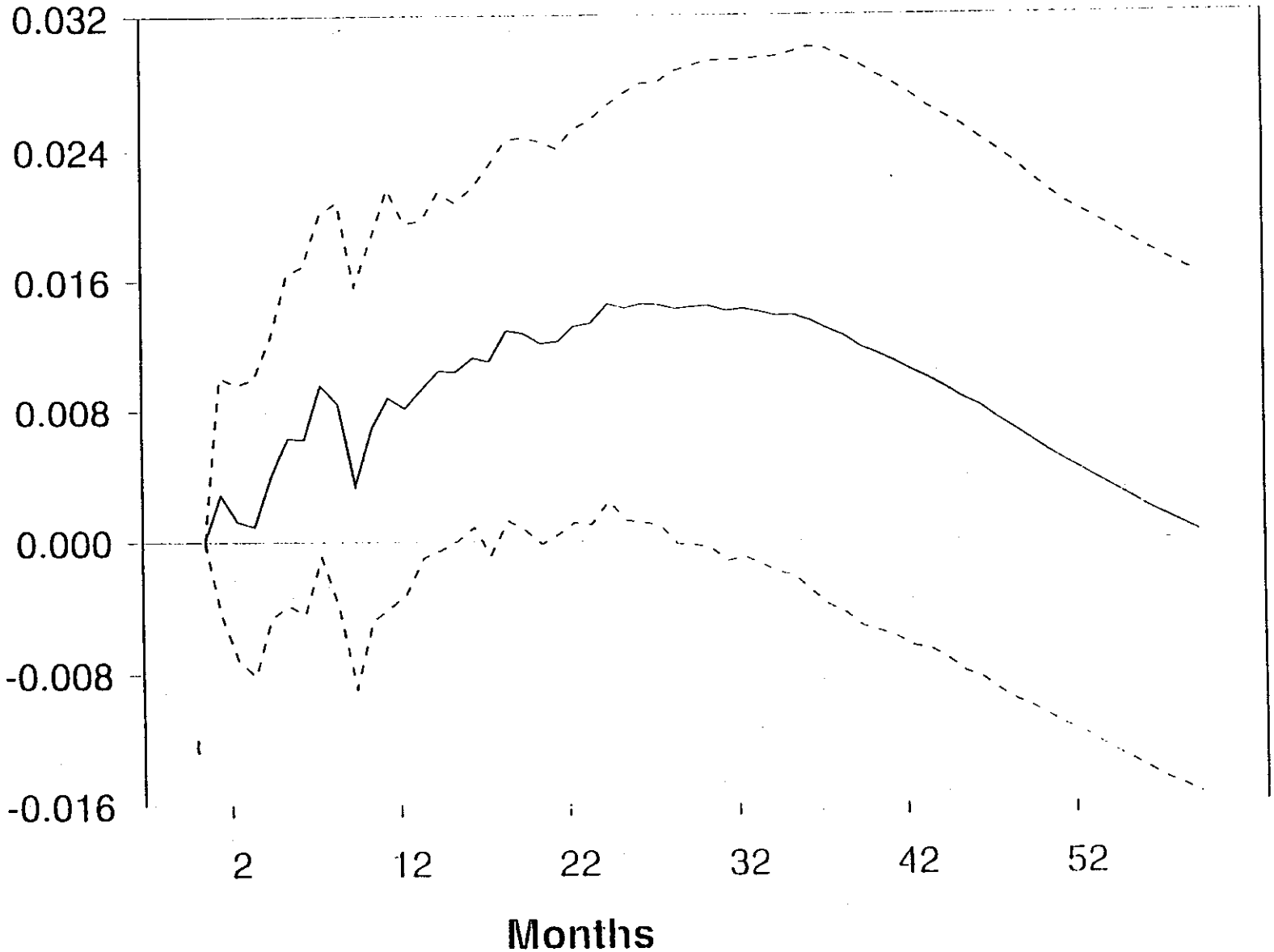

Figure 7

Response of Inventory-Sales Ratio to Mix shock and Two S.E. Bands

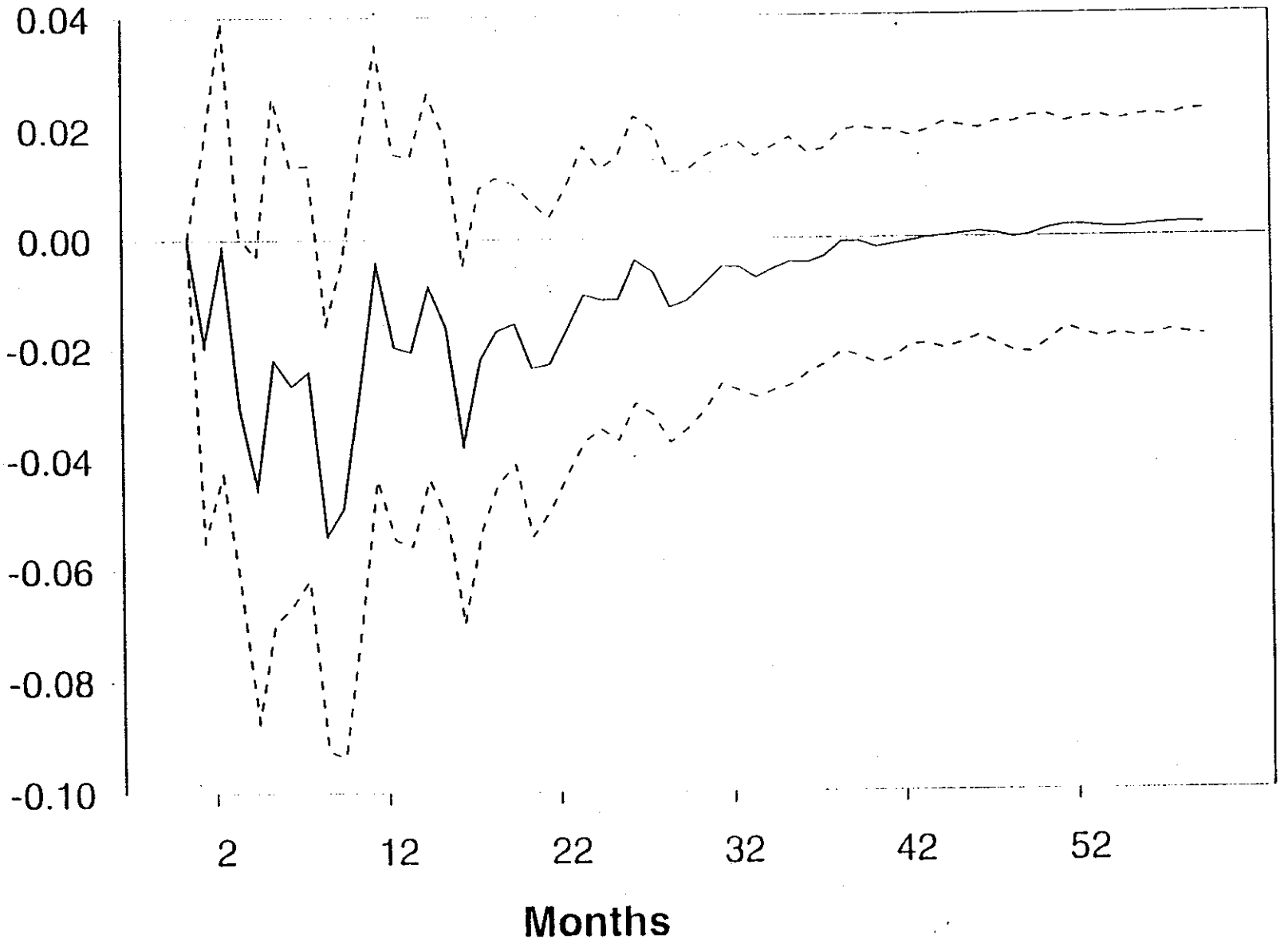

Figure 8

Response of Bank-F.C. Rate Spread to a Funds Rate shock and Two S.E. Bands

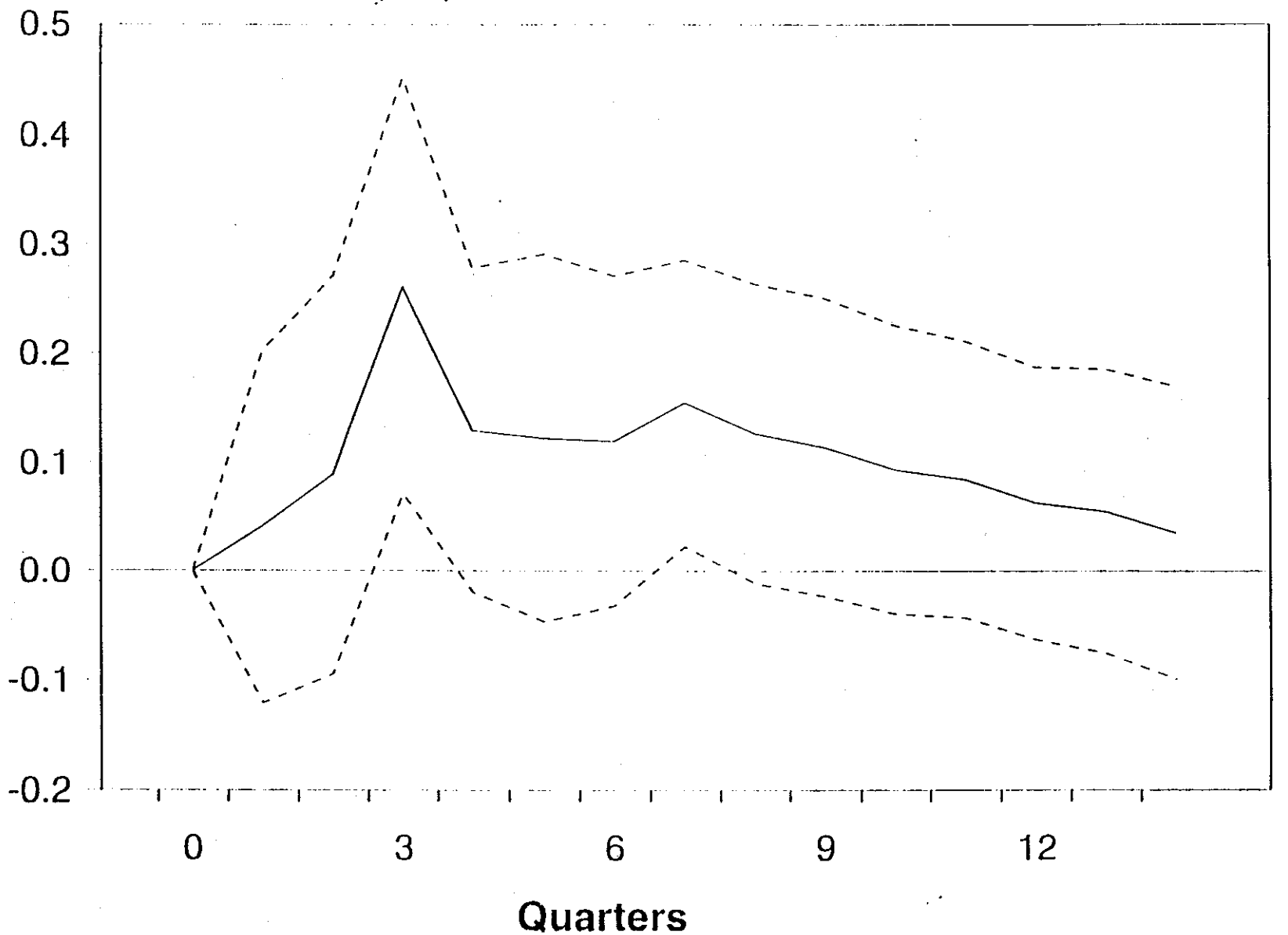

Figure 9

Response of F.C. Rate to Funds Rate shock and Two S.E. Bands

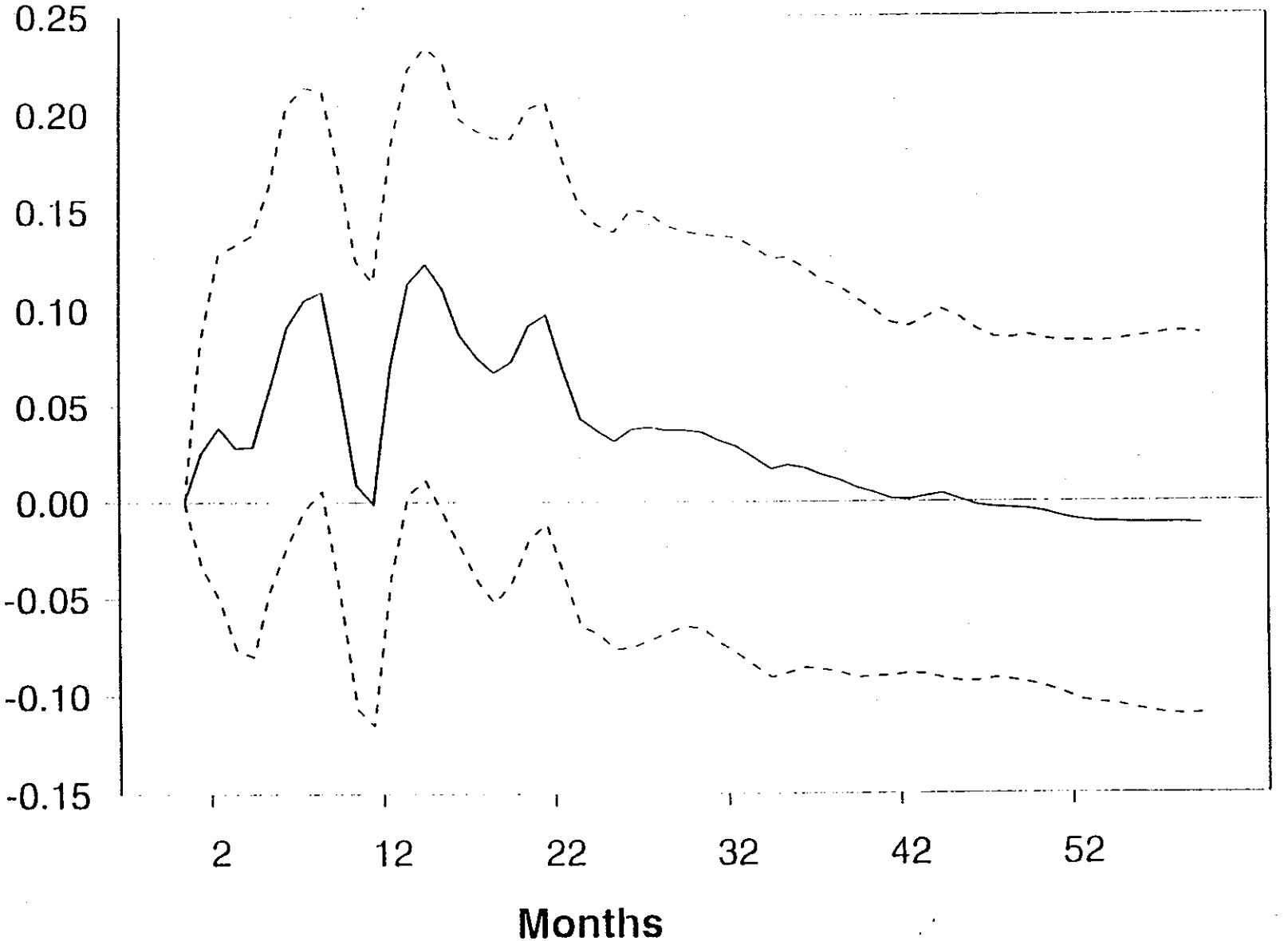

Table 1

Automobile Demand Equations
Dependent Variable: S_t, 1968:1 to 1994:11

FC	$\Sigma^3_{i=0}FC_{-i}$	Y	X_{-1}	RP	$\Sigma^3_{i=1}RP_{-i}$	C	$\Sigma^3_{i=1}C_{-i}$	r
...	...	0.797 (0.11)	(-0.001) (0.001)	15.49 (13.38)	...	...	...	...
19.67 (1.72)	...	0.797 (0.096)	0.002 (0.001)	17.672 (2.854)	...	...	...	...
15.77 (2.022)	...	0.796 (0.099)	-0.0002 (0.001)	12.288 (3.198)	...	...	...	-19.46 (5.586)
16.017 (2.013)	...	0.831 (0.099)	-0.0004 (0.001)	-12.289 (17.64)	25.371 (17.38)	...	...	-19.754 (5.56)
18.527 (1.635)	...	...	(0.000) (0.001)	-10.852 (16.89)	25.501 (16.78)	0.019 (0.005)	-0.012 (0.005)	...
53.619 (23.803)	16.275 (1.706)	...	-0.002 (0.001)	-8.672 (16.60)	21.564 (16.52)	0.017 (0.005)	-0.009 (0.005)	...
53.401 (24.399)	14.572 (2.044)	...	-0.002 (0.001)	-11.298 (16.75)	22.002 (16.54)	0.015 (0.005)	-0.007 (0.005)	-7.820 (5.646)

Notes: OLS estimation, standard errors in parentheses; S is auto sales, FC is the financing composition, defined as bank loans divided by total. Y is real, personal disposable income. X is the consumer's stock of automobiles computed assuming a quarterly depreciation rate of 2 %. RP is the Consumer Price Index for Cars divided by the implicit price deflator for personal consumption expenditures. C is personal consumption expenditures, and r is the rate on three month treasury bills.

Table 2

Reduced Form Equations
Dependent Variable: S_t, 1968:1 to 1994:11

FC	$\Sigma^3_{i=0}FC_{-i}$	X_{-1}	I_{-1}	Z_{-1}	C	$\Sigma^3_{i=1}C_{-i}$	W	$\Sigma^3_{i=1}W_{-i}$	PFWL
...	...	-0.04 (0.01)	0.00 (0.05)	0.11 (0.01)	6.9 (3.3)	1.5 (3.4)	0.22 (0.03)	-0.12 (0.04)	...
10.8 (0.96)	...	0.00 (0.01)	-0.10 (0.05)	0.10 (0.01)	10.6 (2.8)	-2.5 (2.9)	0.21 (0.03)	-0.08 (0.03)	...
14.7 (12.4)	10.4 (0.98)	0.00 (0.01)	-0.09 (0.05)	0.09 (0.01)	9.9 (2.8)	-1.7 (2.9)	0.22 (0.03)	-0.08 (0.03)	...
8.2 (1.2)	...	-0.01 (0.01)	-0.13 (0.05)	0.09 (0.01)	8.5 (2.8)	-1.3 (2.9)	0.20 (0.03)	-0.06 (0.03)	-2.6 (0.73)
9.8 (12.3)	7.7 (1.2)	-0.02 (0.01)	-0.12 (0.05)	0.09 (0.01)	7.7 (2.8)	-0.42 (2.87)	0.20 (0.03)	-0.06 (0.03)	-2.7 (0.72)

Notes: OLS estimation, standard errors in parentheses; S is auto sales, FC is the financing composition defined as bank loans divided by total. X is the consumer's stock of automobiles computed assuming a quarterly depreciation rate of 2 %. I is retail automobile inventories, Z is the index of industrial production for autos, C is personal consumption expenditures, W is the average hourly wage of production workers in the automobile industry, and PFWL is the Producer Price index for fuel. Monthly strike dummies, t, t^2 also included.

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