THE INTEREST SENSITIVITY OF GDP AND ACCURATE REG Q MEASURES

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Abstract

This study constructs Reg Q measures that account for the introduction of small saver certificates in 1979 and money market certificates in 1978. In nonVAR models, not properly accounting for Reg Q upwardly biases the estimated real rate elasticity of U.S. GDP and yields rate elasticities that are not stable enough for practical use. Although the impact of real funds rate innovations remains sensitive to sample period, accurately measured Reg Q innovations are significant in VARs and, in contrast to innovations in a naive Reg Q measure, have impulse response functions that do not change much as samples are extended beyond the early 1980s.

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Introduction

In 1993, the Federal Reserve (1993) de-emphasized M2 and put more weight on real interest rates as guides used in formulating monetary policy. Typical objections to using real rates as economic indicators include the difficulty of measuring expected inflation, variability in the interest sensitivity of investment (or marginal product of capital) over the business cycle, and shifts in monetary policy regimes that affect observed real rate elasticities. Another problem is that the impact of real interest rates has changed because of financial innovation and deregulation. This concern is particularly relevant to housing given the large institutional changes in mortgage finance, the sensitivity of housing to interest rates, deposit deregulation, and the important role of housing in U.S. business cycles [e.g., Gordon (1988)] and the transmission of monetary policy [e.g., Bosworth (1989) and Mauskopf (1990)]. Aside from housing, there is evidence that Reg Q also affected the availability of consumer credit and purchases of consumer durables [Duca and Garrett (1995)]. Although the Federal Reserve has less influence on long-term than on short-term interest rates, it may alter short-term rates in light of GDP forecasts partly based on estimates of the effects of long-term real rates on interest sensitive sectors and on overall GDP. With these considerations in mind, this study investigates whether and to what extent changes in deposit regulations (Reg Q) can account for changes in the observed sensitivity of U.S. aggregate output to real interest rates since the early-1980s.

This study is organized as follows. The next section clarifies how this study improves upon the previous literature in measuring Reg Q effects. Section 3 describes the baseline GDP model and the data used. Then, the fourth section presents results from including Reg Q variables, and the conclusion discusses the policy implications of the findings.

2. Previous Work on Reg Q Effects

Several studies have argued that the impact of interest rates on housing has been reduced by deposit deregulation, the advent of adjustable rate mortgages (ARMs), and the development of the mortgage-backed securities market [e.g., Bosworth (1989), Brueckner and Follain (1989), Kahn (1989), Pozdena (1990), Ryding (1990), and Throop (1986)]. The larger impact of interest rates before the 1980s has been attributed to disintermediation; it has been argued that mortgages had been rationed more with non-price terms by depositories when households shifted out of deposits because market interest rates rose above deposit rate ceilings [e.g., Jaffee and Rosen (1978, 1979), Mauskopf (1990), Pozdena (1990), Ryding (1990), and Throop (1986)].[1]

Not controlling for this structural change has two major implications for housing equations. First, the observed interest elasticity of housing has fallen since deregulation, implying that full sample estimation will yield a rate elasticity that is too low for the pre-deregulation period and too high for the post-deregulation period. Second, given the role of finance in housing, omitted variable bias may affect other coefficients in such models and lead to parameter instability over time given that most household deposit rates were deregulated in the early-1980s.

As shown in Duca (1995), each of these implications is borne out by the

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[1] In a post-Reg Q era, mortgages may be partially rationed with nonprice terms, consistent with the findings of Duca and Rosenthal (1991), because of adverse selection/moral hazard effects [Jaffee and Russell (1976) and Stiglitz and Weiss (1981)] and because lenders face deadweight costs of default [Williamson (1986)]. Rosenthal, Duca, and Gabriel (1991) find that the interest sensitivity of housing is boosted by mortgage-payment-to-income ratios which are more likely to be binding as mortgage payments rise with mortgage rates. Thus, lifting Reg Q has likely reduced, but not eliminated, the effect of nonprice terms on the observed interest sensitivity of housing.

Federal Reserve Board's model ("FRB model") of the growth rate of the real U.S. housing stock. First, if one drops the disintermediation dummy variable in the FRB model, the long-run real rate elasticity of housing drops by 18% as the end of sample is extended from 1979:Q4 to 1992:Q4. Second, estimated coefficients of key variables differ greatly when a better Reg Q measure and a dummy for the credit controls of 1980:Q2 are added and these parameter estimates move much less over time when the FRB model is altered in this way.

Three approaches have been used to control for disintermediation. The first and seminal approach adds deposit outflows at thrifts as an independent variable to housing regressions [see Hendershott (1980) and Jaffee and Rosen (1978, 1979)]. With respect to identifying the nonReg Q interest sensitivity of housing, a shortcoming of this approach is that deposit outflows reflect not only disintermediation induced by Reg Q, but also the impact of interest rates and declining income on money demand.[2] In addition, using a thrift deposit variable is problematic in samples including the late-1980s and early-1990s because of the shrinkage of the thrift industry. Finally, such deposit flow variables are sometimes marginally significant, as in Jaffee and Rosen (1979), though Hendershott (1980) finds them to be significant with an implied impact that is half the size implied by the Jaffee and Rosen estimates.

A second approach to handling Reg Q effects is to separate out periods of credit rationing when estimating the interest sensitivity of housing. This strategy, as employed in old versions of the MPS model [Brayton and Mauskopf (1985)], has two drawbacks. First, it throws out much of the sample when interest rates rose sharply, thereby limiting our ability to identify the

[2] Money demand still falls in the short-run when interest rates rise because deposit rates adjust sluggishly [see Moore, Porter, and Small (1990)].

nonReg Q interest sensitivity of housing. Second, after periods of disintermediation, large deposit inflows accompanied declining interest rates, and housing starts tended to surge as pent-up demands were met. Rather than dummy out rate terms in disintermediation periods, the current FRB housing model uses a non-interactive dummy for these periods. Nevertheless, the rate sensitivity in this model may still shift over time [Mauskopf (1990, p. 997)].

A third approach is to use measures of how binding Reg Q ceilings were and thereby sort out the underlying interest sensitivity. These variables are typically defined as the difference between a market rate and some deposit rate ceiling when the ceiling is binding, and 0 otherwise. However, studies indicate that estimated coefficients on such Reg Q measures are unstable over the mid-1970s and the late-1970s/early 1980s [Ryding (1990)]. This may reflect that some partially deregulated substitutes for small time deposits (e.g., small saver certificates) were introduced in the late-1970s before most deposit ceilings were lifted in 1983 [see Mahoney, et al. (1987)] and that Reg Q effects were cushioned in the late-1970s by the secondary mortgage market and Federal Home Loan Bank Board (FHLBB) advances to thrifts.

In adopting the third approach to measuring Reg Q, Duca (1995) shows how Reg Q measures accounting for the introduction of new deposit instruments can improve the FRB model of housing. The current study tests these measures in simple models of GDP. By doing so, this study provides both explanations for and measurements of the evolution of the interest rate sensitivity of GDP that are based not on loose references to financial innovations, but rather on explicit measures of them. Results show that a carefully measured Reg Q variable improves the performance of some simple macro-models.

3. Specification and Data

3a. Baseline Specification

The baseline nonVAR specification used to assess Reg Q effects is:

$$\Delta y_t = GAP_{t-1} + \sum_{i=1}^{8} \alpha_{t-i}\Delta y_{t-i} + \sum_{i=1}^{8} \delta_{t-i}RFM_{t-i} + X. \qquad (1)$$

where y ≡ real GDP, GAP ≡ the GDP gap ([potential GDP - actual GDP]/potential GDP), RFM ≡ the real federal funds rate, and X denotes stationary variables including oil price, Reg Q and fiscal policy measures, and a dummy variable for the 1980:Q2 credit controls. A lag length of 8 quarters was used based on the view that monetary policy affects the economy with a 1-2 year lag and because an 8 quarter lag length generally eliminated serial correlation in the errors in contrast to a 4 quarter lag length.

3b. Data and Variables

The variables used fall into six categories: (a) real GDP, (b) real interest rate, (c) oil price, (d) fiscal policy, (e) exchange rate regime, and (f) regulatory variables.

Real GDP Variables

DRI's estimate of full employment output was used to measure potential or trend output and all real GDP terms were defined in 1987 dollars.

The Real Federal Funds Rate

The real ex ante federal funds rate (RFM) equals the nominal federal funds rate minus the average, four-quarter ahead expectation of inflation according to the University of Michigan's Consumer Confidence Survey. This ex ante rate was used instead of an ex post rate for three reasons. First, theory suggests that the ex ante rate should affect behavior more than an ex post rate. Second, the ex ante real rate is stationary unlike an ex post real funds rate based on the 4-quarter moving average of past inflation. Third, expectations are more likely to differ when the inflation rate changes in a large and abrupt manner, such as in the disinflation of the early 1980s.[3]

Oil Shock Variable

To control for the short-run adjustment to oil price movements, lags of the change in real oil prices (ΔROIL, where ROIL is producer price of oil divided by the implicit GDP deflator) were included. It was not necessary to add long-term oil terms because long-run effects of energy prices are already reflected in the potential output series used to create the GDP GAP variable.

Fiscal Policy Measures

Fiscal policy was measured by DRI's estimate of the real full employment federal surplus divided by DRI's full employment real GDP series.[4] To save on degrees of freedom, only one lag of FES was included because later lags were very insignificant, reflecting that fiscal policy hits the economy quickly. (Qualitative results were unaffected by including the t-2 to t-8 lags of FES.)

Exchange Rate Regimes

The switch to flexible exchange rates in 1973 may have bolstered the effect of the real funds rate and reduced that of fiscal policy.[5] A dummy equal to 1 before 1973:Q2 was interacted with RFM and the fiscal policy measure to create RFMFIX and FISFIX, respectively.

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[3] Real long-term rates were not used because data on long-term inflation expectations do not go back to the early 1960s, ex post real long rates are not stationary, and R^2's were higher when real funds rate measures were used.

[4] Cohen's (1989) fiscal impetus measure scaled by DRI's full employment GDP estimate was used in other runs. Although Cohen's measure may be superior in principle, FES yielded higher R^2's in comparable runs while the qualitative results w.r.t. interest rates and Reg Q effects were unaffected.

[5] Although the U.S. went off the gold standard in 1971, the dollar's value was reset and the dollar was not allowed to fluctuate until 1973:Q2.

Regulatory Variables.

Several Reg Q measures and a dummy for the credit controls of 1980:Q2 were tested in different permutations of equation (1).

Reg Q Spreads. Three Reg Q variables were based on spreads between market rates and deposit rate ceilings, which raises three issues: (1) which retail deposit rate to use, (2) whether rate ceilings for thrifts or banks should be used, and (3) how to handle the introduction of market-rate based deposits prior to the lifting of rate ceilings on nontransactions deposits in 1983.

With respect to issue (1), the Reg Q spreads reflected regulations affecting small time deposits for two reasons. First, small time deposits have maturities closer to that of mortgages than those of demand or passbook savings deposits. Second, most market-based deposits that were introduced in the late-1970s were, by design, substitutes for small time deposits.

In handling issue (2), rate ceilings on thrifts were used. Thrifts were much more important home mortgage lenders owing to tax incentives that encouraged thrifts to hold mortgages and because rate ceilings on thrift accounts were as high or if not higher than those on bank deposits.

In addressing issue (3), there were two types of partially regulated deposits that were legally allowed before 1983: small-saver certificates (SSCs) and money market certificates (MMCs). Using SSC regulations to construct a Reg Q variable is preferable on two grounds. First, the maturity of SSCs (2 to 4 years) was more relevant for funding mortgages than that of MMCs (6-months). Second, the minimum balance requirements on SSCs ($500-$1,000) were much more similar to those on retail deposits than were the requirements on MMCs ($10,000) over the late-1970s and early-1980s. This latter factor made SSCs more substitutable for small time deposits.

On the other hand, because they lacked rate ceilings, MMCs had an advantage over SSCs. In addition, different minimum balance requirements may not have made SSCs substantially more effective in reducing disintermediation than MMCs for two reasons. First, the minimum balance requirement on MMCs equaled the minimum size of Treasury securities in the late-1970s and early 1980s, and Treasuries were the main competing financial asset for retail deposits. Second, because they were federally-insured, MMCs allowed many thrifts and small- to mid-size banks to issue a non-traded substitute for uninsured large time deposits. Because this market was not very deep at the time, many depositories were not effectively able to issue large time deposits until the mid-1980s. Because mortgage markets had been dominated by such institutions up through the mid-1980s, MMCs enabled many thrifts and non-money center banks to raise loanable funds when Reg Q was binding in the late-1970s and early 1980s. Thus, the advent of MMCs rather than of SSCs may have ended Reg Q-induced disintermediation. Therefore, it is an empirical issue whether Reg Q effects more closely reflected regulations on MMCs or on SSCs.

Given these considerations, three Reg Q measures were defined using spreads between market interest rates and small time deposit and/or SSC rate ceilings. One (REGQU) equaled the quarterly average spread between the three-year Treasury rate and the rate ceiling on three-year small time deposits when the ceiling was binding, and 0 otherwise. In May 1982, ceilings on 2-1/2 to 3-1/2 year small time deposits were lifted. This measure is similar to that of Ryding (1990) and serves as a benchmark for comparing the performance of more detailed Reg Q measures. The second Reg Q variable (REGQSSC) equals REGQU before 1979:Q3. Starting in 1979:Q3 when SSCs were created, REGQSSC equals one of the following based on quarter averages of monthly data: (a) any legislated spread between market interest rates and SSC rates (0 to 50 basis points in certain quarters), (b) the maximum of 0 and the 2-1/2 year Treasury yield (constant maturity) minus any legislated cap on SSC rates, or (c) 0 since August 1981 when rate ceilings on SSCs were removed.[6] The third Reg Q variable (REGQMMC) equals REGQU until 1978:Q2 and 0 thereafter on grounds that MMCs did not have any rate ceilings on them. Historically, REGQMMC is very similar to a Reg Q variable that assumes that Reg Q effects ended when ceilings on large time deposit rates were lifted in 1976. For details on deposit regulations, see Mahoney, et al. (1987). Accounting for SSCs results in a Reg Q variable that is smaller over 1979-81 (see Figure 1).[7]

1980 Credit Controls. A dummy was included for the imposition of credit controls (CONTROL) in 1980:Q2, which equaled 1 in 1980:Q2.[8] Although they exempted household borrowing, the controls depressed borrowing because many consumers thought that it was illegal to borrow and because many lenders

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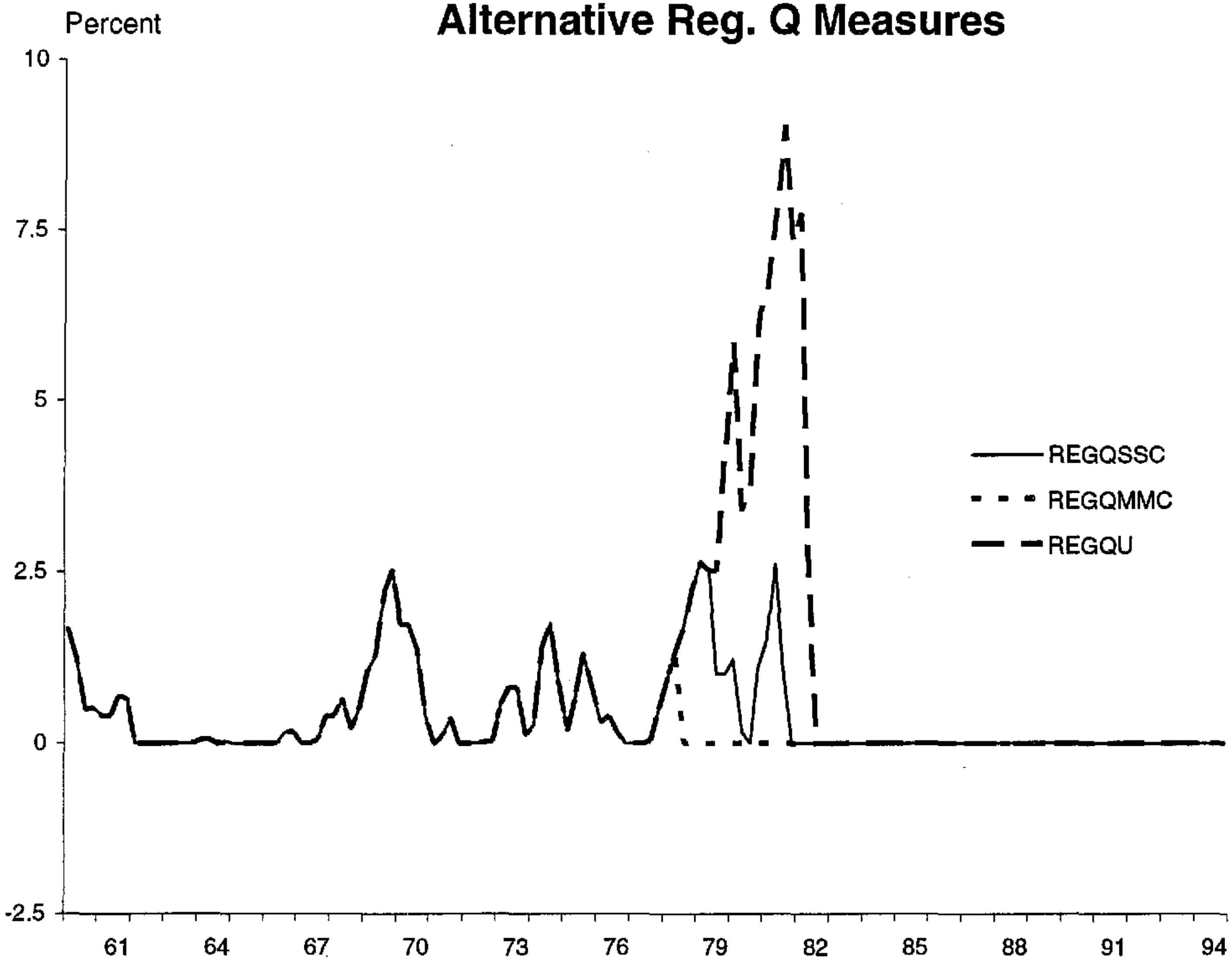
[6] In January and February 1980, SSC rates were set at 50 basis points below the 2-1/2 year constant maturity Treasury yield. In March and April 1980, SSC yields could be as high as the maximum of 12 percent and the 2-1/2 year constant maturity Treasury yield minus 50 basis points. From June 1980 through July 1981, SSC yields could equal the 2-1/2 year constant maturity Treasury yield when this yield was between 9.5 and 12.0 percent, could be as high as 9.5 percent when this Treasury yield was below 9.5 percent, and could be as high as 12.0 percent when this Treasury yield exceeded 12.0 percent.

[7] One drawback of these measures is that they do not control for the declining role of deposits in funding mortgages. The secondary mortgage markets also reduced the impact of Reg Q by allowing originators to sell mortgages. However, these markets were not very well developed until the mid-1980s and thus, may not have altered the impact of Reg Q effects much. In regressions not presented here, multiplying the Reg Q terms by the shares of mortgage originations held by depositories did not improve model fit, nor did multiplying Reg Q measures by the liability share of retail deposits at thrifts to control for the growing use of large time deposits which were not subject to rate ceilings (this shift was small up through the early-1980s).

[8] Real GDP fell at a annual rate of 10% in 1980:Q2. In a comment on Hendershott (1980), Jaffee (1980, p. 447) remarked that, "the 1980 credit crunch would rank among the best.., albeit it is something of a new breed."

Figure 1
Alternative Reg. Q Measures



curtailed all types of loans in order to meet overall loan targets and to limit their credit risk exposure during this depressing regulatory episode. Because the 1980:Q2 episode is a very large outlier that owes to an unusual government intervention, not accounting for the credit controls can result in substantial omitted variable bias as found by Duca (1995) and Emery (1995).[9]

4. Results

This section assesses how the observed real rate sensitivity of GDP is affected by Reg Q. First, regression results are reviewed. Then, rolling regression estimates of real rate elasticities are presented. Finally, VAR results are presented. Both nonVAR and VAR findings are provided because each approach has relative advantages. VARS have an advantage over nonVARs because they can, in principle, assess the impact of exogenous changes in monetary policy. On the other hand, changes in the Fed's reaction function could make it difficult to identify exogenous from endogenous monetary policy moves [see Sims (1992)]. As a result, VARs may run into misspecification problems that may cause impulse response functions to be very sensitive to sample periods. While the VARs examined in this study remained sensitive to sample periods, VAR (and nonVAR) models were improved by including REGQSSC.

4a. NonVAR Regression Results

Reg Q variables were assessed with and without oil and exchange rate regime variables. Table 1 reports regression results from models including no exchange rate or real oil price terms, whereas table 2 presents findings from models with both types of variables. To conserve space, the tables report the sum of coefficients on lags of GDP growth, real funds rate, and Reg Q

[9] The inclusion of a credit control dummy actually reduces the statistical significance of Reg Q variables. Nevertheless, the preferred Reg Q variable, REGQSSC, remains highly significant in its presence.

variables along with F-statistics in parentheses. Two samples are used: 1960-94 and 1960-82. Both begin in 1960 owing to the availability of data on GAP and FES, and the thinness of the federal funds market in the 1950s. One sample ends in 1982 for two reasons. First, it is interesting to see how the estimated real rate elasticities may have changed since the passing of Reg Q ceilings on small saver certificates late in 1981. Second, 1982 provides at least 10 years of sample when exchange rates were flexible.

Several patterns emerge across the real federal funds rate regressions reported in table 1. First, the sum of RFM coefficients has the expected sign in each model, but RFM lags are jointly significant only in the nonReg and REGQSSC models. Second, the joint significance of lags of RFM rises slightly when lags of REGQSSC are added, but falls when lags of REGQU or REGQMMC are included. Third, the credit control dummy is always significant, in contrast to the fiscal variable whose significance is sensitive to the inclusion of other variables. Fourth, among the Reg Q variables, only lags of REGQSSC are significant (with a negative sum of coefficients). Fifth, compared to the nonReg model, the estimated short-run real rate elasticity of GDP is about 25% smaller in the REGQSSC model in both samples. Using full sample estimates, a 100 basis point rise in the real federal funds rate reduces near-term GDP growth by .82 percentage points in the nonReg model and by a smaller .60 percentage points in the REGQSSC model which strips out Reg Q effects. Together, these results imply that carefully accounting for Reg Q effects is important for assessing the impact of the real fed funds rate.

To control for different exchange rate regimes and for relative oil price movements, the models in table 2 add eight lags of RFMFIX, one lag of

FESFIX, and eight lags of ΔROIL to the corresponding models in table 1.[10] The exchange rate regime terms are generally significant and lags of the noninteracted RFM terms are always jointly significant, with coefficients from the best full sample model (REGQSSC) indicating that the real federal funds rate had less of an effect and fiscal policy had a stronger effect under fixed exchange rates. In addition, the joint significance of each Reg Q variable rises, with REGQU and REGQMMC becoming marginally significant in the full sample and significant over the shorter sample. Once again, REGQSSC very noticeably outperforms the other Reg Q measures in terms of model fit over the full sample, and implies that after stripping out Reg Q effects, the real federal funds rate has a smaller effect on real GDP growth. While the oil price variables are jointly insignificant, the sum of coefficients on the eight lags for the full sample period (1960-94) has the expected negative sign and falls within a fairly narrow range across the models (-.0005 to -.0007).

One interesting pattern is that the marginal information contained in lags of REGQSSC and REGQMMC is higher in models controlling for exchange rate regime differences. One plausible explanation for this pattern is that the coefficients on Reg Q terms may be downwardly biased by not accounting for exchange rate regimes. Exchange rates were fixed over most of the sample under Reg Q ceilings, but were flexible over the entire post-Reg Q era. If a fixed exchange rate regime reduces the estimated impact of real funds rate changes (add the RFM and RFMFIX coefficient sums for effects under fixed exchange rates), then including lags of REGQSSC or REGQMMC without exchange

[10] The one-quarter lags of FES and FESFIX were sometimes significant, while other lags were never jointly significant, suggesting that the fiscal policy measures have less of a leading effect than RFM.

rate regime variables could, when estimating Reg Q coefficients, inadvertently blend Reg Q effects of the funds rate with the weaker impact of interest rates under fixed exchange rates. This explanation may also explain why sum of RFMFIX coefficients is negative in the nonReg model, but positive in the REGQSSC and REGQMMC models using the 1960-94 sample.

The models in table 2 have much higher R^2's than corresponding models in table 1, and the REGQSSC model in table 2 has the highest full sample fit. On the other hand, as samples are extended from 1960-82 to 1960-94, the short-run real rate elasticity of GDP growth[11] barely changes in the nonReg and REGQSSC models in table 1, whereas those in table 2 fall a good deal. Even then, it is noteworthy that the full sample rate elasticity in table 2 falls much more in magnitude for the nonReg model (.01004) than for the REGQSSC model (.00245), and that in each sample, the real rate elasticity is lower in the REGQSSC model. In comparing tables 1 and 2, the fact that extending the end-of-sample results in bigger changes in the estimated rate elasticities in table 2 could simply reflect that extending the end-of-sample doubles the period when exchange rates were flexible from 1973-82 to 1973-94. Nevertheless, full sample results favor the models in table 2 over those in table 1.

Full sample regression results imply that monetary policy has operated under 3 different regulatory regimes: fixed exchange rates with deposit rate ceilings, flexible exchange rates with deposit rate ceilings, and flexible exchange rates and flexible deposit rates. The findings in table 2 indicate that not properly accounting for Reg Q effects can result in an omitted

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[11] The short-run elasticity = Σ(RFM coefficients)/[1-Σ(Δy coefficients)]. The elasticities in tables 1 and 2 are neither annualized nor converted into percentage point effects. To do this, simply multiply them by 400.

variable bias that gives the mistaken impression that the real federal funds rate had a greater effect under fixed than under flexible exchange rates.

4b. Ex Post Forecast Results

Forecasts of GDP growth starting in 1983:Q1 were run using coefficients from models in table 2 estimated using in-sample periods beginning in 1960:Q1 and actual values of all right-hand side variables since the beginning of the forecast periods. Consistent with the regression results, the nonReg model yielded a forecast S.S.E. that was 26% and 17% higher than that of the REGQMMC and REGQSSC models, respectively. On this criterion, the REGQU model not only did worse than the other Reg Q models, but even yielded an S.S.E. that was 60% higher than that of the nonReg model. This last result further illustrates the importance of carefully accounting for deposit regulations.

4c. The Evolution of Real Rate Elasticities

In addition to improving regression and forecast results, including a carefully measured Reg Q variable is also important for obtaining real rate elasticity estimates that are less volatile and drift less over time. Figures 2 and 3 plot estimated real rate elasticities from the nonReg, REGQU, and REGQSSC models in table 2 using a common starting date of 1960:1 and rolling forward up to 1994:4 (e.g., the 1985:1 data point comes from a regression over 1960:1-85:1). Figures 2 and 3 show that the estimated ex post real rate elasticities from the nonReg and the naive Reg Q (REGQU) models are quite volatile in contrast to the relatively more stable elasticities from the REGQSSC models. Indeed, the variances of short-run rate elasticities from the nonReg and REGQU models are 93% and 99% higher, respectively, over 1979:1-94:4 than those from the REGQSSC model. Furthermore, abstracting from temporary movements during the economic distress of the early-1980s, the elasticity

Figure 2
Real Rate Elasticities: with Exchange Rate and Oil Price Variables

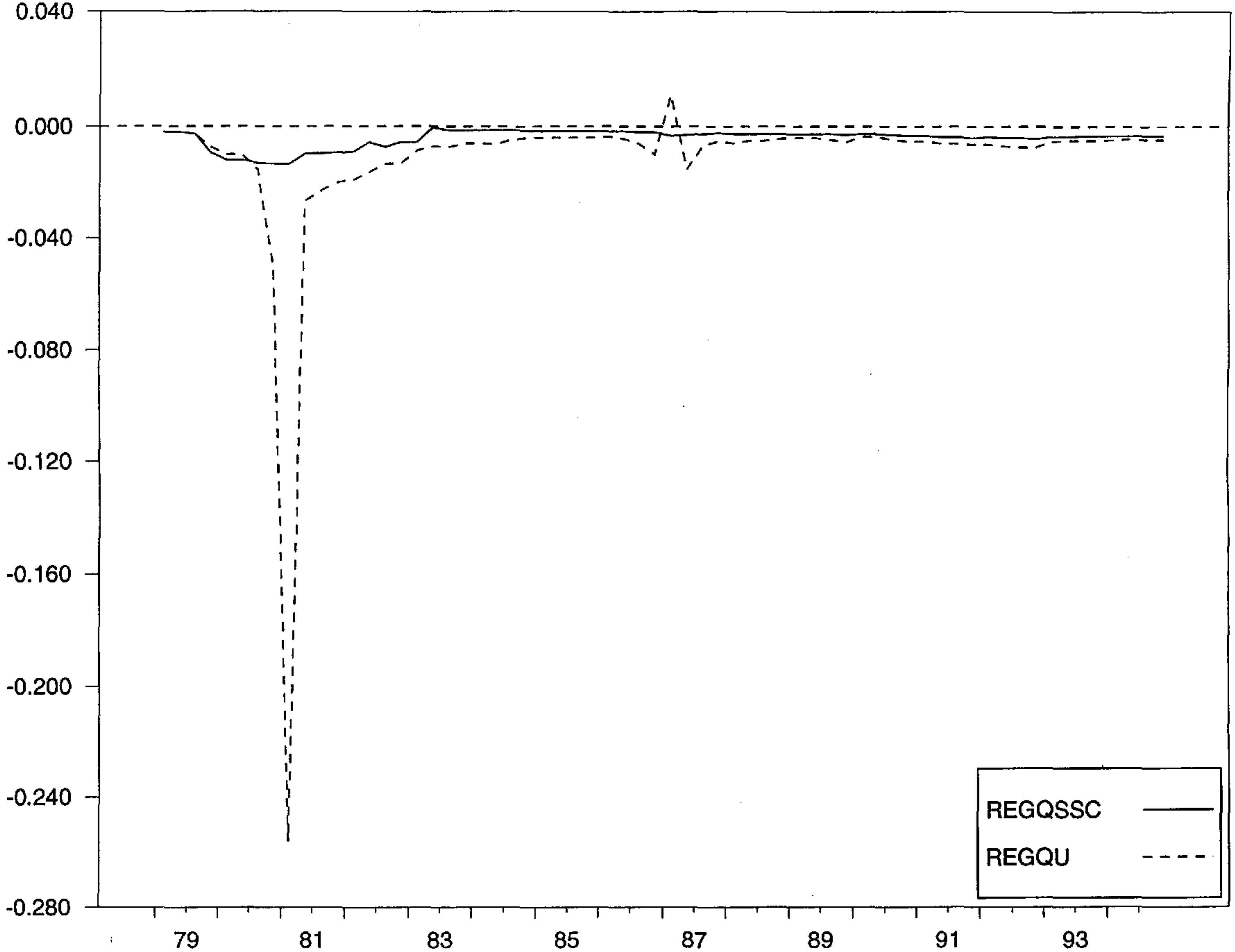
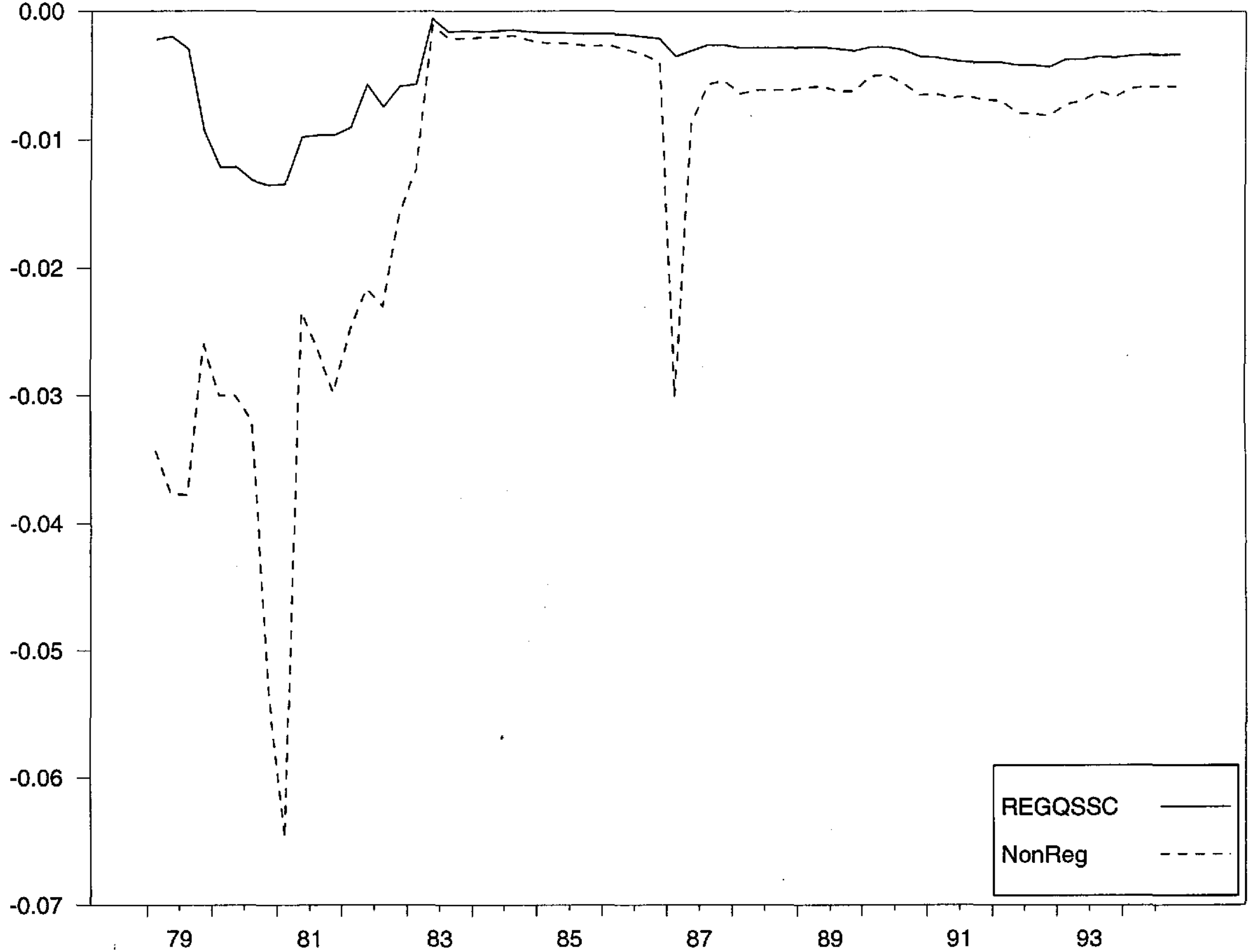


Figure 3
Real Rate Elasticities: with Exchange Rate and Oil Price Variables



estimates from the nonReg model fall dramatically as the end-of-sample is extended from 1979 to 1994, while those from the REGQSSC model do not.

4d. VAR Results

VARs were run to see whether the real funds rate has different effects in models including REGQSSC and to assess the impact of Reg Q innovations. Along with a dummy for the credit controls of 1980:2, each VAR included 4 lags of Δy, Δp, GAP, ΔROIL, and RFM, with 4 lags of REGQSSC included in the "REGQSSC" VARs.[12] The variables in the "nonReg" VAR were ordered as follows: GAP, Δy, Δp, ΔROIL, and RFM. The variables in the "REGQSSC" VAR were ordered as follows: GAP, Δy, Δp, ΔROIL, REGQSSC, and RFM.

Consistent with prior results, REGQSCC has a significant negative short-run effect on GDP growth (Figure 4), is empirically more important than Δp, RFM, and ΔROIL according to variance decompositions (table 3), and its inclusion results in RFM accounting for a smaller share of real GDP growth innovations over 1960-94 and 1973:2-94 (table 3).[13] In addition, the short-term negative impact of RFM on GDP growth is somewhat weaker in models including REGQSSC according to the full (1960-94) sample (Figure 5) and flexible exchange rate (1973:2-94:4) subsample (not shown to save space).

Consistent with prior results, the impulse response of Δy to REGQSSC is changes little when the sample is extended from 1960:1-82:4 to 1960:1-94:4, while that of Δy to REGQU changes a lot (Figures 6 and 7). However, somewhat at odds with nonVAR results, including REGQSSC does not affect how the impulse

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[12] FES was excluded to conserve degrees of freedom because it did not affect the qualitative results.

[13] Error bands show that REGQSSC has a significant negative effect in quarters t+2 to t+5 in the full sample, in quarters t+2, t+4 and t+5 under fixed exchange rates, and in quarters t+2 and t+3 under flexible rates.

Figure 4
IMPULSE RESPONSE OF GDP GROWTH TO REGQSSC

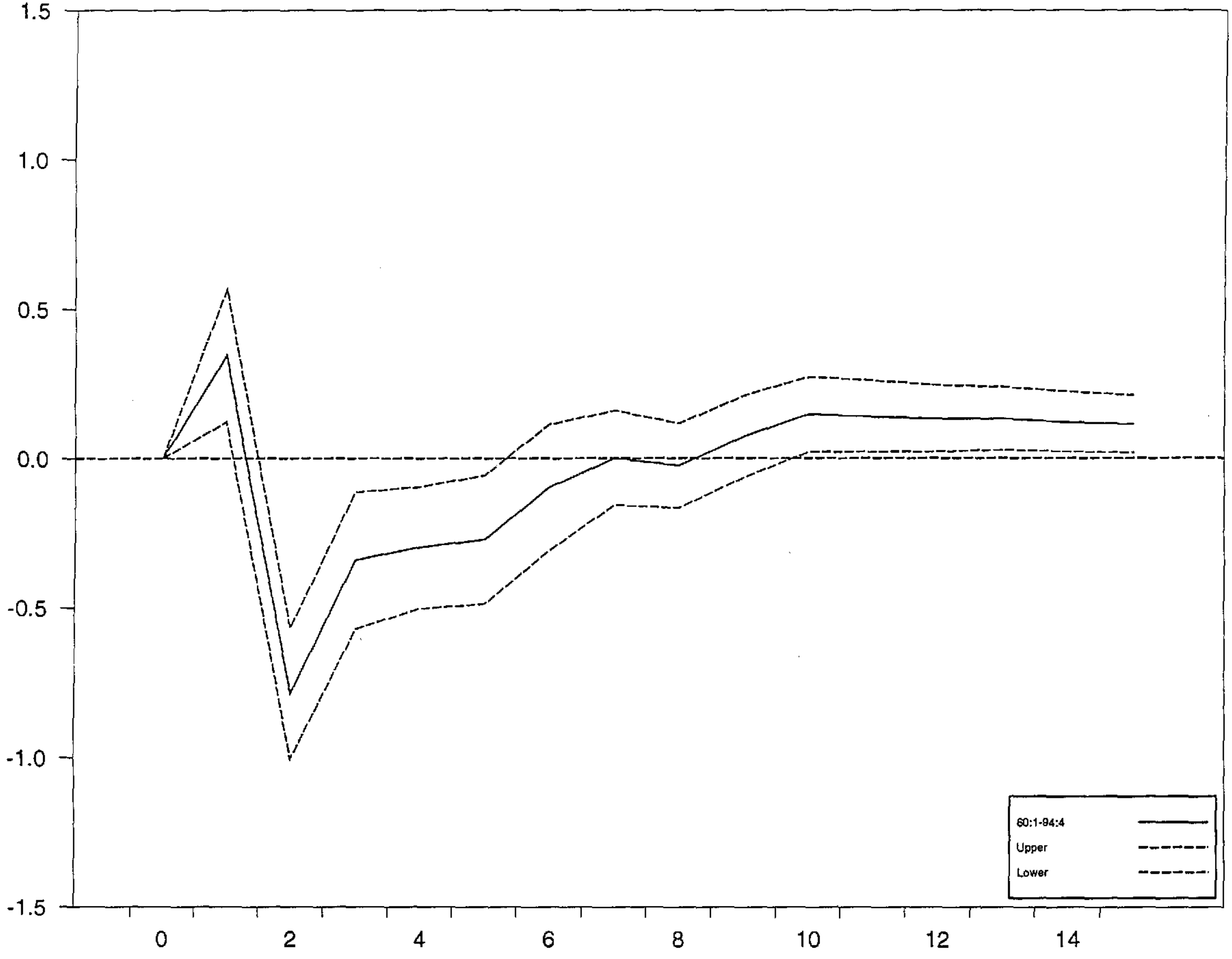


Figure 5

IMPULSE RESPONSE OF GDP GROWTH TO RFM

60:01 - 94:04

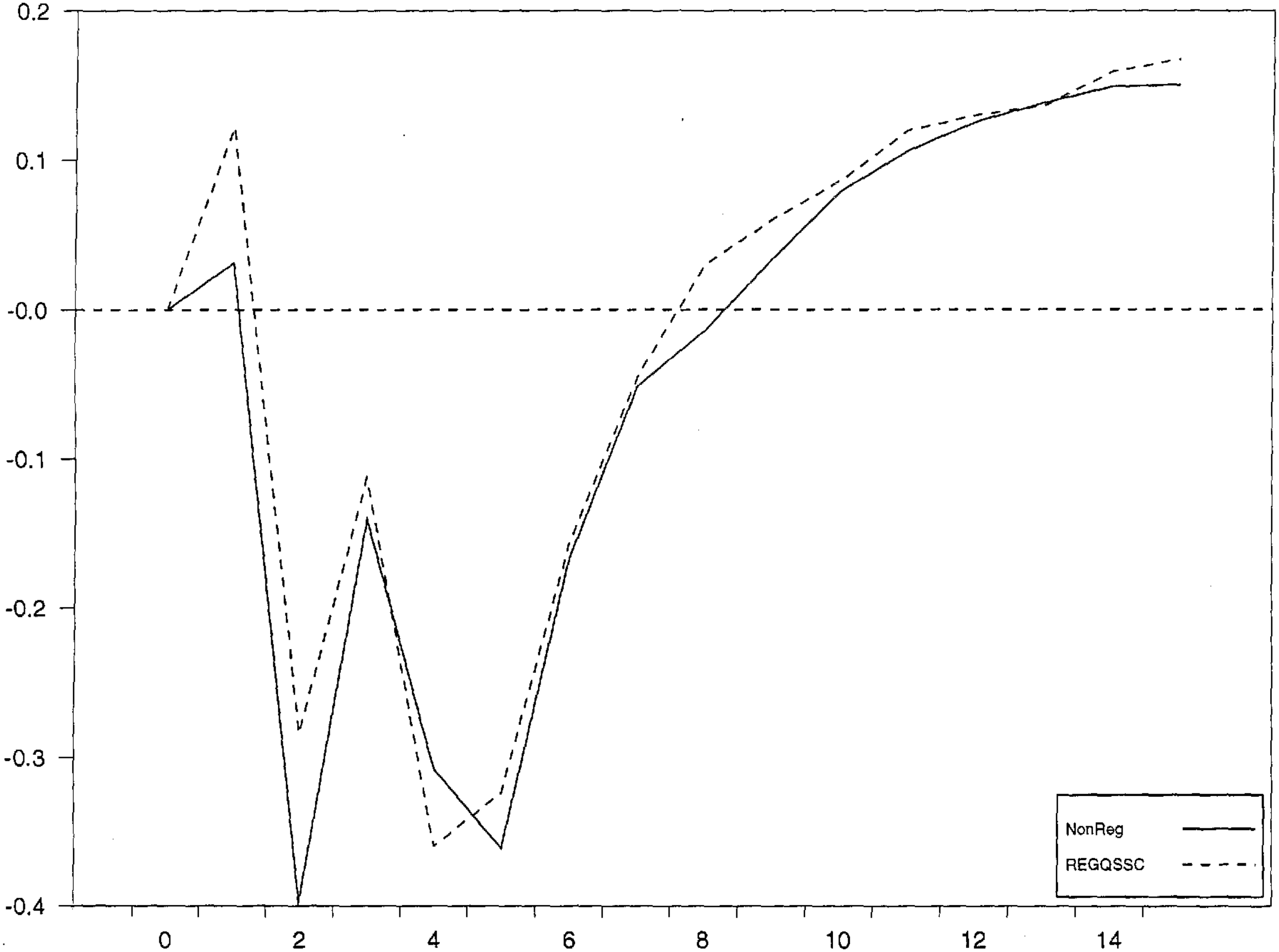


Figure 6

IMPULSE RESPONSE OF GDP GROWTH TO REGQSSC

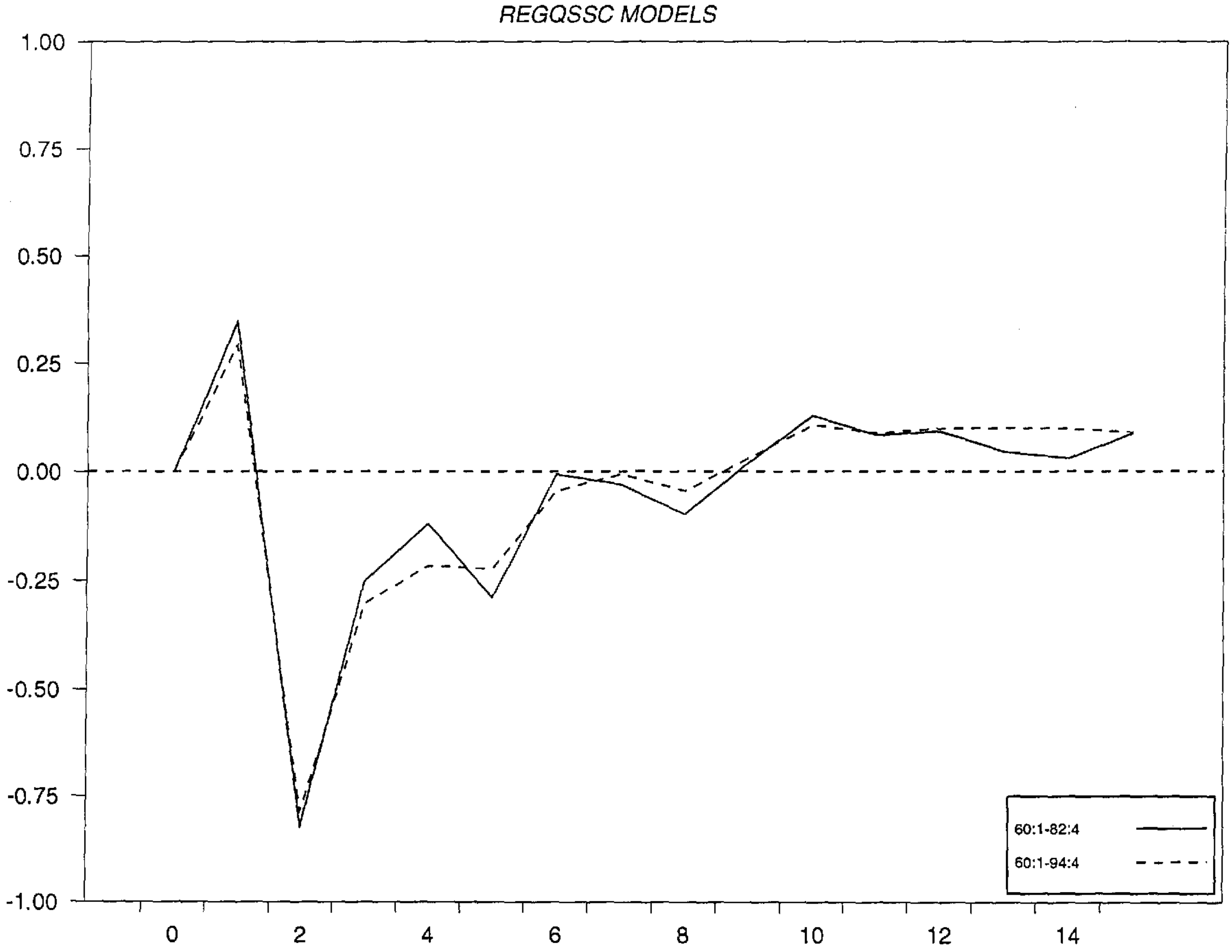
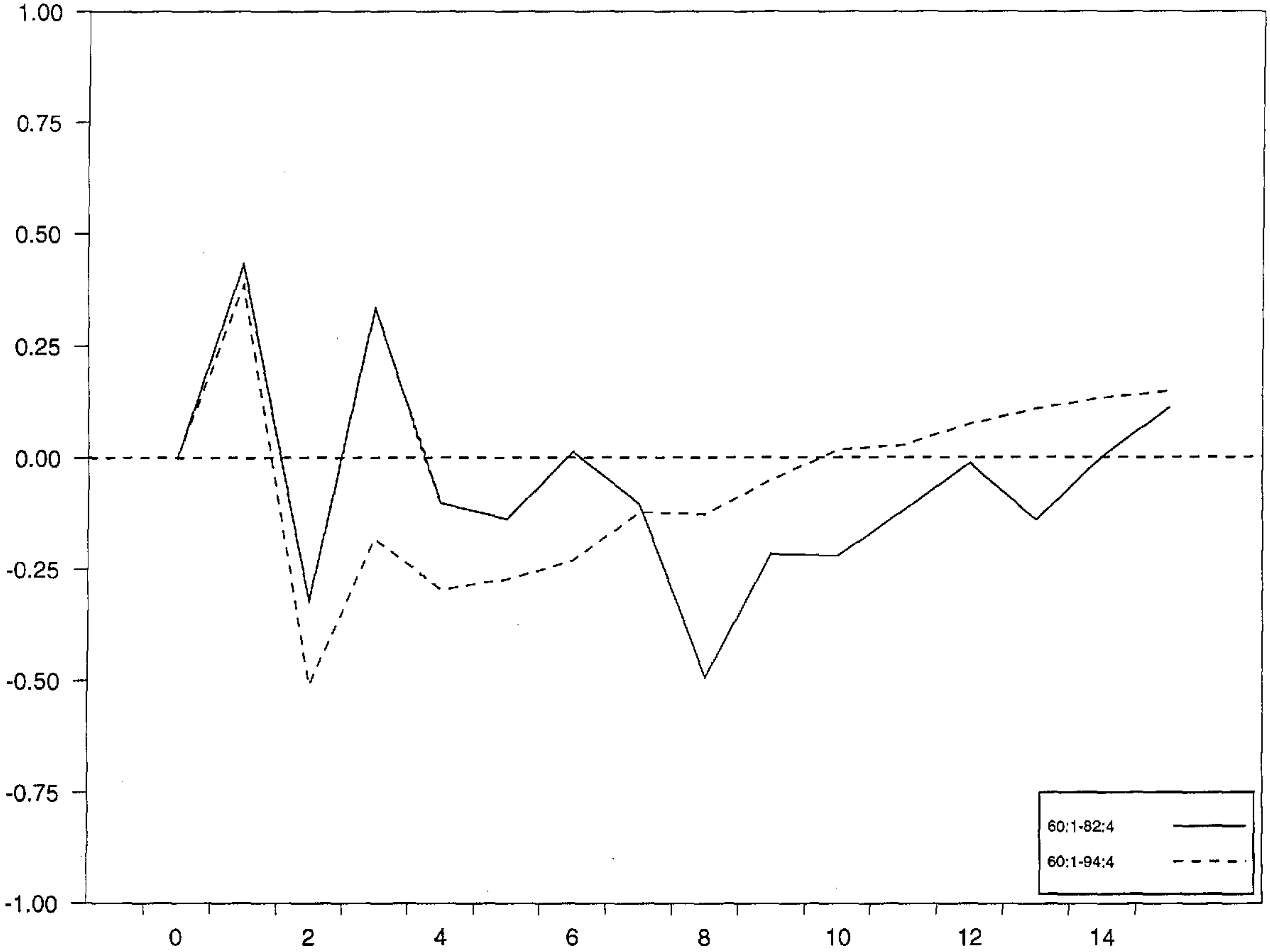


Figure 7
IMPULSE RESPONSE OF GDP GROWTH TO REGQU

REGQU MODELS



response of GDP growth to RFM innovations shifts as the end-of-sample is extended from 1982:4 to 1994:4 (Figures 8 and 9). A plausible explanation for this discrepancy is that the Fed's reaction function shifted in the early-1980s which could result in VARs yielding estimated funds rate effects that are sensitive to the sample used [Sims (1992)], but which would not affect nonVAR results that use actual, rather than predicted, Fed policy moves. Although the impact of real funds rate innovations remains sensitive to the sample, REGQSSC is statistically and economically significant in these VARs.

5. Conclusion

This study improves upon previous research on Reg Q by explicitly measuring how regulatory changes have affected the observed, short-run real rate elasticity of GDP. Findings show that Reg Q effects are economically and statistically significant in VAR and nonVAR models. NonVARs results show that not accounting for Reg Q effects results in omitted variable bias that upwardly distorts the real rate elasticity of GDP and gives the mistaken impression that adopting flexible exchange rates has weakened rather than enhanced the effectiveness of monetary policy. NonVAR results also imply that GDP models are unlikely to yield rate coefficients that are stable enough for practical use unless they accurately control for regulatory changes. With respect to recent macroeconomics controversies, these findings are consistent with the view that the relative strength of the bank credit channel of monetary policy has declined over time [e.g., Miron, Romer, and Weil (1995)].

These aggregate output findings are also consistent with results from two sectoral studies. In one, Duca (1995) finds that key coefficients of a Fed model of aggregate housing change substantially since the 1970s unless one

Figure 8

IMPULSE RESPONSE OF GDP GROWTH TO RFM

Non Reg Models

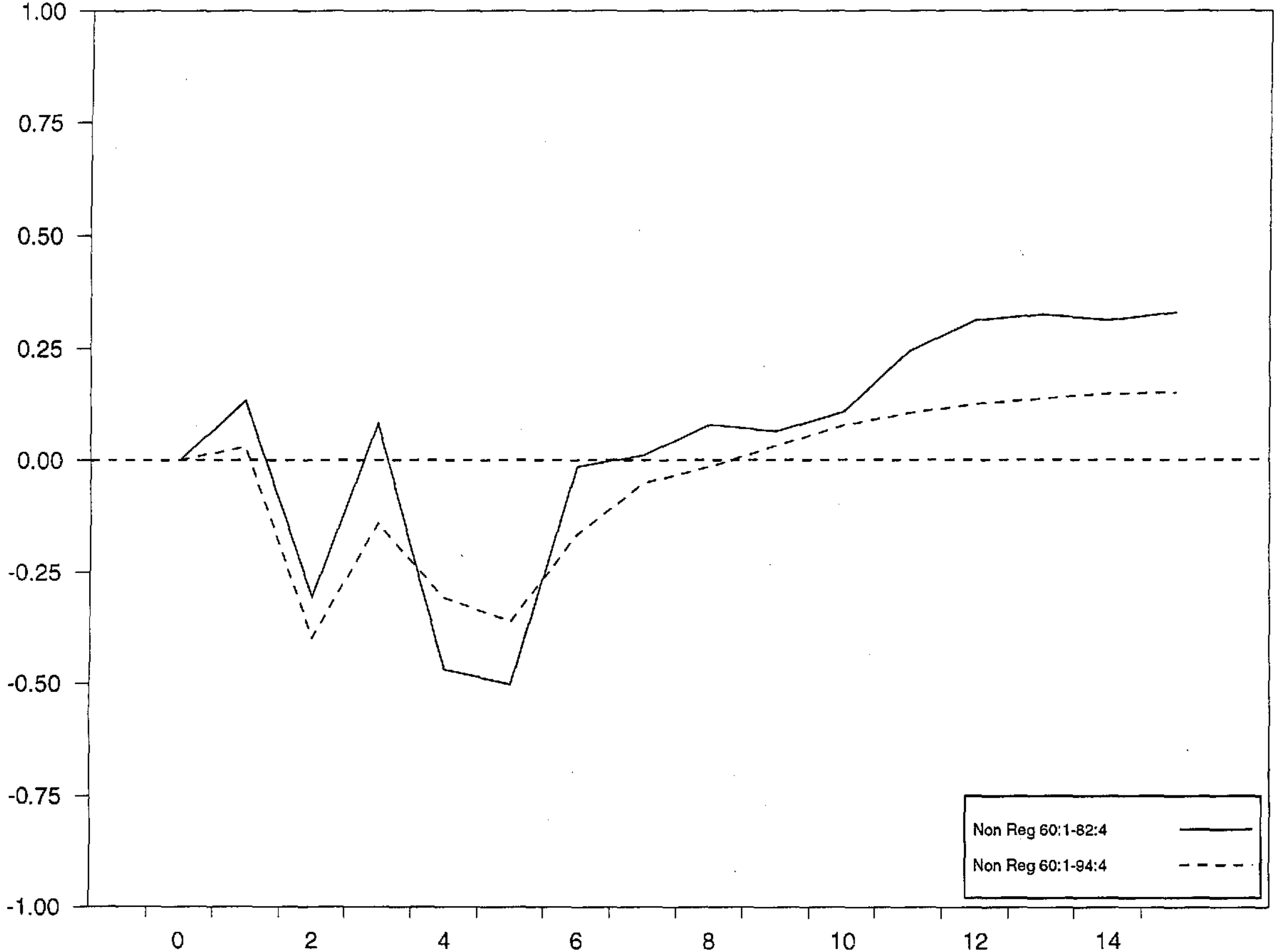
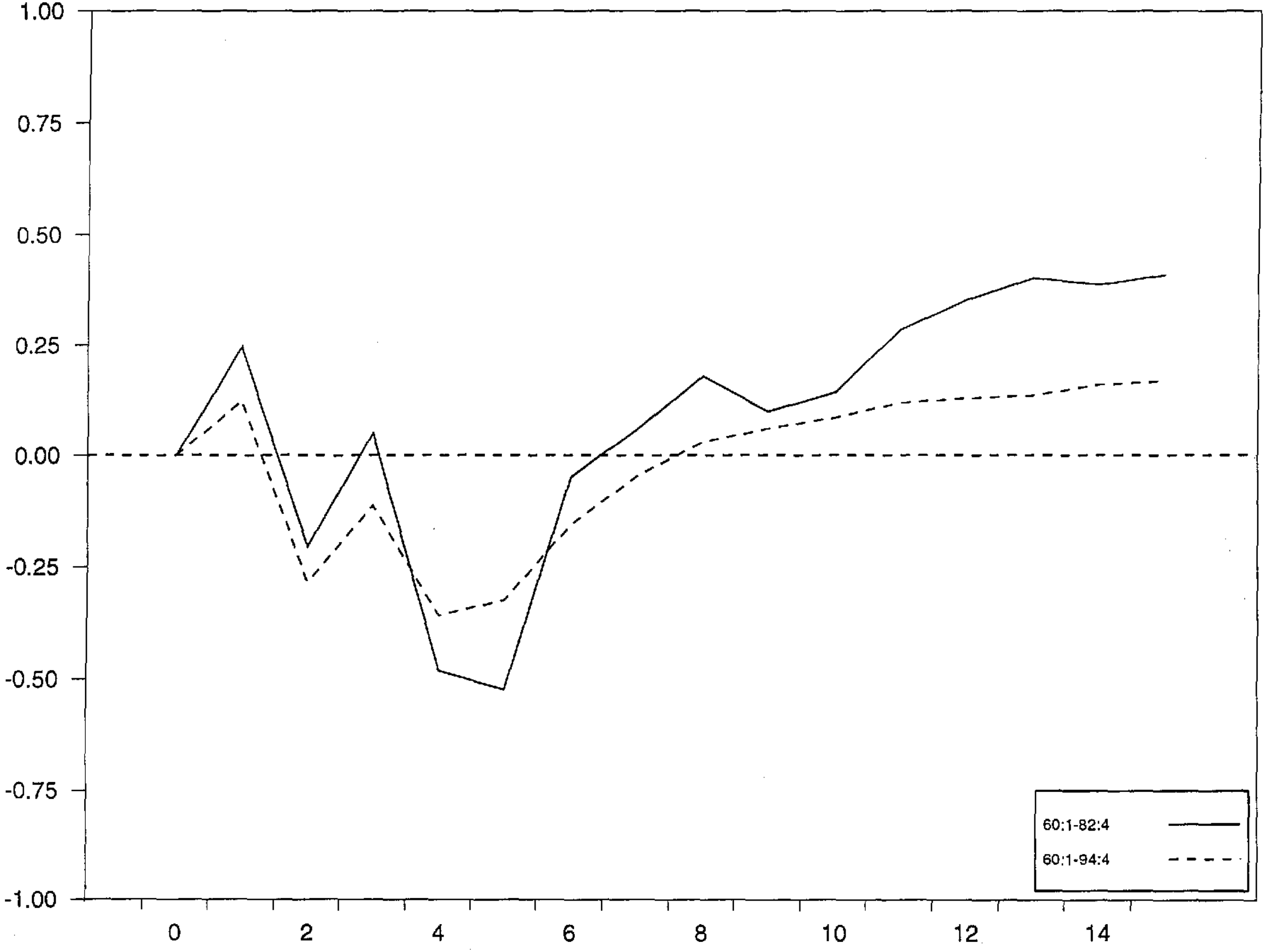


Figure 9

IMPULSE RESPONSE OF GDP GROWTH TO RFM

REGQSSC MODELS



includes an accurate measure of Reg Q effects (e.g., REGQSSC). In the other study, Duca and Garrett (1995) find that not accounting for Reg Q effects leads one to overestimate the current effect of fed funds rate changes on consumer credit availability, that the availability of bank consumer loans had not declined as much in the late-1980s as in prior credit crunches, and that a Fed model overpredicted the late 1980's decline in consumer durables spending unless it was modified to include an index of consumer credit availability.

In terms of which specific deposit regulations are crucial to accurately measuring Reg Q effects, the present study finds that Reg Q variables should account for the introduction of small-saver certificates in the late-1970s and that the introduction of money market certificates was somewhat less important. Because a Reg Q variable based on money market certificates would closely mimic a Reg Q term based on large time deposit rate ceilings, the findings imply that Reg Q effects associated with regulations on retail deposit rates were more important than those on wholesale deposit rates. One plausible explanation for this finding is that small- to mid-sized banks and thrifts who once accounted for much mortgage lending, could not easily issue uninsured large time deposits in the late-1970s and early 1980s.[14] Because the mortgage-backed securities markets were also not highly developed back then, binding Reg Q ceilings led these depositories to curtail lending and boosted the general impact of the real federal funds rate.

The Fed's use of real interest rates as a policy guide is controversial on several grounds. Some, such as how well one can measure ex ante real

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[14]Kashyap and Stein (forthcoming) find evidence supporting their theory that because small banks have less access to non-core deposit funds (e.g., large time deposits) that small bank credit declines relative to large bank credit during episodes of tight monetary policy.

rates, track the equilibrium real rate over a business cycle, and control for every conceivable monetary policy regime are beyond the scope of this paper.[15] With these caveats in mind, this study implies that if real interest rates are used to help guide policy, one should carefully account for regulatory changes to get a handle on the current real rate sensitivity of GDP. By constructing a more informative Reg Q measure, this study may help U.S. policy-makers avoid one of the pitfalls of using real rates as policy guides. In this sense, although Reg Q ended more than a decade ago, it is still with us.

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[15] As a partial evidence on monetary regime effects, other nonVARs regressions (not shown) tried interacting the real federal funds rate with a dummy for 1979:4-82:4. One to four lags of this variable were insignificant.

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Table 1: Real GDP Growth Regressions[1]
No Ex. Rate Regime or Oil Price Variables

Variable	Non Reg 60-82	Non Reg 60-94	REGQU 60-82	REGQU 60-94	REGQMMC 60-82	REGQMMC 60-94	REGQSSC 60-82	REGQSSC 60-94
$\Sigma_{i=1}^{8}\Delta y_{t-i}$	0.5386	0.6533^{+}	0.2836	0.4411	0.1173	0.4991	0.1556	0.5401
	(0.94)	(1.94)	(0.63)	(1.47)	(0.56)	(1.18)	(0.81)	(1.47)
$\Sigma_{i=1}^{8}RFM_{t-i}$	-0.0009^{*}	-0.0007^{*}	-0.0003	-0.0011	-0.0009	-0.0006^{*}	-0.0012^{*}	-0.0007^{*}
	(2.14)	(2.64)	(0.47)	(1.04)	(1.52)	(2.39)	(2.14)	(2.59)
$\Sigma_{i=1}^{8}REGQ_{t-i}$			-0.0028	-0.0005	-0.0040	-0.0029	-0.0043^{+}	-0.0017^{*}
			(0.90)	(1.56)	(1.20)	(1.71)	(1.77)	(2.22)
GAP_{t-1}	0.0957	0.1252^{*}	0.1200	0.1065^{+}	0.0567	0.1022^{+}	0.0772	0.1073^{*}
	(1.41)	(2.42)	(1.35)	(1.86)	(0.74)	(1.90)	(1.08)	(2.00)
$DUM80Q2_{t}$	-0.0345^{**}	-0.0297^{**}	-0.0264^{*}	-0.0266^{**}	-0.0403^{**}	-0.0363^{**}	-0.0297^{*}	-0.0252^{**}
	(-3.45)	(-3.53)	(-2.30)	(-2.92)	(-3.83)	(-4.19)	(-2.52)	(-2.63)
FES_{t-1}	-0.1886	0.1042	-0.2753	0.0614	0.0527	0.1461^{+}	-0.0071	0.1341^{+}
	(-0.80)	(1.63)	(-1.00)	(0.76)	(0.18)	(1.85)	(-0.02)	(1.66)
ϵ_{RFF}	-0.00193	-0.00206	-0.00039	-0.00198	-0.00107	-0.00128	-0.00143	-0.00149
ϵ_{REGQ}			-0.00390	-0.00096	-0.00458	-0.00576	-0.00514	-0.00372
d.h.	-0.5452	-0.8529	0.1597	0.1791	-1.0110	-1.5039^{+}	0.3096	-1.0866
q(24)	18.36	30.51	16.26	20.44	18.01	26.51	17.65	24.11
R^2	.2287	.2561	.2203	.2831	.2460	.2900	.2899	.3122

1. Sums of coefficients are listed with F-statistics in parentheses for lags of Δy, RFM, and REGQ.
*(**,$^{+}$) denotes significant at the 5% (1%,10%) levels.

Table 2: Real GDP Growth Regressions With Ex. Rate Regime and Oil Price Variables[1]

Variable	Non Reg 60-82	Non Reg 60-94	REGQU 60-82	REGQU 60-94	REGQMMC 60-82	REGQMMC 60-94	REGQSSC 60-82	REGQSSC 60-94
$\Sigma_{i=1}^{8}\Delta y_{t-i}$	0.7813 (0.50)	0.8222* (2.19)	0.7086 (0.85)	0.7440* (2.26)	-1.0618 (0.69)	0.4329 (1.25)	0.3433 (0.25)	0.6892+ (1.77)
$\Sigma_{i=1}^{8}RFM_{t-i}$	-0.0035** (2.85)	-0.0010** (2.81)	-0.0040* (2.28)	-0.0012+ (1.96)	-0.0054** (4.11)	-0.0013** (3.26)	-0.0038** (3.15)	-0.0010** (3.63)
$\Sigma_{i=1}^{8}RFMFIX_{t-i}$	0.0013+ (1.88)	-0.0008+ (1.86)	0.0016* (2.38)	-0.0003+ (1.88)	0.0088** (3.90)	0.0027* (2.24)	0.0033* (2.53)	0.0001** (2.72)
$\Sigma_{i=1}^{8}REGQ_{t-i}$			+0.0008* (2.53)	-0.0008+ (1.84)	-0.0205** (3.72)	-0.0072+ (1.88)	-0.0047* (2.22)	-0.0014** (3.08)
$\Sigma_{i=1}^{8}\Delta ROIL_{t-i}$	0.0006 (1.60)	-0.0006 (0.68)	0.0005+ (1.86)	-0.0005 (0.91)	-0.0015* (2.48)	-0.0007 (0.69)	0.0001 (1.20)	-0.0006 (0.72)
GAP_{t-1}	0.2313* (2.50)	0.2420** (3.72)	0.1927 (1.65)	0.2493** (3.50)	0.2843* (2.67)	0.2222** (3.05)	0.2342* (2.07)	0.2216** (3.10)
$DUM80Q2_t$	-0.0170 (-1.53)	-0.0269** (-3.30)	-0.0146 (-1.13)	-0.0237** (-2.72)	-0.0206+ (-1.98)	-0.0321** (-3.80)	-0.0087 (-0.65)	-0.0240* (-2.57)
FES_{t-1}	0.5078 (1.31)	0.1716* (2.01)	0.5898 (1.44)	0.1459 (1.38)	0.6520+ (1.87)	0.2180* (2.46)	0.4139 (1.09)	0.1749+ (1.96)
$FESFIX_{t-1}$	-1.4216* (-2.47)	-1.3241** (-3.31)	-1.3061* (-2.28)	-1.2662** (-3.15)	-0.5956 (-1.09)	-0.8361* (-2.03)	-1.0941+ (-1.80)	-1.0681** (-2.76)
$\epsilon_{\Delta RFF}$	-0.01590	-0.00586	-0.01361	-0.00463	-0.00260	-0.00225	-0.00582	-0.00337
ϵ_{REGQ}			-0.00288	-0.00307	-0.00993	-0.01264	-0.00708	-0.00457
d.h.	-0.3073	-0.3795	0.1033	1.0468	-0.7486	-1.0957	0.1368	0.4973
q(24)	20.20	30.78	23.07	22.62	29.35	30.19	27.02	24.99
R^2	.3399	.3312	.4134	.3726	.5271	.3743	.4399	.4245

1. Sums of coefficients are listed with F-statistics in parentheses for lags of Δy, RFM, REGQ, ΔROIL, and RFMFIX. *(**,+) denotes significant at the 5% (1%,10%) levels.

Table 3: Variance Decompositions of Real GDP Growth[1]

Horizon	Δy	Δp	REGQSSC	ΔROIL	RFM
			REGQSSC Model, 1960-94		
4 quarters	.859	.077	.054	.002	.008
8 quarters	.794	.090	.064	.040	.013
12 quarters	.784	.090	.070	.041	.014
16 quarters	.781	.093	.070	.041	.015
			NonReg Model, 1960-94		
4 quarters	.899	.082		.004	.015
8 quarters	.823	.104		.050	.023
12 quarters	.820	.106		.051	.023
16 quarters	.818	.109		.051	.023
			REGQSSC Model, 1973:2-94		
4 quarters	.826	.069	.058	.011	.035
8 quarters	.713	.068	.097	.091	.031
12 quarters	.700	.067	.102	.096	.036
16 quarters	.696	.070	.103	.095	.036
			NonReg Model, 1973:2-94		
4 quarters	.846	.097		.012	.045
8 quarters	.744	.116		.092	.047
12 quarters	.741	.117		.094	.047
16 quarters	.740	.118		.094	.047

1. Each model includes a dummy for the credit controls of 1980:Q2.

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