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Residential Fixed Investment and the Macroeconomy: Has Deregulation Altered Key Relationships?

JEAN GAUGER
Department of Economics, 526 Stokely Management Center, The University of Tennessee, Knoxville, TN 37996, USA
E-mail: jgauger@utk.edu

TRICIA COXWELL SNYDER
Department of Economics and Finance, William Paterson University, P.O. Box 920, Wayne, NJ 07474, USA

Abstract

Financial deregulation in 1980 potentially altered key relationships between residential fixed investment (RFI) and key macroeconomic variables. This study uses a vector error correction model to examine relationships between RFI, money, interest rates, and output in pre-deregulation and post-deregulation sub-periods. Results indicate short-term interest rate shocks account for much of RFI variability pre-deregulation. After deregulation, long-term FHA interest rate shocks better account for RFI movements. Results also show that, in the post-deregulation era, RFI shocks have increased predictive power for overall gross domestic product movements. Thus, the study finds altered relationships between RFI and macroeconomic variables.

Key Words: residential investment, deregulation, monetary policy

1. Introduction

The investment sector is seen as generally important in the macroeconomy. The measure of investment most commonly used in both theoretical and empirical studies has been aggregate investment or business fixed investment (BFI). Empirical work frequently makes no distinction among various types of investment and their differing behaviors, with regard to interest rates or real income impacts. However, some prior evidence indicates that residential fixed investment (RFI) and business investment behave differently over the business cycle.

Business fixed investment appears to respond to fluctuations in overall economic activity. Residential investment movements typically lead movements in other sectors and the overall economy. In seven of the nine recessions since World War II, RFI led the decline in BFI, consumption, and real gross domestic product (GDP) by at least two quarters. In the 1980 recession, for example, RFI led by four quarters the downturn in the overall economy, while sectors such as consumption and BFI lagged two quarters behind. Recently, Green (1997), Coxwell (2000), and Coulson and Kim (2000) examined the components of GDP in predicting changes in business cycles. These studies all found that shocks to RFI lead changes in the overall economy, while GDP leads changes in BFI.

While the residential investment sector comprises a small share of GDP, it accounts for a disproportionate share of fluctuations in GDP. For example, RFI comprises about five percent of real GDP. However, fluctuations in RFI account for a disproportionate 14 percent of a change in GDP. The RFI sector displays more fluctuation than BFI, total fixed investment, consumption, and GDP.

Thus, movements in RFI appear to be an important feature of business cycles in the overall economy. Evidence suggests that the housing sector may serve as a useful predictor for fluctuations in the overall economy. Better understanding of RFI fluctuations may contribute to better understanding of cycles in the overall economy. Despite the clear value of RFI analyses, it has not received broad attention, relative to aggregate investment or BFI.

In an evaluation of residential investment, impacts from an episode of major financial deregulation warrant attention. Prior to 1980, regulation of depository institutions placed ceilings on interest rates at depository institutions and prohibited nationwide offering of a number of newly innovated financial assets. In 1980, widespread changes occurred in the regulation of depository institutions. This episode of major deregulation and financial innovation potentially has altered relationships for residential investment and the macroeconomy. Little previous research has addressed how deregulation may have affected links between RFI, short- or long-term interest rates, and GDP. Studies prior to the early 1980s found that investment, especially RFI, was very sensitive to interest rates. However, this may arise from constraints on housing credit availability, prior to deregulation. Since deregulation had a particular impact on Savings and Loans (S&Ls), a re-evaluation of key relationships is warranted. These issues are discussed further in Section 2.

Given these prior indications of a potentially key economic role from residential investment, this study examines the relationship between RFI, the money stock, interest rates, and real GDP shocks. It further examines whether key relationships have changed after the financial innovation and deregulation of the early 1980s. More specifically, a vector error correction model (VECM) is used to analyze the predictive power of shocks to the money supply (M2), interest rates (short- and long-term), and output (GDP) for innovations in RFI in both pre- and post-deregulation periods. The remainder of this of the paper is organized as follows: Section 2 discusses the issues surrounding the deregulation and financial innovations of the early 1980s. This section also summarizes the evidence from previous empirical research. Section 3 describes the data and empirical procedure. Section 4 reports empirical findings and Section 5 presents conclusions.

2. Deregulation and financial innovation

2.1. The issues

Deregulation and financial innovations in the early 1980s offered many benefits to individuals, via competitive interest rates on savings assets, new savings options, and expanded borrowing options in some economic environments. Across the broader

economy, the 1980s deregulation potentially altered previous monetary–macroeconomic relationships. RFI and interest rate impacts are a prime example, most notably via the phase-out of Regulation Q. Prior to 1980, during eras of high market interest rates, Regulation Q created constraints within the housing sector. Regulation Q placed a ceiling on deposit interest rates paid by S&Ls. When a shock (such as a monetary tightening) caused short-term interest rates to rise above the regulated ceiling rate, savers shifted funds away from S&Ls (towards other financial assets such as U.S. Treasury bills). Since S&Ls were an important source for mortgage borrowing (supplying nearly 90 percent of home mortgage loans), this reduced funds available for mortgage lending. Thus, when savers responded to unregulated short-term interest rates above ceiling rates, this process called '' disintermediation'' was triggered. As a result, shocks to short-term interest rates affected mortgage fund availability and housing investment.

The long-term FHA mortgage interest rate was not very responsive to market forces. Most states imposed usury laws during Regulation Q, prohibiting S&Ls from freely adjusting their interest rates in times of excess demand for mortgage credit. FHA mortgage interest rates showed minimal fluctuation during regulation. In an era of disintermediation and credit availability constraints, non-interest rate mechanisms were used to ration the supply of mortgage credit, rather than movements in the long-term FHA interest rate. According to Kent (1980), credit rationing allocated credit based on non-price alternatives, such as lending fees, collateral requirements, and larger down-payments, lowering the amount some borrowers received, and eliminating potential borrowers who required low down payment loans.

The problems from the era's constraining interest rate regulations and associated financial innovation were evident to participants in financial markets during the 1970s. By 1979 and 1980, the extreme problems affecting depository institutions and the monetary sector were recognized more generally. In 1980, Congress passed the Depository Institutions Deregulation and Monetary Control Act (DIDMCA), aimed at addressing a spectrum of issues related to regulation, Federal Reserve supervision, and financial innovation. Among the various measures, the 1980 law deregulated interest rates, allowing savings and borrowing rates to respond more fully to market forces. The law also authorized nationwide a variety of financial assets at depository institutions.[1]

Several reforms helped '' complete'' the mortgage loan market, by better matching the needs of lenders and borrowers. First, deregulation of deposit rates removed the primary cause of financial disintermediation. By allowing S&Ls to price their deposits more competitively, deregulation removed the incentive for depositors to shift funds out of financial intermediaries during periods of high market interest rates. Further, the development of secondary markets made the industry more complete by expanding the lending funds in the housing market, via '' securitization'' in the mortgage market. In addition, adjustable mortgage rates commonly became available. The lower initial rates on variable rate loans encouraged some borrowers into the residential housing market. Thus, a number of notable changes occurred in the housing finance market, with potential consequences for relationships between the housing sector, interest rates and the macroeconomy.

2.2. Evidence from previous empirical research

Many of the initial studies following deregulation focused on credit rationing issues. Several empirical studies of credit rationing done in the 1980s and early 1990s indicate that non-price terms, such as loan-to-value ratios, maturity, and customer relations continued to allocate home mortgage loans, despite the 1980 deregulation. Using a single-equation ordinary least squares (OLS) framework, Kent (1980), Topel and Rosen (1988), Dokko et al. (1990), Duca and Rosenthal (1991), Van Order and Dougherty (1991), and Pozdena (1990) all found evidence of continued credit rationing in the housing market. Similarly, Goodwin (1986) concludes that mortgage credit rationing created constraints in the housing market that reduced RFI and, consequently, its ability to explain output during the regulated period.

Several of these earlier OLS-based studies do not address non-stationarity issues common to macroeconomic data series. In addition, although these studies included interest rates in the investigation, they did not allow for endogenous interest rates. To avoid endogeneity bias, Chowdhury et al. (1985), Kahn (1989), Pozdena (1990), Daniell (1991), Green (1997), and Coulson and Kim (2000) examined RFI using a vector autoregression (VAR) method made widely familiar by Sims (1972, 1980). Chowdhury et al. (1985) ascertained that money and long-term interest rates exert separate influences on RFI; the evidence indicates that monetary impacts are not solely via interest rates. This study also concluded that deregulation altered the link between housing and interest rates. Studies by Kahn (1989) and Daniell (1991) found that RFI was less sensitive to short-term interest rates after deregulation (1983.1–1989.4), than during regulation (1955.1–1979.4). Kahn suggests that the elimination of interest rate ceilings on consumer deposits at thrift institutions theoretically has made RFI less sensitive to short-term interest rates.

Note that the phase-out of Regulation Q extended over a six-year period. Given the date of these investigations, some of these studies may not contain adequate post-deregulation observations. Expanded evidence is needed, based upon a post-deregulation sample period that is dominated by post-1986 data, to verify which patterns are robust. Further, methods in these previous studies did not take advantage of long-term relationships that may exist in macroeconomic data series.

The Sims (1980) VAR study of monetary relationships and real economic activity found that the explanatory power of monetary shocks declined if an interest rate were included in the analysis. Given this evidence, subsequent studies typically include an interest rate (along with money) in the investigation. However, there is no consensus on which interest rate is the most appropriate for inclusion. Hartman (1980), Chowdhury et al. (1985), and Abdullah and Tank (1989) all adopt the view that a long-term rate is the relevant measure of the user cost of capital in the investment decision. In contrast, Hall (1977), Bernanke (1983), Schwab (1983), and Greenwald and Stiglitz (1993) use a short-term interest rate. Kahn (1989) argues that a short-term rate is a better indicator of monetary policy actions. Given prior studies' varying results, a comparison of results under short-term vs. long-term interest rate specifications is warranted. This study compares results using the short-term Federal Funds interest rate and the long-term FHA interest rate. Results below indicate some interesting patterns in results across interest rates. Presentation of results for

both rates can be useful in evaluating conclusions in the existing literature. The next section addresses empirical procedures used to investigate these several issues.

3. Empirical procedures

As the previous discussion highlights, residential investment, and interest rate impacts warrant evaluation, including assessment of whether key relationships have changed since the 1980s deregulation. To pursue these issues, this paper examines for two periods the relationship between RFI and shocks to the money supply (M2), the FFR and FHA interest rates, and real output (GDP). Common approaches used in previous literature to assess the relationship between interest rates and RFI have been single-equation OLS, two-stage or three-stage least squares simultaneous equations methods or, in more recent literature, a VAR approach. Many of the earlier studies used a single-equation ''St. Louis'' type approach, which places structural causality assumptions onto the model. The imposed structure can affect the conclusions of the model. Given this, numerous studies opt for a non-structural model (see, for example, Chowdury et al., 1986, Green, 1997, and Coulson and Kim, 2000), and this is the approach adopted here.

Specifically, the estimation procedures here use a VECM. As Engle and Granger (1987), and Enders (1995) indicate, if each variable in the model is non-stationary, and there is a long-term relationship between variables, then a VECM should be employed, rather than a standard VAR. In a VECM, the error correction term adds information regarding the long-term (co-integrating) relationships between variables, and improves efficiency compared with the standard VAR technique. As Enders (1995) notes, if a standard VAR is estimated, without incorporating existing long-run relationships, the model will be misspecified. In particular here, the VECM method incorporates into the estimation the long-term relationships that exist between the money supply, interest rates, RFI, and output variables.

To proceed with estimation, data are needed on RFI, the M2 money supply, the Federal Funds interest rate, the FHA long-term interest rate, and real output. Data for real GDP and RFI for the period 1959.Q1–1999.Q4 are reported by the Bureau of Economic Analysis (BEA). Money supply and interest rate data in nominal annualized terms are obtained from the FRED data bank of the St. Louis Federal Reserve Bank. All data are in log values, except the interest rates. Most previous studies use a single interest rate in the model, but vary on the choice of a short- or long-term interest rate. In order to allow comparability with existing studies, the format here uses a single interest rate in each specification.[2]

The overall time period is divided into two sub-periods. Chow test results, shown in Table 1, indicate a significant break occurred in the behavior of FHA mortgage rates and in RFI around 1981. Cusum Squares results in Figure 1(a) and (b) further support this breakpoint after the 1980 deregulation. The overall sample period was divided into the sub-periods: period one, 1959.Q1–1979.Q4 (pre-deregulation) and period two, 1982.Q1–1999.Q4 (post-deregulation).[3] The 1999 end date is based upon data availability, as it is the last full year that FHA rates are available.

For a VECM to be appropriate, all variables must be non-stationary, integrated of the same order, and a long-run cointegrating relationship must exist within the variable set.

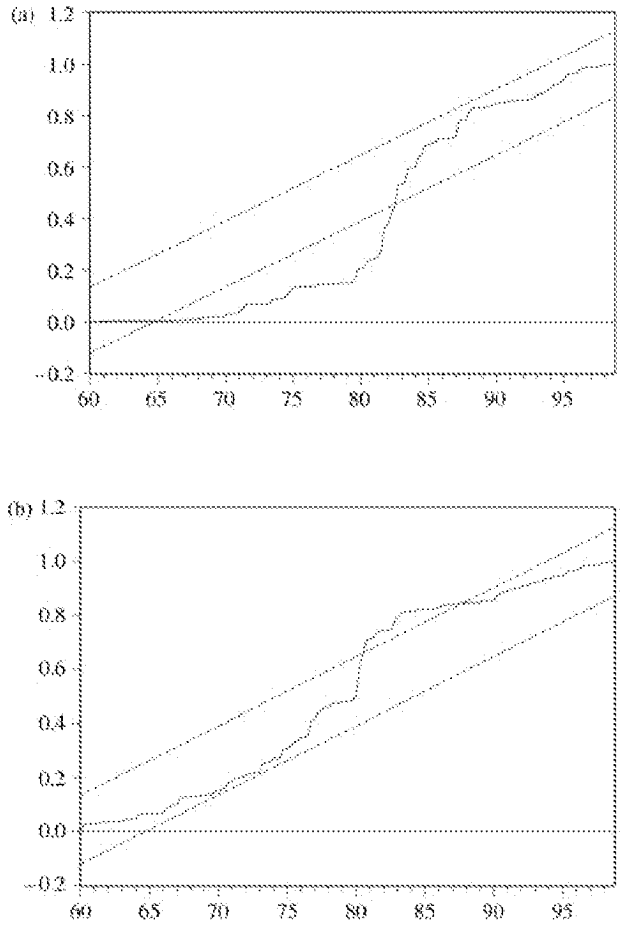

Figure 1. (a) FHA cusum squares. (b) RFI cusum squares.

Thus, several initial assessments of the data are necessary prior to VECM estimation, to determine whether an error correction model is appropriate for the system. The appropriate lag length for the variables needs to be determined (to avoid omitted variable bias) prior to conducting unit root tests. Likelihood ratio tests indicate that four lags of each variable are appropriate, which is consistent with results elsewhere (see, for example, Lawrence and Siow, 1985, and Coxwell, 2000).[4] To evaluate stationarity properties, Augmented Dickey Fuller (ADF) tests are used to test for unit roots. The ADF tests in Table 2 show that the null hypothesis of a unit root cannot be rejected at the 5 percent significance level, indicating that each series has a unit root and is non-stationary.

Given evidence of non-stationary data, the next issue to assess is whether any cointegrating relationships exist within the variable set. Johansen tests are used to

Table 1. Chow breakpoint test result.

	RFI				FHA Rate			
Time	*F*-stat.[a]	Prob.[b]	LLR[a]	Prob.	*F*-stat.	Prob.	LLR	Prob.
1980.1	1.45	0.229	6.01	0.199	3.36	0.069	3.37	0.066
1980.2	1.35	0.254	5.59	0.232	3.60	0.060	3.61	0.058
1980.3	1.82	0.128	7.48	0.112	2.76	0.099	2.77	0.096
1980.4	4.90	0.028	4.89	0.027	4.90	0.028	4.89	0.027
1981.1	6.70	0.011	6.64	0.010	6.70	0.011	6.64	0.010
1981.2	2.13	0.080	8.71	0.069	7.40	0.007	7.32	0.006
1981.3	2.98	0.021	12.10	0.017	10.75	0.001	10.53	0.001
1981.4	6.36	0.0001	24.77	0.0001	18.20	0.0000	17.44	0.0000
1982.1	1.38	0.244	5.71	0.222	9.78	0.002	9.61	0.002
1982.2	1.39	0.238	5.77	0.217	13.62	0.0003	13.23	0.0003
1982.3	1.40	0.236	5.79	0.215	2.77	0.029	11.25	0.024
1982.4	1.41	0.232	5.84	0.211	3.09	0.018	12.51	0.014

Notes. [a]Denotes *F*-statistic and log likelihood ratio values.
[b]Denotes probability level of statistical significance.

Table 2. Augmented Dickey Fuller test statistics.

Variable	ADF Test Statistic
M2	− 1.798229
FFR	− 2.678561
FHA	− 1.929779
RFI	− 1.408496
GDP	− 1.219442

Notes. Critical value of the test statistic at 5 percent level = − 2.89.
The Augmented Dickey Fuller test is equivalent to testing whether $\beta = 0$ in the equation:

$$\Delta Y_t = \alpha + \beta Y_{t-1} + \sum_{i=1}^{p} \gamma_i \Delta Y_{t-i} + \varepsilon_t,$$

where Y_t is a series in the system. The ADF statistics show that the null hypothesis of a unit root cannot be rejected at the 5 percent significance level.

determine whether variables are cointegrated and the appropriate number of cointegrating terms for the VECMs. Table 3 results indicate that the variables are cointegrated, which is consistent with findings in Green (1997). Results indicate that the inclusion of one cointegrating term is appropriate to incorporate long-term relationships.

Following Hamilton (1994) or Enders (1995), a VECM takes the form:

$$\Delta y_t = \Pi_0 + \Pi y_{t-j} + \Pi_1 \Delta y_{t-1} + \Pi_2 \Delta y_{t-2} + \cdots + \Pi_p \Delta y_{t-p} + e_t, \quad (1)$$

Table 3. Cointegration test results.

Eigenvalue	Likelihood Ratio	5% Critical Value	Hypothesized no. Cointegrating Equations
M2, FFR, RFI, GDP			
0.01479	50.41	47.21	None*
0.10959	25.60	29.68	At most 1
0.02780	7.61	15.41	At most 2
0.02069	3.24	3.76	At most 3
M2, FHA, RFI, GDP			
0.16169	49.74	47.21	None*
0.08745	22.40	29.68	At most 1
0.03748	8.22	15.41	At most 2
0.01471	2.30	3.76	At most 3

Notes. *Denotes: Reject null hypothesis.
The Johansen test is based upon the following reparameterization of the unrestricted VAR:

$$\Delta Y_t = \alpha + \xi_0 Y_{t-1} + \xi_1 \Delta Y_{t-1} + \xi_{p-1} \Delta Y_{t-p+1} + \varepsilon_t.$$

If h linear combinations of the variables in Y_t are stationary, then the variables in Y_t are cointegrated, with cointegration rank (r) equal to h. If h equals one, then the VECM will need one error correction term using levels of the series. Critical values for the reduced rank cointegration test are given by Osterwald-Lenun (1992).

where y_t is a vector of endogenous variables (here, M2, FFR or FHA, RFI, and GDP); y_{t-j} is the error correction term; Π is a matrix with elements Π_{jk}, such that one or more $\Pi_{jk} \neq 0$, Π_i are $(n \times n)$ coefficients matrices; t indexes time, p represents the lag length, and e_t is a $(n \times 1)$ vector of disturbance terms.

All VECMs are estimated using a Cholesky decomposition to ensure that the covariance matrix of the innovations is diagonal.[5] In results presented below, monetary variables enter first and aggregate output enters last. This ordering is comparable with orderings in related studies.[6] Procedures here evaluate sensitivity of results to alternate orderings. Results for major relationships of interest are robust across alternate orderings.

With VECM or VAR models, innovation accounting methods provide useful information on relationships among variables over time. These include forecast error variance decomposition (FEVD) and impulse response functions (IRFs). Information about the properties of the forecast errors is useful in uncovering interrelationships among the variables in the system. A forecast error variance decomposition tells the percentage of the forecast error variance attributable to shocks to each variable in the system. Impulse response functions show the impact over time on the system's variables from a one unit shock to a given variable. An IRF plot is a useful way to represent the behavior of a given series, in response to shocks to the system. The multi-period assessment here allows assessment of potential changes, pre- and post-deregulation, in RFI and macroeconomic variables.

4. Empirical results

The VECM procedures described are used to assess pre- and post-deregulation relationships between RFI and shocks to M2, the short-term Federal Funds interest rate (FFR) or the long-term FHA mortgage interest rate, and real GDP. Impacts of RFI shocks on GDP innovations also are a key interest in this study.

Results indicate that deregulation does appear to alter the relationship between RFI and interest rates. Forecast error variance decomposition results in Table 4 indicate that, prior to deregulation, FFR shocks account for almost one-half of RFI's forecast error variance. However, after deregulation the predictive power of FFR shocks for RFI innovations falls sharply: FFR shocks account for less than a fifth of the RFI forecast error variance. This is consistent with evidence elsewhere showing weaker ties between RFI and the short-term interest rate after financial deregulation in the 1980s.

Impulse response function evidence is consistent with this finding, indicating the important role of short-term interest rate shocks in the period one regulated environment.[7] Figure 2 shows the IRF for short-term rate shocks and residential investment during the regulated period. This IRF indicates that a one-time shock to FFR has large and significant

Table 4. FEVD: residential fixed investment with FFR.

	Period one (1959.Q1–1979.Q4)				Period two (1982.Q1–1999.Q4)			
Horizon (quarter)	M2	FFR	RFI	GDP	M2	FFR	RFI	GDP
2	39	1	60	0	50	3	47	0
4	45	15	32	8	65	7	27	0
6	25	36	22	17	72	12	20	0
8	14	48	18	20	68	20	11	1

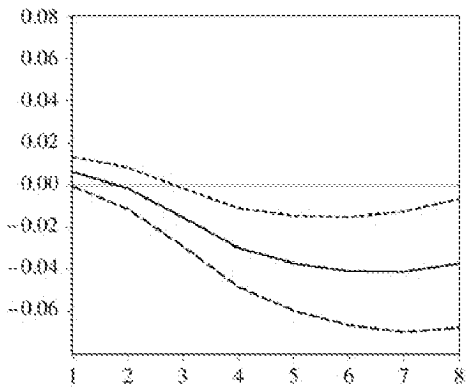

Figure 2. RFI to FFR shock (IRF—period one).

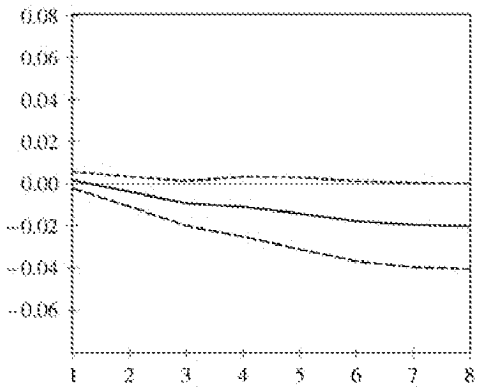

Figure 3. RFI to FFR shock (IRF—period two).

negative impacts on RFI movements over the eight quarter horizon. Post-deregulation results in Figure 3 show that impacts of FFR shocks on RFI are greatly reduced relative to period one impacts, especially during the first four quarters after the shock. Results are consistent with those found by Kahn (1989), suggesting that deregulation reduced the sensitivity of RFI to a FFR interest rate shock.

Assessing longer-term interest rate shocks in each period, results indicate that FHA shocks provide better predictive power in the post-deregulation period. The FEVD in Table 5 shows that, in period one, FHA rate shocks account for very little of the RFI forecast error variance (less than 10 percent). It appears in period one that monetary impacts on RFI do not move predominantly via FHA interest rate movements: results indicate that, prior to deregulation, shocks to M2 account for more of RFI innovation than do FHA rate shocks. While not a direct test, these results are consistent with other studies' findings of credit availability issues being more important than FHA rate movements in the Regulation Q era. After deregulation, FHA shocks are notably more important to RFI movements than they were pre-deregulation. After deregulation, FHA shocks explain up to 25 percent of the RFI error variance. The FHA rate shocks in period two account for more of the RFI variability than do real GDP or M2 shocks.[8] The results here highlight the increased importance of long-term interest rate movements in today's deregulated environment.

Table 5. FEVD: residential fixed investment with FHA rate.

	Period One				Period Two			
Horizon (Quarter)	M2	FHA	RFI	GDP	M2	FHA	RFI	GDP
2	36	1	63	0	4	16	78	1
4	53	3	43	1	3	24	72	1
6	51	7	39	3	2	25	71	1
8	45	9	41	5	2	25	70	4

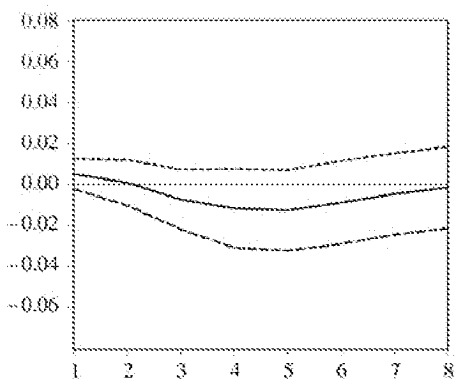

Figure 4. RFI to FHA shock (IRF—period one).

Impulse response functions support this indication of increased influence of long-term interest rates on RFI after deregulation. The period one IRF in Figure 4 shows that a FHA shock has a modest negative impact on RFI in period one. The post-deregulation results in Figure 5 show stronger impacts from a FHA shock. Thus, evidence here indicates long-term rate shocks display a more rapid and increasingly more important role in determining RFI innovations after deregulation (Figure 6). Collectively, these results support Chowdhury et al. (1985), which finds that long-term interest rates are currently a good indicator of changes in housing investment.

Results here provide some information on the question of which rate is a better predictor of RFI innovations. Results suggest that prior to deregulation, FFR shocks held a key role in explaining innovations in residential housing investment; FHA rate shocks played a more modest role. After deregulation, roles are reversed.[9]

These results are consistent with a major shift in the residential housing market. Findings are consistent with Pozdena (1990), where results indicate impacts of potential

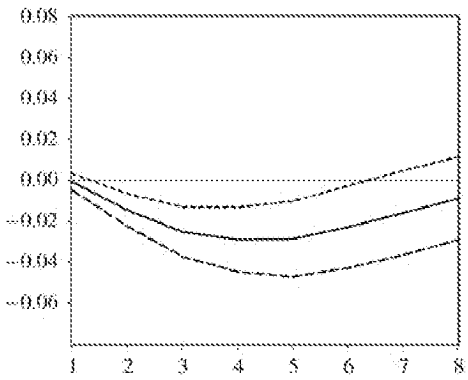

Figure 5. RFI to FHA shock (IRF—period two).

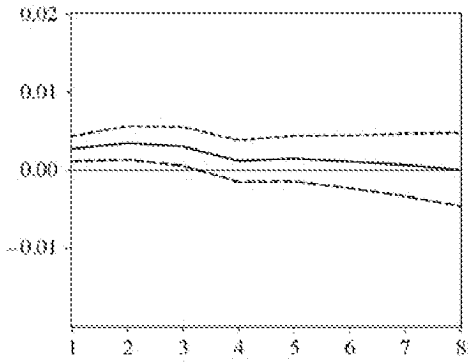

Figure 6. GDP to RFI shock (IRF, with FFR—period one).

credit rationing during regulation. During regulation, disintermediation reduced the explanatory power of FHA rates for RFI. Short-term rates carried higher predictive power, potentially because high short-term market rates could induce disintermediation and credit rationing in the housing market. Here and in other studies, short-term rate shocks explain RFI movements better than long term rates prior to deregulation. After deregulation, disintermediation and credit rationing problems diminished; short-term rate shocks have corresponding diminished predictive power. In period two, the larger issue for residential investment is long-term rate shocks.

The findings for the two interest rates give valuable information to evaluate results in other studies. Results here suggest that use of a short-term FFR and post-deregulation data may lead to conclusions that ''interest rate shocks are much less important after deregulation.'' The fuller slate of evidence here indicates that interest rate shocks remain important post-deregulation; however, now it is the long-term rate shocks that carry more information for housing sector movements.

Although interest rate impacts are the larger focus for RFI fluctuations, the FEVD results in Tables 4 and 5 contain some other evidence of interest. Tables 4 and 5 results show that a shock to real GDP explains only about five percent of the innovations in RFI.[10] This result reinforces those found by Chowdhury et al. (1986), Garrison (1991) and Green (1997). For example, Garrison assesses the behavior of RFI vs. BFI. The study finds that RFI shows stronger responses to interest rate movements and a modest response to real

Table 6. FEVD: real GDP with FFR.

	Period One				Period Two			
Horizon (Quarters)	M2	FFR	RFI	GDP	M2	FFR	RFI	GDP
2	1	1	7	92	4	5	30	62
4	4	5	4	87	24	3	25	48
6	3	28	3	66	48	2	16	34
8	2	49	3	46	61	2	11	26

Table 7. FEVD: real GDP with FHA rate.

	Period One				Period Two			
Horizon (Quarters)	M2	FHA	RFI	GDP	M2	FHA	RFI	GDP
2	11	1	14	74	0	4	37	60
4	37	1	9	53	1	2	50	48
6	52	8	7	34	1	2	57	39
8	56	15	6	24	2	3	63	32

income. The relatively small impact of GDP shocks upon RFI is consistent with evidence elsewhere that RFI movements typically lead changes in GDP.

Turning to real GDP behavior, another key interest is how well RFI shocks predict GDP innovations. Tables 6 and 7 show the FEVD results for real GDP. Findings here support a growing importance of RFI shocks in predicting changes in overall output. This reaffirms findings in Goodwin (1986), Garrison (1991), Green (1997), McConnell et al. (1999), Coulson and Kim (2000), and Shbikat (2001). As Tables 6 and 7 results show, RFI shocks account for a much larger amount of GDP variability after deregulation. For example, Table 7 shows that, prior to deregulation, RFI shocks account for 15 percent or less of the forecast error variance in GDP. After deregulation, an RFI shock explains a noteworthy 63 percent of GDP's forecast error variance by the eighth quarter (Figure 7). This conclusion of strong post-deregulation RFI impacts holds across both the short-term rate and FHA rate specifications.[11] The high explanatory power of an RFI shock for GDP is similar to that found in Coulson and Kim (2000) and Shbikat (2001), where RFI is seen as a strong and rapid indicator of U.S. business cycle movements. Impulse response functions support the increased importance of RFI for predicting GDP movements in the post-deregulation era. Figures 8 and 9 show the IRFs for RFI shocks and GDP responses (using FHA rate). Residential investment's minimal predictive power in period one is evident in Figure 8.[12]

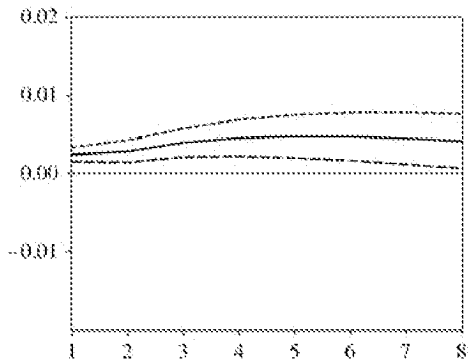

Figure 7. GDP to RFI shock (IRF, with FFR—period two).

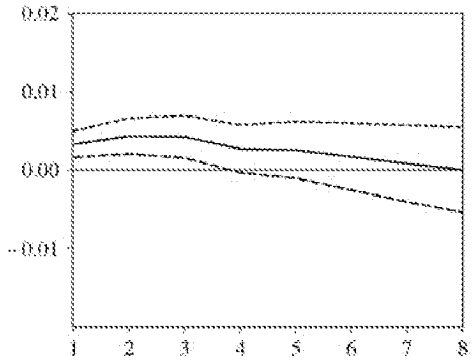

Figure 8. GDP to RFI shock (IRF, with FHA—period one).

Period two impacts are stronger and grow over most of the eight quarter horizon. Thus, results indicate that RFI shocks have become a better predictor of business cycle movements since deregulation. RFI's strong results are particularly notable when considering that RFI comprises only five percent of GDP.

Addressing interest rates and the overall economy, the FEVD results in Table 6 indicate a decline after deregulation in the predictive power of the FFR shocks for GDP variability, especially at longer time horizons. IRF results for FFR shocks (Figures 10 and 11) are consistent with reduced predictive power of FFR shocks for GDP innovations after deregulation. Results for FHA rates and real GDP variability are shown in Table 7 and Figures 12 and 13. FHA rates do not show the notable changes in predictive power found for FFR shocks. For overall GDP, RFI has stronger predictive power than the FHA rate shocks. The post-deregulation increase in the FHA rate predictive power for RFI has been noted previously. Results here could reflect monetary actions operating via new mechanisms in the post-deregulation era: FHA rate shocks have stronger impacts on

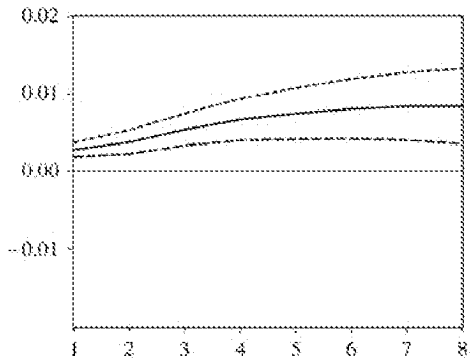

Figure 9. GDP to RFI shock (IRF, with FHA—period two).

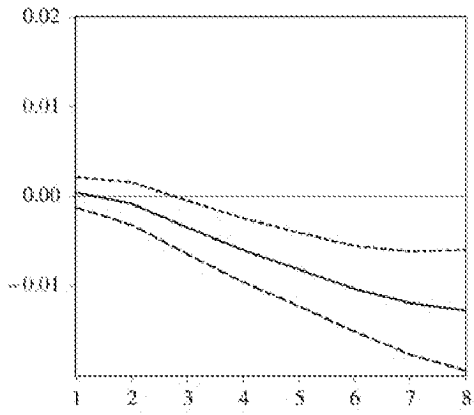

Figure 10. GDP to FFR shock (IRF—period one).

RFI movements, which themselves have stronger predictive power for real GDP innovations.

The focus here is on RFI relationships with interest rates and GDP, rather than on M. Sims (1980) notes that monetary aggregate results may be sensitive to variable orderings. As FEVD results here indicate, conclusions for M2 shocks vary across periods and specifications. In Table 7 (FHA rate specification), M2 shock values for GDP variability fall after deregulation. This pattern does not occur in Table 6 (FFR specification).[13] Although procedures here do not provide a direct test, one possible explanation is that M2 may be capturing some credit availability effects. In the pre-deregulation period, FHA rates did not adjust quickly to allocate credit. As a result, credit availability was an important issue that may be captured by M2 shocks during this era. In period two,

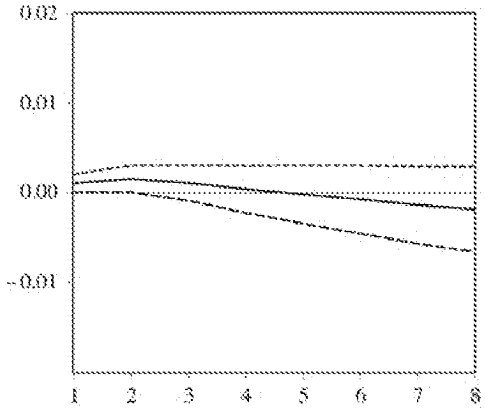

Figure 11. GDP to FFR shock (IRF—period two).

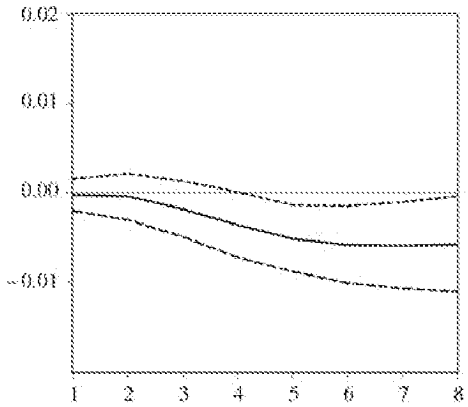

Figure 12. GDP to FHA shock (IRF—period one).

deregulation notably reduced disintermediation and credit rationing issues. Further, FHA rates better reflected market forces. To the extent that M2 shocks captured credit availability in period one, it became less important after deregulation. This may account for the post-deregulation decline in Table 7 for M2 shocks and GDP variability.

The monetary aggregate results can be useful in interpreting patterns in existing studies. Results here indicate that, for studies of GDP movements, use of a longer-term interest rate such as the FHA rate may correspond to findings of reduced impacts from monetary aggregate shocks, especially for studies using post-deregulation era data. The next section summarizes conclusions from this study.

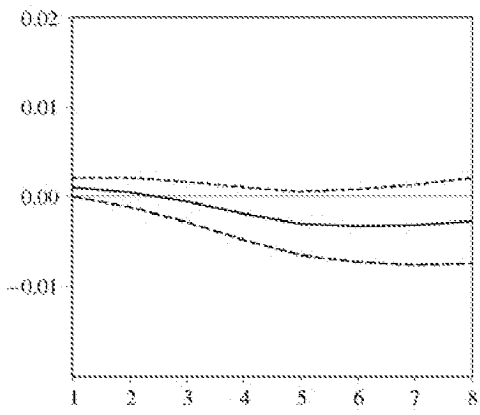

Figure 13. GDP to FHA shock (IRF—period two).

5. Conclusions

Residential fixed investment plays a potentially key role in the overall economy. Improved understanding of this sector may produce wide benefits. Prior to 1980, regulation of depository institutions particularly impacted S&L institutions and the residential housing market. In 1980, major changes occurred in the regulation of depository institutions. This potentially has altered macro-monetary relationships in the housing market and through the broader economy. This study empirically examines whether deregulation altered key relationships between RFI and macroeconomic variables. Using a VECM, the relationships between RFI, money supply, interest rates, and GDP are evaluated in pre-deregulation and post-deregulation sub-periods.

This study finds that, after deregulation, notable changes did occur for RFI and key macroeconomic relationships. Prior to deregulation, short-term interest rate shocks explain much of the variability of RFI. After deregulation, long-term FHA interest rate shocks are a stronger predictor of RFI variability. Results here are consistent with studies such as Kahn (1989), Pozdena (1990), and Daniell (1991), which find that short-term interest rates played a larger role in the housing market prior to deregulation. Prior to deregulation, short-term rate movements could trigger disintermediation, with strong consequences in the housing sector. In this period, FHA rates did not fluctuate to capture credit market conditions, and carry minimal predictive power in the period one results here. After deregulation, long-term FHA rate movements better capture credit market conditions, and show improved information content for RFI fluctuations. This is not to suggest that monetary policy has lost potency, merely that it may operate more strongly via long-term interest rate impacts now that the era of disintermediation is past.

Results here can be useful in interpreting patterns in existing studies. Results reported here for the two interest rates suggest that use of a short-term FFR and post-deregulation data may lead to conclusions that ''interest rate shocks are much less important after deregulation.'' The fuller slate of evidence here shows that interest rate shocks remain important post-deregulation. However, now long-term rate shocks carry more information for housing sector movements.

Findings here also give evidence on the role of residential investment shocks and real GDP movements. Results indicate that, in the post-deregulation period, RFI shocks hold increased predictive power for movements in the overall economy. As Green (1997) and Coulson and Kim (2000) note, although RFI is a small component of aggregate demand, it is closely linked to interest rates and aggregate output. It appears that RFI movements play an increasingly important role in predicting business cycle movements for the overall economy. Results here indicate that the housing market warrants increasing attention from policy makers and others interested in aggregate economic performance.

Acknowledgments

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Notes

1. Among the various provisions of DIDMCA, in the early 1980s, interest rate ceilings on deposits at banks and thrifts were phased out. The Act also authorized nationwide offering of interest-bearing transactions accounts. In 1981, the Federal Home Loan Bank Board established adjustable federally insured FHA mortgage loans. In 1982, the Garn–St Germain Depository Institutions Act authorized money market deposit accounts with unregulated deposit rates. The law also extended the set of financial institutions reporting to the Federal Reserve.
2. Pozdena (1990) uses a rate spread, but the more common treatment in the literature is use of a single short- or long-term rate in the model. A priority was placed on maintaining comparability of results with existing studies. For reference, a five variable model was estimated, using both interest rates; patterns of results for the major variables of interest are robust with those discussed below. These results are footnoted where relevant.
3. Excluding the years 1979–1982 helps avoid incorporating lags from the regulated time period into the deregulation analysis and allows for behavioral time adjustments. This procedure is consistent with Pozdena (1990).
4. This is a standard finding for studies using quarterly data. Here, in tests across longer lags, calculated test statistics are substantially below critical values. For example, for a test on lags 5–8, the calculated LLR test statistic is 12.51, vs. a critical value of 83.3. LLR tests reject use of lags lengths shorter than four. (LLR test for 2 vs. 4 lags is 76.6; the critical value is 46.98.) AIC and SBC tests also support use of four lags.
5. The cointegrating coefficients for the normalized cointegrating equations are given by: [M2 -0.174551 FFR $-$ 1.70411 RFI $-$ 0.45861 GDP $+$ 3.03] and [M2 $-$ 0.469129 FHA $-$ 0.365230 RFI $-$ 1.468814 GDP $+$ 4.511434].
6. Granger Causality (GC) tests further support this ordering. Granger Causality results measure the precedence and information content of one series to another. Pairwise GC tests show that M2 and interest rates Granger cause RFI and GDP. Granger Gausuality results do not establish whether money or interest rates occur first; each helps predict changes in the other. Since impacts likely occur within the same quarter time period, this is not a surprising outcome with quarterly data. Based on these findings, monetary variables enter first; real economic activity variables enter last. Procedures here evaluate sensitivity of findings to alternate orderings. For example, in an ordering with interest rates first and money last (termed a ''real business cycle'', RBC, ordering), the results are robust for the key relationships of interest. As expected, FEVD values on M2 fall when it enters last. However, particularly given findings elsewhere of the sensitivity of monetary aggregate results, M2 shocks are not a major focus here. For interested readers, results for this alternate ordering are footnoted where relevant below.
7. Dashed lines in the IRF diagrams give 95 percent confidence bands.
8. This finding (that after deregulation, long-term FHA rate shocks account for more of RFI variability) is robust across alternative model specifications and alternative orderings. For example, in a five variable specification (with two interest rates), at the eight quarter horizon, FEVD values for the FHA interest rates are 1 percent in period one; 18 percent in period two. The stronger period two value for FHA rate shocks also persists in the RBC ordering (interest rates first and M2 last).
9. This result is evident in the five variable model (both interest rates): FEVD values for FFR are strong in period one, than fall substantially in period two. Post-deregulation, FHA rate shock values are six times the FFR values. For interested readers, in the five variable model, FEVD values at the eight quarter horizon are (values presented are pre-deregulation/post-deregulation): M2 9/8; FFR 64/3; FHA rate 1/18; RFI 12/67; GDP 14/4.
10. This finding (of modest GDP shock impacts on RFI) holds in alternative orderings that place GDP earlier and in the five variable specification.
11. This conclusion (of strong RFI shock impacts upon GDP innovations) is robust in alternative orderings, such as the RBC ordering, and the five variable specification (both interest rates). (In an RBC ordering, FEVD values at an eight quarter horizon are 17 percent pre-deregulation and 63 percent post-deregulation. In a five variable model, at eight quarters, the FEVD values for RFI shocks and GDP are 7 percent pre-deregulation; 57 percent post-deregulation.) In general, the results for the five variable model are very comparable to those for the FHA specification.

12. Figures 6 and 7 show consistent IRF patterns.
13. In general, conclusions for GDP, RFI, FFR and FHA are robust across alternative specifications. Conclusions for M2 shocks showed more sensitivity to alternate specifications. In the five variable model (with both interest rates), conclusions for M2 shock impacts and RFI innovations match those for the FHA specification (Table 5): FEVD values for M2 drop notably in period two. In the five variable model, FEVD results for GDP innovations show that, in both periods, M2 shocks have only modest impacts upon GDP variability. (For both periods, FEVD values for a M2 shock are between 1 and 3 percent.) In general, the finding of sensitivity of monetary aggregate results is not unique to this study.

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