Regulation and the Neo-Wicksellian Approach to Monetary Policy

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Abstract

Laubach and Williams (2003) employ a Kalman filter approach to jointly estimate the neutral real federal funds rate and trend output growth using an IS relationship and an output gap based inflation equation. They find a positive link between these two variables, but also much error surrounding neutral real rate estimates. We modify their approach by including variables for regulations on deposit interest rates and on wages and prices. These variables are statistically significant and notably affect estimates of two policy relevant coefficients: the sensitivity of output to the real interest rate and that of inflation to the output gap.

JEL Codes*: E50, E43, E44*

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The neo-Wicksellian approach to optimal monetary policy uses estimates of the neutral real interest rate, often in a Taylor-Rule. In a system with IS and output-gap inflation equations, Laubach and Williams (2003) use a Kalman filter approach to jointly estimate the neutral real federal funds rate and trend output growth. They find a positive link between these two variables, which Trehan and Wu (2007) show reduces the potential for policy to be misled by errors in tracking trend output. Laubach and Williams (2003) note that there is much error and uncertainty surrounding estimates of the neutral real rate, as Clark and Kozicki (2005) also find. Although their estimation assumptions allow their approach to track the impact of drawn-out structural changes on the neutral real rate, they may not control for institutional factors that may have large, but temporary effects. But addressing such factors entails complicating a Laubach-Williams specification, which runs the risk that coefficient estimates may not converge to sensible values. Hence, a tension between greater precision and the need for parsimony arises.

We modify the Laubach-Williams model in a computationally tractable way by altering their IS relationship to reflect the extra, disintermediation channel through which nominal interest rates at times made regulatory ceilings on deposits binding and find that the effective federal funds rate was higher in these episodes. We use Duca's (1996) estimates of how binding Regulation Q deposit ceilings were, which is statistically and economically significant in traditional models of residential construction (Duca, 1996) and GDP (Duca, 1998), as well as in a more modern DSGE framework (Mertens, 2006). When these ceilings were binding, monetary policy induced disintermediation which curtailed lending in an era before the mortgage-backed securities market became deep. Thus when Reg Q was binding, monetary policy had a more restrictive overall effect, which if unaccounted for, leads to omitted variable bias and parameter instability in samples spanning the deposit regulation era and the post-1982 deregulated era.

We also modify the inflation equation to include Gordon's (1977) variables for the imposition and lifting of the Nixon wage-price controls. Given the small number of business cycles in the post-Korean War era, omitting an important factor affecting prices could affect inflation coefficients. Indeed, including these variables results in a much larger estimated effect of the output gap on inflation. Furthermore, the inclusion of both price and deposit regulation variables has notable effects on key economic coefficients, which have important implications for how policy should respond to deviations of inflation and output from desired levels.

II. Estimating the Natural Rate and Key Parameters

As in Laubach and Williams (2003), we use the Kalman filter to estimate neutral real rate (r^*) and reduced-form IS equations with an output-gap model of inflation:

$$\tilde{y}_t = a_{y1}\tilde{y}_{t-1} + a_{y2}\tilde{y}_{t-2} + \frac{a_r}{2}\sum_{i=1}^{2}(r_{t-i} - r^*_{t-i}) + \varepsilon_{1t} \qquad \text{(IS)} \qquad (1)$$

$$\pi_t = \sum_{i=1}^{8} b_{\pi i}\pi_{t-i} + b_y\tilde{y}_{t-1} + b_i(\pi^i_t - \pi_t) + b_o(\pi^O_{t-1} - \pi_{t-1}) + \varepsilon_{2t} \qquad \text{(inflation)} \qquad (2)$$

$$r^*_t = cg_t + z_t \qquad \text{(neutral real rate)} \qquad (3)$$

$$y^*_t = y^*_{t-1} + g_{t-1} + \varepsilon_{4t} \qquad \text{(potential output)} \qquad (4)$$

where r is the ex ante real federal funds rate, g is the trend growth rate of potential output, z contains other determinants of r^*(e.g., rate of time preference), y (y^*) is the log of (potential) real GDP, $\tilde{y}$ is the output gap (y-y^*) as a percentage, π is the quarterly core PCE inflation rate, π^i is core (non-computer) import price inflation, and π^o is crude imported oil price inflation. In constructing the ex ante real federal funds rate we follow Laubach and Williams (2003) by measuring inflation expectations with the forecast of 4-quarter-ahead inflation generated from a univariate AR(3) of inflation estimated over the prior 40 quarters. Also, as in Laubach and Williams, we assume that the neutral real rate and potential output are random walks with drift:

$$z_t = z_{t-1} + \varepsilon_{3t} \qquad \text{(neutral rate innovations)} \qquad (5)$$

$$g_t = g_{t-1} + \varepsilon_{5t} \qquad \text{(potential output innovations)} \qquad (6)$$

To this baseline model, we add Duca's (1996) Regulation Q variable (*RegQ*) to the IS relation (1) and wage-price control dummies to eq. (2):

$$\tilde{y}_t = a_{y1}\tilde{y}_{t-1} + a_{y2}\tilde{y}_{t-2} + \frac{a_r}{2}\sum_{i=1}^{2}(r_{t-i} - r^*_{t-i}) + \frac{\gamma}{2}(RegQ_{t-1} + RegQ_{t-2}) + \varepsilon_{1t} \qquad (7)$$

$$\pi_t = \sum_{i=1}^{8} b_{\pi i}\pi_{t-i} + b_y\tilde{y}_{t-1} + b_i(\pi^i_t - \pi_t) + b_o(\pi^O_{t-1} - \pi_{t-1})$$

$$+ b_{NIXON}NIXON + B_{NIXOFF}NIXOFF + \varepsilon_{2t} \qquad (8)$$

where *NIXON* and *NIXOFF* are Gordon's (1977) 0-1 variables for the imposition (*NIXON* = 1 over 1971:Q3-1972:Q3; 0 otherwise) and lifting of the Nixon wage-price controls (*NIXOFF* = 1 in 1974:Q2-75:Q1; 0 otherwise) for models of contemporaneous inflation.[1] *RegQ* equals the extent to which a market interest rate exceeded a deposit rate ceiling, and entails selecting which deposit rate to use and addressing market interest rate-based deposits introduced before most deposit rate ceilings were lifted in 1983. *RegQ* is based on regulations on small time deposits, because their long maturity enabled them to fund mortgages and other loans. In particular, *RegQ* equals the maximum of zero and the gap between the 3-year Treasury yield and the ceiling on 3-year small time deposit rates until 1978:Q2. From 1978:Q3-82:Q2, rate ceilings on small saver certificates (SSCs) are used because these semi-deregulated, small-sized deposits offered higher interest rates than did small time deposits [Mahoney, et al. (1987) and Duca (1996,1998)]. *RegQ* equals 0 after 1982:Q2, when all deposit interest rate ceilings were lifted (see Figure 1).[2]

[1] Wages and prices were initially frozen for 90 days in 1971, followed by three other phases that limited wage and price increases (Council of Economic Advisors, 1972, 1973, and 1974) before controls ended in 1974:Q2.
[2] After 1979:Q3, *RegQ* equals any legislated spread between market and SSC rates (up to 50 basis points); the maximum of 0 and the 2 – ½ year Treasury yield minus any cap on SSC rates; or 0 since April 1982, when rate ceilings on SSCs were lifted. Dummies for the effects of credit controls of 1980 were insignificant in models not shown.

Table 1 reports estimates with and without the regulation variables using a sample of 1962:Q1-2006:Q2. *RegQ* is statistically significant with the expected negative sign. And, in its presence, the size of the real interest rate coefficient is smaller (-0.0662 in the baseline LW model vs. -0.0526 in the regulation model), without reducing its statistical significance, reflecting a smaller standard error on the interest rate coefficient. These results are consistent with the view that omitting a Regulation Q variable will lead to over-estimates of the impact of real rate interest rates in the post-Regulation Q era and less precisely estimated coefficients.

The wage-price control variables are also statistically significant, with the imposition and lifting of the controls having the expected negative and positive effects, respectively. Moreover, their inclusion raises the sensitivity of inflation to the output gap by 53% (0.0670 in the baseline LW model vs. 0.1024 in the regulation model). A plausible interpretation is that excluding these variables leads to an omitted variable bias that will give a misleading under-prediction of how the output gap affects price pressures because the wage-price controls effectively prevented inflationary pressures from lagged inflation and the output gap from normally affecting inflation in the early 1970s. Reflecting the significance of both regulatory variables, differences in log-likelihood statistics imply that the regulatory model has a statistically significant better fit than the baseline model. For completeness, other models with only one regulatory variable are also shown.

In each of the baseline and regulation models (models 1 and 4, respectively), the one-sided estimates of the neutral real interest rate are more variable than two-sided estimates (see Figure 2), underscoring the real-time difficulties that Laubach and Williams note in estimating the neutral real rate. Nevertheless, estimates of the neutral real interest rate from the regulation model are higher than those from the baseline model before Regulation Q ended.

III. Implications for Monetary Policy

The monetary policy implications of the baseline and regulatory models can be assessed by reviewing how the effective federal funds rate could differ between the models and how the coefficient and neutral real interest rate estimates can lead to differences in policy prescriptions under a Taylor Rule.

Although post-1982 estimates of the neutral real interest rate are similar in the baseline and regulation models (models 1 and 4, respectively, see Figure 2), the models have different implications for gauging monetary policy. The effective federal funds rate in the regulation model equals the real (notional) federal funds rate plus the estimated impact of Regulation Q, where the latter equals the Regulation Q coefficient multiplied by the actual values of *Reg Q*:

$$r_t^e = r_t + \frac{\gamma}{a_r} RegQ_t \ . \tag{9}$$

This effective funds rate is well above the actual federal funds rate when Regulation Q was binding (*Figure 1*), implying that the overall effect of monetary policy was greater owing to disintermediation effects, but that these differences essentially vanish in the post-Reg Q era.

Nevertheless, the coefficient estimates still have different implications for monetary policy as conducted under a Taylor Rule. To illustrate this, we append to each model the following Taylor Rule and trace out the implied impacts of output gap, inflation, and federal funds rate shocks on output, inflation, and monetary policy:

$$r_t = r_t^* + g_\pi(\pi_{t-1} - \pi^*) + g_y \tilde{y}_{t-1} + \varepsilon_{rt} \tag{10}$$

where the coefficients on the inflation and output gaps are both 0.5 as in Taylor (1993).

The impact of shocks can substantially differ across the models. For example, the impact of a one-standard deviation shock to monetary policy (about a 75 basis points rise in the real federal funds rate) on the output gap (*upper-right panel, Figure 3*) is smaller in the regulatory model, which has a smaller-sized real rate sensitivity of aggregate demand than the baseline model. In fact, the peak difference occurs 5 months following a shock, with the impact being 20 percent smaller in the regulatory model (-0.0419 versus -0.0524). To a similar extent, the output gap responds less to an inflation shock (which lowers the real rate) in the regulation model. This is illustrated by the response to a one standard deviation (about 75 basis points) shock to inflation (*top middle-panel, Figure 3).* Furthermore, inflation responds much more sharply to a one-standard deviation output (excess demand) shock (about 0.30 percent) in the regulatory model, with the largest difference (61%; 0.0634 in the baseline model versus 0.1018 in the regulation model) occurring in the 24th month following an initial shock (*left middle panel Figure 3*) .

Differing output gap responses to monetary shocks and inflation responses to output shocks result in somewhat different responses of the real funds rate to output shocks. (Similar results arise for other combinations of Taylor Rule coefficients on the inflation and output gaps.) The real rate prescribed by the Taylor Rule rises similarly at first in both models, but after a few quarters, less of the initial real rate hike is undone in the regulatory model (*lower left panel, Figure 3*). The responses differ most 15 months after the initial shock, with the real rate 33% higher in the regulation model (0.0677 in the baseline and 0.0900 in the regulation model). Nevertheless, these differences should be interpreted with caution as they are not statistically significant owing to the wide error bands.

We also tried several alternative specifications for robustness. In particular, Clark and Kozicki (2005) suggest that model uncertainty can lead to notably different estimates of the neutral real rate, for instance, when using the Congressional Budget Office (CBO)'s estimates of potential real GDP instead of jointly estimating potential output in the model. Accordingly, we estimated an alternative model which directly used the CBO's measure of potential real GDP instead of estimating it with a Kalman filter, and adjusted the Kalman filter estimation of the model to reflect fewer latent and more observable variables (details are available upon request from the authors). It is reassuring that the results are qualitatively similar in models 5-8.

IV. Conclusion

This paper extends the model of Laubach and Williams to include statistically significant regulatory variables and illustrates their economic importance in gauging the stance and conduct of monetary policy. Although we find estimates of the real neutral interest rate are similar in regulation and baseline models, there are large differences in the implied effective real federal funds rate in the Regulation Q era and large differences in key coefficient estimates. Our results are consistent with the findings of Dynan, Elmendorff, and Sichel (2006) that financial deregulation and innovation have notably altered the time series behavior of GDP. In a somewhat broader sense, not controlling for important regulations can result in omitted variable bias that misleads analysts into not only over-predicting the impact of real interest rates on output and the output gap, but also under-predicting the impact of the output gap on inflation.

Furthermore, when coupled with a Taylor Rule, our results imply that monetary policy may have a greater need to react to a given sized output gap shock if inflation is to be kept under control. In addition, because monetary policy has a somewhat smaller effect on aggregate demand when controlling for statistically significant regulations, our findings imply that the target federal funds rate prescription under a Taylor Rule would react somewhat more than would be indicated by a model omitting regulatory variables.

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Table 1: Parameter Estimates for Various Natural Rate of Interest Models

	Jointly Estimated Natural Real Rate and Potential Output				*Estimated Natural Real Rate Using CBO Potential Output*			
Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
$\Sigma\ a_y$	0.9507^{**}	0.9463^{**}	0.9621^{**}	0.9612^{**}	0.9362^{**}	0.9319^{**}	0.9408^{**}	0.9404^{**}
	(50.28)	(40.87)	(64.73)	(68.81)	(35.93)	(34.77)	(36.19)	(35.49)
a_r	-0.0662^{**}	-0.0854^{**}	-0.0550^{**}	-0.0526^{**}	-0.1158^{**}	-0.0995^{**}	-0.1037^{**}	-0.0958^{**}
(real rate)	(-3.45)	(-3.59)	(-3.61)	(-3.49)	(-5.82)	(-4.88)	(-5.23)	(-4.65)
b_y	0.0670^{*}	0.0987^{**}	0.0600^{*}	0.1024^{**}	0.1032^{**}	0.1172^{**}	0.0865^{**}	0.1170^{**}
(output gap)	(2.48)	(2.99)	(2.26)	(3.06)	(4.81)	(5.05)	(4.20)	(5.10)
c	1.0277^{*}	1.1322^{**}	1.4299^{**}	1.4084^{**}	0.9824^{*}	1.3534^{**}	1.1225^{**}	1.2277^{*}
(trend growth)	(2.36)	(2.68)	(2.70)	(2.84)	(2.61)	(3.04)	(2.62)	(2.59)
ReqQ			-0.2400^{**}	-0.2005^{*}			-0.2701^{*}	-0.2681^{*}
			(-2.70)	(-2.41)			(-2.27)	(-2.12)
NIXON		-1.1458^{**}		-1.0190^{**}		-1.1480^{**}		-1.2310^{**}
		(-3.50)		(-3.14)		(-3.67)		(-3.98)
NIXOFF		1.5003^{**}		1.5896^{**}		1.4630^{**}		1.7929^{**}
		(4.02)		(4.26)		(3.84)		(4.64)
$\sigma_1(y)$	0.3400	0.4728	0.2957	0.3059	0.7272	0.7308	0.7129	0.7160
$\sigma_2(\pi)$	0.7911	0.7546	0.7961	0.7522	0.7947	0.7561	0.7828	0.7526
$\sigma_3(z)$	0.2222	0.2396	0.2327	0.2217	0.2720	0.3182	0.2977	0.3235
$\sigma_4(y^*)$	0.6182	0.5353	0.6285	0.6200	0.0887	0.0887	0.0886	0.0866
$\sigma_5(g)$	0.0893	0.0773	0.0908	0.0895	0.0128	0.0128	0.0128	0.0128
$\sigma(r^*)$	0.2404	0.2551	0.2665	0.2550	0.2723	0.3187	0.2980	0.3238
Log likelihood	-415.5446	-408.3838	-411.2751	-403.0551	-236.6400	-228.6687	-232.7885	-224.7617
X^2*(ex. nonbaseline)*		14.3216^{**}	8.5390^{*}	24.9790^{**}		15.9426^{**}	7.7030^{*}	23.7566^{**}

Sample: 1962:Q1-2006:Q2. t-statistics are in parentheses. $^{*}(^{**})$ denotes significant at the 10% (5%) level. σ_5 is expressed at an annual rate.

Figure 1: Real Federal Funds Rate, Effective Real Federal Funds Rate, and Reg Q

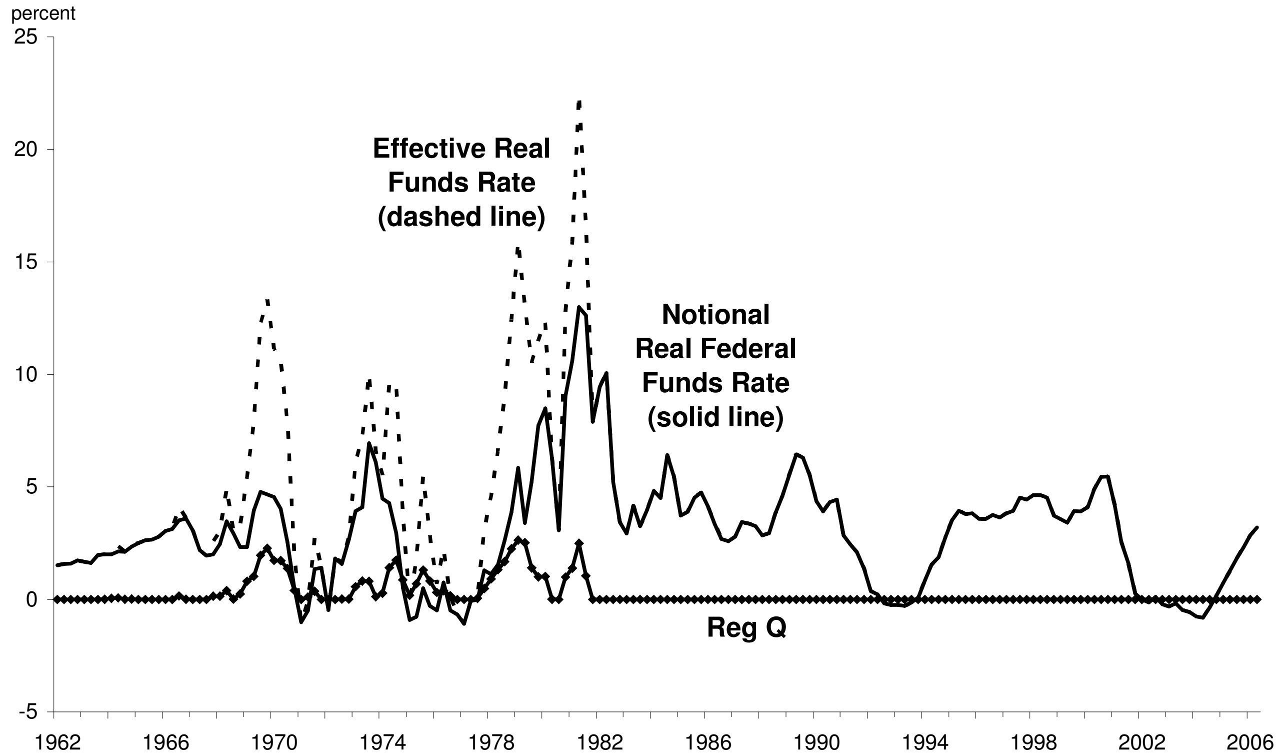

Figure 2: Estimates of Neutral Real Interest Rate

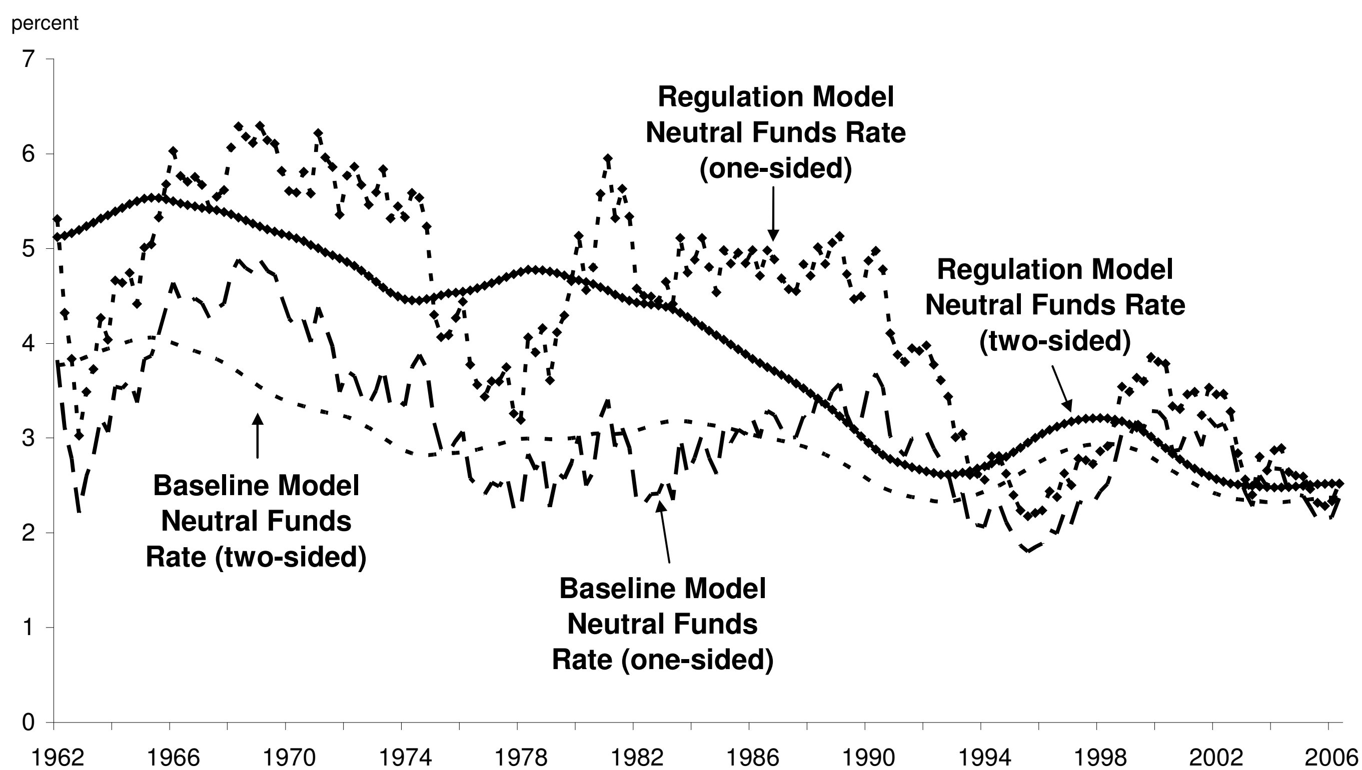

Figure 3: Impulse Responses