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The liquidity effect for open market operations

Seth J. Kopchak *

Department of Business, Organizations and Society, Franklin & Marshall College, 415 Harrisburg Ave., Lancaster, PA 17604, USA

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ABSTRACT

The liquidity effect is the negative relationship between the supply of federal funds and the overnight federal funds rate. Deviations of the federal funds rate from its target can be interpreted as demand innovations for federal funds. Permanent adjustments to demand are modeled as an unobserved component and estimated using the Kalman filter to identify liquidity effects. The demand-based approach for identifying the liquidity effect contrasts previous work which concentrates on errors forecasting the supply of federal funds. This paper finds a liquidity effect several times larger than that from previous studies, indicating the market for federal funds is less liquid than previously thought. The effect of a $1 billion increase in open market operations over a 1-week period is a decrease of the federal funds rate by about 12 basis points.

1. Introduction

The federal funds rate, the price negotiated between depository institutions (banks hereafter) for overnight loans between accounts at the Fed, serves as a primary instrument for the implementation of monetary policy and, thus, is an integral link in the transmission process of policy to the economy. In the context of the federal funds market, the liquidity effect refers to the specific relationship between the supply of federal funds and the overnight lending rate; an increase in the supply of reserve balances brings about a lower federal funds rate. The elusiveness of an accurate and non-controversial estimate for the magnitude and properties of the liquidity effect can be attributed to the difficulty isolating exogenous policy activity of the Federal Reserve from the effect of the Fed's anticipation of the expected funds rate, the market's anticipation of the Fed's future actions, or other endogenous factors.

This article identifies the relationship between the market rate for overnight loans and the quantity of funds supplied through open market operations. Demand for additional reserves is segmented into a permanent component and transitory shocks, where demand-forecast errors produce deviations of the funds rate from the target. This approach contrasts with previous studies which concentrate on forecast errors of the supply of federal funds. Estimates suggest that an increase in weekly open market purchases of one billion dollars reduces the funds rate by 12 basis points.

The Federal Reserve Bank of New York's Open Market Trading Desk (the Desk) affects the supply of federal funds as it conducts sales and purchases debt securities to achieve its mandate from the Federal Open Market Committee (FOMC). Kos (2004) reports the directive of the Desk, "... to foster conditions in the reserves market consistent with maintaining the federal funds rate at an average around a specified target rate." Each day, the Trading Desk determines the type and size of open market operations to be initiated, based on forecasts regarding the market for reserves. The transactions are executed and the funds rate and market conditions are monitored.[1] Estimates for the path of reserve balances are altered based on the behavior of the funds rate and new information. A liquidity effect implies the funds rate will increase when the Fed reduces the supply of reserves available to banks, but this relation need not always hold. For example, expectations of lower future rates might depress current demand and move the funds rate lower, in absence of a contemporaneous increase in supply. Seasonally driven reserve demand, discount window borrowing, or other factors may induce the Desk to conduct open market operations which relate to the observed funds rate differently than implied by a strict liquidity-effect analysis. Furthermore, some portion of each open market operation offsets fluctuations in reserve levels caused by changes in US Treasury balances, the impact of check float, or other

* Tel.: +1 717 358 5922; fax: +1 717 358 4568.
E-mail address: seth.kopchak@fandm.edu

[1] Feinman (1993) provides a detailed examination of the operational procedure of the Trading Desk.

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autonomous variability affecting the supply of non-borrowed reserves. The liquidity effect informs the desk's decisions regarding the timing and quantity of funds to supply through open market operations.

Banks' demand for federal funds is driven by the management of reserve balances used to meet statutory requirements and to facilitate check clearing and transfers. During the 2-week maintenance period, which ends on a Wednesday, banks must hold, by daily average, an FOMC-determined fraction of their total demand-deposit account holdings as reserves. These reserves include deposits in accounts at the Fed (federal funds) and currency in the bank's vaults. Since 1998, the reserve requirement must be met against demand-deposit balances held over a computation period two maintenance periods earlier. While bank managers know the average-reserve-balance requirement during each maintenance period, uncertainty remains regarding realized current-period transfers, deposits, and withdrawals. Additionally, banks may autonomously choose to hold excess reserves against the possibility of overdrafts or, for any other purpose. Borrowing and spending behavior of the institutions' customers, borrowing from the Fed's discount window, transfers into US Treasury accounts and, thus, out of the pool of tradable federal funds, all affect the overall quantity of reserves available and thus the demand for additional funds supplied by the Fed. Therefore, the regulatory requirement determines only a portion of a bank's maintenance-period demand for additional federal funds.

Hamilton (1997) delivers an important innovation to the approach for estimating the liquidity effect. He proposes the Trading Desk's forecast miss of US Treasury account balances serve as an instrument for exogenous changes in the supply of reserves, and estimates the daily liquidity effect. Following the treatment of Gilchrist (2001), discussing (Thornton, 2001), system (1b) summarizes the high frequency liquidity effect models focusing on the supply and demand of *total* reserves (TR),

$$TR_t^d = \beta ffr_t + v_t^d, \tag{1a}$$
$$TR_t^s = B_t + v_t^s, \tag{1b}$$

where the supply of total reserves is adjusted by the Desk, with the objective to supply B_t^*, the level of reserves which achieves the target rate

$$B_t = B_t^* + \omega_t, \tag{2}$$
$$B_t^* = \beta ffr_t^*. \tag{3}$$

Here, v_t^s, v_t^d, and ω_t are i.i.d. and ω_t equals the control error for the desired level of reserves. The model reduces to:

$$ffr_t = ffr_t^* + \frac{1}{\beta}(v_t^s - v_t^d + \omega_t), \tag{4}$$

obtaining a result analogous to the solution of this paper's model developed below. Hamilton (1997) estimates supply forecast misses which serve as an instrument for v_t^s and estimates the liquidity effect of total reserves, $1/\beta$. Carpenter and Demiralp (2006) use a more comprehensive and accurate measure of the same forecast miss, and find an estimable liquidity effect, but one that according to Carpenter and Demiralp (2008), implies, "the change in balances necessary for even a 25-basis point change in funds rate would lead to implausibly large open market operations."

Thornton (2001) disputes the effectiveness of Hamilton's approach, citing sensitivity of results to a small subset of days with large spikes in the funds rate. Thornton (2006) reassesses the contribution of Carpenter and Demiralp (2006), and finds a very small, but statistically significant liquidity effect, with little practical economic significance. Thornton (2007), noting that the Fed cannot judge perfectly the magnitude of autonomous factors affecting reserve supply such as currency, float, and the Treasury balance, investigates an operating policy rule for open market operations for a liquidity effect, with particular attention paid to the conduct of operations at the time of target changes. Not finding convincing evidence, he proposes an explanation: market forces may drive interest rates higher or lower, relieving the Fed of the requirement to conduct sizable open market operations to affect changes in the market rate. This paper seeks to bridge the gap between the previous work on the liquidity effect by incorporating the suggestion that the structure of those market forces, modeled as persistent increases in demand for funds, can be used to identify the liquidity effect.

Thornton (2004) proposes that because of what he calls policy endogeneity, the liquidity effect can only be identified if, in response to a shock in the real interest rate, policymakers adjust the nominal interest rate by an amount greater than is needed to keep the rate unchanged. This would only be the case if they did so precisely, since deviations from the nominal target rate provide information about the market demand for reserves and thus the amount by which the Fed's open market operations are failing to placate demand at the target rate. It is this observation which is utilized to identify the liquidity effect.

Specifically, as the Desk conducts an open market purchase, the counterparties' accounts are credited by the Trading Desk, and thus, non-borrowed reserves are increased. This instantaneous augmentation of non-borrowed reserves occurs *without* measurement error. While part (perhaps the majority) of any open market operation is made to offset or sanitize idiosyncratic fluctuations in reserves resulting from factors such as float, currency demand, or Treasury balance adjustments, these factors reside outside of the Fed's influence, and manifest as innovations of demand for additional funds supplied by open market operations. Since the Desk supplies additional reserves inelastically to achieve the target rate, there is no distinction between a (positive) demand forecast error and a supply forecast error resulting in insufficient funds to achieve the target rate.

Hamilton (1997) addresses the possibility that the liquidity effect estimated using an instrument for the supply of reserves may be, in part, incorporating the influence in the demand-for-reserves function. At the daily level, (Klee, 2010) shows that aggregate uncertainty, proxied by operational problems with the balance transfer mechanism, may lead bank managers to seek additional funds in the market. While (Judson and Klee, 2010) include a model specification incorporating banks' uncertainty with respect to end-of-day balances, (Carpenter and Demiralp, 2006; Judson and Klee, 2010 and Hamilton, 1997) control for the banks' demand for federal funds through use of dummy variables related to days within the maintenance period or the calendar.

There is an important distinction to be made between estimation procedures utilizing supply-forecast miss, the method related to Hamilton (1997), (utilizing v_s as in Eq. (4)) and the present study. The demand-shock framework developed here addresses the possibility of demand misspecification by estimating the relationship between the observable quantity of additional funds supplied by open market operations and unobserved innovations in demand. Figs. 1 and 2 summarize the implications of the demand-shock framework. As shown in the timeline of Fig. 1, in each period, the desk determines the size of the open market operation. A demand shock δ is realized, and then the market funds rate is

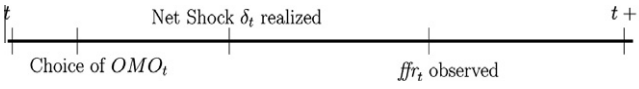

Fig. 1. Timeline of information arrival in funds market. This diagram shows the timing of observation for the variables of interest.