



The Federal Reserve's balance sheet and overnight interest rates: Empirical modeling of exit strategies



Jaime Marquez^a, Ari Morse^b, Bernd Schlusche^{a,*}

^a Board of Governors of the Federal Reserve System, 20th Street and Constitution Avenue, NW, Mailstop 85, Washington, DC 20551, United States

^b Carnegie Mellon University, Tepper School of Business, United States

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ABSTRACT

This paper provides a comprehensive study of the interplay between the Federal Reserve's balance sheet and overnight interest rates. We model both the supply of and the demand for excess reserves. Treating outright securities holdings of the Federal Reserve as a policy tool, we estimate the effects of unconventional monetary policy on overnight funding rates. Further, we offer the first empirical assessment of the FOMC's principles of the exit strategy. Assuming a path for removing monetary policy accommodation that is consistent with the FOMC's exit principles, we project that the federal funds rate increases to 70 basis points by 2016, settling in a corridor bracketed by the discount rate and the interest rate on excess reserves, as excess reserves of depository institutions decline to near zero.

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1. Introduction

In response to the financial crisis of 2008, the Federal Reserve adopted a variety of unconventional monetary policy measures, which are discussed, for example, in Clouse et al. (2003), Bernanke and Reinhart (2004), and Bernanke et al. (2004). The use of these measures led to an unprecedented change in the size and composition of the Federal Reserve's balance sheet that affected short-term interest rates (see Carpenter et al., 2012 for a discussion of the effect of unconventional monetary policies on the Federal Reserve's balance sheet). Initially, the Federal Reserve implemented various liquidity and credit facilities to promote the functioning of financial markets. The associated increase on the asset side of the Federal Reserve's balance sheet was matched by a comparable increase in reserve balances of depository institutions (DIs) on the liability side of the balance sheet.¹ As the crisis went on and various liquidity facilities wound down, the Federal Reserve began its large-scale asset purchases, which led to an even sharper increase in re-

serve balances of DIs. Over this period, short-term interest rates declined in line with cuts in policy rates by the Federal Reserve (Fig. 1). As these reserve balances began to increase, rates experienced even more downward pressure. Indeed, the federal funds rate and other short-term interest rates reached their zero lower bound and have remained there since.²

In the June 2011 minutes of the Federal Open Market Committee (FOMC), the Federal Reserve articulated the *principles* that will guide its strategy to exit the accommodative stance of monetary policy that has been in place since 2008 (see FOMC, 2011b). The effectiveness of these *principles*, however, is not known because they have not been assessed empirically, leaving important practical questions unanswered. How large should the asset sales of the Federal Reserve be to normalize the functioning of the federal fund market? What is the adjustment profile of overnight rates to these sales? Going forward, how important are the discount rate and the interest rate on excess reserves (IOER rate) in a corridor system for implementing monetary policy?

* Corresponding author. Tel.: +1 202 452 2591; fax: +1 202 452 2301.

E-mail address: bernd.schlusche@frb.gov (B. Schlusche).

¹ Note that the Supplemental Financing Account (SFA), established by the US Treasury in September 2008, somewhat offset the increase in reserve balances.

² See, e.g., Afonso et al. (2011), Bech and Klee (2012), and Gorton and Metrick (2012) for details on the functioning of overnight funding markets during the financial crisis.

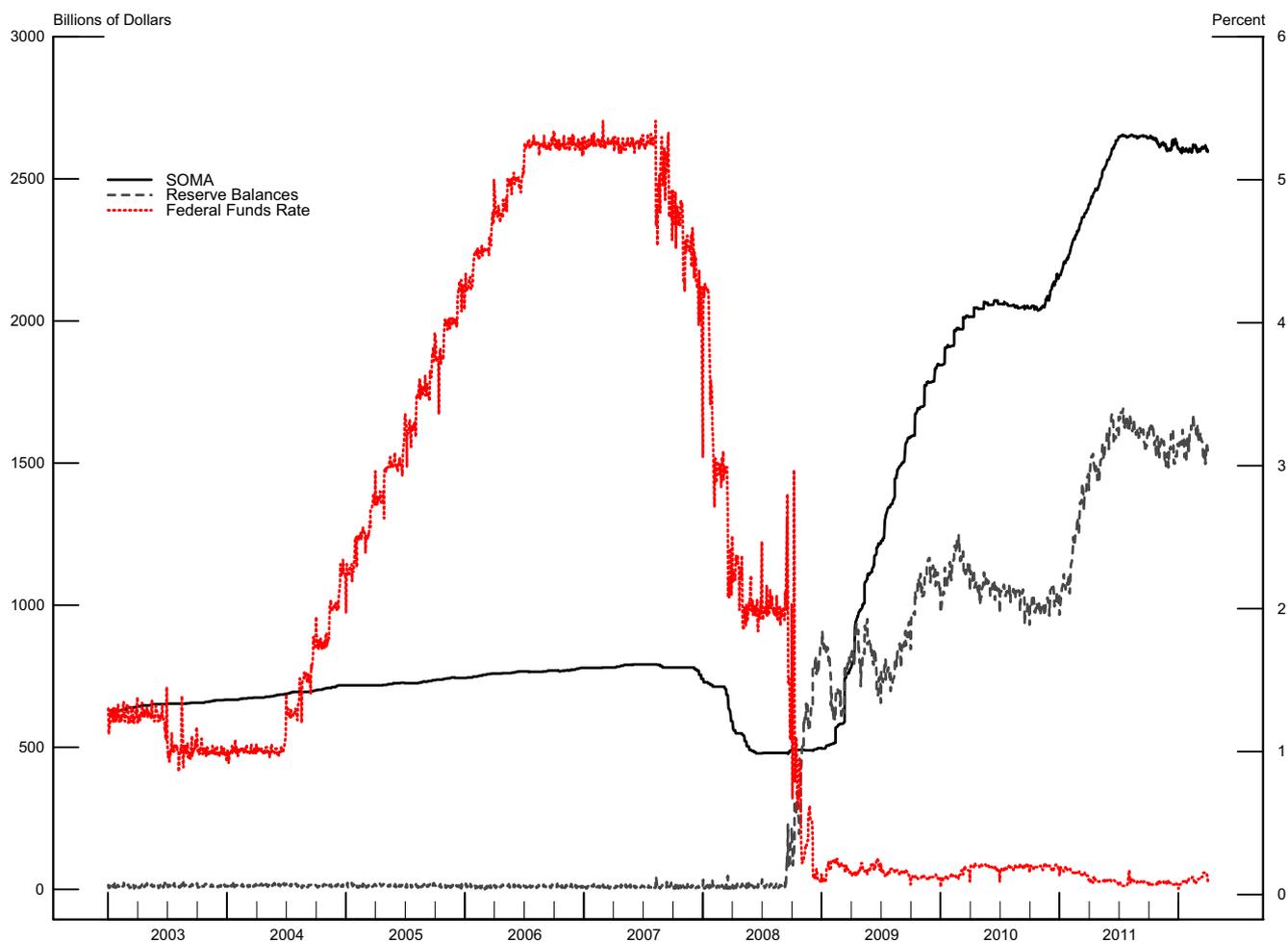


Fig. 1. Federal funds rate, reserve balances of depository institutions, and securities held by the Federal Reserve.

The purpose of this paper is to model the interplay between the Federal Reserve's balance sheet and overnight interest rates, while allowing for interdependencies among these rates. This framework is used to assess the removal of the monetary policy accommodation currently in place. Our exit strategy simulations are based on the *exit principles* specified in the June 2011 minutes of the Federal Open Market Committee (FOMC), FOMC (2011b).

Our framework differentiates the demand for reserves from the supply of reserves. To model the supply of reserve balances, we treat the Federal Reserve's securities holdings and several other assets as policy variables and endogenize reserve balances held by DIs. Specifically, we model required reserve balances as a function of reservable deposits held at banks.³ Moreover, we assume that a change in required reserves is matched by the Federal Reserve with a change in repurchase agreements of equal size. Excess reserves respond to ensure that total assets of the Federal Reserve equal total liabilities plus capital. To model the demand for reserve balances, we use as a non-linear, simultaneous system of equations determining the federal funds rate, the Treasury general collateral (GC) repo rate, and the Eurodollar rate.

An empirical assessment of the FOMC's *exit principles* is challenging because they provide no information on the associated magnitudes or implementation dates of policy actions. Under cer-

tain assumptions about the path for the removal of monetary policy accommodation that is consistent with the June 2011 FOMC *exit principles*, our projections suggest that the accommodative stance of monetary policy in place since 2008 is effectively reversed and excess reserves return to a normal level by historical standards. Under our assumptions, the model predicts that the federal funds rate increases to 70 basis points by 2016, settling in the middle of the corridor bracketed by the discount rate and the IOER rate.

Our work contributes to the literature in several ways. First, this paper extends previous work on the "liquidity effect"—the response of short-term interest rates to a change in the amount of reserve balances—as studied by Hamilton (1996), Hamilton (1997), Carpenter and Demiralp (2006), Carpenter and Demiralp (2008), Judson and Klee (2010), Bech and Klee (2012), and Kopchak (2011). Specifically, previous empirical work on the liquidity effect, except for Bech and Klee (2012), quantifies the effect of monetary policy changes with no allowance for interdependencies among short-term interest rates. In contrast, we accommodate linkages among banks' various short-term funding options with the associated implications for overnight rates. Specifically, in our framework, a change in the federal funds rate simultaneously affects the repo rate and the Eurodollar rate; these changes then feed back to the federal funds rate. Second, we use the full-information maximum likelihood method for parameter estimation in order to account for the simultaneous determination of reserves and the federal funds rate. Previous work uses limited information estima-

³ Throughout the paper, we use the generic term *bank* and depository institution interchangeably when referring to institutions holding accounts at the Federal Reserve, i.e., commercial banks, credit unions, and thrift institutions.

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