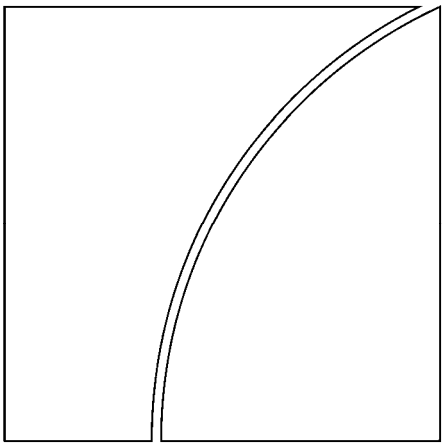
BANK FOR INTERNATIONAL SETTLEMENTS



BIS Working Papers
No 269

Monetary policy implementation: Misconceptions and their consequences

by Piti Disyatat

Monetary and Economic Department

December 2008

JEL codes: E40, E41, E51, E52, E58

Keywords: Monetary policy implementation, transmission mechanism, interest rates, money, liquidity effect, bank lending channel, sterilized intervention

BIS Working Papers are written by members of the Monetary and Economic Department of the Bank for International Settlements, and from time to time by other economists, and are published by the Bank. The views expressed in them are those of their authors and not necessarily the views of the BIS.

Copies of publications are available from:

Bank for International Settlements
Press & Communications
CH-4002 Basel, Switzerland

E-mail: publications@bis.org

Fax: +41 61 280 9100 and +41 61 280 8100

This publication is available on the BIS website (www.bis.org).

ISSN 1020-0959 (print)

ISSN 1682-7678 (online)

Abstract

Despite constituting the very heart of the monetary transmission mechanism, widespread misconceptions still exist regarding how monetary policy is implemented. This paper highlights the key misconceptions in this regard and shows how they have compromised the understanding of important aspects of the monetary transmission mechanism. In particular, the misplaced emphasis on open market operations as the means through which monetary policy is implemented can give rise to inappropriate characterizations of monetary policy, as well as to ill-defined discussions of liquidity effects, the bank lending channel, and sterilized exchange rate intervention.

JEL Classification: E40, E41, E51, E52, E58

Keywords: Monetary policy implementation, transmission mechanism, interest rates, money, liquidity effect, bank lending channel, sterilized intervention

Table of contents

Monetary policy implementation: Misconceptions and their consequences

Piti Disyatat[1]

1. Introduction

The mechanics through which monetary policy is implemented are at once fundamental to monetary economics, since they constitute the very first step of the monetary transmission mechanism, and also subject to widespread misconceptions. The cause of these misconceptions does not appear to be a lack of research on the nuts and bolts of monetary policy implementation – in fact there exists a substantial body of work in this area – but rather the presumption that the simplifications adopted in the mainstream literature on this topic have no important bearing on analyses at the macroeconomic level. This paper aims to show that this is not always the case by highlighting some key areas of the literature where an imprecise depiction of policy implementation can significantly compromise the analysis as well as the conclusions drawn.

The central misconception regarding monetary policy implementation is the proposition that monetary policy actions are effected through open market operations that alter some quantity aggregate, such as the monetary base or a reserve aggregate. Such a depiction of monetary policy implementation is prevalent in the academic literature and standard in leading macroeconomic textbooks.[2] It is, however, also distinctly at odds with how implementation is viewed by practitioners. For example, Paul Tucker, a member of the Bank of England's Monetary Policy Committee, provided the following observation on how central banks can steer interest rates: "(o)ne is to use OMOs to adjust the quantity of reserves to bring about the desired short-term interest rate, implicitly or explicitly drawing on an identified demand schedule. Neither in the past nor in the current review have we even briefly entertained the notion that this is realistic." (Tucker, 2004, p. 12)

These starkly contrasting perspectives are also reflected in the dichotomy that exists regarding how money is treated in modern analysis of monetary policy and conventional expositions of policy implementation. The former typically starts with a simple assertion that the central bank sets the short-term interest rate and analyses the implications for the economy following that decision. Money is completely demand determined and essentially irrelevant to developments in the economy. On the other hand, textbook descriptions of monetary policy implementation put the supply of money controlled by the central bank at centre stage in determining where money market interest rates lie. The interest rate targeted by central banks is achieved through exogenous variations in the supply of central bank money via open market operations.

---

[1] I would like to thank David Archer, Claudio Borio, Andrew Filardo, David Laidler, William Nelson and Christian Upper for helpful comments and discussions. All remaining errors are mine. The views expressed in this paper are those of the author and do not necessarily represent those of the Bank for International Settlements. Please address all correspondences to piti.disyatat@bis.org

[2] Ireland (2006, p. 1), for example, asserts that "(c)entral bank liabilities include both components of the monetary base: currency and bank reserves. Hence, the central bank controls the monetary base. Indeed, monetary policy actions typically begin when the central bank changes the monetary base through an open market operation, purchasing other securities – most frequently, government bonds – to increase the monetary base or selling securities to decrease the monetary base."

Such divergent treatment of money reflects a curious lack of interest in how monetary policy is implemented in practice. Despite a substantial and growing body of literature on both the theoretical and empirical modeling of monetary policy implementation and the interbank market, these micro-foundations have generally not been embedded into mainstream macroeconomic analysis of monetary policy.[3] Thus while the behavior of central banks, firms, households, and financial intermediaries have been motivated from first principles, the actual nuts and bolts of monetary policy implementation has largely been swept under the carpet. In fact, treatment of interest rate determination in the money market has changed little from the basic LM curve exposited by John Hicks in the 1930s.

The purpose of this paper is to encourage some revisions in the way monetary policy implementation is modeled and conceptualized in the mainstream academic literature. There is a clear gap between how policy practitioners perceive their actions and many academic representations of what they do. In the spirit of concern that modeling without good micro-foundations can produce erroneous policy prescriptions, it is important to emphasize some of the limitations in mainstream stylized representations of monetary policy implementation.

The fundamental point that will be stressed is that the setting of a short-term interest rate depends not on the *amount* of central bank money that is supplied but crucially on how central banks *manage the access* to this money. Central banks are able to control short-term interest rates because as a monopoly supplier of reserves that are demanded by the banking system, they can set the quantity *as well as the terms* on which they are provided. This provides the basis for the crucial role of market expectations in determining where interest rates lie and reflects the influence that central banks have over the characteristics of the demand for reserves. Standard conceptualizations of monetary policy implementation focus narrowly on central banks' control over the quantity of money whereas in practice it is the terms on which it is available that plays the primary role in influencing interest rates. Moreover, while the attainment of specific interest rate targets may have a bearing on various quantity aggregates, there is generally neither a clear nor stable link between the two.

Against this backdrop, the paper will highlight specific areas of the literature where misconceptions regarding policy implementation have their starkest impact on the appropriateness of the modeling and empirical strategies pursued, and thus on the proper understanding of monetary policy in their respective contexts, namely: i) the characterization of monetary policy; ii) the liquidity effect; iii) the bank-lending channel of monetary transmission; and iv) foreign exchange intervention and sterilization. Given the prevalence of interest rate operational targets, much of the discussion in this paper will be through this perspective. That said, since the mechanics underpinning interbank interest rate determination are broadly similar across countries, the issues highlighted are also generally pertinent to operational frameworks that do not focus on interest rate targets.

The outline of the paper is as follows. The next section describes how monetary policy is implemented in practice, highlighting in particular the mechanics of interbank interest rate determination and how this contrasts with the typical characterization in the mainstream literature. The consequences for several strands of the monetary economics literature of an insufficiently precise characterization of monetary policy implementation are set out in section three and the last section concludes.

---

[3] Recent studies on the microeconomics of interbank markets include Whitesell (2006), Bartolini and Prati (2004), and Bindseil (2004), Guthrie and Wright (2000), and Borio (1997). Tucker (2004) provides a particularly insightful exposition of monetary policy implementation based on the experience in the United Kingdom. See also Mac Gorain (2005) for a concise explanation of the thinking behind the Bank of England's operation framework.

2. The theory and practice of monetary policy implementation

It will be useful at the outset to define some terminology. Monetary policy implementation consists of three key elements. The first is the selection of a 'policy signal' to formally express the stance of policy. This is often an overnight interbank interest rate but can also be a rate at which the central bank commits to transacting with the market (such as the minimum bid rate at the ECB and the Bank of England's official Bank Rate). The second element is the choice of an 'operational target' that can be used as a gauge to ensure that the intended monetary policy stance is being attained, a short-term money market rate being the typical choice. In most cases the policy signal and the operational target are the same, such as the Fed Funds Rate in the United States, but they can also differ. For example, under the Bank of England's framework, the policy rate is the official Bank Rate which represents the overnight rate at which reserves are remunerated as well as the rate at which regular short-term repos are conducted, but the implicit operational target is to achieve a fairly flat money market yield curve close to the policy rate out to the next policy meeting.[4] The third component is the design and utilization of various 'instruments' to achieve the operational target. Key instruments include open market operations, standing facilities, reserve requirements, and the rate of remuneration on reserves.

Much of the conventional academic literature has placed a heavy, if not exclusive, emphasis on open market operations as the means through which interest rates are influenced. As a result, changes in the stance of monetary policy have been invariably associated with changes in some quantity aggregate. While policy signals, as defined above, can obviously be changed without any corresponding market operation (eg. the Federal Reserve simply announces the target Fed Funds rate), the relevant question is how desired variations in the operational target can be affected without any corresponding adjustment to quantities. This section addresses this question and in so doing, highlights some of the common misconceptions regarding the control of short-term interest rates.

2.1. Money supply and central bank operations

Much of the misunderstanding regarding monetary policy implementation can be traced to the failure to distinguish between different monetary aggregates and their relationship with the interest rate that central banks target. The latter is typically a short-term interest rate in the interbank market, which is a market for central bank *balances* (also often referred to as bank reserves). A proper understanding of monetary policy implementation requires a full appreciation of what these balances are, their function, and the source of their demand.

Central bank balances are deposits of financial institutions at the central bank that are used to achieve final settlement of all financial transactions. In countries where reserve requirements are in place, balances are comprised of required reserves balances and excess reserves balances. Each component of balances is driven by different factors.

Required reserves are generally fixed as a proportion of outstanding deposits, often with a lag so that required reserves for any given maintenance period – the period over which banks' average holdings of reserves are assessed relative to requirement – depends on the average amount of deposits in some past calculation period. As such, the level of required reserves is not directly affected by interest rates. The only way that interest rates may affect required reserves is if an increase in rates, say, results in a lower demand for deposits as economic activity slows down which, in turn, reduces the base used to calculate reserve requirements for subsequent maintenance periods. This link necessarily embodies lags

[4] See Mac Gorain (2005) for details.

which would typically be several months long. As such, required reserves balances *react* to the level of interest rates and not the other way around. Their variation plays no role whatsoever in *determining* rates.

Excess reserve balances are held primarily as a cushion to buffer against unexpected payment shocks and are typically very small. As they often earn no interest, or earn interest at a discount to market rates, they represent a cost to banks. The main determinant of their size is the degree of uncertainty regarding payment flows, institutional characteristics of the payment system, as well as the expected costs of overdrafts. Thus while market interest rates directly affect the costs associated with excess reserves, the levels that banks maintain already reflect the minimum levels that they are able to hold given the institutional setting of the payment system. As such, they do not typically vary much in response to changes in interest rates. That excess reserve balances are generally interest inelastic is reflected in the observation that even in situations where they can be easily swept into interest-bearing deposit facilities at the end of each day, as in the euro area for example, excess reserve balances are still held. For countries with no reserve requirements, such as Australia and Canada, so that all reserves are by definition excess, day-end balances are also usually positive though quite small. These excess reserves balances are held because of payment uncertainties and the associated transaction costs of trying to achieve exactly a zero excess reserve balance each day (cost of 'staying late in the office' in the terminology of the ECB).[5]

All in all, the quantity of central bank balances demanded is fundamentally highly interest inelastic and their variation over time are determined by factors such as the size of the reserve requirement, uncertainty regarding payment flows, and seasonal variations in the demand for cash. As such, *a given amount of balances can be consistent with a large range of interest rates.* This is the fundamental point that underpins a proper understanding of monetary policy implementation. Figure 1 shows the evolution of balances as well as the paths of actual and targeted interest rates for Australia, the euro area, the United Kingdom, and the United States. Clearly, balances are generally anchored around a fixed trend while interest rates can be varied across a wide range and there is no perceptible link between the two.[6]

In terms of the supply of central bank balances, a general characterization is

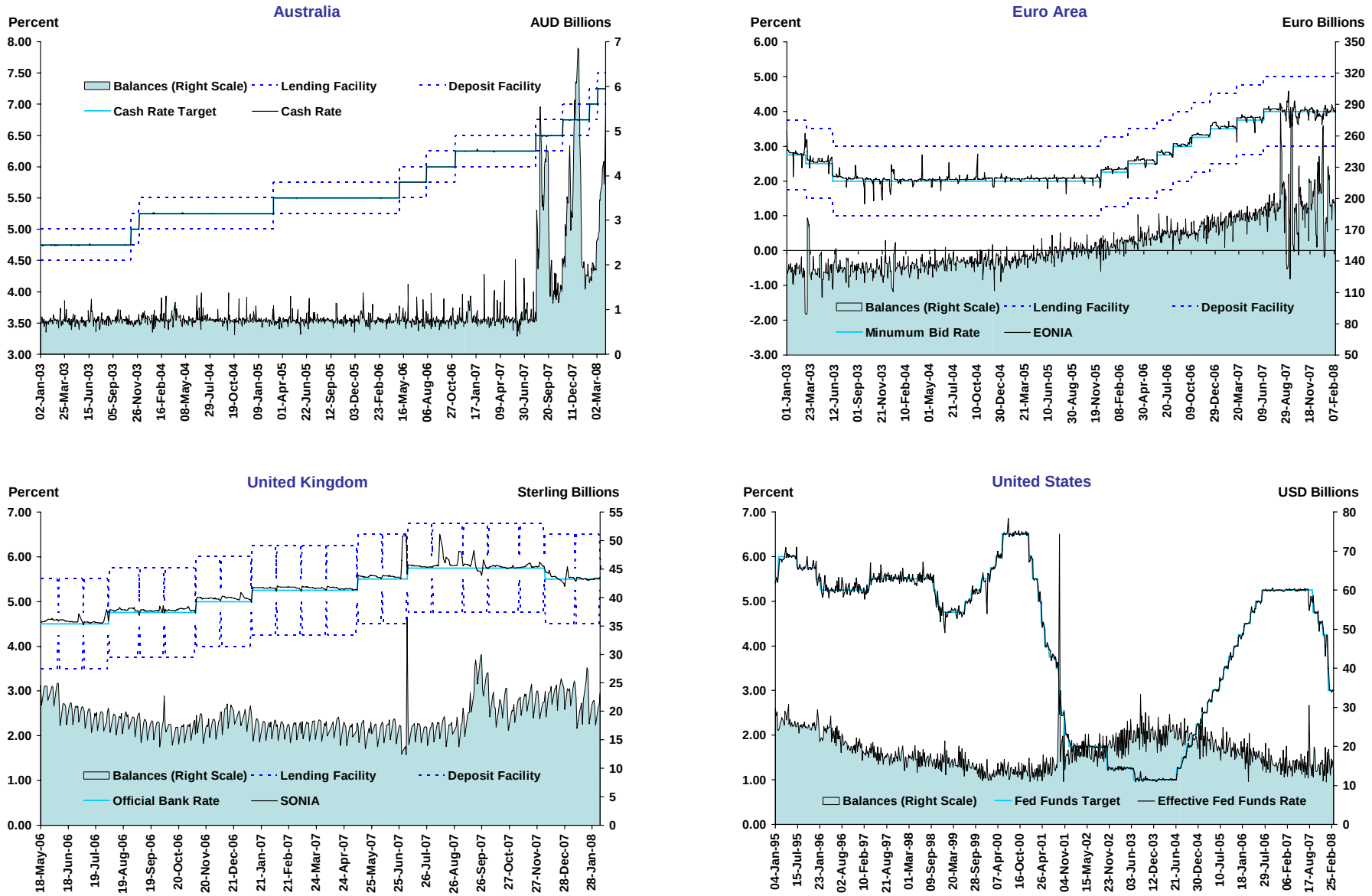
Change in Supply = Net Autonomous Factors + Net Use of Standing Facilities + Net Open Market Operations

Autonomous factors reflect transactions such as changes in the treasury balance (government deposits) or the public's demand for currency that are not controlled by the central bank but affect the supply of reserves directly. For example, as households deposit more of their cash holdings with the banking system that, in turn, deposit the cash at the central bank, the supply of reserves expands. Similarly, the use of standing facilities – end-of-day windows where banks can either deposit excess balances or borrow additional balances directly from the central bank at pre-specified rates – leads to changes in the supply of reserve at the initiative of banks. The only item conducted at the discretion of the central bank is open market operations. The key point here is that central banks are not always able to control the supply of balances perfectly. The precision of their control depends

[5] See ECB (2002, p. 46). Using euro area data, Bindseil et al. (2004) show that excess reserves does not depend on interest rates and, as such, can be treated largely as an exogenous demand factor in terms of open market operations.

[6] The erratic movements in balances in Australia and the euro area during the end of 2007 reflect exceptional money market tensions associated with the turmoil in global financial markets at the time. The oscillations in the Bank of England's standing facility rates reflect the fact that these rates are reduced to ± 25 basis points on the final day of the monthly reserve maintenance period.

Figure 1: Interest rates and central bank balances



Source: National central banks. Daily data except the US where only weekly data is available.

largely on the degree with which the autonomous factors can be anticipated by the operation desk on a daily basis.

Since the quantity of balances demanded is highly interest inelastic, the main function of open market operations is to ensure that the banking system's demand for balances are satisfied either on a day-to-day basis or, where reserve requirements with averaging provisions are in place, over the reserve maintenance period. Failure to do so would result in extreme interest rate volatility (see below). *Open market operations are not used to set interest rates.* This fact is evident in the ability of many central banks such as the Bank of England and the ECB to maintain interest rates close to target on a daily basis while conducting open market operations only once a week. In fact, before 2003 the ECB used to announce its policy decisions on a Thursday, with immediate impact on interest rates, while weekly operations were conducted on Tuesdays. Thus the ECB was able to routinely move market rates without undertaking *any* open market operation. Moreover, in certain circumstances market rates can move even before the announcement of a policy change. This so called 'anticipation effect' has been documented by Carpenter and Demiralp (2006a) in the case of the United States.[7] Thus not only can interest rates move towards the new target without the central bank needing to undertake any operations, but they can move even without a policy announcement!

So how do central banks in practice exercise a close influence over interest rates? This section has argued that the *quantity* of balances demanded depends largely on exogenous factors that are typically not dependent on the stance of policy. The determination of interest rates, then, must be understood in terms of factors that influence the *price* at which banks are wiling to pay for a given amount of balances. This is the subject of the next section.

2.2. The control of short-term interest rates

To be sure, the supply of balances certainly *can* affect the level of interest rates. For on any given day, if banks find themselves short of balances needed to clear payments or satisfy reserve requirements, they will bid up interest rates sharply in a desperate move to avoid the high reputation costs associated with such failures. Conversely, if the amount of balances that banks have far exceeds what is needed for reserve requirements and payment uncertainty, they will try to dump the excess into the market and, in so doing, drive interest rates down. Absent good liquidity management by the central bank, the overnight rate would either shoot up precipitously or fall to zero most of the time (or to the ceiling and floor of the standing facilities where they operate). Given an appropriately managed supply of aggregate balances so that the system as a whole is square, the distribution of balances among banks is affected through trades in the interbank market. But at what rate? And need changes in that rate be necessarily associated with changes in the overall supply of balances?

The growing literature on monetary policy implementation under 'channel' or 'corridor' systems (as implemented, for example, by Australia, Canada, the Euro-area, New Zealand, and the United Kingdom), where standing facilities provide explicit ceilings and floors on interest rates that move in lock-step with the policy rate, has emphasized how market rates can be moved without the central bank needing to undertake any open market operation.[8]

---

[7] The existence of this phenomenon is due primarily to intertemporal arbitraging by banks of their reserve holdings across days of the reserve maintenance period. While Carpenter and Demiralp (2006a) focus their attention on how the operation desk could vary the supply of reserves to offset such moves, the practical solution actually lies in a simple rescheduling of the reserve maintenance period so that they do not span policy decision days—as done, for example, by the Bank of England and the ECB.

[8] For formal theoretical treatments see Whitesell (2006), Bindseil (2004), Woodford (2003, 2000), Guthrie and Wright (2000).

The treatment, however, often gives the impression that such systems are peculiar to the handful of countries that apply them, and for those with other operation frameworks, changes in interest rates still need to be affected through changes in the relative scarcity of balances. But can it really be the case that the underlying relationship between balances and interest rates are so fundamentally different in countries that utilize corridor systems and those that do not? Are the forces that allow some central banks to move rates without undertaking any operations really absent in others?

In addressing these questions, it is instructive to go beyond the specific institutional setup for monetary operation, which differs greatly across countries (see BIS (2008)), and focus on the fundamental underpinnings of central banks' influence over interest rates. At the root of this influence is the central banks' ability to create and remove as much balances from the system as they wish, at whatever price they wish. The price of balances, representing what could be earned on them at the end of each day, is the overnight rate. As such, central banks are able to set the overnight rate to any particular level if they so wished by standing ready to buy and sell as much balances as needed at that rate, effectively becoming the market maker for the whole system. In practice, the key difference across central banks is the manner in which they choose to utilize this ability.

This preference can be usefully captured through the notion of a 'policy implementation reaction function' (PIRF). Broadly, a PIRF describes how the central bank will react to deviations of the reference market rate from its policy rate. In a typical PIRF, balances traded by the central bank are adjusted, at varying frequencies depending on the country and circumstances, to achieve a target overnight rate. In corridor systems, the PIRF is well described by the automatic reactions built in through standing facilities that constitute the ceiling and floor on overnight rates. Market understanding and perception of the PIRF is a crucial determinant of the level of interest rate that prevails. Given an announced target for interest rates, if the market believes that the central bank will act aggressively to offset significant deviations from that rate, then trades will be concentrated near the target. In cases where there is a high degree of uncertainty or a lack of credibility regarding the PIRF, volatility in market rates are generally more pronounced.[9] The fundamental point is that by virtue of their ability to fully regulate the supply of balances, central banks can set the price at which they are supplied or withdrawn *at the margin.* So long as the public knows this price and expects the central bank to take action accordingly when the price moves sufficiently far away from it, market trades will typically be anchored at or close to this price.

The forces that underpin the influence of a PIRF on interest rates are similar to that highlighted by Guthrie and Wright (2000) in their discussion of 'open mouth' operations. Simply by announcing their intentions, central banks can move rates without needing to undertake any operations because the threat to adjust liquidity as needed to achieve the rate is enough to make markets coordinate on the new rate. Viewed in this way, a policy rate is simply a commitment by the central bank to use instruments at its disposal to achieve the target and so long as that commitment is credible, the instruments do not actually need to be used for this purpose.[10]

Once it is recognized that interest rates are anchored around public perception of the PIRF, it becomes apparent that differences in operating procedures across central banks constitute only differences in the way the PIRF is expressed, rather than some inherent difference in

---

[9] Thus interest rate volatility can arise from two sources: i) inappropriate supply of reserves; and/or ii) uncertainty about the intentions of the central bank.

[10] This does not mean that central banks are not taking any action. In corridor systems, for example, the rates on standing facilities have to be moved along with the policy rate but they do not necessarily have to be accessed.

market functioning. Thus the underlying difference between policy implementation under corridor frameworks that rely heavily on standing facilities and more "traditional" frameworks that do not emphasize these facilities (such as the Federal Reserve up until 2008), is simply how the PIRF is communicated to the public. In corridor systems, the PIRF is made explicit through standing facilities. In other systems, the PIRF is implicit. Hence the same conceptual underpinnings that rationalize how interest rates can be moved in corridor systems without any market operation can also be applied to systems where such a corridor is absent. From the market's perspective, most central banks (even those that do not officially target interest rates) do in fact impose a corridor on rates, although this may be only implicit. Insofar as interest rate determination is concerned, the key element is market participants' *beliefs* about central banks' action at the margin. It really does not matter whether the margins are enforced explicitly through standing facilities or implicitly through open market operations. Moreover, so long as the central bank is highly credible and liquidity is managed well, interest rates can be anchored without those margins actually being tested.[11]

In the context of demand and supply that is often used to describe policy implementation, what the discussion above boils down to is the fact that the central bank influences both supply and demand. While the quantity of balances demanded may be determined by exogenous factors, the price that banks are willing to pay for those balances depends on their perception of the operating objectives of the central bank, particularly how the central bank will respond to deviations of interest rates from target. The level of interest rate that prevails in the market is therefore a manifestation of demand and supply functions, both of which are influenced by the central bank. This is in contrast to standard expositions where the central bank only determines the supply function through open market operations. On the contrary, central banks' control over interest rates, and in particular their ability to move them in small precise increments, relies very little on their operations to vary the supply of balances. As such, there is not necessarily a direct correspondence between interest rates and monetary quantities.

3. Consequences of misconceptions

The proposition that monetary policy implementation can be summarized through open market operations is deeply ingrained in the academic literature and reinforced by some of the most widely used macroeconomic textbooks. While such treatment of the subject may be viewed as simply a heuristic device to capture central banks' control over interest rates, the implications and extensions of the underlying logic to the broader realm of monetary analysis can lead to significant problems. To the extent that they result in a flawed conceptual framework, policy prescriptions may be erroneous, not least because empirical work on monetary transmission may become premised on inappropriate identifying assumptions. Policy makers are also less likely to be convinced of the usefulness of analysis where the treatment of policy implementation is not in tune with actual practice. This section highlights some of the contexts in which misconceptions about monetary policy implementation have had their starkest impact, both from the academic as well as policy perspectives.

[11] For example, since they were introduced in May 2006 up until February 2008, the standing facilities of the Bank of England were actually used only on 22 occasions. In the case of the Reserve Bank of Australia, the average number of times that the Overnight Repurchase Repo Facility (the end-of-day lending facility) was used between 1999 and 2007 was 15 times per year.

3.1. The characterization of monetary policy

The natural place to begin is to reconsider the standard academic treatment of money in the monetary policy process. One consequence of the view that policy implementation revolves around the adjustment of quantities through open market operations has been the prevalent, though no longer standard, characterization of monetary policy through money growth rules.[12] Thus while much of the work on interest rate rules – notably by Woodford (2003) – have succeeded in justifying their use, they have apparently not discredited the practice of representing monetary policy through a money growth rule. To be sure, many have viewed the latter as simply a heuristic device to capture the broad influence of monetary policy, one that could be seen, given a well-defined money demand schedule, as equivalent to setting a path of interest rate over a relevant horizon that is consistent with a particular path of money. Such a perspective, however, is undermined by some key problems.

Firstly, the fact that a money growth rule is strongly contrary to the practice of policy implementation only serves in many cases to confound the underlying transmission mechanism. Indeed, typically in models where monetary policy is represented by a money growth rule, the dominant source of influence on the dynamics of the economy comes from the implied effect that money has on interest rates, generated crudely through the money market clearing condition. Given that interest rates are what matters for agents' behavior, it seems peculiar to complicate the analysis by adding another layer in the form of a one-to-one correspondence between money and interest rates and then assuming instead – contrary to actual practice – that the central bank controls the money supply. Moreover, in models embedded with a banking sector that plays a non-trivial role, the characterization of monetary policy through the control of money supply implicitly assumes that central bank actions have *direct* bearing over banks' supply of loanable funds, and thus on their intermediation activity.[13] This presumes that central banks are more powerful than they really are. In practice, the influence of monetary policy over financial intermediation relies more on the impact that changes in interest rates have on relative asset yields and bank funding conditions rather than on some ability to directly affect the quantities on intermediaries' balance sheets. Clearly then, whether monetary policy is characterized through the control of interest rates or money is not innocuous to the ensuing analysis.

Secondly, the assumed interchangeability between interest rates and money in representations of monetary policy – embedded in the conventional LM curve – is more apparent than real. It is often argued that through such a relation, the same equilibrium outcome can be achieved either by setting the path of interest rates and letting money supply be endogenous, or setting the path of money supply to achieve the same path of interest rates.[14] While this follows from a mathematical point of view, it is distinctly at odds with the reality of interest rate determination in the money market. In the market for balances, interest rates are largely anchored to perceived targets set by the central bank and the amount of balances outstanding is primarily determined by exogenous needs of the system (reserve requirements and payments uncertainty). There is no sense in which a given path of interest

---

[12] Some recent examples include Boháček and Mendízábal (2007), Edge (2007), Goodfriend and McCallum (2007), Krause and Lubik (2007), Williamson (2006), Keen (2004), Alvarez et al. (2002), Alvarez et al. (2001), and Christiano et al. (1997). Open economy macroeconomic models, in particular, often accord an important role to evolutions of money supply because monetary policy is described through money growth rules (see Lane (2001) and Obstfeld and Rogoff (1996)).

[13] For recent examples, see Boháček and Mendízábal (2007) and Goodfriend and McCallum (2007). More generally, both limited participation models and the bank lending view of the transmission mechanism discussed in sections 3.2 and 3.3, respectively, imply a close connection between monetary policy and the supply of loanable funds.

[14] Svensson (2003) and Woodford (2003), for example, utilized the interchangeability between interest rates and money in their argument that money is redundant in New Keynesian models.

rates can be attained through a particular path of balances since a given amount of balances can and does support a large range of interest rates. When the notion of money is broadened to include cash and bank deposits, whose demand depends on the interest rate (either directly or through its effect on the level of economic activity), the link between money and interest rates may be more apparent. However, the fact that central banks provide as much cash and commercial banks as much deposits as are demanded implies that the dynamics of such monetary aggregates would *reflect* prevailing rates of interest rather than *determine* them.[15] The LM curve should thus be viewed more as an empirical description of how monetary aggregates, real activity, and interest rates may be associated. Flipping the relationship around to obtain the appropriate level of monetary aggregate to set in order to achieve a given level of interest rates is an exercise in reverse causality.

The recognition that a given path of money may not necessarily pin down a unique path of interest rates raises some important questions regarding the determinacy of equilibrium in rational expectation models where monetary policy is represented by a money growth rule. Following the influential work of Sargent and Wallace (1975), the determinacy of equilibrium under interest rate versus money growth rules has been a much studied topic. As discussed in Woodford (2003), price level determinacy, in essence, requires a regime under which *interest rates* respond in a systematic and appropriate fashion to variations in the price level. In models with exogenous monetary growth rules, determinacy obtains because upward shifts in the price level automatically induce an increase in short-term nominal interest rates (ie. real money demand falls as prices increase). But if one allows for the possibility that money supply and interest rates do not have a one-to-one correspondence, as is the case when money is defined to be balances, this relationship breaks down and money-growth targeting may lead to indeterminacy.

Finally, many analyses of implementation based on money growth rules do in fact literally take money and the interest rate to be alternative policy implementation devices. This is most apparent in the literature on the optimum choice of monetary policy 'instrument' dating back to the work of Poole (1970). In that paper, Poole utilized a simple IS-LM framework to show that, on the basis of output variability, monetary policy implementation through an interest rate target is preferable to money targeting if money demand (LM) shocks are more important than real (IS) shocks. To this day, this conclusion is accepted as the primary justification for the use of interest rates as the instrument of monetary policy and still defines the academic debate in the area of central bank targeting procedures. The analysis continues to be expounded in several leading textbooks and the underlying idea remains a subject of ongoing research. Gavin et al. (2005), Collard and Dellas (2003), and Ireland (2000), for example, embed the original Poole analysis in New Keynesian models and show that the basic conclusion continues to hold.

A key problem with the Poole framework from an implementation perspective is that it confounds the concepts of monetary policy instruments, operational targets, and intermediate targets. Poole defined an instrument to be a 'policy variable which can be controlled without error' (Poole 1970, p. 198) and proceeded to treat the money stock as one such instrument to be compared to a short-term interest rate. Yet while the latter comes close to something that the central bank can influence tightly (though not without error), the money stock certainly is not something that such a definition would apply to. In terms of base money or broader aggregates that are typically the focus in such analyses, even if the central bank wanted to target these, it would have to be done through an appropriate calibration of

[15] That said, a facet of the monetarist view contends that money may play an active role insofar as an excess supply of money is created as a by-product of bank lending, and the resultant "buffer stock" adjustment towards an underlying portfolio equilibrium exerts an influence over relative asset yields. A concise exposition can be found in Laidler (1999).

interest rates to bring about the appropriate level of economic activity corresponding to a demand for money at the targeted level. Those central banks that have been identified as having pursued money targeting operating procedures at some point, such as the Bundesbank, have in fact only adopted money as intermediate targets and actual operating procedure was always focused on steering short-term interest rates.[16] Monetary aggregates can, at most, only serve as intermediate targets. As such, the choice presented by a literal interpretation of Poole (1970) is not one that exists in practice.

In the case where money is defined to be balances, treating the latter as an instrument results in a mixing up of concepts related to *monetary policy strategy* with those pertaining to *monetary operations*. The former focuses on appropriate adjustments to operational targets – the influence over interest rates – to attain specific macroeconomic outcomes while the latter – the control of balances – relates to the mechanics by which these operational targets are achieved. For the most part, the two domains are completely separate and independent. In fact, the literature on optimal instrument choice is not really about instruments at all. Given that the focus is on output fluctuations and output, as modeled through an IS curve, depends only on the interest rate, the analysis is inherently more about the appropriate interest rate response in the face of various shocks. Indeed, as pointed out by Woodford (2003), the output stabilization benefits in the face of IS shocks under the money-targeting procedure of Poole's model obtains precisely because it would imply an appropriately counter-cyclical *interest rate* response. The enduring result of Poole's analysis should have been that the optimal interest rate response to fluctuations in output and prices depends on the underlying source of the shocks – consistent with the optimal policy literature based on New Keynesian models – rather than the misconstrued trade-off between money and interest rate targeting.

3.2. Liquidity effects

Underlying the heavy focus on quantities in the characterization of monetary policy is the same basic intuition that forms the basis for the very large literature on 'liquidity effects'. This refers to the proposition that changes in the money supply induce changes in short-term nominal interest rates of the opposite sign. The liquidity effect is held to be central to the monetary transmission mechanism and the broad assent that his proposition commands is illustrated by their prominence in leading macroeconomic textbooks. Walsh (2003, p.208), for example, asserts that "(m)ost economists, and certainly monetary policy makers, believe that central banks can reduce short-term nominal interest rates and can do so by employing policies that lead to faster growth in the money supply." The significance attached to this proposition is such that theoretical models are often evaluated in part on whether they are able to replicate a liquidity effect. Much effort has also been expended in attempts to capture this effect empirically. It is striking, therefore, that the underlying premise of the liquidity effect has not always been particularly clear or uniform across studies.

At its most basic level, the liquidity effect is the proposition that short-term interest rates are influenced by central bank liquidity. As discussed in Section 2, variations in central bank balances certainly have the potential to affect interest rates: if the central bank were to reduce balances to zero or flood the market with enormous amounts of liquidity, interest rates will obviously swing dramatically. In fact, for countries with no reserve requirements, relatively minor errors in central bank liquidity management that leaves the system with an aggregate shortage/surplus of liquidity on any given day can lead to large deviations in the overnight rate. In cases where reserve requirements with averaging apply, similar forces operate on the last day of the maintenance period when the amount of reserves that banks

[16] Bindseil (2004) provides a detailed account of the evolution of monetary operation frameworks in the twentieth century for the United States, United Kingdom, and Germany/euro area.

require becomes determinate. As such, a liquidity effect defined narrowly as the ability for central bank balances to affect short-term interest rates undoubtedly exists and can, paradoxically, appear too powerful. The real issues have more to do with the role that it plays in practice, namely: i) can the liquidity effect be detected or measured? ii) how important is it for monetary policy implementation? iii) does it matter for the transmission of monetary policy to the broader economy? As will become apparent, the answers are not really; not very; and not at all.

A central problem with most of the empirical research on this issue is that the *potential* for central bank liquidity to influence interest rates is recast in terms of a smooth and stable relationship between money supply, loosely defined, and interest rates together with a causal assumption running from the former to the latter. This neglects the fact that money is largely demand-determined, especially at the daily or weekly frequency which pertains to the liquidity effect. With the operation desk adjusting the supply of balances to meet the system's needs and given that the latter is driven by factors largely independent of the interest rate level, there will generally be no perceptible link between the two. Of course, for a sufficiently large change in the supply of balances, interest rates will move sharply but this would typically indicate large mistakes in forecasts of liquidity conditions made by the operation desk. Thus somewhat paradoxically, the ability to detect a liquidity effect is greater the *less* effective is the central bank's liquidity management.

The existence of a liquidity effect is thus trivial and at the same time almost impossible to detect. Certainly at the monthly and quarterly frequency, such effects will neither be detectable nor have any important bearing for the evolution of the economy. Given the macroeconomic focus inherent in much of the analysis on liquidity effects, however, most empirical studies have focused precisely on such a monthly or quarterly frequency (examples include, Lastrapes and McMillin 2004, Bernanke and Mihov 1998, Christiano et al. 1996, Leeper et al. 1996, and Strongin 1995). Moreover, none of the measures of money used in these studies (ranging from narrow measures such as non-borrowed reserves, borrowed reserves, and total reserves to broader measures such as base money, M1, and M2) is appropriate for the liquidity effect since this is only meaningful with respect to balances at the central bank.[17]

This is reflective of a more general tendency in macroeconomics to lump all forms of money together even though analyses of the demand for money on an aggregated basis can be misleading. Base money consists of three very different components – currency, required reserves, and excess reserves – each associated with its own distinct demand function. The problem is compounded for broader aggregates. Barnett et al. (1992) pointed out that there are six different types of assets summed in constructing M1, eighteen to obtain M2, and twenty-two to arrive at M3. The sum of these disparate quantities does not result in a particularly meaningful quantity, at least in terms of analyzing short-term interest rates. Indeed, since balances are netted out in broader monetary aggregates, these measures of money do not even include the underlying asset whose trade determines short-term interest rates!

Some more recent contributions to the empirical literature have recognized that any meaningful study of the liquidity effect must utilize a correct measure of money – balances – as well as high frequency data. Examples include, Carpenter and Demiralp (2008, 2006b), Thornton (2006), Bartolini and Prati (2004), and Hamilton (1997), most of which used daily data. In general, the results are not clear cut but those studies that do find a liquidity effect at

[17] Note that for the United States, various measures of reserves that have been used exclude contractual clearing balances which make up a sizeable component of balances at the Federal Reserve. At the same time, non-borrowed reserves also include vault cash used to satisfy reserve requirements, which is unrelated to the market for balances.

the daily frequency, the estimates are invariably quite small – not surprising given that the countries studied generally have highly effective liquidity management frameworks. Nevertheless, a basic question that confronts all empirical work on liquidity effects remains unanswered. That is, why does obtaining an estimate of the liquidity effect or verifying the existence of one matter at all?

At the macroeconomic level, where the focus is on the low frequency effects of monetary policy shocks, the search for a liquidity effect seems ill-defined. At the same time, the existence of a liquidity effect at the high-frequency level is precisely the reason why central banks are able to exert close control of short-term rates so the issue is rather moot. Of course, this does not mean that central banks need to adjust the supply of liquidity to affect interest rates nor that there should be a stable link between the two, but beyond a certain level, fluctuations in liquidity supply will certainly affect interest rates. That is, the liquidity effect exists but its use is not required to move rates. For all the effort put into obtaining a precise statistical measure of the size of the liquidity effect at this high frequency, it is not obvious what practical applications or meaningful economic interpretation can be derived from such an estimate, since staff at operation desks only aim to offset autonomous factors and do not engage in careful calibration of their open market operation to move interest rates in a specific way. In fact, operations are typically geared to ensure that the liquidity effect does not occur in the first place!

These considerations also bear implications for the voluminous body of work that has been produced aimed at developing theoretical models that can generate a liquidity effect. Since the early works of Kimball (1995) and King and Watson (1996), monetary models with sticky prices have been shown to be able to generate responses of real variables and prices to monetary policy shocks that are in line with empirical estimates. However, these models have generally failed to produce a drop in nominal interest rates following an expansionary monetary policy shock (i.e. the liquidity effect). Since the liquidity effect is so fundamental to the received view of how monetary policy affects the economy, the failure of sticky price models to produce this effect has been viewed as a critical flaw prompting tremendous efforts in seeking ways to redress this shortcoming. Edge (2007), Keen (2004), Alvarez et al. (2002, 2003) and Andrés et al. (2002) exemplify some of the more recent attempts in this respect and contain concise summaries of previous work along the same lines.

The basic difficulty in generating liquidity effects in general equilibrium models stems from the opposing effects that monetary disturbances impart on real interest rates and expected inflation (i.e. the Fisher effect). As a simple illustration, consider a standard cash-in-advance model with exogenous endowment of goods, Y_t. The nominal interest rate is determined by the usual consumption Euler equation (imposing goods market clearing)

$$1+i_t = \frac{1}{\beta}\left\{E_t\left[\frac{u_c(Y_{t+1})}{u_c(Y_t)}\frac{P_t}{P_{t+1}}\right]\right\}^{-1}$$

where β is the discount factor, $u_c(Y_t)$ the marginal utility of consumption, i_t the net nominal interest rate, P_t the price level, and E_t the expectations operator. Money market equilibrium implicit in the cash-in-advance constraint implies that

$$M_t = P_t Y_t$$

where M_t is the money supply which grows at an exogenous rate and is subject to serially uncorrelated shocks.

In this setting, an unexpected increase in money would be spent by households immediately on a fixed quantity of goods. This raises the price level one-for-one with the increase in money supply leaving real balances unchanged. Moreover, given serially uncorrelated money shocks, expected inflation is constant. Through the Euler equation, fixed marginal utilities and constant expected inflation imply a constant nominal interest rate. In the case

where money shocks are persistent, households expect inflation to rise following a positive money shock so that nominal interest rates would actually increase, completely contrary to the liquidity effect proposition.[18]

To overcome these forces, the literature has focused predominantly on asset market frictions of one form or another. Following the work of Grossman and Weiss (1983), Rotemberg (1984) and Lucas (1990), a large literature based on 'limited participation' in asset markets has developed to capture the liquidity effect.[19] Essentially, these models break the link between interest rates and consumption Euler equations by introducing frictions that prevent all households from adjusting their money holdings immediately in response to monetary shocks. Following such shocks, modeled in terms of lump-sum injections of money directly to banks, interest rates are determined by the subset of agents who are able to adjust their portfolios to accommodate the new supply of money and a liquidity effect is obtained at short horizons.

Yet from the practical perspective of monetary policy implementation, the underlying premise of these efforts is tenuous. It is not entirely clear how to interpret the outcomes of models that primarily try to generate a fall in interest rates following injections of central bank money when in practice, policy changes are not effected in this manner. Moreover, since the liquidity effect is not really a meaningful concept at the low frequency associated with these models, it is questionable whether the imposition of frictions on agents' adjustment of money holdings is really justified. The liquidity effect is inherently a phenomenon associated with short-term interest rates in the market for central bank balances. In this highly efficient market, there are essentially no frictions to adjusting reserve holdings. And while there may conceivably be costs associated with households' adjustment of cash holdings, this would not affect the determination of short-term rates because the latter is determined in the market for balances, not cash. Indeed, to generate realistic co-movements between money, interest rates, and prices, limited participations models typically need to impose implausibly large asset market frictions.[20]

3.3. Money multiplier and the bank lending channel

One of the clearest manifestations of the proposition that monetary policy implementation can be described through a quantity perspective is in the concept of the money multiplier. Implicit in this view of the transmission mechanism is the assumption that central banks implement policy through exogenous variations in the supply of reserves and in so doing, can exert a direct influence on the amount of loans and deposits in the banking system.[21] While being highly intuitive, the utilization of the money multiplier in expositions of monetary transmission can be misleading.

---

[18] In more complex general equilibrium models with sticky prices, variable output, and endogenous capital, the real interest rate response tends to make liquidity effects even harder to obtain. See Edge (2007) and Keen (2004) for a detailed discussion.

[19] Examples include Keen (2004), Alvarez et al. (2002, 2003), Cook (1999), Christiano et al. (1997), and Fuerst (1992).

[20] The most successful parameterizations in Alvarez et al. (2003), for example, require the representative household to make withdrawals of money from an asset market account once every 24-36 months.

[21] This simple intuition is pervasive in popular discussions. Paul Krugman, for example, explains in a newspaper column that "(w)hen the Fed is worried about the state of the economy, it basically responds by printing more of that green paper, and using it to buy bonds from banks. The banks then use the green paper to make more loans, which causes businesses and households to spend more, and the economy expands." (Krugman, 2008)

This is illustrated, for example, in the literature on the bank-lending channel (Bernanke and Gertler 1995; Bernanke and Blinder 1988). Three assumptions are responsible for engendering banks a special role in this particular view of the transmission mechanism: i) binding reserve requirements limit the issuance of bank demand deposits to the availability of reserves; ii) banks cannot substitute between demand deposits and other forms of funding easily so that loans must be reduced when the central bank cuts the supply of reserves; and iii) some firms are dependent on bank loans which links the level of economic activity to the availability of reserves.

Most critiques of the relevance of the bank lending channel have taken issue with assumption ii), arguing that in developed economies, banks have access to alternative forms of financing so that the effects on the supply of loanable funds of a given contraction in reserves will be much attenuated (see, for example, Romer and Romer (1990)). From a monetary policy implementation perspective, however, the problem is in assumption i). This is premised on the notion that central banks set the level of reserves as the operational target of policy and that banks' deposit base, and thus their supply of loanable funds, is linked directly to variations in reserves through the money multiplier mechanism. In fact, the true causal relationship actually runs in exactly the opposite direction. The banking system creates deposits as they are demanded by the private sector, and the central bank's main liquidity management task is to ensure a sufficient supply of balances for the system as a whole to maintain reserve requirements, if any, associated with those deposits. It is the amount of deposits that the banking sector can attract that determines the level of reserves not the other way around.

While more recent interpretations of the bank lending channel have moved away from assuming that central banks conduct policy through variations in the supply of reserves, they still posit an assumption that changes in interest rates have a direct impact on deposits. In practice, however, it would not appear that deposits are responsive enough to changes in interest rates for them to be the main catalyst of variations in the supply of loans following a shift in the policy stance. In many countries, deposit rates are closely linked to money market rates so that changes in policy would not result in any meaningful changes in the opportunity cost of holding deposits. For deposit accounts that pay rates of return at a substantial discount to money market rates (checking accounts for example) it would stand to reason that holders of these funds are not interest-sensitive to begin with anyway.

Rather then being directly amenable to central bank action, the demand for deposits are driven more by the level of economic activity and the public's relative preference for bank deposits versus other forms of assets. A striking example of the inability of central banks to affect deposits directly is the Bank of Japan's 'quantitative easing' experience during 2001–2006. Despite significant expansions in reserve balances, deposits in the Japanese banking system did not increase absent a pickup in economic activity and the money multiplier fell steadily. Thus without an impact on interest rates because of the zero lower bound, the ability of monetary policy to influence bank lending was severely limited even though the capacity to control the supply of reserve balances was retained.

Nonetheless, the underlying idea that the existence of agency costs generates a disproportionate impact of monetary policy on loans to bank-dependent firms is highly plausible. Indeed, Bernanke's (2007) recasting of the bank lending channel in terms of a mechanism that works through the impact of monetary policy on banks' balance sheets and their own external finance premium provides a much more realistic conceptual framework for this channel. By putting more emphasis on the broader effects that monetary policy can have on banks' loan supply functions, the narrow quantity mechanism featured prominently in the traditional perspective is downplayed significantly. This is consistent with a related point made by Woodford (2007) that the introduction of credit frictions to the monetary transmission mechanism does not imply any particular role for monetary aggregates to play as important state variables. These frictions, prominent in 'financial accelerator' models, derive from imperfect information and specific circumstances of the borrower and have no

correspondence with any monetary aggregate. They are instead reflected in different interest rate spreads on different borrowers.[22]

That said, the mechanical link between reserves and the supply of loanable funds continues to inform much of the discussion on the role of banks in the transmission mechanism. The continued use of reserve requirements as a tool to control bank lending is a testament to persistent adherence to this over-simplified intuition *even at the policy level*. Although such a policy could, in principle, reduce the supply of loanable funds if the supply of bank reserves is held constant, in practice, central banks typically accommodate the extra demand for reserves fully to maintain interest rate stability. Thus reserve requirements do not act as a direct constraint on the bank lending.[23] The overall effect of higher reserve requirements is simply a higher tax on the banking system, and to the extent that this is passed on in the form of higher retail rates, loan demand may slow. One may well argue that the same effect could be achieved through raising the policy rate without imposing greater distortion on bank intermediation activity.

Moreover, the quantity-theoretic view of monetary policy implementation has also formed the basis for much of the empirical work on the bank lending channel. The crucial element in empirical tests of this channel lies in the strategy adopted to disentangle the effects of monetary policy on the demand for and supply of bank loans. The latter being associated with the existence of a bank lending channel. Building on the mechanistic view of deposit creation, most of the empirical work has tried to achieve identification by focusing on the characteristics that may affect banks' ability to raise alternative funding in the face of a contraction of deposits following a tightening of policy. These have included, among others, the size of the bank, the share of liquid assets, and the capital base. A typical finding is that the effect of monetary policy on lending is less for bigger banks with more liquid balance sheets and/or larger capital base.[24]

That the effects of monetary policy on lending is more pronounced for some banks than for others does not necessarily imply, however, that differences in ability to makeup for a central bank induced shortfall in deposits is the primary driving force. Rather, bank-specific characteristics may be serving as proxies for the type of loans that each bank has so that differences in lending behavior following a monetary policy tightening may simply reflect differences in the interest-sensitivity of each bank's loan portfolio and customer base. Alternatively, the divergence in loan response could reflect differences in funding costs brought about by disparities in the impact of monetary policy on banks' balance sheet conditions. This would be in line with a transmission mechanism that works through a link between interest rates and banks' external finance premium as outlined earlier. Thus while the empirical results are not invalidated as such when assessed from the practical context of policy implementation, their interpretation changes in important ways.

Given that central banks supply reserves endogenously, the existence of a bank lending channel in practice depends on whether changes in money market interest rates can have an independent impact on banks' loan supply. For example, an increase in interest rates may affect the economic outlook of banks and increase the perceived riskiness of loans leading to

---

[22] For example, in Goodfriend and McCallum (2007), it is the spread between interest rates on bank loans and risk free ones that propagates shocks not the quantity of bank deposits. The latter is given a prominent role only because it is assumed that monetary policy involves direct control of money supply. If the central bank is assumed instead to set interest rates, then the effects of monetary policy shocks will be attenuated since monetary aggregates then play no role in influencing the model dynamics.

[23] The only direct constraint on bank lending is the amount of capital that it holds.

[24] For example, Gambacorta (2005), Kishan and Opiela (2000), Kashyap and Stein (2000, 1995).

an inward shift in banks' loan supply function.[25] The original exposition by Bernanke and Blinder (1988) actually raised the possibility of a link between perceived riskiness of loans and banks' supply of loans, but not in the context of changes in monetary policy. It may be more pertinent, then, for empirical work to focus on characteristics that make banks' loan supply schedules more or less responsive to changes in relative asset yields, funding conditions, and/or perceived riskiness of loans following changes in short-term interest rates rather than characteristics that influence banks' ability to replace lost deposits. To the extent that monetary policy has an independent impact on loan supply, it is likely to take place through these balance sheets effects and revisions of risk perceptions than through any mechanical link between stance of policy and the quantity of deposits.

3.4. Foreign exchange intervention and sterilization

Another area where the quantity-theoretic view of monetary policy implementation has been particularly influential is in discussions of sterilized and unsterilized intervention. The latter is generally defined to be foreign exchange purchases or sales whose liquidity implications are not offset, thus resulting in a corresponding interest rate movement. Such textbook distinction between sterilized and unsterilized intervention that focuses on quantities, however, is a misnomer.

First, intervention that is fully sterilized does not require that the exact same amount of liquidity be withdrawn as that injected through the spot transaction. This reflects the fact that the demand for balances can shift and that a given interest rate can be consistent with a range of aggregate balances in the system. Second, unsterilized intervention in the quantity sense rarely occurs in practice. The liquidity impact of foreign exchange intervention is much the same as that of changes in one of the autonomous factors and as such, must be offset in order to maintain aggregate reserve balances in line with demand. Failure to do so would result in large swings in interest rates that may disrupt the functioning of the money market. It also follows that there can be no such a thing as partial or incomplete sterilization. Either the central bank maintains adequate aggregate reserve balances or it does not.

The quantity-theoretic view of sterilization is prevalent both in academic as well as popular discussions. A typical example is Aizenman and Glick (2008), where the focus is on the changing patterns of sterilization among a number of emerging market countries. They attempt to estimate the 'degree of sterilization' through the following regression

$$\Delta NDA / RM_{-4} = \alpha + \beta \Delta NFA / RM_{-4} + Z$$

Where NDA and NFA denote net domestic assets and net foreign assets of the central bank, respectively, RM_{-4} is the monetary base lagged four quarters, and Z other control variables that might influence money demand. The degree of sterilization is then identified with the estimated value of β, with $\beta = -1$ indicating full sterilization and $\beta = 0$ no sterilization. Aizenman and Glick perform rolling regressions of the above equation and obtain β coefficient generally close to -1 with some variations which they interpret as changes in the degree of sterilization.

Given that central banks always offset the liquidity impact of their intervention operations, however, such attempts to quantify the degree of sterilization does not seem to be a meaningful exercise. Indeed, since $NDA \equiv RM - NFA$, the above equation is equivalent to

$$\Delta RM / RM_{-4} - \Delta NFA / RM_{-4} = \alpha + \beta \Delta NFA / RM_{-4} + Z$$

[25] This is consistent with a 'risk-taking' channel of monetary policy transmission discussed in Borio and Zhu (2007).

If base money was constant, β would obviously equal to -1. But with a changing path of base money, to the extent that this is not entirely captured by the variables in Z, the coefficient will be different than -1. It is not clear how this relates to the degree of offsetting operations.

A further problem with such a framework is that it gives the impression that sterilization constitutes another policy choice that, depending on the degree to which it is carried out, can influence macroeconomic outcomes. This can potentially lead to inappropriate interpretations of central bank actions. Roubini (2007), for example, discusses at length the implications of 'partial sterilization' in the case of China. In practice, the more pertinent issue is how central banks adjust their *policy stance* in response to the broader macroeconomic consequences associated with capital flows.[26] A more meaningful definition of unsterilized intervention would thus be an exchange rate intervention that is supported by a change in interest rates. The latter is a conscious decision and does not involve any changes in balances – that is, it would still be sterilized in the quantity sense.[27]

Conventional definitions of sterilized intervention can also potentially confound discussions of the effectiveness of intervention. For example, a widely accepted proposition is that sterilized intervention is ineffective. However, if sterilized intervention is defined in the quantity sense, then such interventions are undoubtedly effective, since central banks operating under fixed exchange rate regimes are obviously able to control the exchange rate but will still offset any liquidity impact of foreign exchange intervention. By contrast, when sterilized intervention is defined in terms of the monetary policy stance, the intervention conducted by central banks in fixed exchange rate regimes is not considered sterilized because domestic interest rates are allowed to be freely determined through international interest rate arbitrage.

The potential for such misunderstandings reflect a broader under-appreciation of the fact that the underlying mechanics of monetary operations across central banks are actually quite uniform *regardless* of the monetary policy framework pursued. Irrespective of whether the operational target is the level of the exchange rate (for countries with pegs and managed exchange rates) or a short-term interest rate, the operational aspects of liquidity management are largely the same. A good example is the Monetary Authority of Singapore (MAS) which uses an undisclosed exchange rate band as its operational target. Here too, the main aim of daily market operations is to ensure that the supply of balances is adequate to meet the liquidity needs of financial institutions. When the MAS conducts foreign exchange intervention to ensure its operational target, these are always offset to mitigate undue interest rate volatility arising from inappropriate supply of balances.[28] The change in market interest rates occurs through arbitrage and does not involve any corresponding change in reserve quantities.

4. Conclusion

That the implementation of monetary policy is often misunderstood can be partly attributable to the predominance of stylized macroeconomic treatments of the subject. With a firm focus on the broader economic effects of monetary policy, the details and mechanics through

---

[26] Thus one can make a distinction between 'sterilized intervention' and 'sterilizing capital flows'. The former concerns the liquidity impacts of intervention which is a rather moot issue given automatic offsetting operations, while the latter concerns the broader and more pertinent question of how the monetary policy stance maybe adjusted to offset the macroeconomic impacts of capital flows.

[27] This distinction has been made, for example, in Melick and Galati (2002) and Humpage (2003).

[28] See Monetary Authority of Singapore (2007).

which interbank interest rates are determined have largely been swept under the carpet. While this may by justifiable in many cases, the details matter a great deal in several other contexts. The most pervasive and ingrained misconception in this regard is the proposition that monetary policy implementation revolves primarily around the control over quantity aggregates. Although the underlying source of central banks' influence over interest rates is partly related to its ability to vary balances in the system, this is not the typical nor even predominant avenue through which this influence is exercised in practice. This paper has attempted to highlight some prominent examples where an inaccurate conceptualization of monetary policy implementation can detract significantly from the ensuing analysis.

A related conclusion from the discussions in this paper is that the general move in the last few years towards analyzing monetary policy based on interest rules has helped to limit the need for explicit consideration of the practical details of monetary policy implementation. Under such a setup, the focus is firmly on the impact of various monetary policy strategies and the institutional details of how a given path of interest rate is achieved can be safely relegated to the background. That said, the conceptualization of monetary policy through some form of money growth rule is still pervasive. For the reasons discussed at length in this paper, such a representation of monetary policy cannot be reconciled with the practice of policy implementation in any meaningful way. Its continued use only serves to further propagate misunderstandings on this topic. To the extent that the academic literature can become more attuned to actual practice in this respect, policymakers are likely to be more convinced of the usefulness of the analysis done.

References

Aizenman, J. and R. Glick (2008), "Sterilization, Monetary Policy, and Global Financial Integration," NBER Working Paper 13902.

Alvarez, F., A. Atkeson and C. Edmond (2003), "On the Sluggish Response of Prices to Money in an Inventory-Theoretic Model of Money Demand," NBER Working Paper 10016.

Alvarez, F., A. Atkeson and P.Kehoe (2002), "Money, Interest Rates and Exchange Rates with Endogenously Segmented Markets," *Journal of Political Economy* 110(1), 73-112.

Alvarez, F., R. Lucas and W. Weber (2001), "Interest Rates and Inflation," *American Economic Review Papers and Proceedings* 91(2), 219-225.

Andrés, J., J, López-Salidoa and J. Vallésa (2002), "Intertemporal Substitution and The Liquidity Effect in a Sticky Price Model," *European Economic Review* 46, 1399-1421.

Bank for International Settlements (2008), "Monetary Policy Frameworks and Central Bank Market Operations," Markets Committee Compendium, June 2008.

Barnett, W., D. Fisher, and A. Serletis (1992), " Consumer Theory and the Demand for Money," *Journal of Economic Literature* 30, 2086-2119.

Bartolini, L. and A. Prati (2004), "Cross-country Differences in Monetary Policy Execution and Money Market Rates' Volatility," *European Economic Review* 50, 349-376.

Bernanke, B. (2007), "The Financial Accelerator and the Credit Channel," speech give at The Credit Channel of Monetary Policy in the Twenty-first Century Conference, Federal Reserve Bank of Atlanta.

Bernanke, B. and A. Blinder (1988), "Credit, Money, and Aggregate Demand," *American Economic Review* 78 (May), 435–439.

Bernanke, B. and M. Gertler (1995), "Inside the Black Box: The Credit Channel of Monetary Policy Transmission," *Journal of Economic Perspectives* 9 (Fall), 27–48.

Bernanke, B. and I. Mihov (1998), “The Liquidity Effect and Long-run Neutrality,” Carnegie-Rochester Conference Series on Public Policy, 49, 149–94.

Bindseil, U. (2004), *Monetary Policy Implementation*, Oxford University Press, New York.

Bindseil, U., G. Camba-Mendez, A. Hirsch, and B. Weller (2004), “Excess Reserves of Banks with the Central Bank and the Liquidity Management Framework of the Euro Area,” ECB Working Paper No. 361.

Boháček R. and H. Mendízábal (2007), “Credit Markets and the Propagation of Monetary Policy Shocks,” *Journal of Money, Credit, and Banking* 39 (6), 1429-1455.

Borio, C. (1997), “The Implementation of Monetary Policy in Industrial Countries: A Survey,” Bank for International Settlements Economic Papers, No. 47.

Borio, C. and H. Zhu (2007), “Capital Regulation, Risk-Taking and Monetary Policy: A Missing Link in the Transmission Mechanism?” mimeo, Bank for International Settlements.

Carpenter, S. and S. Demiralp (2008), “The Liquidity Effect in the Federal Funds Market: Evidence at the Monthly Frequency,” *Journal of Money, Credit, and Banking* 40, 1-24.

_____, (2006a), “Anticipation of Monetary Policy and Open Market Operations,” *International Journal of Central Banking* 2(2) June, 25-63.

_____, (2006b), “The Liquidity Effect in the Federal Funds Market: Evidence from Daily Open Market Operations,” *Journal of Money, Credit, and Banking* 38, 901-920.

Christiano, L., M. Eichenbaum, and C. Evans (1997), “Sticky Prices and Limited Participation Models: A Comparison,” *European Economic Review* 41, 1201–1249.

_____, (1996), “The Effects of Monetary Policy Shocks: Evidence from the Flow of Funds,” *Review of Economics and Statistics*, 78, 16–34.

Collard, F. and H. Dellas (2005), “Poole in the New Keynesian Model,” *European Economic Review* 49, 887-907.

Cook, D. (1999), “The Liquidity Effect and Money Demand,” *Journal of Monetary Economics* 43, 377-390.

Edge, R. (2007), “Time-to-Build, Time-to-Plan, Habit-Persistence, and the Liquidity Effect,” *Journal of Monetary Economics* 54, 1644-1669.

Ellingsen, T. and U. Söderström (2001), “Monetary Policy and Market Interest Rates,” *American Economic Review* 91 (5), 1594-1607.

European Central Bank (2002), “The Liquidity Management of the ECB,” Monthly Bulletin, May 2002, 41-54.

Fuerst, T. (1992), “Liquidity, Loanable Funds and Real Activity,” *Journal of Monetary Economics* 29, 3–24.

Gambacorta, L. (2005), “Inside the Bank Lending Channel,” *European Economic Review* 49, 1737-1759.

Gavin W., B. Keen, and M. Pakko (2005), “The Monetary Instrument Matters,” *Federal Reserve Bank of St. Louis Review* 87 (5), 633-58.

Grossman, S. and L. Weiss (1983), “A Transactions-Based Model of the Monetary Transmission Mechanism,” *American Economic Review* 73(5), 871-880.

Goodfriend, M. and B. McCallum (2007), “Banking and Interest Rates in Monetary Policy Analysis: A Quantitative Exploration," NBER Working Paper no. 13207, June 2007.

Guthrie, G., and J. Wright (2000), “Open Mouth Operations,” *Journal of Monetary Economics* 46, 489—516.

Hamilton, J. (1997), “Measuring the Liquidity Effect,” *American Economic Review* 87(1), 80-97.

Humpage, O. (2003), “Government Intervention in the Foreign Exchange Market,” Federal Reserve Bank of Cleveland Working Paper 03 (15).

Ireland, P. (2006), “ The Monetary Transmission Mechanism,” Federal Reserve Bank of Boston Working Papers 06-1.

_____, (2000), “Interest Rates, Inflation, and Federal Reserve Policy Since 1980,” *Journal of Money, Credit, and Banking* 32 (3), 417–434.

Kashyap, A. and J. Stein (1995), “The Impact of Monetary Policy on Bank Balance Sheets,” Carnegie Rochester Conference Series on Public Policy 42, 151–195.

_____, (2000), “What Do a Million Observations on Banks Say About the Transmission of Monetary Policy?” *American Economic Review* 90 (3), 407–428.

Keen, B. (2004), “In Search of the Liquidity Effect in a Modern Monetary Model,” *Journal of Monetary Economics* 51, 1467–1494.

Kimball, M. (1995), “The Quantitative Analytics of the Basic Neomonetarist Model,” *Journal of Money, Credit, and Banking* 27, 1241–1277.

King, R. and M. Watson (1996), “Money, Prices, Interest Rates, and the Business Cycle,” *Review of Economics and Statistics* 78, 35–53.

Kishan, R. and T. Opiela (2000), “Bank Size, Bank Capital, and the Bank Lending Channel,” *Journal of Money Credit, and Banking* 32 (1), 121-141.

Krause, M. and T. Lubik (2007), “The (Ir)relevance of Real Wage Rigidity in the New Keynesian Model With Search Frictions,” *Journal of Monetary Economics* 54, 706—727.

Krugman, P. (2008), “Betting the Bank,” International Herald Tribune 15 March 2008.

Laidler, D. (1999), “Passive money, active money and monetary policy”, *Bank of Canada Quarterly Review* (Summer), 15-25.

Lane, P. (2001), “The New Open Economy Macroeconomics: A Survey,” *Journal of International Economics* 54, 235-266.

Lastrapes, W. and W. McMillin (2004), “Cross-country Variation in the Liquidity Effect: The Role of Financial Markets,” *The Economic Journal* 111, 890-915.

Leeper, E., C. Sims, and T. Zha. (1996), “What Does Monetary Policy Do?” Brookings Papers on Economic Activity, 2, 1–63.

Lucas, R. (1990), “Liquidity and interest rates,” *Journal of Economic Theory* 50, 237-264.

Mac Gorain, S. (2005), “Stabilising Short-Term Interest Rates,” Bank of England Quarterly Bulletin, Winter.

Melick, W. and G. Galati (2002), “Central Bank Intervention and Market Expectations,” *BIS Papers* No. 10.

Monetary Authority of Singapore (2007), Monetary Policy Operations in Singapore, April.

Obstfeld, M., Rogoff, K. (1996), *Foundations of International Macroeconomics*, MIT Press, Cambridge, MA.

Poole, W. (1970), “Optimal Choice of Monetary Policy Instruments in a Simple Stochastic Macro Model,” *Quarterly Journal of Economics* 84 (2), 197-216.

Romer, C. and D. Romer (1990), “New Evidence on the Monetary Transmission Mechanism,” Brookings Papers on Economic Activity 1, 149-214.

Roubini, N. (2007), “Why China Should Abandon Its Dollar Peg,” *International Finance* 10(1), 71-89.

Rotemberg, J. (1984), “A Monetary Equilibrium Model with Transaction Costs,” *Journal of Political Economy* 92(1), 40-58.

Sargent, T. and N. Wallace (1975), “Rational Expectations, the Optimal Monetary Instrument, and the Optimal Money Supply Rule,” *Journal of Political Economy* 83, 241-254.

Strongin, S. (1995), “The Identification of Monetary Policy Disturbances: Explaining the Liquidity Puzzle,” *Journal of Monetary Economics*, 25, 463–497.

Svensson, L. (2003), “Comment on: The Future of Monetary Aggregates in Monetary Policy Analysis,” *Journal of Monetary Economics*, 50, 1061-1070.

Thornton, D. (2006), “The Daily Liquidity Effect,” Federal Reserve Bank of St. Louis Working Paper 2006-020A.

Tucker, P. (2004), “Managing the Central Bank’s Balance Sheet: Where Monetary Policy Meets Financial Stability,” Lecture delivered to mark the Fifteenth Anniversary of Lombard Street Research.

Walsh, C.E. (2003), *Monetary Theory and Monetary Policy* (Second Edition), MIT Press, Massachusetts.

Williamson, S. (2006), “Search, Limited Participation, and Monetary Policy,” *International Economic Review*, Vol. 47, No. 1, 107-128.

Whitesell, W., (2006), “Interest-rate Corridors and Reserves,” *Journal of Monetary Economics* 53, 1177-1195.

Woodford, M. (2007), “How Important is Money in the Conduct of Monetary Policy?” NBER Working Paper 13325.

_____, (2004), “Inflation Targeting and Optimal Monetary Policy,” *Federal Reserve Bank of St. Louis Review*, 15-41.

_____, (2003), *Interest and Prices*, Princeton University Press, Princeton.

_____, (2000), “Monetary Policy in a World Without Money,” *International Finance* 3, 229-260.