Rethinking the Implications of Monetary Policy:
How a Transactions Role for Money Transforms the Predictions of Our Leading Models*

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Over the past several decades, economists have devoted ever-growing effort to developing economic models to help us understand how changes in interest rates brought about by monetary policy actions affect the production and provision of goods and services in the economy. Although New Keynesian models have broad appeal in explaining how changes in the money stock can affect business activity, these models generate results that are inconsistent with what we know about how interest rates move with policy-induced changes in the money stock. In this article, Julia Thomas argues that by extending the New Keynesian model to reintroduce money's liquidity role, we can resolve some of the remaining divorce between economic theory and the patterns observed in the workings of actual economies.

Each meeting of the FOMC is met with widespread interest by everyone from financial market participants on Wall Street, to real estate agents, to the cashier at your local grocery store. People perceive changes in the FOMC's target for the federal funds rate — the interest rate at which banks borrow and lend to each other, usually overnight, through the federal funds market — as relevant and important in their everyday lives. Business people view changes in this interest rate as an important determinant influencing everything from car and home sales to consumer spending over the Christmas holiday season. Whenever business conditions are widely perceived to be weak, most people welcome cuts in the federal funds rate.

Despite these observations, however, the means through which changes in an interest rate affect business activity is, in fact, far from obvious. Over the past few decades, economists have devoted ever-growing effort to developing formal economic models to help us understand precisely how changes in interest rates brought about by monetary policy actions affect the production and provision of goods and services throughout the economy. While there are several different types of models describing how monetary policy actions drive short-run changes in total employment and GDP, a growing consensus has emerged. Most often, when an economic model is used as an additional tool with which to analyze the consequences of alternative monetary policy actions, it is drawn from a class of models known as New Keynesian (or sticky price) models.

New Keynesian models have broad appeal because they provide a relatively simple explanation for how changes in the stock of money can affect business activity and because they are, in some respects, quite consistent with what economists know about how actual changes in the money stock affect the economy. Unfortunately, though, versions of these models capable of generating realistic effects of changes in the money stock for production and employment are, at their most basic level, inconsistent with what we know

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*The views expressed here are those of the author and do not necessarily represent the views of the Federal Reserve Bank of Philadelphia or the Federal Reserve System.

about how interest rates move with policy-induced changes in the stock of money.

This article argues that, by extending the New Keynesian model to reintroduce an abandoned *liquidity* role of money found in earlier models, we can resolve some of the remaining divorce between our economic theory and the patterns we observe in the workings of actual economies.[1] What is this role of money? It is the idea, from classical economics, that money serves a special purpose in allowing transactions to take place between buyers and sellers, since it is the only financial asset universally accepted as a means of payment. Other assets, such as stocks and bonds, are typically not accepted as a means of payment and cannot be directly used to buy goods and services. Thus, in contrast to money, these nonmonetary assets are relatively illiquid.

When we introduce the classic liquidity role of money into the New Keynesian model, and we acknowledge the fact that it is costly to convert nonmonetary assets into monetary ones (and vice versa), we arrive at a richer model that is consistent with our knowledge of how interest rates are affected by changes in the stock of money. At the same time, the mechanics of the New Keynesian model become more complicated with this improvement, because the level of an individual's monetary assets takes on an independent role in his or her spending decisions. Exploring the effects of changes in monetary policy in this richer environment, we find that the overall magnitude of these effects and the rate at which they spread throughout the economy can depend importantly on how much money is typically held and how rapidly it changes hands, on average. In short, our extended theoretical model offers new insights about how the effects of monetary policy are transmitted throughout the economy.

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WHAT HAPPENS FOLLOWING A CHANGE IN MONETARY POLICY?

For many economists, at the most basic level, the changes in the economy associated with a change in monetary policy may be traced to changes in the rate at which the supply of money grows over time, rather than to movements in the interest rate. Indeed, the means through which central banks actually move their key interest rates is through open market operations, wherein government bonds — a nonmonetary asset — are exchanged for money. For example, the monetary authority can reduce the overall level of money in the economy by undertaking an open market sale of government bonds for money.[2] In the process of such a contractionary open market operation, the overall supply of bonds for sale is increased, which puts downward pressure on the price at which each bond is sold. This, in turn, increases the difference between a bond's payoff at maturity (its par value) relative to its purchase price today, ultimately raising the rate of return on bonds — that is, the interest rate.

Macroeconomists generally associate an easing of monetary policy with a cut in interest rates. As Nobel Laureate Milton Friedman put it in his 1968 presidential address to the American Economic Association, "The initial impact of increasing the quantity of money at a faster rate than it has been increasing is to make interest rates lower for a time than they would otherwise have been." Indeed, there is such consensus about the inverse relationship between short-term interest rates and the growth rate of the aggregate money supply that the relationship has been given a name: the *liquidity effect*.[3]

There is even greater consensus that changes in nominal variables, such as the interest rate, have notable consequences for the paths of real

[1] The expanded model we pursue throughout this discussion is drawn from my article with Robert King, which builds upon my work with Aubhik Khan.

[2] See the article by Frederic Mishkin or Dean Croushore's book for a more thorough discussion of the implementation of open market operations.

[3] Most evidence of the liquidity effect is indirect, in that the relationship is inferred by examining economic data through the lens of complex empirical models beyond the scope of this article. However, Seth Carpenter and Selva Demiralp directly establish the existence of the liquidity effect at a daily frequency by studying the forecast errors made at the New York Fed's Trading Desk in conducting open market operations on behalf of the Federal Reserve System. Using these errors to identify exogenous changes in the supply of reserves to the banking system, the authors establish a negative and statistically significant correlation between unanticipated changes in high-powered money and the federal funds rate. Elsewhere, John Cochrane provides direct evidence that the liquidity effect exists for broader measures of money and interest rates. He examines changes in the growth of M1 (total currency and checkable deposits) and in the nominal yields on U.S. Treasuries between October 1979 and November 1982 (a historical episode throughout which the Federal Reserve expressly targeted the quantity of money held by commercial banks). Cochrane uncovers statistically significant negative effects of M1 growth on both three-month Treasury bill rates and 20-year Treasury bond rates and thereby establishes that increases in the rate of money growth are associated with declines in nominal interest rates lasting up to one year.

variables like GDP and employment. Such real effects arising from a change in monetary policy are termed nonneutralities. Perhaps the most celebrated example of nonneutrality is the observation that reductions in inflation caused by contractionary monetary policy are associated with temporary increases in unemployment, a relationship termed the Phillips curve tradeoff.[4]

NEW KEYNESIAN MODELS

It is not easy to reproduce the patterns in the movements of money, interest rates, employment, and output observed in actual economies within our economic models; however, doing so is an important step toward understanding why these patterns arise and how they may be influenced by monetary policy. To generate nonneutralities in our models, we must first find a way to overcome their tendency to exhibit a related, and quite opposite, phenomenon known as the neutrality of money. This term applies whenever changes in an economy's money stock are transmitted immediately into the overall level of prices and have no effect at all on the real quantities of goods and services produced and sold.

Neutrality of Money. To illustrate the neutrality of money, consider the following simple example of a remote island with a single good and a single currency. Let us assume that the mango is the only good valued by inhabitants of the island and that local suppliers typically harvest and sell 50 mangos each week. The single currency used to purchase these goods is the seashell; that is, islanders buy and sell mangos using only seashells. There are 100 seashells on the island this week, as in many previous weeks, and all mangos are sold (and all seashells are exchanged for mangos) precisely once each week. Under these circumstances, the price of a mango will be two seashells.

Next, let us suppose that a nearby hurricane causes 100 additional seashells to wash up on the island's beaches next week, unexpectedly doubling the supply of currency (or money). This would seem to imply twice as many island dollars next week chasing after the same weekly harvest of 50 mangos. So what will happen to the price of a mango? One possibility is that it will immediately rise to four seashells, thereby doubling the island price level, with no change in the number of mangos harvested and sold. If this happens, the rise in the money supply will have simply led to a proportionate rise in the price level, with no consequence at all for the island's real activity – its employment and GDP – and we have a textbook case of the neutrality of money.

Nonneutrality of Money. In contrast to the scenario suggested above, most economists are convinced that actual economies exhibit short-term departures from the neutrality of money. Like the many individuals actively watching for the outcome of each meeting of the FOMC, economists generally accept that changes in the supply of money induce temporary movements in output, employment, and the real return to holding assets measured in units of consumption — the *real* (or inflation-adjusted) interest rate, to which we will return later in this article.[5] Let us reconsider our island economy of seashells and mangos in light of this consensus view.

It is not easy to reproduce the patterns in the movements of money, interest rates, employment, and output observed in actual economies within our economic models.

If the price of each mango does not immediately double in response to the unexpected doubling of seashells on the island, the quantity of mangos supplied must rise to prevent unfilled demand for mangos and undesired idle seashells. But how might this happen? New Keynesian models have a simple answer to the question. They assume that the firms supplying goods and services — in our example, the islanders gathering mangos — cannot

[4] This relationship is named after Alban William Phillips, who documented an inverse relationship between changes in unemployment and nominal wages in the United Kingdom across roughly 100 years of data. However, some argue that acknowledgment should instead go to Irving Fisher, who had suggested a similar relationship roughly 20 years earlier. The relationship was theoretically formalized to consider its policy implications by Paul Samuelson and Robert Solow.

[5] Economists use rich empirical methods to study the joint movement of interest rates, prices, and output. Their findings suggest that a persistent increase in the nominal interest rate is initially accompanied by a small decline in the growth rate of output, with little or no change in the growth rate of the price level. Over the course of several subsequent quarters, it is followed by declines in both output growth and inflation. At some point thereafter, the changes in the quantities of goods and services produced in response to the change in the interest rate eventually vanish. For further discussion, see the articles by Lawrence Christiano, Martin Eichenbaum, and Charles Evans; Harald Uhlig; and Robert King and Mark Watson.

always change their prices at will. Rather, some must honor prices that they set in the past.[6]

For simplicity, suppose that one-third of the mango sellers on our island are able to change their prices in any given week, with a single crayon used to reset prices on cardboard advertisements alternating between each of the three groups of sellers on the island each week. In this case, when the new seashells arrive, the average price of a mango will not immediately jump to four seashells. Instead, the island price level will rise only part way in the first week, since only one-third of all sellers can respond to the increase in the supply of seashells with an increase in their prices.

Assuming that all sellers are forced to supply the quantity of mangos that is demanded of them at their posted prices (or that they face sufficiently harsh penalties for not doing so that they choose to comply), the staggered price adjustment described above is all that is needed to break the neutrality of money in our island economy. With the average price in the economy not initially doubling, and assuming that all consumers on the island spend their extra seashells, the total demand for mangos will rise above the usual weekly supply of 50, and more mangos will have to be harvested. As a result, mango suppliers (and their employees) will work more relative to the normal level of labor effort on the island, and more fruit will be sold. Put another way, given temporary price stickiness among a fraction of sellers, the unexpected increase in the amount of currency on the island will have real effects, raising employment and/or the average hours worked per employee, as well as total production (real GDP).

The real effects of the rise in the island's money supply are not permanent, however. Instead, the initial week's high level of real activity will begin to subside as the economy's price level continues responding to the doubled supply of seashells. In the following week, as an additional one-third of sellers are able to raise their prices, the average price of a mango will rise further. Thus, while total demand will remain higher than usual, it will be less so than initially, and total mango production and sales will move nearer to their customary level. Eventually, as all sellers have had the opportunity to respond to the new economic conditions, the island price level will reach precisely double its original level, and the quantity of mangos harvested each week will return to the same 50 as existed before the hurricane.

The example above illustrates how unexpected increases in the money supply can temporarily stimulate economic activity. However, its mechanics are very different from the way we usually think of a change in monetary policy. Note, in particular, that our example never even mentioned a change in the interest rate! This is where the problems begin for the basic New Keynesian model.

Interest Rate Movements. In contrast to the liquidity effect observed in actual economies, the formal relationships between money, interest rates, inflation, and output at the core of the New Keynesian model lead it to predict that the interest rate *rises* when the money supply is expanded. Why do interest rates move the wrong way in the model? To understand this, we must consider a key relationship between (nominal) interest rates and *real* interest rates: the Fisher equation, named after Irving Fisher.[7] The Fisher equation says that the interest rate — the ratio of the dollar payoff on an asset relative to its dollar purchase price — is approximately equal to the sum of the real interest rate and the expected rate of inflation. To see why it is natural that this equation should hold, at least approximately, we begin with a broad definition of the real interest rate. The real interest rate is the ratio of an asset's payoff in units of future consumption of goods and services relative to the consumption

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[6] See the articles by William Kerr and Robert King; Bennett McCallum and Edward Nelson; and Michael Woodford for analytically tractable examples of the basic New Keynesian environment.

[7] Fisher's exposition of the relationship in *The Theory of Interest*, published in 1930, is now out of print. However, it is available online at the Library of Economics and Liberty (www.econlib.org/library/classics.html). The topic is also routinely covered in most macroeconomics texts; see, for example, Robert Barro's book.

that must be forgone today for its purchase; in other words, it is the return on savings measured not in money but in goods and services.

Returning to the island analogy above, let us suppose that our islanders are able to borrow and save. In particular, if an inhabitant saves 10 seashells this week, an island banker will lend them to some other islander and return to the original lender 11 seashells next week. Thus, the weekly nominal interest rate is 10 percent. Suppose also that the price of a mango will rise over the course of the week from one seashell to 1.01 seashells; in other words, the weekly rate of inflation is 1 percent. Under these circumstances, a mango forgone this week implies one seashell of savings deposited with the island banker that will return 1.1 seashells next week (each worth 1/1.01 mangos), allowing the lender to buy 1.089 additional mangos at that time. Notice that the real interest rate, measured in units of island goods, is then approximately 9 percent. In this way, we have arrived at the key relationship defined by Irving Fisher; the interest rate on our island is roughly equal to the sum of the real interest rate and the inflation rate.

Given the discussion above, it is straightforward to summarize why the basic New Keynesian model fares poorly with regard to the liquidity effect. In the basic model economy, an increase in the money supply implies very little change in the real interest rate. However, at the same time, it leads to comparatively substantial increases in future inflation rates. Referring back to the Fisher equation, it is then natural that the model should predict that the interest rate initially rises when the supply of money in the economy is expanded. This is a somewhat disconcerting feature of our standard model, given the broad consensus regarding the liquidity effect — the inverse relationship between changes in interest rates and changes in the money supply observed in actual economies.

EXTENDING THE MODEL: TRANSACTIONS ROLE FOR MONEY AND INFREQUENT PORTFOLIO ADJUSTMENTS

Basic New Keynesian models fail to reproduce the liquidity effect essentially because they place no emphasis on the nature of the open market operations that implement monetary policy.[8] We can correct this problem if we extend our theoretical model to reflect the fact that individuals hold both liquid assets, broadly interpretable as money, as well as illiquid assets, such as stocks and government bonds, and we also take account of the fact that individuals infrequently adjust their portfolios between these two types of assets.

In this extension of the model, we allow money to serve a particular purpose not reflected in the basic New Keynesian environment. Here, we acknowledge the fact that individuals hold low-yield liquid assets, or money, because they must draw on them for transactions. Quite simply, goods and services can be purchased only with money (which we might think of as currency, checkable deposits, and time and savings deposits). At the same time, individuals also choose to hold higher-yield nonmonetary assets, such as government bonds, as a means of saving. While these assets cannot be used directly for transactions, they pay significantly higher rates of return than money.

Various events — some expected, some unexpected — occasionally lead people to adjust their asset portfolios, moving wealth out of bonds (illiquid assets) into money (liquid assets), or vice versa. When an individual puts a down payment on a mortgage, she may do so by converting CDs or other high-yield assets into money that is deposited into her bank account and then write a check from that account to make the down payment. However, for the average person, such events are relatively infrequent. Thus, in any given month, most individuals are not actively adjusting their asset portfolios — or what we will loosely term "active in the bond market."

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[8] More elaborate versions of these models do succeed in generating a liquidity effect. However, Bill Dupor, Jing Han, and Yi-Chan Tsai raise an inherent tension regarding this success. They find that the additional assumptions needed to make the basic New Keynesian model consistent with the observed responses in interest rates, inflation, and output following changes in monetary policy have the unfortunate consequence of making it inconsistent with observed responses following nonmonetary disturbances.

that the monetary authority conducts an open market operation.[9] For example, the monetary authority might repurchase bonds from them and pay for the bonds by making deposits into their bank accounts. When these individuals are induced to sell bonds and receive the associated payments of money into their bank accounts, the overall supply of money in the economy is increased. However, the full rise in the stock of money does not find its way into economic activity right away. Instead, much of it remains in the recipients' bank accounts for some time.

It is precisely the fact that most people are active in the bond market only occasionally in our extended model that implies that a change in the overall money supply is not immediately transmitted throughout the economy. Most of the individuals involved in the expansionary open market operation from above do not expect to sell more bonds in the near future, so they save much of the current increase in their bank accounts to finance their expenditures over future months and boost their spending only gradually. Thus, the injection of new money into the economy does not lead to an immediate equivalent increase in aggregate spending but instead induces a more protracted rise in spending as more and more of the additional money is drawn from the recipients' accounts.

The slow increase in overall nominal spending in our extended model reduces the upward pressure on inflation relative to that in the basic New Keynesian model. How might this alter the model's performance with regard to the liquidity effect? Recalling the Fisher relationship from above, we know that the more gradual rise in inflation increases the likelihood that the interest rate will fall in response to a money injection. All that is required for this to happen is that the real interest rate exhibit a fall of sufficient magnitude to outweigh the initial rise in inflation.

This brings us to the fall in the real interest rate. For the increase in the money supply to find its way into general economic activity, individuals participating in the open market operation must be induced to increase their spending and thus their real consumption of goods and services. This can only happen, however, if the opportunity cost of an increase in their current consumption (the forgone return of a greater increase in consumption next month) is not intolerably high. To ensure that this is the case, the real interest rate must fall relative to its average level, which is precisely what happens in our extended version of the New Keynesian model. On balance, our extended model delivers a fall in the real interest rate while simultaneously reducing the upward pressure on inflation, and thus it has the ability to reproduce the liquidity effects we see following expansionary open market operations in actual economies.

MONEY VELOCITY IN THE EXTENDED MODEL

To reconcile reductions in short-term nominal interest rates with expansionary monetary policy that stimulates output and employment over the short run, we have extended the New Keynesian model to introduce an explicit transactions role for money, alongside infrequent trading of bonds by the typical individual. However, the repercussions of this extension go beyond merely resolving the problem of the absent liquidity effect. In fact, the new elements we have introduced into the model can have large and important implications for the way in which monetary policy affects the economy, because they, in turn, create a prominent role for movements in the velocity of money.

Velocity Defined. The velocity of money is another classic feature of models of the monetary economy that has been largely ignored in New Keynesian models. It is a very basic concept reflecting the average number

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[9] For expositional convenience, we proceed through the remainder of this discussion as though the monetary authority directly interacts with individuals when conducting open market operations. In reality, of course, interactions between the Federal Reserve System and individuals are not direct, since the Desk actually conducts open market operations through the primary dealers.

of times a unit of money is used within a specific time period, and it lies at the heart of traditional monetary theory. To compute velocity, we need only take the ratio of total nominal spending on goods and services relative to the overall stock of money in the economy. This observation comes straight from the velocity equation MV = PY, wherein M represents the aggregate money stock, V is velocity, P is the aggregate price level, and Y is real aggregate output. Notice that by simply rearranging the velocity equation, we have V = PY/M.

Let us consider our island economy once again. There, within a typical week, all seashells changed hands exactly one time, with a total of 100 available seashells being used to buy 100 seashells' worth of mangos. Thus, the weekly velocity of money was one. Now, let us suppose that, when the extra 100 seashells wash onto the island in the week of the hurricane, only one person is out on the beach to receive the unexpected "money injection," so that he is the only inhabitant to receive any additional money or even know of it. If we further suppose that this islander spends only 50 of the extra seashells this week and tucks the remainder away for future use (holding them idle in his hut for quick and costless access), total nominal spending on the island will rise to only 150 seashells out of a total seashell supply of 200. Thus, the average number of times any one seashell changes hands in the week will be 150/200, implying a money velocity of 0.75.

In our example above, when only one islander was on the beach to receive the unexpected injection of seashells, and he chose to hold half of the injection idle rather than immediately spending it or investing it in island bonds, we saw that the velocity of money dropped from its average weekly level of 1 to 0.75. This is analogous to what happens in our extended version of the New Keynesian model following an expansionary open market operation. Because only a fraction of all individuals actually take part in the open market operation, and those individuals that do participate elect to save much of the increased money stock in their bank accounts to finance near-term expenditures, there too velocity falls with an increase in the money supply.

> When an open market operation increases the bank balances of individuals who are trading bonds, their spending rises, but it rises by less than the increase in their bank accounts.

How Changes in Velocity Influence the Transmission of Monetary Policy. Changes in velocity over time can have important consequences for the rate at which nominal phenomena, such as unexpected movements in the supply of money, transmit themselves into real effects. In the basic New Keynesian model, where money has no distinct role in facilitating transactions, movements in velocity do not feed back into the operation of the real economy. It is true that money helps to determine the interest rate through the interaction of money demand and the aggregate money supply. However, once the interest rate is determined, the aggregate quantity of money and the velocity of money have no further role.[10] Put another way, changes in interest rates always affect output, employment, and inflation in the same way, irrespective of the money supply and the resulting number of times each currency unit is used.

In our expanded model, by contrast, individuals' bank balances help determine their spending over and above their total income or wealth. An individual with a total wealth of $1000, but with only $100 currently available as money in her bank account, will spend less on nondurable goods this week than will another individual who has the same $1000 but who holds it entirely in her bank account. Because money is necessary for transactions in our expanded model economy, the role of the aggregate money stock and its velocity does not end with the interest rate. Rather, the quantity of money that individuals hold and the rates at which they spend it have a direct influence on the aggregate demand for goods and services even after the interest rate has been determined. Thus, we cannot anticipate the changes in production, employment, and inflation that will follow a given change in monetary policy by simply knowing the implied path of interest

[10] This is essentially because the system of equations governing the model has only a single equation involving the demand for real balances, and that equation is effectively quarantined from the rest of the economy in that it links real balances only to the nominal interest rate and the money growth rate. Apart from the money demand equation, there is a core block of equations that contain no monetary variables at all but that together determine output, inflation, and the real interest rate as a function of the interest rate. In the most basic formulation of the model, this block of equations is simply (1) an Euler equation describing households' optimal savings behavior, (2) the Fisher relation discussed above, and (3) a Phillips curve relating current inflation and the aggregate supply of goods and services to expected inflation.

rates; instead, we must also know how individuals' money holdings and their money spending rates (velocities) will respond to the change in policy.

When an open market operation increases the bank balances of individuals who are trading bonds, their spending rises, but it rises by less than the increase in their bank accounts. Thus, we see a rise in the fraction of the money supply sitting idle awaiting future use, money changes hands less frequently than before, and velocity falls. Unlike the basic New Keynesian model, where changes in velocity have no independent influence on the economy, the decline in velocity in our expanded model has an important role in shaping the economy's response to the expansion of the money supply. When velocity falls, there are fewer dollars in circulation for undertaking transactions than there would be otherwise. This places a restraint on the economy's overall demand for goods and services and thus dampens the initial rise in production and employment. Moreover, recalling our money velocity equation from above, we know that the fall in velocity (V) means that aggregate nominal spending (PY) initially rises by less than the rise in the money supply (M).

Thus, the fall in velocity helps to restrain the rise in the aggregate price level, and the inflation rate rises by less than it would were velocity unchanged or irrelevant (as in the basic model).

Over time, as the individuals who participated in the open market operation begin to spend more and more of the extra money they are holding, aggregate velocity begins to rise back toward its normal level. Over the early part of this transition, as more and more money balances enter circulation, aggregate demand continues to rise, thereby propping up the responses in employment and output. At the same time, the rises in aggregate nominal spending must also serve to prop up the inflation rate. Thus, we see that, while the initial decline in velocity dampens the initial changes in both real quantities and inflation, these subsequent upward movements in velocity serve to protract those changes. For this reason, our economy's responses to an open market operation cannot be completed until velocity has recovered to its normal level, when the full increase in the money supply has found its way into circulation and individuals have resumed their usual spending rates.

As indicated above, the time it takes for an open market operation to flow throughout our model economy will depend on how long it takes for velocity to return to its ordinary level. In a setting where velocity is initially very high, money changes hands very frequently. There, despite some resulting decline in velocity as described above, the effects of a change in monetary policy that are unique to our expanded model are likely to vanish rapidly. This is because new money held by individuals participating in an open market operation will not be left idle for long but will instead rapidly enter circulation. After that has happened, the aggregate responses in our expanded model economy will closely resemble those of the basic New Keynesian model. By contrast, a setting with low initial velocity is one where people spend their money slowly, and the fall in aggregate velocity following an expansionary open market operation only reinforces this fact. In that setting, it will take far longer for the full effects of the same increase in the aggregate money supply to be transmitted through the economy, since it will take far more time for the new balances to fully enter into circulation.

The movements in velocity arising in our expanded New Keynesian model are, in truth, an attempt to formalize Milton Friedman's views on the transmission of monetary policy. In his words, "The initial effect of a change in monetary growth is an offsetting movement in velocity, followed by changes in the growth of spending initially manifested in output and employment, and only later in inflation."[11] If the nominal interest rate is cut when velocity is low, we will observe a slow and gradual response in output, employment, and prices in our model economy. However, the transmission of an expansionary change in policy will look quite different if velocity is high. In that case, the increase in money supply corresponding to a nominal interest rate cut will quickly find its way into circulation, yielding a more abrupt rise in production and employment and more quickly bringing about the full

When velocity falls, there are fewer dollars in circulation for undertaking transactions than there would be otherwise.

[11] This passage is drawn from Friedman's testimony to the House of Commons Select Committee in 1979; for the full text, see the 1980 reference to Friedman.

implied rise in inflation.

By extending the New Keynesian model to correct its prediction regarding the liquidity effect, we have arrived at a richer setting where movements in the velocity of money over time themselves feed back through the economy to influence how much and for how long changes in monetary policy affect real activity. As a result, our expanded theory suggests that central bankers must be attentive to more than just the change in the nominal interest rate and a simple Phillips curve relationship in considering the effects of a change in policy. They must also take into account the ways in which velocity will affect the transmission of monetary policy. Since velocity is, in part, determined by individuals' bank account balances, these balances become relevant as we anticipate the consequences of a policy change. Moreover, our theory suggests that we need to know something about individuals' willingness to alter their money spending rates over time, since this too will influence how velocity responds to a change in the growth rate of the money supply.

CONCLUSION

Economists use New Keynesian models to study how short-term nonneutralities allow monetary policy to affect real economic activity. The basic New Keynesian model explains how changes in money supply can yield temporary changes in output and employment. However, it does not explain why nominal interest rates fall when the central bank increases the money supply through an open market operation. We have discussed an extension of the model that corrects this problem by introducing an explicit transactions role for money and taking into account the fact that individuals adjust their portfolios of bonds and money infrequently.

This more complex model reconciling the New Keynesian theory with a liquidity effect exhibits important changes in the velocity of money over time. These changes vary from one economy to another depending on how much money individuals need to hold against their coming spending and depending on how willing they are to alter their money savings patterns in response to changes in aggregate conditions. Our theory predicts that the effects of changes in monetary policy will depend on both the average velocity in an economy as well as its movements over time. Thus, to anticipate the effects of a particular change in policy, we need to be able to predict how velocity will evolve in response to the change in the nominal interest rate.

On balance, when we extend our standard model to achieve greater realism with regard to interest rate movements, we find that monetary policy becomes a more complicated exercise than we may have thought and that it cannot be well understood without explicit attention to the determinants underlying the overall demand for money balances throughout the economy.

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